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BRITANNICA

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THE UNIVERSITY OF CHICAGO

"Let knowledge grow from more to more
and thus be human life enriched."

The New

Encyclopædia Britannica

in 30 Volumes

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15TH EDITION

Encyclopædia Britannica, Inc.
William Benton, Publisher, 1943–1973
Helen Hemingway Benton, Publisher, 1973–1974
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JIMMY CARTER

PRESIDENT OF THE UNITED STATES OF AMERICA

and

HER MAJESTY QUEEN ELIZABETH II

It is appropriate that this
15th edition of the Encyclopædia Britannica
be regarded as a memorial
to its Publisher, William Benton (1900–1973).
Though he would have rejected the idea
of the Britannica as the vision or the work of one man,
it is a fact that his faith and inspiration
were necessary to its conception,
and his dedicated determination and guidance
were necessary to its completion.

Helps for the reader

Important information to assist the reader in the efficient use of this edition of the *Britannica* has been provided as follows:

1. The use of the *Propædia* is dealt with in the section *How to use the Propædia* in the *Propædia* volume, pages 8–9, and in the *Table of contents* in the *Propædia* volume, pages 10–16.

2. The use of the *Micropædia* is dealt with in sections entitled *How to use this volume*, opposite page 1 in volumes I–X; *Introduction* to the Addenda in the *Micropædia* in volume X, pages 910–911; *Maps in Encyclopædia Britannica*, with glossary and abbreviations of geographical terms, in volume X, pages 1027–31.

3. The use of the *Macropædia* without reference first either to the alphabetical list of subjects in the *Micropædia* or to the topical list of contents in the *Propædia* is not to be encouraged. The *Micropædia* in particular is designed as both a Ready Reference and an Index to the *Macropædia* (as its title indicates) and should be so used.

4. In consulting the *Micropædia* as a guide to the use of the *Macropædia*, always make sure that you are following the reference that fits your need at the moment. For example, if you want geographical information, current economic and population statistics, a review of current cultural activities, or topographical details, you will find these in the country articles carrying such titles as "Soviet Union," "Spain," or "France." But if you want information on the evolution or historical development of the political, economic, and social institutions of these same countries, look under the "History of" articles, such as "Russia and the Soviet Union, History of," "Spain, History of," "France, History of," etc.

5. The Addenda at the end of the *Micropædia*, volume X, should be especially noted. Beginning on page 907, there are more than a hundred pages of comprehensive world statistical tables in 12 sections. These are followed by the *Macropædia* map legend and glossary and abbreviations of geographical terms; the texts of six of the great charters of the Western tradition; and flags of the world in full colour.

6. The initials at the ends of *Macropædia* articles are those of contributors, whose names are provided in the list entitled *Initials of Contributors and Consultants to the Macropædia* in the last section of the *Propædia* volume, pages 7–104; a list of *Names of Contributors and Consultants to the Macropædia* follows on pages 105–121.

Foreword

The Fifteenth Edition of the *Encyclopædia Britannica* represents a revolution in encyclopaedia making. It began with the organization of the Board of Editors in 1947.

The Board's task was to engage in long-range planning. This necessarily involved criticism, favourable and unfavourable, of *Britannica* as it then was. That encyclopaedia was based on the Fourteenth Edition, published in 1929. Annual printings were kept up-to-date by changes that took into account the most important new developments.

Britannica could claim at that time to be the best encyclopaedia in English; but the process of annual revision was necessarily partial. Articles were eliminated and new ones substituted. Alterations were made in other articles. But the encyclopaedia as a whole could not be reexamined. Single articles were changed, but other articles connected in some way with them, which might run into hundreds, often could not be. The relations among the articles became in some fields more and more tenuous. Hence the possibility of understanding those fields through planned reading in *Britannica* became more and more remote.

The program of annual revision led to a compilation of accurate articles. In the nature of the case it could not lead to an encyclopaedia edited in accordance with a plan. The excellence of *Britannica*, which was undisputed, rested on the authority of the scholars who wrote the articles. As 1929 receded, it became more and more difficult to discern the plan on which the encyclopaedia was based.

It soon became clear to the Board of Editors that *Britannica* had, or could have, two functions: it was a reference work, and it could be an educational instrument. Although information is often confused with education, a moment's reflection will convince the reader that they are not the same. Facts are indispensable to education, but the possession of any quantity of facts does not guarantee that understanding which alone deserves to go by the name of education.

The Board of Editors found that the reference function of *Britannica* was on the whole well performed. If one wanted to discover the birthday of Marie Antoinette or obtain a summary of the work of Isaac Newton, one could do so and be confident of the accuracy of the information received. It was harder to discern Marie Antoinette's place in history and the background and consequences of the Newtonian revolution.

In short the Board's problem was how to make *Britannica* more than a "hunt-and-find" book, how to make it an instrument of education. Nobody wanted to sacrifice the reference function. *Britannica* had to continue to furnish correct, up-to-date information. Was it possible, while maintaining *Britannica*'s standing as a reference work, to make it a means of understanding?

The problem is illustrated by the "topical" encyclopaedias, which present subjects to be learned, but from which it is frequently hard to gain information.

The Board, after many years of debate, came to the conclusion that *Britannica* should be both informational and educational.

The Board decided that the reference function should be carried out by a number of volumes giving, in capsules of 750 words or less, statements of fact about the subject and indications showing where further information about it could be found in the set. One who wanted the answers to questions of fact could find them in these reference volumes. These volumes would also show the reader where he might locate places in *Britannica* that gave him the chance for systematic study.

Chances of this kind would be offered in the larger articles in the set, contained in other volumes, all assembled according to a plan designed to lay the circle of learning open to the reader. This plan evolved from the studies that Warren E. Preece, then Secretary of the Board of Editors, began as early as 1961.

These principles having been adopted, the question became one of execution. No such encyclopaedic venture had ever been attempted. There were no models to imitate and no horrible examples to shun. Clearly, the cost of the enterprise, involving the organization and writing of more than 42 million words, would be staggering.

At this point the character of the Publisher, Senator William Benton, was decisive. Although he believed that *Britannica* was already a work of which he and his associates could be proud and although he was under no pressure to publish a new edition, his own standards led him to conclude that he must do what he could to make *Britannica* better still. As a member of the Board of Editors he had taken part in all the meetings that had led to the new program. He committed the company to its realization, and never wavered. It is distressing that he did not live to see the completion of a project to which he devoted so much time and effort and which he justly regarded as one of the great contributions he had made to the cause of education in the course of a long and distinguished career.

Having authorization to proceed, the Board of Editors faced a new order of questions: What was the plan to be? The Board spent several years debating this issue, making experiments, and reviewing preliminary drafts

by various hands. Between 1965 and 1968 Mortimer J. Adler, a member of the Board of Editors, worked out the scheme of the new encyclopaedia. In addition to his celebrity as a philosopher, Dr. Adler had been the moving spirit in the publication by Britannica of *Great Books of the Western World* and had had the responsibility for the *Syntopicon*, a task that had required him to organize and present the vast range of knowledge in *Great Books*. The architectural design of the Fifteenth Edition as developed by Dr. Adler in consultation with the Board of Editors was approved. His own description of it follows on page 5. Dr. Adler became Chairman of the Editorial Planning Committee in 1966, Chairman of the Editorial Executive Committee in 1969, and project manager thereafter. It is safe to say that without his learning, imagination, and drive the Fifteenth Edition might never have been started or brought to completion.

After the formulation of the plan came its execution. This responsibility was assumed by the Editor, Warren E. Preece, who had been variously Secretary of the Board of Editors, Editor, General Editor, and, again, Editor. The breadth of his education, his clear conception of what an encyclopaedia ought to be, his wide acquaintance in the learned world, and his ability to build up a devoted editorial staff made possible the completion of a task the magnitude of which would have overwhelmed a less capable and less dedicated man.

The result is a revolution in encyclopaedia making. This work combines the reference and educational functions. The reference function, and the index function, too, is performed by ten volumes called the "Micropædia." The educational function is carried out in two ways: through an introductory volume called the "Propædia," which is an outline of knowledge and guide to the *Britannica*, and through 19 volumes called the "Macropædia," made up of more extended treatment of fields of human knowledge and major topics of human interest. These three—the *Propædia*, the *Micropædia*, and the *Macropædia*—are designed to meet the encyclopaedic needs of the reader, whatever they may be.

The Board of Editors is proud to have had a part in one of the great publishing ventures of our time. The Board believes that the Fifteenth Edition is an important step toward the goal all its members share, a learning society.

ROBERT M. HUTCHINS
Chairman, The Board of Editors, 1947–1974

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Editor's preface

Bibliographically, the volumes that follow this preface constitute the Fifteenth Edition of the *Encyclopædia Britannica*. For the first time in more than four decades, the editors of this work have determined that the times require an encyclopaedia so new and so fundamentally different from those that have gone before it that the practice of annually revising the printing of the previous year would have to be replaced by a one-time return to the preparation of a totally new and newly numbered edition.

To understand the importance of such a step requires some understanding of the nature of encyclopaedias, some knowledge of the history of this encyclopaedia in particular, and some insight into what it was about the state of knowledge in the world that appeared to make changes of the order herein offered a necessity.

The First Edition of the *Britannica* appeared serially, beginning in 1768 and culminating in three bound volumes in 1771. For more than 150 years after that, the set was sporadically revised in new numbered editions as were required in the view of its editors. Each of the editions varied in the amount and kind of change introduced in it. The Third, for instance, was the first edition in which articles were prepared by working authorities in the fields of knowledge to be covered, rather than by editors who abstracted from the learned literature of the day. The Ninth brought an almost wholly new orientation, requiring that its articles be longer and deeper and systematically arranged. The Eleventh marked a return to a combination of relatively long "systematic" articles supported by thousands of shorter and more specific entries.

By 1929, and the appearance of the Fourteenth Edition, it had become clear to almost everyone that the system of numbered editions, revised in a major way only erratically and supplemented by new material only occasionally, could no longer meet the demands of a serious encyclopaedia and its users. A new policy, called "continuous revision," was instituted, under which articles were assigned to academic specialists for periodic review, were then scheduled for revision on the basis of the needs suggested by advisory reports concerning them, and new versions of them were introduced into the set as required by the subject matter and permitted within the limited flexibility allowed by the alphabet and the state of printing technology.

Clearly, the system was an improvement over that which it replaced. In each of the last several years, annual revision programs have seen the introduction into the set of from three to eleven million words of new or substantially revised material. To note that the present set, by its very nature, constitutes a temporary return to the earlier practice of extensive change as implied by renumbered editions is not, therefore, to assert the end of the program of continuous revision that worked so well that for more than 40 years no two editions of the *Britannica* were ever completely similar, and so effectively that despite an increase of knowledge almost without parallel, successive users of this reference work have had at their disposal a collection of volumes that provided in balanced and thorough fashion a continuing account of the size and shape of the expanding world of knowledge.

Works, at first encyclopaedic in spirit and content, and, later, in form, have existed throughout the world almost since the development of the written word. Before the name itself had been created, men were trying to capture within the confines of written pages the content and organization of the knowledge at their disposal as they understood it. Every seriously intentioned encyclopaedia has been based on—has been a reflection of—the quantity and quality of the scholarship of its time and the degree to which it was disseminated among men. Obviously, much of this year's *Britannica* simply could not have been written for the Eleventh Edition of the set published 1910–11; hardly any of the scientific theory that was to lead to either the nuclear bomb or the conquest of space had been formulated and much of it had been only guessed at by a handful of advanced workers in each of the fields involved; quantum mechanics as a name had little currency; psychoanalysis and Marxism were barely at the threshold; Russia was still the domain of a tsar, Hitler was hardly known even in his own city, and Sun Yat-sen was leading a revolution in China. World War I had not been fought. In art, in literature, in music, in economic theory, in medicine, in almost every aspect of man's mental and technological activity it was, beyond dispute, a world almost unrecognizable today. And it is no denigration of the Eleventh Edition to note now that it reflected its world so perfectly that it has value today as little more than a historical novelty of interest largely to sentimentalists and those whose work requires that they know and understand the scholarship of an earlier age.

Only 18 years later, when the Fourteenth Edition appeared, there was a different—neither necessarily better nor worse—world to be contended with. A World War had cut gashes across the globe, redrawing the political boundaries of many of its lands and testing the political loyalties of many of its peoples. Communism had become a force to be dealt with and there was new knowledge at large. Not everyone accepted Freud's explana-

tions of themselves, but few could doubt the reality of his influence. Scientific theory had changed. Depression on a vast scale was about to test man's understanding of his economic systems and to demonstrate (if demonstration was required) that the nations of the world would have to exist (if they were to exist at all) interdependently. In Germany, Hitler was only a few years away from a political victory that would influence history until long after his death.

Indisputably, an encyclopaedia suitable to the world of 1911 would have been found to have only little relevance to the world of 1929, and even less to that of 1974. There are limits after which the mere addition of new information at the ends of old articles cannot be made to suffice. There are periods after which it must be recognized that what once seemed to be truths may have been at best little more than half-truths. There are times when only a totally new statement of the past as currently understood and the present as now glimpsed will meet the requirements of a general encyclopaedia. A *Britannica* that set out seriously to report the general state of intellectual knowledge in 1974 could, for instance, hardly assign 30 of its pages to a study of Chivalry, 30 to an analysis of Heraldry, and three to the legal position of pornography, obscenity, and censorship. Even if it were possible to do so, it would be little more than quaint to treat each new year's exploits in space as simple chronological continuations of Columbus' explorations of the Atlantic. It is not irrelevant to note here that in the last several printings of the Fourteenth Edition, there was but one article dealing with acclimatization. It was 3,800 words long and was supported by only three references elsewhere in the set. When the editors and the experts with whom they worked in preparing this Fifteenth Edition reexamined the same subject, they found that a single article was required but, that man's present understanding of the phenomenon would demand the further support of 43 additional references elsewhere in the set.

First work on this edition of the *Britannica* began, as has been pointed out elsewhere, in 1947 with the appointment of a Board of Editors under the leadership of Robert M. Hutchins. It took on a new seriousness and a new immediacy a few years later, when innovative developments in printing technology opened the way to more extensive annual revisions, thus making it more necessary than it had been before that the set's editors have a set of goals and criteria against which such annual printings could be planned. It continued in an even more serious way after 1957 when Dr. Hutchins and the late Lord Crowther, then vice-chairman of the Board, led investigations into what a totally new encyclopaedia—one planned, for instance, as if it had no earlier versions with which to comport—might be like. It moved further forward from 1961 and 1964 when the Center for the Study of Democratic Institutions in California undertook to determine the ways in which it might prove to be (or, equally, not to be) the case that conditions in the world had changed to the extent that such a genuinely new encyclopaedia was (or, equally, was not) required. At a more immediate level, planning began in earnest in 1966, with the appointment of an enlarged staff of senior editors and advisers to work out the topical contents of a new set under the direction of an Editorial Planning Committee established especially for that purpose.

Elsewhere in this volume, the Director of Planning, who was Chairman of that committee, has described the basic intellectual document on which the contents of the present set find their foundation—*i.e.*, the outline of the traditional body of knowledge which at some level of generalization must be included within the pages of any serious general encyclopaedia.

The editor of the First Edition of the *Britannica* wrote in his preface that only to the extent that it was useful could it, or any other set of similar volumes, lay claim to the approbation of mankind. Every succeeding editor of the set has accepted the dictum as his own. The question that had to be answered before work on the new set could begin in full seriousness had to do, then, with what it would mean in the last quarter of the 20th century for an encyclopaedia to be as useful—or, even, more useful—in its time, as its predecessors had been in theirs.

Though encyclopaedists frequently debate the question of utility in terms of whether their works should be "alphabetical" or "topical" in organization, the fact is that the argument misses the point. In itself, knowledge does not exist in either a topical or an alphabetical form and knowledge can be organized only in a method that is both topical and alphabetical. By implication, then, what is at stake to the editors of encyclopaedias has to do only with the presentation of knowledge which traditionally has tended to be either topical or alphabetical.

What seems to be the more important issue surrounding the question is the degree to which knowledge is to be either fragmented or synthesized around some organizing principle. In the so-called "alphabetical" presentation, the editorial effort is usually on finding the smallest part or parts into which the segments of the whole of the circle of knowledge can be broken. Such works are likely to be long on short entries, on articles that focus wherever possible on a single—or at the very most on a few—aspect of larger topics. They are sometimes called "look-it-up" books because their organization makes it more or less simple for the user to equate a topic about which he desires factual information with a plausible matching title and then go directly to the volume containing such a title within its segment of the alphabet. The problem with such sets is that they imply that these small bits of knowledge will either be meaningful and intelligible in themselves or that, if they are not, the reader will (1) already know the background necessary to understand the relation of each to the whole or (2) be willing to

go to another article to secure that background information. What usually happens, instead, is that the reader assumes that a smattering of knowledge is better than nothing at all and proceeds as if background information, relationships, contexts, are all of no consequence. It is as if the significance of the reoccupation of the Rhineland in the period between the two World Wars could be understood without any prior knowledge of the history that had led to the demilitarization of the zone in the first place.

Experience indicates that contemporary encyclopaedia users use, or on separate various occasions would like to use, encyclopaedias in three ways.

First, there are the occasions on which a reader desires to look something up—the "something" in such cases being more often than not quite limited in its scope—the size of the whale, the feeding habits of the robin, the achievements of Rudolf Virchow, or the circumstances surrounding the discovery of radium.

Second, the user may turn to an encyclopaedia for information about a broader, but still relatively limited, subject. He may, on such occasions, be more interested in the causes of the war in Vietnam than in the casualty statistics of the Tet offensives that were a part of that war; he may want to know how interest rates can be used to control the volume of currency in circulation rather than how to define compound interest; he may be interested in a broad survey of French literature and not necessarily—at the time, at least—in the date or occasion of the publication of a book by Camus.

Third, users may on occasion seek that genuine understanding that in itself somehow defines what the world means by the word education. On such occasions, his interest is in neither the size of the whale nor the taxonomic characteristics of the family to which the lion belongs, but in an insight into what has been known and conjectured about the whole sweep of life on Earth. In such instances the reader is interested not in zoology or botany (or biology which is the older combination of both) but in an understanding of the objects of studies of all of the sciences as they relate to something grander than the disciplines themselves.

Starting, then, with the decision that an encyclopaedia is nothing at all if it is not a summary statement of the traditional knowledge of the culture that has produced it, and that utility is in fact the name of the unit in which encyclopaedias must inevitably be measured, it was clear that any new edition of the *Britannica* would have to set out to meet all three of these functions and do so without detracting from the degree to which it also met the others.

The three-part organization of the present encyclopaedia, into *Propædia, Macropædia,* and *Micropædia,* seemed almost to suggest itself as the obvious solution to the problem thus posed. It must be emphasized here that although there are circumstances in which each user will wish to exploit only one of the several ways in which the set may be utilized, and although each of the three parts might appear to lend itself superlatively, if not exclusively, to one or another of the uses, the fullest value of the set is to be attained only in the utilization of the whole. The Fifteenth Edition of the *Encyclopædia Britannica* is not three encyclopaedias; it is one encyclopaedia specifically planned to be usable in three different ways.

A written statement of editorial policies to govern the construction of the Fifteenth Edition began with an enumeration of goals expressed in terms of the qualities for which the *Britannica* so long had been famous that its name had become almost a generic word meaning "encyclopaedia":

> The existing *Britannica* is marked, to a greater or lesser degree, by six encyclopaedic qualities that must be attained to an even greater degree in the new *Britannica*:
>
> a. *Authoritativeness:* Whether it speaks in its own voice, or in that of its contributors, the new *Britannica* must speak from and with authority;
>
> b. *Comprehensiveness:* The proper scope of a general encyclopaedia is the whole circle of learning. The presence of all parts of that circle must be a demonstrable characteristic of the new *Britannica*;
>
> c. *Encyclopaedic brevity of condensation:* A general encyclopaedia is a summary statement of learning. In the new *Britannica* even the longest articles on even the most major subjects should be less lengthy than books or treatises on the subject and must be scaled so as to be commensurate with the purposes of an encyclopaedic survey;
>
> d. *Accessibility:* By the imaginative use of an alphabetical arrangement of articles, a useful alphabetical index, internal cross-referencing, and other devices, the contents of the new *Britannica* must be efficiently available to its users;
>
> e. *Accuracy:* No matter how clearly the new *Britannica* manifests its other qualities, it will fail to the extent that inaccuracy renders its contents undependable;
>
> f. *International orientation:* While the new *Britannica* is uniquely a product of the culture of the West, it must not be parochially Western in its view of learning.

In connection with the point just made, the editors note with some pride that in their determination to secure the best authorities and the best writing skills available anywhere in the world, they have produced a version of this set in which for the first time in its more than 200 years of publication, only about one-half of its authors have been drawn from the country within which the enterprise is owned and largely directed. Articles on subjects spread across the whole of the broad spectrum of knowledge have been assigned to experts without regard to their place of origin, of residence, or of occupation. The entry on electric power is by a member of the Japanese Atomic Energy Commission; that on nuclear fusion is by a Russian, and that on defense expenditure by an Englishman. An Australian has written on Vladimir Nabokov, a Canadian has written on the history of Rome, and a German has written on the history of China.

Earlier studies of the rate at which new information is being produced and the degree to which specialization is producing a kind of deleterious academic frag-

mentation felt even in the faculties of major universities, suggested that the utility of the new *Britannica* would in the end be measured in part by the degree to which it could maintain its superiority in terms of the qualities mentioned above and, at the same time, achieve new qualities based on these new realities.

First, it was clear that knowledge is proliferating at rates, and specialization is developing in ways such that a general encyclopaedia can no longer hope to be useful (if, indeed, it ever had been) to the specialist in his own field. It is a fact of which no encyclopaedist can possibly be ignorant that the finite and limited pages available in a general encyclopaedia for the treatment of any given subject make the bound volumes of such sets inappropriate sources of information for the professional reader in his own field. It was assumed, therefore, that although all readers of the *Britannica* might be specialists—or have the interests of specialists—in some area of knowledge, they will turn to a general encyclopaedia only as generalists interested in fields outside of their own.

A consequence of grave editorial importance followed from such a conclusion. It was clear that although many years of almost worldwide experimentation in mass education had produced an educated readership hardly even imaginable to earlier editors of the *Britannica,* they had in many cases also produced a readership so specialized that workers in all fields found it increasingly difficult to communicate with each other across fields. It must also be noted that the proliferation of education for all had not necessarily raised the *general* educational background of all. A general encyclopaedia can exist, *Britannica*'s editors were warned by more than one academic, only if it can find a language with which to keep some kind of communication common to all, open to all.

The new objectives of the new *Britannica* were described in the statement of editorial policy as follows:

1. Readability by, and intelligibility to, the curious, intelligent layman. Although the user of the *Britannica* may be, and frequently will be, a specialist in some field of knowledge, it is assumed that he will never turn to its pages to meet his own needs within that field. The user is therefore presumed to be, on every occasion of use, a curious, intelligent, but nonspecialist reader. While the specialist must not be offended by the encyclopaedia's treatment of his own specialization, that treatment should not attempt to be adequate to his needs within it;
   a. Articles should, therefore, be positioned at a level of generality above that of purely specialized detail and should be characterized by an appropriately reduced density of detail rather than by an apparent determination to pack everything known about a subject into an allotted space.
   b. Further, articles should not assume detailed background knowledge on the part of the reader: if forced to choose between more facts unexplained and fewer facts explained, the treatment should always tend toward the latter.
   c. Finally, in the treatment of certain subjects that are by their nature irreducibly difficult and technical or communicable only in a language understood solely by specialists, at least some portion of the article should be readable to the layman to whom, at a minimum, the significance and general bearings of the subject must be made comprehensible.
2. Integration and coherence. As a summary report of the whole circle of learning, the new *Britannica* will function efficiently only to the degree that its treatment of the subjects that make up that circle is consistent, coherent, and integrated.
   a. Subjects that are related to each other, as parts of a whole or as wholes encompassing parts, must be treated so that their relationships to each other and to their wholes are manifest to the reader.
   b. Subjects that are alike in kind, quality, or scale should be treated alike and at a similar scale.
3. Controlled fragmentation and duplication. To the extent that the circle of learning is seamless, any survey of it consisting of more than one article is destined to be marked by some degree of fragmentation and therefore some degree of duplication. An overriding goal of the new set is to achieve a minimum of fragmentation and a maximum control of duplication.
   a. Although any given subject may be treatable in several contexts, its major treatment should be developed in one article rather than in several separate and unconnected articles. Articles dealing with subjects demanding treatment in different contexts must, therefore, be planned with this requirement in mind.
   b. Complex subjects that call for unity of treatment should be developed in articles dealing with them as wholes rather than in disconnected articles about their parts; and in such cases the consolidated article, whenever possible, should be oriented toward detailed treatment of its subsidiary parts. The unity of the subject and the interconnections of its parts should be the controlling principle in the consolidated treatment.
4. Objectivity and neutrality.
   a. Articles should be so written that they avoid expressions of bias or prejudice on any matter about which a respectable and reasonable difference of opinion exists.
   b. Further, in all areas in which the scholarly world acknowledges significant and reputable differences of opinion, diverse views concerning such differences should be fairly presented, though the majority or accepted view may be so designated.
5. Topical as well as alphabetical accessibility to the contents of the set. By combining topical and alphabetical accessibility, the new *Britannica* will function more effectively as an educational instrument and an ordered statement of learning to be read and studied as well as a reference tool containing information so organized that it can be easily "looked up."
   a. The aim of topical accessibility is to serve the needs of the reader who asks "What can I learn from study in the encyclopaedia and how can I learn it?"
   b. In offering an answer to this question, topical accessibility can provide a systematic outline of the whole circle of learning, so structured that the parts can, if the reader desires, be reassembled as a whole.

Against the background of these considerations and the broad statements of policy growing from them, an expanded group of senior editors and university advisers met almost daily to create an outline of knowledge on the basis of which a list of all of the topics

requiring treatment in a general encyclopaedia could subsequently be prepared and the treatment of them assigned as appropriate to one or another of the sections of the set. Of more interest to encyclopaedists than to lay readers, the meetings today seem notable as one of the few known instances in which senior editorial people representing all of the fields of knowledge could meet regularly to discuss the disposition of that knowledge within—as it were—a circle, and could relate their actions to decisions made concerning the whole of the circle rather than the individual parts as represented by the specialties of the editors and advisers involved. It was at no time the intention of those involved in the process that the evolving outline should represent a particular system of knowledge and none of the staff of this reference work would want to argue that knowledge can be organized in only one way; that any monolithic system can be made to serve the needs of a general encyclopaedia. Nor would any want to argue that the outline that evolved from their sessions necessarily constitutes the best such outline. All that was hoped for, and what was achieved, was the construction of a workable and defensible outline, one that, without contentiousness, would set forth in some orderly way the major topical rubrics that must ultimately be dealt with in a general encyclopaedia.

On the basis of advice from experts not previously associated with the development of the outline itself, the first draft of that document was revised and the editors next began to compile a list of the articles that would be required in order to deal in some appropriately balanced way with all of the topics named in the statement of intentions—then the working name of the "Outline of Knowledge." Predictably, it was found that there were instances in which several rubrics might find their best treatment combined in but a single article; that in other instances, sections or even subsections of single rubrics might require treatment in several articles. The important consideration was that wherever possible fragmentation and duplication be eliminated, and that wherever this was impossible, they be, at the very least, rigorously controlled.

In a drastic departure from past *Britannica* practice, each projected article was then outlined as to its content. The purpose of such outlines—each author was informed—was to assure that all of the circle of knowledge would be covered somewhere in the set on the one hand, that wherever possible each of its parts would receive its major treatment in only one place, and that each of its parts would be treated on a scale determined by all of the other parts. As authorities, authors were, of course, given wide latitude in reordering the presentation of the material called for by their outlines, and much latitude in reevaluating the amount of space to be assigned to each of the topics for which they were to accept responsibility.

Senior editors were required to nominate as potential contributors for each of their own articles three authors whose work they had read and could interpret as indicating that the nominee, in addition to being an expert in the subject matter involved, could—and equally importantly, presumably would be willing to—write for the curious, intelligent lay reader. It was further required that in every case at least one of the contributors nominated be from a country other than the United States.

The processes and policies described so far had their greatest influence in connection with the development of the 19 volumes of the current edition of the *Britannica* that became known as the "Macropædia." The articles in these volumes total 4,207. But long before any of the work on this part of the set had been seriously considered, it had been recognized that such volumes and such articles could, in fact, be used satisfactorily only if a way could first be found to lead the reader from what might be a very general or, in some instances, a very specific interest to an article either less, or more, general in concept. The role of the Outline of Knowledge in leading the reader from some general interest in a whole field of knowledge to the separate arcs under which segments of the circle are dealt with in the *Macropædia* is considered in the preliminary pages of the "Propædia" section of this volume.

As to the other side of the coin, it has long been recognized that the educational values of general encyclopaedias could be enhanced, could, in fact, be realized at all, only if readers could be brought to use an index as their first point of entry into the set. Every editor's file contains instances of complaints that a given topic is not dealt with in a set, when all that the reader really means is that it is not dealt with in an article bearing the name under which he had expected to find it, and that he has not yet troubled himself to refer to the index—where, as often as not, he might find several references to his topic of interest. In planning this Fifteenth Edition of the *Britannica,* it was assumed that one solution to the problem might lie in making the index volumes a uniquely indispensable key to the whole, on the one hand, and a valuable source of reference information about the subject being researched on the other. It may, then, be asserted that the reader who turns first to the appropriate part of the *Micropædia* will learn immediately whether or not the subject in which he is interested is treated in the set and, even more importantly, will find there much of the so-called "reference data" concerning that subject and may indeed—if his point of interest was specific in nature—find there the answer to the question that led him to the book in the first place. In such cases he will, obviously enough, need to look no further, though hopefully the short *Micropædia* article may succeed in arousing his interest to the point at which he will wish to learn more. In such cases, he will find how the subject is treated in the set, where in the *Macropædia* his topic of interest is dealt with in its more general aspects, where else in the *Micropædia* he will find further related data. In addi-

tion to serving as an index to the whole of the set, the *Micropædia* will, then, be seen to constitute in itself a 10-volume source of encyclopaedic information.

The editors believe that no other arrangement of the whole of the circle of knowledge to be dealt with in the confines of a general encyclopaedia can serve so well the varied uses to which encyclopaedias are put by those who turn to them.

Several more practical editorial decisions and developments flowed naturally from the same series of considerations that had led to the decision to proceed with the creation of an entirely new edition of the *Britannica* in the first place. They are considered here in an order that does not necessarily reflect the editor's sense of their importance:

1. In a world characterized by academic and professional specialization, it is not uncommon for the author of an encyclopaedic article to find it necessary to refer to workers, living or dead, whose names may be unknown to his lay readers no matter how well educated they may be in other fields. *Britannica* authors were asked, therefore, to identify, whenever such identification appeared to be reasonably necessary, all names not the "common property" of all educated readers. Because such identification so frequently has involved the designation of a nationality and a status within an academic discipline (*e.g.*, "eighteenth-century French mathematician") it has sometimes seemed that the internationalism proclaimed in the statement of editorial policy was in danger of being violated in the execution of that policy. Such, of course, was not the intention of the editors, who were well aware that such phrases normally constitute the minimal identification with which dictionaries of biographies begin their articles. That men and women may be born in one country, practice in another, and die in a third, or may follow careers that do not lend themselves to unique description makes the device difficult but does not render it unuseful.

2. Although the editorial policies set out for the set as a whole could not always be met in the case of mathematics, which remains both a subject matter and a language in itself, two devices have been introduced in the effort to make science articles in general more intelligible to the lay reader. In the first place, wherever possible, equations and formulas have been verbalized or "written out" as statements in words as well as a series of letters and symbols; in the second, such equations have, in many of the mathematics articles, been removed from the text of the article (where their places have been taken by more generalized statements in "natural" language) to boxes, where they remain available to the reader able to utilize them.

3. In logic, it is possible to make only one assumption about the language capabilities of the *Britannica* user. Since this encyclopaedia, though it is available in many countries throughout the world, is printed only in an English-language edition, it has been assumed that all users of the set must inevitably share the ability to read in that language with some degree of fluency. Many, of course, speak other languages; many more read other languages. Nonetheless, since English is the only language known for certain to be understood by the *Britannica* user, *Britannica* authors and editors have been at pains to limit the use of non-English words and phrases and to provide translations or paraphrases of such wherever their use has been unavoidable.

4. Importantly, in assuming that the specialist turns to a general encyclopaedia for information only about fields in which he is not a specialist, the editors accepted, as well, the corollary that the *Britannica* user should be required to deal in general only with the language and the literary conventions of the literate man and woman, and not with those of the specialist. The editors recognize that technical language and technical conventions have a valid utility within each academic specialty. They provide a precision and a unique method of communication between people who work within that specialty. They may, however, be confusing and uninformative to the reader from another specialization. Since a general encyclopaedia cannot deal in the vocabulary and literary conventions of all specialties, it was determined that it should, wherever possible, deal in the vocabulary and conventions of none. Professional jargon has been eliminated where possible and its terms defined wherever its elimination was impossible.

5. Bibliographies at the ends of articles in which they have been included have in general been lengthened for the benefit of the reader who wishes to read more deeply in the subject matter involved. At the same time, they have, by design, been annotated so that the lay reader might know in advance the likelihood of his deriving benefits from turning to any given work. Authors have been urged to avoid the inclusion of titles likely to exist only in small numbers of rare copies carefully guarded in but one or two libraries throughout the world.

6. The use of place names and personal names in an encyclopaedia prepared for distribution in many countries has always been a particular problem to the editors of general encyclopaedias. Whether to use the name of a country or a city preferred within the place itself, or one generally used in other countries is a problem that admits of no easy solution. On the advice of experts who have consulted with *Britannica* on the problem, this edition of the *Britannica* uses place names as recommended by the boards of geographic place names in the United States and the United Kingdom. Exceptions to this general rule are few, and are limited to cases in which the recommended name would have little meaning in most of the world in which the *Britannica* is used. Similarly, in the case of personal names, it was tempting to rule simply that such names will be in the forms as used by the persons whose names they are or were, and this rule was, in fact, adopted, save for certain exceptions in which the result would fall strangely on too many ears. Thus, though the contem-

porary Russian composer is officially Dmitry Dmitriyevich Shostakovich, he is known in the *Britannica,* as he is in most of the West, as Dmitry Shostakovich; the earlier Russian composer Pyotr Ilich Chaykovsky remains, as in past editions, Peter Ilich Tchaikovsky; and a figure such as King Saud is known thus, as he was in the newspapers, while his father is Ibn Sa'ūd. A constant effort has been made to retain the level of such exceptions to the barest minimum. In the case of Japanese names, as in Japan, the family name is stated first, and the given name last.

7. The older *Britannica* custom of publishing an atlas in the final volume of the set has been abandoned in the conviction that maps belong where they will be most useful to the reader—*i.e.*, throughout the set in proximity to the articles that depend on them for clarity.

8. The use of diacritics, the transliteration of non-Latin alphabets, and the translation of certain non-English languages have been standardized on the basis of rules worked out over a three-year period by *Britannica* editors and advisers.

9. Tables and charts have been used extensively in the *Micropædia* volumes. Geographical statistics, including demographic factors, economic reports, and other similar data, are thus to be found for each country in convenient boxes (accompanied by a picture of the flag of the country) with each *Micropædia* country article. Special large charts providing bases for international comparisons of such data are published in a separate section at the end of Volume X of the *Micropædia.*

10. Finally, it is expected that most readers will find the new lists of major works appended to the biographies of most workers in the arts of great reference value, but the editors would be the first to concede that the definition of "major" is not easy to agree on.

Because it will be asked, it may be said here that all *Britannica* entries after editing are returned for approval to the men and women who first submitted them. Changes required by objections to the editing are seriously considered and, when they involve matters of factual accuracy, or do not violate established editorial policy or stylebook rules, are incorporated in revisions prior to printing. In that fortunately small number of instances in which authors have felt for reasons of their own that the results were still unacceptable to them, the proposed entries have been submitted to a recognized peer of the author and, when such advisers have said that the manuscript was factually accurate and would reflect credit on both the *Britannica* and its contributor, the entry was printed without identification of the author.

The preparation of a general encyclopaedia containing more than 42 million words in 30 volumes obviously has to be the work of more than a single man, a single committee, or a single staff. In the case of the Fifteenth Edition of *Encyclopædia Britannica,* that work involved (in addition to its late publisher whose faith and investment were indispensable, and others listed in appropriate places in this volume) the efforts of an editorial staff of hundreds, an advisory staff of more than 200, and more than 4,000 contributors. It is tempting to list at least all those who as staff members made significant contributions to the outcome of the work. It is also impossible to yield to the temptation.

One must, however, pay particular credit and express particular thanks to Philip W. Goetz and Donald E. Stewart, each of whom brought to the work more than 20 years of encyclopaedic experience that on more than one occasion provided the expertise necessary to keep success from becoming failure. As executive and managing editors respectively, they directed the efforts of all the editors and supervisors whose work was crucial to the completion of the entire project. In England, Christopher H.W. Kent, as Deputy Editor for London, performed with similar distinction his own role with that part of the editorial staff located there.

As assistant project manager, Normand LaJoie worked effectively to assure that the normal reluctance of editors and writers to complete manuscripts for release to printers on time did not impede the achievement of publication dates; Raymond Majesty served as always as a worker of miracles in looking after all of the difficult operations that must be done early if articles are later to appear in proper alphabetical order on pages in volumes, both with numbers that do not yet exist, and that paper and printing are all to come out in proper sequence at the end and on time. Mrs. Anne Long, as Executive Secretary to the Editor, coped with more problems than she should have had to, and did so always with good humour, good grace, and great intelligence.

In citing the few who can be listed above, the editors are equally aware of the tremendous dedication and abilities and efforts of the many who must simply now be listed opposite.

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Barbara Alpert
Anselm Amadio
Peter Ames
Franklin Anderson
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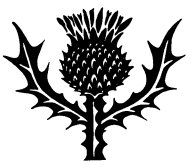


PROPÆDIA

The New Encyclopædia Britannica

PROPÆDIA

Outline of Knowledge
and
Guide to the Britannica

The circle of learning

"The alphabetical system of arrangement," observed the Editors of the Eleventh Edition of the *Encyclopædia Britannica* (1910–11), "with its obvious advantages, necessarily results in the separation from one another of articles dealing with any particular subject." The addition of an alphabetical index can do no more than give the reader "assistance in obtaining information under headings which are not themselves the titles of articles in the Encyclopaedia." Consequently, "the student who desires to make a complete study of a given topic must exercise his imagination if he seeks to exhaust the articles in which that topic is treated." This result is certainly a serious defect in the system for anyone who feels—as did the Editors of the Eleventh Edition—that an encyclopaedia should not be merely a "storehouse of facts," but should also be "a systematic survey of all departments of knowledge." To remedy this defect, the Editors constructed a "Classified Table of Contents," which they believed to be "the first attempt in any general work of reference at a systematic subject catalogue or analysis of the material contained in it."

Remarkable as it was at the time, this Table of Contents did not fully succeed in achieving its objective of overcoming the defects of an alphabetical organization of encyclopaedic articles by means of a topical presentation of their content. A quick glance at the twenty-four major categories into which the Table of Contents was divided will reveal that the alphabet was still the thread on which the parts were strung: I. Anthropology and Ethnology; II. Archaeology and Antiquities; III. Art; IV. Astronomy; V. Biology; VI. Chemistry; VII. Economics and Social Science; VIII. Education; IX. Engineering; X. Geography; XI. Geology; XII. History; XIII. Industries, Manufactures and Occupations; XIV. Language and Writing; XV. Law and Political Science; XVI. Literature; XVII. Mathematics; XVIII. Medical Science; XIX. Military and Naval; XX. Philosophy and Psychology; XXI. Physics; XXII. Religion and Theology; XXIII. Sports and Pastimes; XXIV. Miscellaneous. In each of these categories, the only further subdivisions involved the distinction of general from particular subjects, and the distinction of both of these from biographical entries. Under each of these headings, titles of the encyclopaedia's articles were listed in strictly alphabetical order.

In planning this Fifteenth Edition of *Encyclopædia Britannica,* the present Editors, while deciding to retain the alphabetical ordering of the articles themselves, as printed in the set, sought to improve upon the effort their predecessors had made to overcome the defects of an alphabetical organization by giving the reader a truly topical, and totally nonalphabetical, Table of Contents. It would serve the purpose that the Editors of the Eleventh Edition had in mind, which was to enable the reader to "make a complete study of a given topic"—that is, a department of knowledge or field of learning.

It may be asked why it was not thought better to abandon the alphabetical principle entirely and construct a purely topical encyclopaedia, in which all the articles would be assembled, volume after volume, according to some general schema for the organization of human knowledge. The answer is two-fold. First, a purely topical organization of the articles themselves cannot avoid the appearance of a certain tendentiousness or arbitrariness in the editorial commitment to one rather than another organizing schema or set of principles. The reader is, therefore, provoked to ask: Does this order, volume by volume, and article by article, reflect the only right or proper exposition of the whole of human knowledge?

Second, a purely topical encyclopaedia provides its readers with only one mode of access to its contents. This may be alleviated somewhat, perhaps, by the addition of an alphabetical index; but an index, by its very nature, serves the purpose of enabling the reader to look up *particular* items of information; it does not provide a general and systematic mode of access to the contents of the encyclopaedia.

The basic plan of the new *Britannica,* therefore, aims to give its readers access to its contents by both the topical and the alphabetical mode. General and systematic topical access is provided by the Outline of Knowledge contained in this volume, called the "Propædia" because it is a kind of preamble or antechamber to the world of learning that the rest of the encyclopaedia aims to encompass. Alphabetical access is provided not only by the alphabetical ordering of the long articles in the *Macropædia,* but also by the shorter entries in the *Micropædia,* which are likewise arranged alphabetically.

Unlike the Classified Table of Contents in the Eleventh Edition, which was alphabetically organized by categories and subjects, the Outline of Knowledge in this Fifteenth Edition is a purely topical presentation of the contents of the articles in the *Macropædia.* It is, therefore, reasonable to ask how such a purely topical outline of encyclopaedic content avoids the tendentiousness or arbitrariness that is attributable to an encyclopaedia in which the articles themselves are topically rather than alphabetically arranged. Does not the Outline of Knowledge here presented reflect, perhaps even conceal, a commitment to one set of organizing principles rather than another? Does it not embody biases or preconceptions that are not universally acceptable?

It is hardly possible to say "No, not at all" to these

questions. Two points, however, can be made affirmatively that tend to reduce or alleviate whatever degree of arbitrariness remains unavoidable in a topical outline of the whole of human knowledge. One is that the Outline of Knowledge, while conceived by the Editors, was constructed and corrected in the light of detailed recommendations, directions, and analytical contributions from scholars and experts in all the fields of knowledge represented. A list that includes the advisers who worked with the Editors in the construction of the Outline of Knowledge follows Part Ten of the *Propædia.*

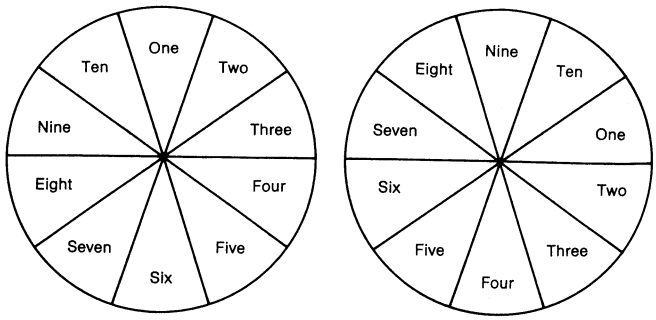
The second point is that the Outline of Knowledge is conceived as a circle of learning. To say that the contents of an *en-cyclo-paedia* form a circle of learning is more than a literal transliteration from Greek to English. In Greek or English, reference to the circle introduces a powerful metaphor, the understanding of which should help the reader to overcome whatever arbitrariness still resides in the Outline of Knowledge in spite of determined efforts on the part of all concerned to minimize this defect. A circle is a figure in which no point on the circumference is a beginning, none is a middle, none is an end. It is also a figure in which one can go from any point, in either direction, around the circumference; in addition, one can go across the circle from any point to any other; or, by any number of transecting lines, starting from a given point, one can go to any number of other points on the circumference, near or far.

The ten parts into which the Outline of Knowledge is divided are disposed not along a finite straight line beginning at this point and ending at that; they are disposed rather as segments of the circle. While it is true that, in this arrangement, one part may lie next to another and at some distance from still another, it is also true that, since the circle can rotate around its axis, any one of the ten parts may be regarded as standing at the top of the circle, or at the left or right side of it, or at the bottom. In other words, with the circular arrangement of the parts, and with the rotation of the circle, the reader can begin anywhere in the circle of learning and go from thence to adjacent parts around the circle; or, moving along interior transecting lines, he can go from any part across the circle to parts that are not adjacent on the circumference.

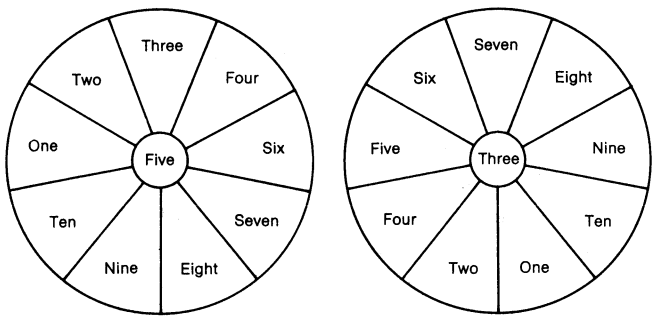
This view of the Outline of Knowledge can be represented in a number of diagrams. The first pair of diagrams shows the ten parts of the outline as segments of the circle. (For a synopsis of the subject matter covered in each part, and its various divisions and sections, the reader is referred to the Table of Contents set forth on pages 10–16 of this volume. The titles of the ten parts are given in the box below.)

Part One. Matter and energy	Part Seven. Technology
Part Two. The Earth	Part Eight. Religion
Part Three. Life on Earth	Part Nine. The history of mankind
Part Four. Human life	Part Ten. The branches of knowledge
Part Five. Human society	
Part Six. Art	

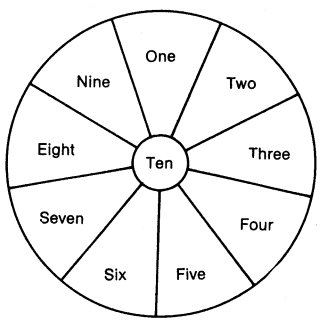
In the first pair of diagrams, below, Part One is placed at the top of the diagram to the left, and Part Nine is at the top of the diagram to the right, to illustrate the effect achieved by rotating the circle.



The second pair of diagrams, following, places one of the ten parts at the centre of the circle with the remaining nine parts as segments of the circle formed by lines radiating from the centre. The point being made here is that any part can occupy the central position—the place in the circle of learning at which one begins, going thence in all directions to the remaining nine parts. To illustrate this, Part Five occupies the centre in the diagram to the left; Part Three, the centre in the diagram to the right.



Finally, the diagram below offers still another approach to the circle of learning. In this diagram, Part Ten occupies the central position; and here there is only one diagram rather than a pair of diagrams because the reason for placing Part Ten in the central position applies to it alone and to none of the other nine parts.



The reason for this special placement of Part Ten stems from the one organizing principle to which the Editors were explicitly committed in planning and producing this new *Britannica.* Briefly stated, that principle involves a distinction between (a) what we know about the world of nature, of man and society, and of human institutions *by means of* the various branches of learning or depart-

ments of scholarship; and (b) what we know about the branches of learning or departments of scholarship—the various academic disciplines themselves. For the most part—there are a few exceptions—Parts One through Nine represent man's knowledge of nature, of man and society, of human institutions, and their history. In clear contradistinction, Part Ten mainly covers the disciplines themselves—the branches of knowledge or fields of scholarship—by which man inquires into, thinks about, or comes to have knowledge of the world in which he lives. Part Ten examines the nature, methods, problems, and history of the various branches of knowledge or scholarly disciplines, the actual content of which is set forth in Parts One through Nine.

Thus, for example, Section 10/34 in Division III of Part Ten examines the nature, methods, problems, and history of the biological sciences; but the knowledge of life that the biological sciences afford is outlined in Part Three. Or, to take another example, Section 10/41 in Division IV of Part Ten examines historiography and the study of history; but the actual history of mankind, achieved by the methods of historical inquiry, is outlined in Part Nine.

There are, however, three departments of learning that are exclusively treated in Part Ten—both with regard to the nature and history of the disciplines themselves and also with regard to the knowledge or understanding afforded by these disciplines. They are logic (in Division I of Part Ten), mathematics (in Division II), and philosophy (in Division V). The reason for this exceptional treatment of these three disciplines is given in the Introductory Essay to Part Ten.

The special character of Part Ten thus explains the diagram in which it occupies the centre of the circle of learning, but that must not be interpreted as attributing prime importance to it. This diagram simply indicates the special function Part Ten performs in relation to the other parts. It alone stands in close relation to all the rest; there are varying degrees of relatedness among the other parts. For example, Parts Three and Four, dealing with Life on Earth and with Human Life, are closely related; Parts Four and Five, dealing with Human Life and with Human Society, are also closely related; but Part Four has a different relatedness to Part Three, on the one hand, and to Part Five, on the other. In the presentation of the Outline of Knowledge, the headnotes and the cross-references give the reader an indication of these interrelationships.

Anyone who is in a position to compare the classified list of articles in the Eleventh or even the Fourteenth Edition with the Outline of Knowledge will be persuaded, the Editors think, that whereas the immediately preceding editions of *Britannica* represented a 19th- and early 20th-century view of the state of human knowledge, the new *Britannica,* in its Fifteenth Edition, is an encyclopaedia that reflects the many changes and innovations in man's knowledge and understanding that are emerging at the end of this century and will continue into the next.

The reader's attention should be called to two further points about the Outline of Knowledge. The first is that it serves as a table of contents only for the 4,207 longer articles in the 19 volumes of the *Macropædia.* It does not cover or refer to the shorter entries in the 10 volumes of the *Micropædia,* or *Ready Reference and Index.* Those ten volumes should always be consulted first if the reader wishes to look up any *specific* point of information by alphabetical means. As indicated in the explanation of how to use the *Propædia,* which follows, the Outline of Knowledge in this volume should be consulted for a different purpose—not to look up a specific point of information which can be found by alphabetical means, but to study a whole segment of human knowledge, or to examine a field of learning, which is here topically outlined so that the reader can discover what he can learn from *Britannica* about that area of knowledge.

The second point to be mentioned is, in the view of the Editors, of singular importance, for it distinguishes the Fifteenth Edition of *Britannica* from all preceding editions. The Outline of Knowledge presented in this *Propædia* volume, which serves as a topical survey of the contents of the articles in the *Macropædia,* was constructed *before* those articles themselves were named, outlined, commissioned, written, and edited. The outline served as the basis for determining what articles should be written, what their scope should be, how they should be related to other articles, and so on. It was, therefore, in origin a table of *intents* rather than a table of *contents.* It represented the intentions of the Editors in laying down a comprehensive plan for producing a new encyclopaedia, appropriate to the state of human knowledge and learning at the end of the 20th century and looking forward to emergent developments in the century to follow. What was originally, or in the planning stage of the work, a Table of Intents, then subsequently became, after the writing and editing of the articles was completed, a Table of Contents that tries to reflect accurately and faithfully the actual content of the articles. In many cases, the articles departed from the original outline and the outline was therefore revised to accord with the improvements of it by the contributors of those articles.

All preceding editions of *Britannica,* as most other encyclopaedias, have been constructed from classified lists of articles. Such classified lists may vary from one edition to another, as they have from the First Edition of *Britannica* through the Fourteenth, but the variations are relatively minor as compared with the fact that they are all the same in form—nothing but classified lists of articles, as exemplified by the one presented in the Eleventh Edition, already referred to. In sharp contrast to such editorial procedures, the Fifteenth Edition has the distinction of being planned not in accordance with a classified list of articles, but rather in the light of an orderly topical outline of the whole of human knowledge, in the form of the circle of learning that is an *en-cyclo-paedia.*

MORTIMER J. ADLER
Director of Planning

How to use the Propædia

The purpose of the Propædia

As its title indicates, the Outline of Knowledge is intended to serve as a topical guide to the contents of the *Macropædia,* enabling the reader to carry out an orderly plan of reading in any field of knowledge or learning that he may wish to study in some depth. The *Propædia*'s Table of Contents gives the reader an overview of the Outline of Knowledge as a whole; the Introductory Essays for each of the ten parts illuminate the major concerns of that part of human knowledge; the headnotes that are affixed to parts, divisions, and sections prepare the reader for his examination of the subjects being covered there; and the outlined presentations of these subjects, accompanied by volume and page references to the places in the *Macropædia* where the subjects are treated, enable the reader to carry on for himself a course of study that may be more or less extensive and detailed in accordance with his own interests and desires.

The *Propædia,* or Outline of Knowledge, helps the reader to answer for himself the question that, in its most general form, is as follows: *What can I learn from the Britannica concerning one or another area of human knowledge?* More specifically, the question, for example, might be: *What can I learn about the Earth?* or *What can I learn about art?* The reader's interest may be even more specific, as the following questions indicate. In the field of the Earth sciences, his question might be: *What can I learn about the Earth's constituent minerals and rocks?* or *What can I learn about weather and climate?* In the field of art, his question might be: *What can I learn about the theory and classification of the arts?* or *What can I learn about music?*

If the reader will now glance at the *Propædia*'s Table of Contents on page 10, he will see that the questions just used as examples have been drawn from the 241 headings in the Table of Contents. The first pair of questions about the Earth and art are taken from the headings of Part Two and Part Six, respectively. The more detailed questions about the Earth are taken from the headings of Sections 214 and 224; and the more detailed questions about art are taken from the headings of Sections 611 and 624. Thus, each of the 241 headings in the Table of Contents can be used to complete a question of the form, *What can I learn from Britannica about .....?* On the other hand, if the reader is interested in a particular subject, he should consult the *Micropædia.* The subject will be treated briefly there. In addition, directions are given for finding places in the *Macropædia* where that subject is treated at greater length or in broader contexts.

The difference between the *topics,* which are the basic elements in the *Propædia,* or Outline of Knowledge, and the *subjects,* which are the component entries in the *Micropædia,* will become clear at once to anyone who examines a page of the *Propædia's* outline and a page of the *Micropædia.*

The structure of the Propædia

Each of the 10 parts, 42 divisions, and 189 sections that make up the *Propædia,* or Outline of Knowledge, is marked in the Table of Contents by a heading or title, which is followed by the number of the page on which that unit of the *Propædia* begins. This structure affords the reader three main options: (1) he can turn to one of the parts as a whole and examine the contents of that part; (2) he can select a particular division of one of the parts and examine the contents of that division; or (3) he can focus on a single section or several sections of such a division, and examine the contents of that section or those sections.

If the reader exercises the first option and considers one of the ten parts as a whole, he will first encounter an Introductory Essay that acquaints him with the major concerns and character of that part of human knowledge. That essay is followed by a headnote that summarizes the content of the part, calls attention, where needed, to the relation of that part to other parts, briefly indicates the content and titles of the several divisions of the part, and gives the page on which each division begins. A thorough examination of the part as a whole will involve him in examining its subordinate divisions and sections.

If the reader exercises the second option and wishes to examine one division of a part, he will be aided by a headnote that summarizes the content of the division he has selected for examination, briefly indicates the content of the sections in that division, and gives the page on which each section begins. A thorough examination of the division as a whole will involve him in examining its subordinate sections.

If the reader exercises the third option and wants to consider one or more sections within a division, he will be aided by a headnote that summarizes the content of the section or sections that he has selected for examination. The section headnote is followed by an outline of the subjects covered in that section. A thorough examination of the section will involve the reader in examining the subjects it comprises, as set forth in the outline.

The sectional outlines

The sectional outlines present, in an orderly arrangement of topics, subjects that are treated in articles in the *Macropædia.* The major subjects in each sectional outline are indicated by capital letters ("A," "B," etc.). There are always at least two major subjects, but there may be many more in a given section. When it is necessary to subdivide a major subject, up to three additional levels may appear in the outline; the first is indicated by Arabic numerals; the second by lower-case letters; and the third by Roman numerals, as shown below:

A. The action of the hydrosphere and atmosphere on the Earth's surface features
   1. Weathering: the disintegration and alteration of rocks at or near the Earth's surface
      a. Processes involved in weathering
         i. Physical processes; *e.g.*, freeze–thaw cycles, crystal-growth pressures

Attached to each topical statement of a particular subject in the sectional outline are listed, in the three columns to the right of the statement, the pages on which the reader will find a treatment or treatments of that subject in the *Macropædia.* The significance of these three kinds of references is explained below.

Although the principal purpose of the sectional outlines is to provide references to articles in the *Macropædia* wherein

this or that subject is treated, the structure of the outlines sometimes requires the topical statement of subjects that do not call for such references. These topics often serve as cross-references to subjects to which references are attached, in other parts of the given sectional outline or in other sectional outlines. Still other topics that are not accompanied by references serve as headings for a set of related subjects grouped in subordination under them. Such topics indicate what is common to the subordinate topics. These, as well as other topics, are often followed by the phrase *with special attention to,* which informs the reader that the topics following do not necessarily exhaust the subject under consideration.

The references

The three columns aligned to the right of each topic in the sectional outlines contain the volume and page numbers of the *Macropædia* articles that, in whole or part, treat the subjects stated in the topic, as illustrated at the bottom of this page. Each of the three columns has a special reference function.

The first column usually contains references to whole articles, the titles of which are given, as well as volume and page references. In the case of articles whose scope covers outline topics in two or more sections, divisions, or even parts, the reference will be to the pages in the article relevant to the topic at which the title is aligned.

The second column contains references to important article sections, the references being given by the page location at which the section cited begins and the page location at which it ends.

The third column contains references to passages that are smaller than article sections, the references being given in the same way as in the case of column two. All references to biographical and to geographical articles are listed in the third column.

In the second and third columns, when two or more article sections or two or more smaller passages are cited, the references are usually arranged in volume and page order; and the distinct references are separated by a slash. However, when the title of an article has been listed in the first column at a particular topic, references to portions of this article at lower-level topics are listed before any other references in the second column.

In the second and third columns, the page references indicate the segment of the page at which the passage cited begins and the segment of the page at which it ends. The segments that are signified by the letters a, b, c, and d, refer to the top, upper-middle, lower-middle, and bottom portions, respectively, of the left column of text on a page. The letters e, f, g, and h, refer to the corresponding portions of the right column of text.

a	e
b	f
c	g
d	h

The word *passim* following a reference in the third column indicates that the material in an article that is relevant to a topic is diffused throughout the treatment of a broader subject rather than being a concentrated treatment of the topic.

Since the content of the biographical and geographical articles that are included in the *Macropædia* does not influence the structure or content of the sectional outlines, the titles of such articles are not listed in the first column. The titles of all other articles appear at least once and sometimes more than once in the first column of references attached to the sectional outlines; however, the titles of biographical and geographical articles are listed alphabetically at the end of parts, divisions, or sections, when their content is relevant to the subject matter covered in the part, division, or section to which they are appended.

	articles	article sections	other references
3. Kinship systems: their functions and types	KINSHIP **10**:477–485	**7**:155b–156h/ **7**:168g–172d	**5**:31f–h/**6**:1127e–g/ **14**:839d–f

Table of contents

Part One. **Matter and energy**
Introduction. *The universe of the physicist, the chemist, and the astronomer* by Nigel Calder *page 17*

Division I. Atoms: atomic nuclei and elementary particles *20*
111. The atomic nucleus; elementary particles *21*
112. The structure and properties of atoms *27*

Division II. Energy, radiation, and the states and transformation of matter *29*
121. Chemical elements: periodic variation in their properties *30*
122. Chemical compounds: molecular structure and chemical bonding *36*
123. Chemical reactions *41*
124. Heat, thermodynamics, and the nonsolid states of matter *45*
125. The solid state of matter *49*
126. Mechanics of particles, rigid bodies, and deformable bodies: elasticity, vibrations, and flow *52*
127. Electricity and magnetism *55*
128. Waves and wave motion *59*

Division III. The universe: galaxies, stars, the solar system *63*
131. The cosmos *64*
132. Galaxies and stars *66*
133. The solar system *70*

Part Two. **The Earth**
Introduction. *The great globe itself* by Peter J. Wyllie *76*

Division I. The Earth's properties, structure, and composition *79*
211. The planet Earth *79*
212. The Earth's physical properties *80*
213. The structure and composition of the Earth's interior *84*
214. The Earth's constituent minerals and rocks *85*

Division II. The Earth's envelope: its atmosphere and hydrosphere *92*
221. The atmosphere *92*
222. The hydrosphere: the oceans, freshwater bodies, and ice masses *94*
223. The motions of the sea and the forces that cause them *97*
224. Weather and climate *99*

Division III. The Earth's surface features *104*
231. Physical features of the Earth's surface *104*
232. Features produced by geomorphic processes acting on the Earth's surface *108*

Division IV. The Earth's history *115*
241. Origin and development of the Earth and its envelopes *115*
242. The interpretation of the geological record *119*
243. The eras and periods of geological time *123*

Part Three. **Life on Earth**
Introduction. *The mysteries of life* by René Dubos *127*

Division I. The nature and diversity of living things *page 130*
311. Characteristics of living things *131*
312. The origin of life and the evolution of living things *132*
313. The classification of living things *135*

Division II. The molecular basis of vital processes *144*
321. Chemicals and the vital processes *145*
322. Metabolism: bioenergetics and biosynthesis *150*
323. Vital processes at the molecular level *152*

Division III. The structures and functions of organisms *154*
331. The cellular basis of form and function *155*
332. The relation of form and function in organisms *157*
333. Coordination of vital processes: regulation and integration *161*
334. Covering and support *164*
335. Nutrition: the procurement and processing of nutrients *167*
336. Gas exchange, internal transport, and elimination *168*
337. Reproduction and sex *172*
338. Development: growth, differentiation, and morphogenesis *175*
339. Heredity: the transmission of traits *179*

Division IV. Behavioral responses of organisms *182*
341. Nature and patterns of behavioral responses *182*
342. Development and range of behavioral capacities: individual and group behaviour *184*
343. Evolution of behaviour *189*

Division V. The biosphere: the world of living things *189*
351. Basic features of the biosphere *190*
352. The community: a collection of interacting populations *192*
353. Hazards of life in the biosphere: disruptions and death *195*
354. Patterns of life in the biosphere *196*
355. Man's place in the biosphere *200*

Part Four. Human life
Introduction. *The cosmic orphan* by Loren Eiseley *206*

Division I. Stages in the development of human life on Earth *209*
411. The order of primates and the emergence of Hominidae *210*
412. Quaternary Hominidae *211*
413. The evolution of man *213*
414. Human heredity: the races of man *215*

Division II. Human health and diseases *217*
421. Human health *217*
422. The structures and functions of the human body *220*
423. Human disease: its manifestations, recognition, and treatment *227*
424. Diseases and disorders of the human body *230*
425. The practice of medicine and the care of health *238*

Division III. Human behaviour and experience *241*
431. General theories of human nature and behaviour *242*
432. Antecedent conditions and developmental processes affecting a person's behaviour and conscious experience *243*

433. Influence of the current environment on a person's behaviour and conscious experience: attention, sensation, and perception *page 246*
434. Current internal states affecting a person's behaviour and conscious experience *251*
435. Persisting capacities that integrate human behaviour and conscious experience *254*
436. Development of a person's potentials: learning and thinking *256*
437. Persisting inclinations that guide and organize human behaviour and conscious experience *259*
438. Personality and the self: integration and disintegration of the person as a whole *261*

Division IV. Communication and language *263*
441. Methods and forms of communication *264*
442. Language *265*

Division V. Aspects of man's daily life *273*
451. The means of subsistence *273*
452. Leisure and play *275*

Part Five. Human society
Introduction. *Man the social animal* by Harold D. Lasswell *280*

Division I. Culture *283*
511. The development of human culture *283*
512. The variety of sociocultural forms *286*

Division II. Social organization and social change *294*
521. Social structure and change *294*
522. The group structure of society *297*
523. Social status *303*
524. Collective behaviour and mass society *305*
525. Human populations: urban and rural communities *307*

Division III. The production, distribution, and utilization of wealth *311*
531. Economic concepts, issues, and systems *311*
532. Human wants and their economic expression *314*
533. Markets, pricing, and the mechanisms for distributing goods *315*
534. The organization of production and distribution *316*
535. The distribution of income and wealth *325*
536. Macroeconomics *328*
537. Economic growth and planning *330*

Division IV. Politics and government *332*
541. Political theory *333*
542. Political institutions: the structure, branches, and offices of government *340*
543. The functioning of government: the dynamics of the political process *342*
544. International relations: peace and war *346*

Division V. Law *352*
551. Philosophies and systems of law *353*
552. Branches of public law, substantive and procedural *357*
553. Branches of private law, substantive and procedural *363*
554. The profession and practice of law *369*

Division VI. Education page 371
561. The aims and methods of education 371
562. Education around the world 372
563. The organization of education 377

Part Six. Art
Introduction. *The world of art* by Mark Van Doren 381

Division I. Art in general 383
611. Theory and classification of the arts 383
612. Experience and criticism of works of art 386
613. Nonaesthetic contexts of art 389

Division II. Particular arts 393
621. Literature 393
622. Theatre 400
623. Motion pictures 404
624. Music 407
625. Dance 414
626. Architecture, garden and landscape design, and urban design 417
627. Sculpture 421
628. Drawing, painting, printmaking, and photography 423
629. Arts of decoration and functional design 428

Part Seven. Technology
Introduction. *Knowing how and knowing why* by Lord Ritchie-Calder 434

Division I. The nature and development of technology 437
711. Technology: its scope and history 438
712. The organization of human work 441

Division II. Elements of technology 444
721. Technology of energy conversion and utilization 444
722. Technology of tools and machines 448
723. Technology of measurement, observation, and control 449
724. Extraction and conversion of industrial raw materials 454
725. Technology of industrial production processes 458

Division III. Major fields of technology 462
731. Agriculture and food production 463
732. Technology of the major industries 469
733. Construction technology 474
734. Transportation technology 477
735. Technology of information processing and of communication systems 482
736. Military technology 489
737. Technology of the urban community 492
738. Technology of Earth and space exploration 495

Part Eight. Religion
Introduction. *Religion as symbolism* by Wilfred Cantwell Smith 498

Division I. Religion in general 501
811. Diverse views about religion 501
812. Religion as an object of study; religious experience and phenomenology 511

Division II. The particular religions *page 517*
821. Prehistoric religion and primitive religion *518*
822. Religions of ancient peoples *520*
823. Hinduism and other religions of India *525*
824. Buddhism *529*
825. Indigenous religions of East Asia: religions of China, Korea, and Japan *532*
826. Judaism *536*
827. Christianity *539*
828. Islām *555*
829. Other religions and religious movements in the modern world *558*

Part Nine. The history of mankind
Introduction. *The point and pleasure of reading history* by Jacques Barzun *560*

Division I. Peoples and civilizations of ancient Southwest Asia, North Africa, and Europe *563*
911. Early peoples and civilizations of Southwest Asia and Egypt, the Aegean, and North Africa *563*
912. Peoples of ancient Europe and the Classical civilizations of the ancient Mediterranean world to AD 395 *570*

Division II. Peoples and civilizations of medieval Europe, North Africa, and Southwest Asia *578*
921. Western Europe, the Byzantine (Eastern Roman) Empire, and the states of eastern Europe from AD 395 to *c.* 1050 *578*
922. The Empire of the Caliphate and its successor states to *c.* AD 1055 *583*
923. Western Christendom in the High and later Middle Ages (*c.* 1050–*c.* 1500) *585*
924. The crusading movement, the Islāmic states of Southwest Asia, North Africa, and Europe, and the states of Eastern Christendom from *c.* 1050 to *c.* 1480 *592*

Division III. Peoples and traditional civilizations of East, Central, South, and Southeast Asia *595*
931. China to the beginning of the late T'ang (AD 755) *596*
932. China from the beginning of the late T'ang (AD 755) to the late Ch'ing (*c.* 1839) *598*
933. Inner (Central and Northeast) Asia to *c.* 1750 *600*
934. Japan to the Meiji Restoration (1868), and Korea to 1910 *602*
935. The Indian subcontinent and Ceylon to *c.* AD 1200 *604*
936. The Indian subcontinent from *c.* 1200 to 1761, and Ceylon from *c.* 1200 to 1505 *606*
937. The peoples and civilizations of Southeast Asia to *c.* 1600 *608*

Division IV. Peoples and civilizations of sub-Saharan Africa to 1885 *610*
941. West Africa to *c.* 1885 *611*
942. The Nilotic Sudan and Ethiopia from *c.* AD 550 to 1885 *612*
943. East Africa and Madagascar to *c.* 1885 *612*
944. Central Africa to *c.* 1885 *613*
945. Southern Africa to *c.* 1885 *614*

Division V. Peoples and civilizations of pre-Columbian America *615*

951. Andean civilization to *c.* AD 1540 *page 616*
952. Meso-American civilization to *c.* AD 1540 *617*

Division VI. The modern world to 1920 *618*
961. Western Europe from *c.* 1500 to *c.* 1789 *620*
962. Eastern Europe, Southwest Asia, and North Africa from *c.* 1480 to *c.* 1800 *628*
963. Europe from 1789 to *c.* 1920 *631*
964. European colonies in the Americas from 1492 to *c.* 1790 *642*
965. Development of the United States and Canada from 1763 to 1920 *644*
966. Development of the Latin American and Caribbean nations to *c.* 1920 *649*
967. Australia and Oceania to *c.* 1920 *654*
968. South Asia under the influence of European imperialism from *c.* 1500 to *c.* 1920 *655*
969. Southeast Asia under the influence of European imperialism to *c.* 1920 *657*
96/10. China from 1839 until the onset of revolution (to *c.* 1911), and Japan from the Meiji Restoration to *c.* 1910 *659*
96/11. Southwest Asia and North Africa (*c.* 1800–1920), and sub-Saharan Africa (1885–*c.* 1920) under the influence of European imperialism: the early colonial period *660*

Division VII. The world since 1920 *662*
971. International movements, diplomacy, and war since 1920 *663*
972. Europe since *c.* 1920 *666*
973. The United States and Canada since 1920 *672*
974. Latin American and Caribbean nations since *c.* 1920 *675*
975. East Asia: China in revolution, the era of Japanese hegemony, and the influence of the United States in the 20th century *680*
976. South and Southeast Asia: the late colonial period and the emergence of new nations since 1920 *683*
977. Australia and Oceania since 1920 *686*
978. Southwest Asia and Africa: the late colonial period and the emergence of new nations in the 20th century *687*

Part Ten. The branches of knowledge
Introduction. *Knowledge become self-conscious* by Mortimer J. Adler *692*

Division I. Logic *694*
10/11. History and philosophy of logic *695*
10/12. Formal logic, metalogic, and applied logic *697*

Division II. Mathematics *699*
10/21. History and foundations of mathematics *700*
10/22. Branches of mathematics *703*
10/23. Applications of mathematics *719*

Division III. Science *725*
10/31. History and philosophy of science *726*
10/32. The physical sciences *729*
10/33. The Earth sciences *735*
10/34. The biological sciences *738*
10/35. Medicine and affiliated disciplines *741*

10/36. The social sciences and psychology *page 746*
10/37. The technological sciences *751*

Division IV. History and the humanities *753*
10/41. Historiography and the study of history *753*
10/42. The humanities and humanistic scholarship *756*

Division V. Philosophy *760*
10/51. The nature and the divisions of philosophy *760*
10/52. History of philosophy *767*
10/53. Philosophical schools and doctrines *772*

Introduction to Part One:

The universe of the physicist, the chemist, and the astronomer

by Nigel Calder

"Give me matter and I will build a world from it." For 200 years since the philosopher Immanuel Kant uttered it, physicists, chemists, and astronomers have striven to make good that boast. That they can now tell an almost unbroken story of events from the birth of the universe to the origin of life on Earth is the result of many cumulative lifetimes spent in careful observation and experiment. Yet even amid this success in updating the first verses of Genesis, new questions nag. Why does familiar matter adopt the forms it does? Are the laws of nature that are known to us enforced throughout the vast, tumultuous universe? What unimaginable worlds of fire or blackness can nature conjure up, quite different from our own?

When men presume to take the fire of the Sun and put it experimentally in a bottle, they forfeit all hope of certainty and repose. Yet the great quest for control over nature starts gently enough. A child at play with building blocks or sand or a rubber ball is a human mind engaged in discovering how matter behaves. Experiments with the rubber ball, for example, reveal laws of reflection. The child finds that the ball will come back to him only if he projects it accurately at a right angle to a flat surface (wall or floor); otherwise it bounces away from him and another child may grab it and interrupt the research program.

If all grown-up children had abandoned this kind of play the human species would still believe that the Earth was at the centre of the universe, that the planets were propelled by angel-power, and that thunder was the voice of God. But some adults retained the boundless inquisitiveness of the young. Isaac Newton, not the most modest of discoverers, likened himself to a child playing on the seashore. Critics nowadays refer scathingly to the "expensive toys" of the physicists who want many millions of dollars to build a particle accelerator. Not unfairly—a particle accelerator, for all its awesome complexity and cost, is simply a modern way of continuing the experiments with the rubber ball, to see what happens when the ball is very small and travels almost at the speed of light.

By strange paths, play leads to far-reaching results. After the discovery that an electric current creates magnetism, Michael Faraday made a note to look for electricity from magnetism. He played repeatedly with magnets and wires until, ten years later, he discovered electromagnetic induction. Today, giant turbogenerators confirm his discovery 60 times a second, as they feed electric power to our factories and kitchens. In James Clerk Maxwell's hands, Faraday's ever-changing electric currents transformed themselves into mathematical equations predicting the existence of waves that travelled at the speed of light—indeed *were* light and invisible radiations of a similar kind, including radio waves. Other researchers who were unwittingly taking atoms to pieces came up with a beam of electrons, which inventors turned into a magic pencil; today those waves and electrons enable lesser men to preen themselves on television screens in 260,000,000 homes.

In this latter part of the 20th century, a word-association test for "physicist" may very well evoke "bomb." By coincidence, investigators of the nature of matter and energy stumbled upon a way of breaking open the storehouse of energy in the nucleus of the atom, just as the human species was entering a period of unprecedented warfare. The swarms of nuclear-powered submarines that cruise with nuclear-tipped, city-killing missiles are a grim enough outcome of the "game." The fact remains that the heart of physics itself is not directed to any such purpose, but is an open, cooperative effort by scientists of all nations to understand the material universe we live in.

We inhabit an electric world. It is true that gravity stops us from falling headfirst into the abyss of space; true also that the daylight that powers all life comes from the nuclear reactor that we call the Sun. But of the great set of natural forces known to the physicist—gravitational, nuclear, and electromagnetic—the last, electromagnetism, is the chief governor of events on Earth.

It operates so discreetly, though, that when men started rubbing amber on their sleeves and found it attracted dust, or considered the seeming magic of the north-pointing lodestone, nothing suggested that these were more than curiosities. There was laughter when Benjamin Franklin said that lightning was electric—until he proved it. Nothing suggested that the colour, quality, and chemical behaviour of all familiar matter would be explained by research in electricity and magnetism. But that is in the nature of physics: you ponder the falling of an apple and realize what holds the planets in their courses; you look to see what happens when you pass electric currents through a gas and, in due course, you find out what holds a stone together and why grass is green.

A series of discoveries in the late 19th and early 20th centuries illuminated the hidden mechanisms of our electric world like star shells on a dark night. Diligent work by chemists had shown that all matter was composed of vast numbers of atoms, different for each chemical element and capable of combining in predictable ways to make molecules and crystals. Indeed there was a remarkable pattern in the so-called "periodic table": when the chemical elements were listed by weight it turned out that elements 3, 11, and 19 . . . all had similar properties; 4, 12, and 20 . . . were also very much alike, and so on.

This pattern made sense only when the physicists discovered the construction of atomic matter. An atom consists of a heavy nucleus surrounded by a number of lightweight electrons exactly neutralizing the electric charge on the nucleus. The electrons group themselves around the nucleus in "shells," like the layers of an onion, each shell being capable of accommodating a definite number of electrons. The outward face of the atom, its outermost shell of electrons, is crucial in determining its chemical behaviour. The number of electrons to be fitted in depends on the charge on the nucleus. In some elements, the metals, there are only one or two easily detachable electrons in the outermost shell. Other elements, the most reactive nonmetals, fall short by only one or two electrons of a complete outermost shell. These "surplus" and "missing" electrons create a supply-and-demand situation in which atoms combine chemically by exchanging or sharing electrons. The repetition of chemical properties throughout the periodic table arises as one shell of electrons is completed and the next one begins to fill.

The mechanisms sketched in these last few sentences ac-

count for almost all the chemical behaviour of all the matter on Earth. The electrical and magnetic behaviour of materials also depends on the arrangements of electrons in their atoms and, in some cases, on the combined effects of many atoms packed together in a crystal. The strength of the chemical bonds formed by electrons, and the related forces between molecules, determine whether materials are solids, liquids, or gases; and they help to fix the strength and flexibility of solids, but in this case the explanations are complicated by the invisible flaws that exist in all materials. The colour of materials is explicable by the "jumps," from one position to another in the vicinity of an atom, which the rules allow an electron to make, as the atom, molecule, or crystal absorbs or emits light of particular energy, or colour. Make the same electrons in vast numbers of atoms "jump" the same way simultaneously and you have a very intense laser beam.

Light and its invisible counterparts—radio waves, infrared, ultraviolet, and X-rays—are the purest form of energy. These "electromagnetic radiations" are created by the jerking of electrons, sometimes quite gently as in a radio antenna and sometimes very fiercely as when a beam of fast-moving electrons is suddenly halted by the target in an X-ray tube. The normal "jumps" of electrons in atoms are of intermediate intensity. All these radiant forms of energy can travel through empty space, for example from the Sun to the Earth.

But energy can readily change from one form to another. Sunlight captured by green leaves is converted into the chemical energy of plant-stuff. Coal is plant-stuff buried millions of years ago when continents collided, and a boiler can convert the chemical energy of coal into a scalding jet of steam that turns the blades of a turbine—these are forms of kinetic energy, the energy of directed movement. Using Faraday's trick, the turbine can generate electrical energy. At the end of this chain of transformations, you can switch on the electrical energy and reconvert it to light energy, thereby enjoying the benefits of sunlight after the Sun has set.

The vibrations of sound and the gravitational energy of water about to cascade down a mountainside are other forms of energy. Sooner or later, though, a shout dies away, water comes to rest, the light from your electric bulb is absorbed in the wallpaper. Where has the energy gone? It has been taken up in those random motions of atoms and molecules that we call heat. All energy degrades to meaningless heat eventually.

Unless there were continuous supplies of new energy, life and indeed all interesting activity in the universe would quickly cease. For example, your brain is kept going, as you read these words, by food—chemical energy produced by sunlight falling on the Earth just in the past few months. Those new supplies of energy come from the transformation of matter into energy.

The Sun is a very ordinary star, lying in the suburbs of a galaxy consisting of about 100,000,000,000 stars; we see the rather flat cross section of the galaxy as the Milky Way, a brushstroke of light across the night sky. There is nothing special, even, about our Galaxy; it is just one of vast numbers of galaxies scattered like ships in a great ocean of space.

The universe is a battleground between gravity and nuclear forces. To make a star, gravity sweeps together a mass of hydrogen gas; it becomes hot and nuclear reactions begin. The nuclei of hydrogen atoms combine together to make heavier elements almost, but not quite, as heavy as the sum of the hydrogen nuclei that went into them. The little bit of matter that is lost is converted into a relatively immense amount of energy. It would blow the star apart but for the strenuous restraint of gravity. A balance is struck and the size and brightness of a star depends on its mass and on how much of its nuclear fuel has been burned. Fortunately, our star, the Sun, is a slow-burner; nevertheless, inexorable physical changes billions of years from now will make the Sun grow to fill the whole of our sky and swallow the Earth.

In a star more massive than the Sun, this "burning" of nuclear fuel proceeds faster and culminates in a vast explosion called a supernova. In the explosion, nuclear reactions proceed apace and make all the different chemical elements. The diverse atoms, heavier than hydrogen, of which our own bodies are constructed, were made in stars that exploded before the Sun was formed. Some of the heavy material was left swirling around the newborn Sun and made the Earth. Radioactive energy stored in some of the elements provided an internal source of heat for the Earth that accounts for volcanoes, earthquakes, and the slow movements of continents. Sunlight stirred the materials on the surface of the Earth into chemical activity. Eventually this activity became organized in peculiar ways, and life began.

So far, so good. But there are new mysteries that are "out of this world," in the sense that matter and energy are involved in events far more violent than anything normally encountered on Earth or even in the Sun. The paramount questions with which physicists are now wrestling can be paraphrased as follows: Why is hydrogen the raw material of the universe? Experiments with the nucleus of the hydrogen atom—the proton—are undertaken in the big accelerators that transform the stuff of the atomic nucleus into bizarre, short-lived particles. These particles have properties, similar to electric charge, called the hypercharge and the baryon number. For example, the proton itself has, besides an electric charge of $+1$, a hypercharge of $+1$ and a baryon number of 1. However the particles may transform themselves in violent interactions, the totals of charge, hypercharge, and baryon number do not change.

Attempting to find out why this partial order remains amid the confused varieties of nuclear matter, theorists are led to the idea that the particles we see consist of combinations of other, quite different particles that they have named quarks. An early success of this theory was the prediction of the existence of a new combination, a particle called the omega minus that eventually turned up in 1964 during an experiment with the big machine at the Brookhaven National Laboratory, Long Island, N.Y. The quarks themselves have not been discovered at the time of writing.

The next big leap in understanding may well come when the theory of how small pieces of matter behave is blended with the theory of gravity, which at present concerns the huge pieces of matter that make up our universe of galaxies, stars, and planets. With such a "unified" theory physicists may at last be able to answer that question about the raw material of the universe—why hydrogen? At the same time we shall perhaps come to understand why matter was formed in the "big bang" with which (as many astronomers now suppose) the universe came into existence some 10,000,000,000 years ago; why the "big bang" was not merely a "big flash."

Even so fundamental an advance would not exhaust the opportunity for fresh discovery in the physical sciences. Another set of pregnant problems results from very strange objects recently discovered in the sky, namely "hot" galaxies, quasars and pulsars. The quasars, in particular, are compact objects of such extraordinary energy that existing laws of physics seem scarcely able to account for them. The pulsars, which flash many times a minute, are also very odd, but less baffling. They are evidently remnants of exploded stars that have collapsed to the enormous density of the material of the atomic nucleus. If an ocean liner were compressed to the density of a pulsar it would be no bigger than a grain of sand.

The evidence of the pulsars encourages a further idea—one of the strangest in the whole history of man's study of matter and energy. In a pulsar, nuclear forces prevent collapse to even greater densities. But if the collapsed star were even more massive, gravity would be stronger and it would overwhelm even the nuclear forces. Then there would be nothing to stop the process until the whole star had collapsed to smaller than a peanut. Through the intense gravitational field thus set up no light could escape and the star would in effect disappear from the universe. Only its gravity would remain, like the grin of the Cheshire Cat in *Alice in Wonderland,* and if a space traveller ran into one of these "black holes" he too would be drawn to the same invisible kernel, there to disappear forever—or at least until the laws of physics change.

The possibility that such black holes exist holds out a hope of explaining the quasars as objects of this kind from which material somehow "bounces" out. But that is only a little comfort, when scientists have now to reexamine the theory of gravity which they thought Einstein had cleared up 60 years ago, and to work out the implications of a universe peppered with black holes where the familiar laws of nature are unlikely to apply. There is even the uncomfortable suggestion that our whole universe may be just a big black hole in someone else's universe! Physics, the master science, cannot evade these new battles of the mind.

Part One. Matter and energy

The outlines, and the articles and parts of articles referred to, in the thirteen sections of Part One are concerned with the work of all the physical sciences. The subject matter of the several Earth sciences is dealt with in Part Two, and that of the biological sciences is treated in Parts Three and Four.

Three further points should be noted about the scope of Part One and its relations to other parts.

The sciences of physics, chemistry, and astronomy have themselves been the object of historical and analytical studies regarding their nature, scope, methods, and interrelations. Part Ten, on the branches of knowledge, is concerned with such studies of the intellectual disciplines. The outline and the articles referred to in Section 10/32 of Part Ten deal with the sciences of physics, chemistry, and astronomy and treat their history, their nature and scope, and their principal problems and interrelations.

The design and operation of observational and experimental instruments are important in the development of the physical sciences. The treatment of scientific instrumentation is placed in Section 723 of Part Seven, on technology.

Accounts of the several kinds of mathematics used in observation and experiments, and in the derivation and application of physical theories, are set forth in Division II of Part Ten.

The three increasingly complementary physical sciences of physics, chemistry, and astronomy strive for knowledge and for organizing theories about matter in all its dimensions, from subatomic particles to the cosmos, about all the states of matter, all the forms of energy, and all the interrelations of matter and energy.

The outlines and the articles referred to in the two sections of Division I deal with modern advances in subatomic and atomic physics.

The outlines and the articles referred to in the eight sections of Division II treat chemical elements; chemical compounds; chemical reactions; heat, thermodynamics, and the nonsolid states of matter; the solid state of matter; the mechanics of particles, rigid bodies, and deformable bodies; electricity and magnetism; and waves and wave motion—both in general and with regard to particular waves, such as light waves and sound waves.

The outlines and the articles referred to in the three sections of Division III treat the cosmos; galaxies and stars; and the solar system.

Division I. Atoms: atomic nuclei and elementary particles 20
II. Energy, radiation, and the states and transformation of matter 29
III. The universe: galaxies, stars, the solar system 63

Division I. Atoms: atomic nuclei and elementary particles

The outlines, and the articles and parts of articles referred to, in the two sections of Division I deal with modern advances in subatomic and atomic physics.

The outline and the articles referred to in Section 111 treat the experimental evidence for and the theories about the atomic nucleus and the many kinds of elementary particles. The section treats the components, structure, and general properties of atomic nuclei, and such nuclear phenomena as radioactivity, nuclear fission, nuclear fusion, and the effects of the passage of radiation through matter.

The outline and the articles referred to in Section 112 deal with modern theories of the structure and properties of atoms. The section first deals with scientific evidence for the existence and the nature of the atoms of matter, with models of atomic structure, and with the wave-mechanical theory of the electronic structure of the atom. It further treats atomic weights, atomic spectra, X-rays and atomic structure, the concept of antimatter, and the fundamental physical constants.

Section 111. The atomic nucleus; elementary particles 21
112. The structure and properties of atoms 27

Section 111. The atomic nucleus; elementary particles

[for Part One headnote see page 20
for Division I headnote see page 20]

The articles and parts of articles referred to in Section 111 deal with nine main subjects: A, the structure of the atomic nucleus and general nuclear phenomena; B, isotopes; C, radioactive nuclei; D, the neutron; E, nuclear reactions; F, nuclear fission; G, nuclear fusion; H, subatomic particles; and I, the effects of radiation on matter.

The outline of subject A begins with the general properties and the components of all atomic nuclei. It then covers the relationships between nuclear masses and nuclear binding energies; the properties of nuclear states; the theories of nuclear structure and binding force; and general nuclear phenomena and reactions. At the end, it treats the formation and evolution of the atomic nuclei in the universe.

Subject B is isotopes, an isotope being one of two or more atomic species of the same chemical element that have different atomic weights. The outline first deals with the classification of isotopes, the isotopic composition of the elements, and their formation by nuclear reactions. It then treats the effects of isotopic substitution on the physical and chemical properties of substances and the chemical and physical separation of isotopes by mass spectrometry and other methods. Finally, it deals with those applications of radioactive and stable isotopes in medicine, physics, chemistry, and geology that are treated in Part Seven.

The outline of subject C begins with the nature of radioactive emissions, the types of radioactivity, and the natural and artificial sources of radioactivity. Dealing with the energetics and kinetics of radioactivity, it covers energy release associated with radioactive decay; the nuclear models used to explain the behaviour of nuclear binding; and the rates of radioactive transitions.

The outline of subject D, the neutron, begins with the properties of neutrons and their role as components of the atomic nucleus. It next deals with the sources of neutrons and with their manipulation and control. Finally, it treats the nuclear reactions produced by neutrons and the methods and apparatus used for neutron detection.

The outline of subject E begins with the classification of nuclear reactions—first according to the kind of bombarding radiation or particles, and then according to nuclear processes involved or according to their products. It next treats the energy relationships of nuclear reactions and the theories and models of nuclear reactions.

Subject F is the splitting of atomic nuclei by nuclear fission. The outline deals first with the general phenomena of nuclear fission, covering the spontaneous and induced fission reactions, the products of nuclear fission, and the energy released in fission. It next deals with fission chain reactions and their control. Finally, it treats the different models used in theories of nuclear fission.

Subject G is nuclear fusion. The outline begins with the general phenomena of fusion, the process in which two or more atomic nuclei combine to form a heavier atomic nucleus. It deals next with fusion reactions, covering their general types and energy yield and their occurrence in the Sun, stars, and hydrogen bombs. Finally, it treats the basic conditions required for the operation of a thermonuclear reactor and the possible approaches to controlled fusion.

Subject H is subatomic, or elementary, particles, the fundamental units of matter and energy. The outline begins with the development of the concept of subatomic particles and the discovery of their several kinds. It goes on to the four basic forces associated with particle interactions, to the various systems for classifying the elementary particles, and to the relation of the particles to conservation laws and symmetry. The outline further treats the sources of the unstable elementary particles; the relations of weak interactions to strong and electromagnetic interactions; the existence of undiscovered particles suggested by contemporary theoretical ideas; the reactions of elementary particles with atoms; and theories of nuclear structure and forces that involve the elementary particles.

The outline of subject I, the effects of radiation on matter, begins with the fundamental processes involved when energetic particles interact with or pass through matter. It then deals with the secondary and tertiary physical, chemical, and biological effects of radiation. It goes on to the significance of radiation-induced changes in fundamental biological processes and in various technological fields. Finally, the outline treats the use of the fundamental processes of energy transfer for the detection and characterization of nuclear and elementary processes themselves.

articles	article sections	other references
NUCLEUS, ATOMIC **13**:334–345		
A. The structure of the atomic nucleus, and general nuclear phenomena		
1. General properties of atomic nuclei	**13**:335b–337b/ **15**:434h–435d	**17**:462a–b
a. Mass	**13**:335b–e	**2**:331e–f/ **2**:343b–345h *passim*/ **9**:1054f–h
b. Charge: atomic number	**13**:335b–d	**4**:118f–g
c. Radius	**13**:335g–h	**2**:331a–e/**14**:79a–c
d. Spin	**13**:335h–336b	**11**:306e–f/**12**:305d–g
e. Magnetic moment: nuclear magnetic resonance phenomena	**13**:336c–f/ **11**:320c–h	**9**:97e/**15**:590d–e/ **17**:474g–475a
MAGNETIC RESONANCE **11**:305–309		
f. Electric quadrupole moment	**13**:336f–337b	
2. Components of atomic nuclei	**13**:337c–g/ **12**:1072e–h	**13**:1022g–h
a. Neutrons [see D., below]		
b. Protons	**13**:337c–f/ **5**:77f–g	**4**:116a–b/**11**:704c–e
c. Other possible short- and long-lived components	**13**:1023g–1025a	
3. Isotopes: atomic species with the same atomic number but with different atomic masses [see B., below]		
4. Systematic relationships between nuclear masses and nuclear binding energies: mass defect	**13**:337g–338b	**4**:118h–119a/**12**:1072f–g/ **15**:441c–f

	articles	article sections	other references
5. Nuclear models and the properties of nuclear states: the (jj)-coupling shell model, the collectively deformed model, the liquid drop model		**13**:338b–342e / **15**:441h–443c / **18**:681f–h	**17**:465a–c
6. Theories of nuclear structure and nuclear binding force		**13**:342e–343c / **12**:1072e–h / **18**:680f–681a	**11**:800b–801c / **13**:1022g–1023a
7. General nuclear phenomena and reactions		**13**:343c–345c / **12**:1074e–1075e / **18**:681a–e	**1**:67d–68b
a. Radioactivity [see C., below]			
b. Interactions with other nuclear particles [see E., below]			
c. Interactions with electromagnetic radiation		**13**:344f–345c / **6**:655f–656c / **15**:403c–406c / **15**:439g–440c	
8. The formation and evolution of the atomic nuclei in the universe: nucleosynthesis in stars, novae, supernovae	CHEMICAL ELEMENTS, ORIGIN OF **4**:118–123	**7**:848f–g / **17**:602a–603d	**13**:309e–310a / **18**:1008e–h
B. Isotopes: atomic species with the same atomic number but with different atomic masses	ISOTOPES **9**:1054–1059		
1. Classification of isotopes or nuclides		**9**:1055c–f / **18**:680c–681a	**4**:117d–e / **15**:452e–f
2. Isotopic composition of the elements		**9**:1055f–1056h / **9**:96b–g	**13**:812h–813d
3. Formation of isotopes by nuclear reactions [see E., below]			
4. Effects of isotopic substitution on physical and chemical properties of substances		**9**:1057d–1058e	**4**:150g–h / **9**:96d–f
5. Chemical and physical separation of isotopes		**9**:1058f–h	
a. Mass spectrometry	MASS SPECTROMETRY **11**:604–609		
b. Other methods of separation; *e.g.*, diffusion, centrifugal separation, thermal diffusion		**13**:322h–323b	**3**:1147a–e / **9**:96b–c
6. Applications of radioactive and stable isotopes [see 723.G.8.]			
C. Radioactive nuclei: their properties and their radiations	RADIOACTIVITY **15**:434–448		
1. The phenomenon of radioactivity whereby the nucleus undergoes a spontaneous transition or transformation with a resulting emission of energy and subatomic particles		**15**:435d–f / **13**:343c–g / **15**:460d–e	**5**:502c–d
2. Types of radioactivity characterized by the nature of nuclear radiation emitted by the parent nucleus: alpha decay, beta minus decay, beta plus decay, gamma decay, isomeric transitions, electron capture, spontaneous fission		**15**:435f–438e / **18**:681a–e	**1**:67e–f / **18**:678e–h
3. Sources of radioactivity		**15**:438e–h / **9**:1056d–1057c / **15**:452h–453f	
a. Naturally occurring radioactive elements		**1**:594g–595a / **5**:208d–e / **15**:452h–453b	**4**:117d–e / **9**:1056d–h / **12**:241d–h / **15**:382b–d / **15**:419c–d / **15**:438e–f
b. Particle bombardment: fission, bombardment with high-energy electromagnetic radiation		**13**:304g–305f / **15**:382e–383b / **15**:453c–f / **18**:678h–680b	**1**:67f–68a / **15**:438g–h
4. Interaction of radiation with matter [see I., below]			
5. The energy release associated with radioactive decay		**15**:440e–441h / **6**:24g–25a	**13**:304d–f
6. Nuclear models used to explain nuclear binding		**15**:441h–443c	
a. The liquid drop model		**15**:441h–442c	**13**:305g–306b / **18**:681f
b. The shell model		**15**:442c–443a	
c. The unified model		**15**:443a–c	

	articles	article sections	other references
7. Rates of radioactive transitions		**15**:443d–447c	
a. Exponential decay law		**15**:443d–444c	**5**:502d–g/**5**:736g–737b
b. Alpha decay		**15**:444c–445c	
c. Beta decay		**15**:445c–446f/ **6**:688g–h	**13**:337d–e
i. Neutrino production			**11**:800h–801c/**15**:445c–g
ii. The nonconservation of parity in beta decay and other weak interactions		**5**:37a–d	**15**:445g–h
d. Gamma transition		**15**:446f–447c	
8. Applications of radioactivity [see 723.G.8.]			
9. Measurement and characterization of radioactivity [see I.4., below]			
D. The neutron as a component of the nucleus, and in nuclear reactions	NEUTRON **12**:1070–1076		
1. Properties of neutrons; *e.g.*, charge, mass, spin, magnetic moment, wave properties		**12**:1071e–1072e	**13**:337c–e
2. The neutron as a component of the nucleus		**12**:1072e–h	**13**:337c–g
3. Sources of neutrons; *e.g.*, reactions initiated by charged particles, by gamma radiation, and by fission		**12**:1072h–1073g	**13**:304a–d
4. Manipulation and control of neutrons: moderation, diffusion, absorption, velocity selection		**12**:1073h–1074e	**13**:314f–h/**15**:440c–d/ **15**:526e–f
5. Nuclear reactions produced by neutrons		**12**:1074e–1075e/ **15**:408d–409a	**13**:301d–h/**13**:314d–f/ **15**:393a–b
a. Elastic scattering [see E.1.b.i., below]			
b. Neutron absorption or capture: nuclear cross sections		**4**:121d–g	**3**:48f–g/**17**:602h–603b
c. Emission of neutrons and charged particles		**12**:1075b–c	**17**:603a–b/**19**:21h–22c
6. Neutron detection based on the secondary effects of nuclear reactions		**12**:1075e–1076d	
E. Reactions of atomic nuclei		**13**:343g–345c	
1. The classification of nuclear reactions			
a. The types of nuclear reactions classified according to the kind of bombarding radiation or particles		**15**:406d–409a	
i. Photons of electromagnetic radiation: X-rays, gamma rays		**12**:1073e–f	**15**:392e–h/**15**:406b–c
ii. Fast electrons		**15**:407g–408d	
iii. Simple nuclear particles; *e.g.*, neutrons, protons, mesons		**12**:1074e–1075e/ **15**:408d–409a	**15**:392h–393b
iv. Heavier nuclear particles; *e.g.*, deuterons, alpha particles, neon ions		**15**:406d–407f	**12**:1073b–d/**13**:344c–e
b. The types of nuclear reactions classified according to the nuclear processes involved or according to their products		**4**:120g–121g	**14**:299g–h
i. Elastic scattering		**6**:662d–663b/ **12**:1074h–1075a	
ii. Inelastic scattering: the Compton effect		**6**:654a–c/ **12**:1075b–c	**15**:404h–405e
iii. Capture to form a radioactive nucleus		**4**:121d–g/ **15**:436h–437h	
iv. Nuclear fission [see F., below]			
v. Nuclear fusion [see G., below]			
vi. Spallation		**5**:205f–h	
vii. Radioactive decay [see C.2., above]			
2. The energy relationships of nuclear reactions		**13**:307f–g	**4**:118h–119b/**12**:492f–g/ **13**:304d–f/**13**:343h–344e
3. Theories and models of nuclear reactions		**13**:305f–307a/ **13**:343g–345c/ **18**:681f–h	

F. The splitting of atomic nuclei by nuclear fission

1. Phenomena of nuclear fission
   a. Spontaneous and induced fission reactions
   b. Products of nuclear fission
      i. Fission fragments: radioactive decay chains
      ii. Prompt and delayed neutrons
      iii. Radiation: X-rays and gamma rays [see E.1.a.i., above]
   c. The energy released in fission
2. Fission chain reactions: the critical mass
   a. Nuclear explosions: nuclear, or atomic, bombs
   b. Controlled nuclear fission
3. Nuclear models and theories of nuclear fission
   a. Liquid drop model
   b. Adiabatic models
   c. Statistical models

G. The fusion of atomic nuclei

1. Phenomena of nuclear fusion
2. Nuclear fusion reactions
   a. General types of fusion reactions
   b. The energy released in fusion reactions
   c. Requirements for intensive fusion reactions
3. Occurrence of thermonuclear reactions
   a. Thermonuclear reactions in the Sun and the stars
   b. Thermonuclear explosions: the hydrogen, or thermonuclear, bomb
4. Basic conditions required for a thermonuclear reactor
   a. The formation of a suitable plasma
   b. The confinement and control of high-temperature plasma
5. The possible approaches to controlled fusion: progress and prospects for the future

H. Subatomic, or elementary, particles

1. Development of the concept of subatomic particles as the fundamental units of matter and energy
   a. The discovery of the various particles
   b. Yukawa mesons and the theory of nuclear forces
   c. Advances in quantum field theory: renormalization theory; dispersion theory
   d. The known elementary particles
      i. The electron
      ii. The positron
      iii. The proton
      iv. The neutron

articles	article sections	other references
NUCLEAR FISSION **13**:301–307		
	13:302f–304f	**13**:343e–g
	13:302f–303b / **15**:437h–438b	**18**:681d–e
	13:303c–304d	
	13:303c–304a	
	13:304a–d / **12**:1073g	
	13:304d–f	
	13:304g–305f	
	13:305a–c	**13**:301h–302a / **13**:324e–326g *passim*
	13:305d–f	
	13:305f–307a / **18**:681f–h	
	13:305g–306b	**18**:681f
	13:306b–d	
	13:306d–g	
NUCLEAR FUSION **13**:307–313		
	13:307b–d	
	13:307d–309e	
	13:307d–f	
	13:307f–g	
	13:308g–309e	
	13:309e–310f	
	13:309e–310c / **4**:120g–121g / **17**:598f–600a	**3**:848f–g / **4**:119a–c / **17**:807h–808b
	13:310c–f / **13**:326g–327c	
	13:310g–312d	
	13:310g–311e	
	13:311f–312d	**14**:508d–f
	13:312d–313h	**6**:623b–c
PARTICLES, SUBATOMIC **13**:1022–1035		
	13:1022e–1026c	
	2:335c–e / **5**:206f–207a	**11**:703e–g / **12**:1071c–e / **13**:334e–335a / **13**:1023b–d
	13:1023g–1025a / **5**:35e–36b / **12**:1072c–d	
	13:1025a–1026c / **14**:420f–422a	**6**:656d–657c *passim*
	5:34e–35e / **11**:703c–h	**11**:317f–g / **12**:870a–b / **15**:399e–h
ELECTRON **6**:665–672	**6**:550e–551e	**11**:305b–c / **11**:320a–c / **11**:795h–796a / **12**:306h–307a
	6:668a–c	**11**:703e–f
	5:77f–g / **13**:337c–f	
	13:337c–g	**12**:1070f–1076d *passim*

	articles	article sections	other references
v. The photon		**6**:653a–655d / **10**:947a–948b	**6**:645d–e / **15**:392e–h
vi. The meson		**13**:1023g–1025a	**13**:343b–c
vii. The other elementary particles		**13**:1027c–h	**11**:704c–e
2. The four basic forces associated with particle interactions		**13**:1026c–1027b / **5**:35d–36b / **14**:427f–g	**11**:705a–c / **11**:800f–801c
a. Gravitational force		**13**:1026c–d	
b. Weak force		**13**:1026d–f	**11**:801b–c
c. Electromagnetic force		**13**:1026f–g	
d. Strong force		**13**:1026g–1027b / **13**:342e–343c	**5**:35e–h / **11**:800g–801b / **12**:1072f–g
3. Systems for classifying the elementary particles		**13**:1027c–1032e	
a. The classification according to the forces that influence them: particles acted upon by strong interactions, called hadrons, and particles acted upon by weak interactions; *e.g.*, graviton, lepton		**13**:1027c–h	**5**:37h–38b
b. The classification according to the kind of statistics they follow: fermions, which follow the Fermi–Dirac statistics, and bosons, which follow the Einstein–Bose statistics		**13**:1029a–b / **6**:668h–669b / **18**:313f–314c	**5**:35b–c / **10**:948h–949a / **11**:163f–h / **13**:337f–g
c. The classification according to their particle–antiparticle symmetries, or into two-particle groups that are alike in some properties and opposite in other properties; *e.g.*, electron and positron			**11**:704a–b
d. The classification according to stability: highly unstable, metastable, and stable particles		**13**:1030b–c	
e. The classification according to charge multiplets		**13**:1030d–1031a	**5**:38b–d
f. The classification according to unitary symmetry, or the SU(3) classification			**5**:38d–g
g. The classification according to charged-hypercharge multiplets, derived from the hypothetical quarks		**13**:1031a–1032e	**5**:38g–39a
4. Elementary particles and the conservation laws and symmetry	CONSERVATION LAWS AND SYMMETRY **5**:33–39	**13**:1027h–1030b	
a. The theory of subatomic particles and the quantum mechanical symmetry operations		**5**:34e–36e	
b. Dynamic symmetries: space and time inversion		**5**:36e–37a	**13**:1029h–1030a
c. Violation of conservation laws: charge conjugation, time-reversal, parity		**5**:37a–d / **13**:1029f–1030a / **11**:704f–705c	**12**:870g / **15**:445g–h / **18**:419e / **19**:1072b–c
d. Internal symmetries		**5**:37d–38g	
i. Properties that always obey the conservation laws: lepton number and baryon number, electric charge, momentum, energy		**5**:37e–h / **13**:1028c–1029f	
ii. Properties that do not always obey the conservation laws: strangeness, isospin symmetry, SU(3), and higher symmetries		**5**:37h–38g	**6**:655c–d / **13**:339g–340a
5. Sources of the unstable elementary particles		**11**:704e–f	
a. Formation of resonances in high-energy accelerators		**13**:1032f–1033g	**1**:23d–31h *passim*
b. Production by cosmic ray interactions		**5**:206f–207a	**9**:794g–h / **15**:381h–382b
6. Relations of the weak interactions to strong and electromagnetic interactions described by conserved current and algebra of current		**13**:1033g–1035a	
7. As yet undiscovered particles suggested by contemporary theoretical ideas		**13**:1035b–g	
8. Reactions of elementary particles with atoms		**5**:208d–f / **15**:406d–409a	**1**:30e–g / **14**:297f–g
9. Theories of nuclear structure and nuclear forces involving the elementary particles		**6**:666d–669b / **12**:1072c–h / **13**:342e–343c	
10. Detection and characterization of the elementary particles [see I.4., below]			

	articles	article sections	other references
I. Effects of the passage of nuclear, or elementary, particles, nuclear radiations, or ionizing radiation through matter	RADIATION EFFECTS ON MATTER **15**:399–416		
1. The fundamental processes involved when energetic particles or radiations interact with or pass through matter		**15**:401f–409a / **11**:703d–h / **15**:379c–h	
a. The passage of electromagnetic waves and their interaction with atomic structure		**15**:401f–406c / **6**:662d–663b / **15**:439g–440c / **16**:1042b–1043a / **19**:1059a–d	**6**:652g–653a / **11**:795c–g / **15**:392f–h
i. Resonance		**15**:403e–g / **12**:306c–307d	**12**:491a–e
ii. Einstein's relations: absorption and emission		**15**:403g–404c / **10**:947f–h	
iii. The Compton effect		**15**:404c–d / **6**:654a–c	**14**:299d–f / **19**:1060b–c
iv. The photoelectric effect		**15**:404e–g / **6**:581d–582c / **6**:653g–654a	**14**:296h–300d *passim* / **19**:1060a–b
v. Pair production		**15**:405e–406b	
b. The passage of particles or radiations through matter		**15**:406d–409a / **13**:307h–308g	**15**:392h–393b
i. Of heavy charged particles		**15**:406d–407f	**15**:439c–e
ii. Of electrons		**15**:407g–408d / **6**:672b–d	**15**:439e–f
iii. Of neutrons		**15**:408d–409a / **12**:1074h–1075e	**13**:345a–b / **15**:393a–b / **15**:440c–d
2. Secondary and tertiary effects of radiation		**15**:409a–415f	
a. Physical effects: structural changes in the crystal—*e.g.*, expansion and distortion; changes in mechanical properties—*e.g.*, strain; changes in transport properties—*e.g.*, heating effects		**15**:409a–c / **15**:412h–414g	**9**:806e–f
b. Molecular activation and related phenomena; *e.g.*, ionization, luminescence, fluorescence, excitation		**15**:409c–410e / **2**:311e–312a / **19**:1058f–1059a	**11**:181h–182a / **14**:292g–294d / **14**:368e / **17**:471b–e
c. Chemical effects: the photochemical process and radiation chemical reactions		**15**:410e–412c	**9**:809f–g / **14**:294d–295a / **14**:370d–h
d. Biological effects: effects in plant and animal metabolic and physiological processes		**15**:414g–415f / **1**:144c–e / **15**:379e–381h	
3. Utilization of high-energy radiation in biological, medical, and technological fields		**15**:415f–416g / **14**:296e–g / **15**:461c–466e	
4. The use of fundamental processes of interaction between radiation and matter for the detection and characterization of nuclear and elementary processes	RADIATION DETECTION AND CHARACTERIZATION **15**:392–398		
a. Mechanisms of detection systems		**15**:393c–394a / **5**:201b–202a / **19**:1063c–h	
i. Ionization and charge collection: Geiger counters, spark chambers, cloud and bubble chambers		**15**:393e–g	**5**:201f–202a / **13**:1033b–f / **17**:474d–e / **19**:1063d–e / **19**:1068e–g
ii. Conversion of the distributed energy of the primary ionizing particle into light: scintillation detectors, photographic films and emulsions		**15**:393g–394a	**5**:201b–f / **12**:1075g–h
b. Properties of ionization media: the mean free path, energy, velocity, and motion of electrons in gases; the conduction of electrons in solids		**15**:394a–396e	
c. Major types of radiation detectors: scintillation counters, ionization detectors, spark chambers, cloud chambers, and bubble chambers [see 723.F.7.]			
d. Applications of radiation detectors in science, technology, and industry [see 723.G.8.]			

Section 112. The structure and properties of atoms

[for Part One headnote see page 20
for Division I headnote see page 20]

The articles and parts of articles referred to in Section 112 deal with six main subjects: A, the atomic nature of matter; B, atomic weights; C, atomic spectra and the electronic structure of the atom; D, X-rays and atomic structure; E, the concept of antimatter; and F, the fundamental physical constants.

The outline of subject A first deals generally with the nature of the atom as consisting of the nucleus, a tiny but massive core, surrounded by electrons, the arrangement and behaviour of which determine atomic interactions. After dealing with early speculations about the atomic nature of matter, the outline treats the modern scientific evidence for the existence and nature of atoms. It then treats developments in atomic theory, covering the Rutherford nuclear model, the Bohr–Sommerfeld atomic model, and the contemporary wave-mechanical theory of the electronic structure of the atom.

The outline of subject B treats the variations in atomic weight as a result of variations in isotopic composition; the significance of atomic weights in chemical analysis and chemical technology; the atomic weight scales; and the chemical and physical methods for determining atomic weights.

Subject C is atomic spectra and the electronic structures of the atom. After dealing with the significance and interpretation of atomic spectra, the outline treats various theories of the origin of atomic spectra in quantized electronic transitions.

The outline of subject D covers general X-ray phenomena; the theory of X-rays and their spectra; the detection and measurement of X-rays; their applications in biological, medical, industrial, and scientific fields; and the diffraction of X-rays by crystals.

Subject E is antimatter, comprising elementary particles that have the mass and charge of electrons, protons, or neutrons—their counterparts in ordinary matter—but for which the charge is opposite in sign. The outline deals first with the general properties of antimatter and with the production of antiparticles in high-energy collisions. It next treats the invariance of the laws of physics under charge conjugation—an operation in relativistic quantum mechanics that transforms every particle into its antiparticle. Finally, it deals with speculations about the possible existence and role of antimatter in the universe.

Subject F is the fundamental physical constants. The outline covers early measurements of such quantities as the velocity of light and the Newtonian gravitational constant; such modern measurements as that of the gyromagnetic ratio and the moment of the proton; the interrelationships among the constants; and the ways leading to official adoption of values for fundamental constants.

	articles	article sections	other references
A. The atomic nature of matter			
1. The general nature of the atom as consisting of the nucleus, a tiny massive core, surrounded by electrons, the arrangement and behaviour of which determine atomic interactions	ATOMIC STRUCTURE **2**:330–343		
		2:330e–332g / **9**:1032d–f / **17**:462a–e / **18**:678c–e	**3**:44e–f / **4**:116a–b / **4**:162b–c / **4**:169a–c / **13**:334a–c / **13**:706g–707a / **13**:811b–d / **13**:1022e–g / **15**:392c–e / **16**:1032h–1033a / **16**:1047g–1048c / **18**:601g–602c
2. Early philosophical speculations on the possible atomic nature of matter		**2**:332g–333d / **2**:346a–350c	**4**:114g–h / **4**:118b–e / **14**:251g–252a
3. The scientific evidence for the existence and the nature of the atoms of matter		**2**:333d–335h / **13**:334d–335a	
a. Developments in chemistry: Dalton's theory; the law of combining volumes of gases; the law of multiple proportions; Avogadro's hypothesis; the periodic law		**2**:333d–334c / **2**:343e–344b / **8**:702a–c	**2**:350c–e / **4**:143f–144c / **14**:390g–391a
b. The development of spectroscopy and the discovery of atomic spectra		**2**:334c–h / **17**:457g–458b	
c. The discovery of the electron as a particle and as a component of all matter		**2**:335c–e / **6**:550e–551e	**18**:349c–d
d. The discovery of X-rays		**2**:335e–g	**15**:457g–h / **19**:1058d–f
e. The discovery of the radioactive transformation of one element into another			**13**:334e–f / **15**:434d–e / **16**:107d–f
f. The Brownian movement of suspended particles	BROWNIAN MOVEMENT **3**:331–333		
		11:605b–h	
			12:304c–309a *passim*
g. The development of mass spectrometry		**2**:336b–339g / **6**:666d–g	**13**:334h–335a
h. The development of scattering and resonance studies with atomic and molecular beams		**2**:336b–c	**16**:107h–108b
4. Models of atomic structure			
a. The Rutherford nuclear model of the atom, based on the alpha-scattering phenomena		**2**:336c–338a / **19**:1061b–d	**2**:1203c–f / **11**:797a–e / **15**:517c–f
b. The Bohr–Sommerfeld atomic model, based on the conception of energy levels and quantization	MECHANICS, QUANTUM **11**:793–799	**2**:338a–339g / **6**:669c–d	**4**:169d–g / **4**:86h–87e / **12**:870b–f / **14**:79d–80a
c. The contemporary wave-mechanical theory of the electronic structure of the atom based on the contributions of Heisenberg, Schrödinger, de Broglie, Pauli, Dirac, Lamb, and others			
B. Atomic weights	ATOMIC WEIGHT **2**:343–345		**2**:331e–f

	articles	article sections	other references
1. Variations in atomic weight as a result of variations in isotopic composition		**2**:343c–e/ **9**:1054f–1056c	**4**:116b–c
2. Significance of atomic weights in chemistry		**2**:343e–344b	**16**:1049b–c
3. Atomic weight scales		**2**:344b–c	**4**:170h–171b
4. Methods used for determining atomic weights		**2**:344d–345d	
a. Chemical methods based on combining weights of elements		**2**:344d–g	
b. Physical methods; *e.g.*, mass spectrometry, gas density ratios, X-ray diffraction		**2**:344g–345d/ **11**:607b–609d	
C. Atomic spectra and the electronic structures of the atom			
1. Atomic spectra: their significance and interpretation			**2**:336d–337g/**4**:119d–e
a. The spectrum of the hydrogen atom		**9**:795h–796a	**2**:244h–245c/**9**:97d–e/ **11**:797b–c/**12**:929c–h
b. The emission spectra of singly and multiply ionized atoms			**2**:242f–243b/**12**:929h–930c/ **17**:588d–589a
c. Atomic absorption spectra: Fraunhofer dark lines in the visible part of the solar spectrum		**17**:801h–802c/ **9**:793b–f	**6**:192g–h/**17**:802f–h
d. The effects of magnetic fields (Zeeman effect) and the effects of electric fields (Stark effect) on atomic spectra		**17**:465g–466a	**6**:604g–h/**6**:666g–667a/ **9**:796a–b/**11**:310c–f
e. Intensities, isotope shifts, and fine and hyperfine structures of atomic spectral lines as related to atomic structure			**2**:240e–g/**11**:308g–h/ **12**:305e–g
2. Theories of the origin of atomic spectra in quantized electronic transitions		**17**:474g–475b	
a. The classical Bohr theory		**2**:339h–340b/ **11**:796f–797f	**12**:929c–e
b. Wave-mechanical interpretations: transition matrix elements, wave functions, charge densities, spin-orbit interactions, the Lamb shift		**17**:463c–e/ **17**:465d–g	**12**:307b–c
D. X-rays and atomic structure	X-RAYS **19**:1058–1064		
1. General X-ray phenomena: production of X-rays in evacuated tubes by high-tension sources, production of secondary radiation, absorption and transmission of X-rays through matter, wave and particle nature of X-rays, continuous and characteristic X-rays		**19**:1058f–1061b/ **15**:459a–460b/ **19**:1064g–1065b	**6**:672b–c/**11**:795d–g/ **15**:406b–c/**17**:473a–c
2. The theory of X-rays and their spectra		**19**:1061b–1063c	
a. The structure of the atom as related to the emission of characteristic X-rays, absorption edges, fluorescence yield, mesic atoms		**19**:1061b–1062g/ **17**:473c–h	
b. Continuous X-rays and bremsstrahlung; *i.e.*, the radiation produced by the sudden retardation of a fast-moving charged particle in an intense electrical field		**19**:1062g–1063c	**15**:405h–406b
3. Detection and measurement of X-rays		**19**:1063c–h/ **19**:1068d–1069b	
4. Applications of X-rays in biological, medical, industrial, and scientific fields [see 423.B.3.c. and 723.G.8.b.]			
5. Diffraction of X-rays by crystals [see 125.A.2.]			
E. The concept of antimatter	MATTER AND ANTIMATTER **11**:703–705		
1. General properties of antimatter		**11**:703d–h	
2. Production of antiparticles in high-energy collisions		**11**:704e–f	
3. Invariance of the laws of physics under charge conjugation, an operation in relativistic mechanics that transforms every particle into its antiparticle		**11**:704f–705c	**5**:37b–d/**13**:1029f–h
4. Speculations about the possible existence and role of antimatter in the universe		**11**:705c–f/ **18**:1008d–h	

	articles	article sections	other references
F. The fundamental physical constants: dimensional and dimensionless constants	CONSTANTS, PHYSICAL **5**:75–84		
1. Early measurements; *e.g.*, of the velocity of light, of the ratio of electron charge to mass, of the ratio of Planck's constant to electron charge, of the Newtonian gravitational constant		**5**:76c–77e / **6**:665g–666d / **8**:292g–294f / **10**:934a–935c	**6**:550f–h / **6**:646e–f
2. Modern measurements; *e.g.*, of the gyromagnetic ratio and moment of the proton, of the free electron *g* factor, of the fine structure of atomic hydrogen		**5**:77e–78b	**12**:306h–307a / **13**:1025b–d
3. New determination of 2e/h; interrelationships among the constants		**5**:78e–79d	
4. Standards of measurement: conversion factors, adjustment of constants, recommended set of fundamental constants, official adoption of values for fundamental constants		**5**:79e–84b / **11**:314f–315c / **14**:292d–g	**6**:657e–g / **12**:318d–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BECQUEREL, HENRI **2**:790
BETHE, HANS ALBRECHT **2**:871
BOHR, NIELS **2**:1203
BROGLIE, LOUIS-VICTOR, DUC DE **3**:323
CURIE FAMILY **5**:371
DALTON, JOHN **5**:439
DIRAC, P.A.M. **5**:825
EINSTEIN, ALBERT **6**:510
FERMI, ENRICO **7**:236
HAHN, OTTO **8**:545
HEISENBERG, WERNER KARL **8**:745
LANDAU, LEV DAVIDOVICH **10**:623
OPPENHEIMER, J. ROBERT **13**:602
PLANCK, MAX **14**:490
RUTHERFORD, LORD **16**:106
SCHRÖDINGER, ERWIN **16**:360
TELLER, EDWARD **18**:127
THOMSON, SIR JOSEPH JOHN **18**:348
YANG, CHEN NING **19**:1071

Division II. Energy, radiation, and the states and transformation of matter

[for Part One headnote see page 20]

Division I dealt with modern advances in subatomic and atomic physics.

The outlines, and the articles and parts of articles referred to, in the first three sections of Division II treat, respectively, chemical elements, chemical compounds, and chemical reactions. The last five sections of this division are concerned with heat, thermodynamics, and the nonsolid states of matter; with the solid state of matter; with the mechanics of particles, rigid bodies, and deformable bodies; with electricity and magnetism; and with waves and wave motion.

The outline and the articles referred to in Section 121 first treat the periodic law of the elements and then give separate treatment to each of the groups of the chemical elements in the long form of the periodic table. The outline then deals with other ways of classifying the elements and with the occurrence and abundance of the elements in nature.

Section 122 first deals with the development of the theory of molecular structure and of the theory of chemical bonding. After dealing with classifications of chemical compounds, the section treats the inorganic chemical compounds and the major groups of organic compounds.

Section 123 is concerned with theories and classifications of chemical reactions; with the energy changes in chemical reactions; with the rates of chemical reactions; with the mechanisms of chemical reactions; with such major types as acid–base, oxidation–reduction, and photochemical reactions; and with the principles of chemical synthesis.

Section 124 first deals with the principles of thermodynamics and the nature of heat. After dealing with the gaseous state and the liquid state of matter, the section treats solutions and solubility; physical effects at surfaces; the plasma state of matter; the properties of matter at extreme conditions; and transport phenomena.

Section 121. Chemical elements: periodic variation in their properties 30
122. Chemical compounds: molecular structure and chemical bonding 36
123. Chemical reactions 41
124. Heat, thermodynamics, and the nonsolid states of matter 45
125. The solid state of matter 49
126. Mechanics of particles, rigid bodies, and deformable bodies: elasticity, vibrations, and flow 52
127. Electricity and magnetism 55
128. Waves and wave motion 59

Section 125, dealing with the solid state of matter, first sets forth descriptive studies of modern crystallography and the general theory of the crystalline solid state. It goes on to deal with ionic crystals and with metals. Finally, it treats semiconductors and insulators and the glassy or amorphous state of matter characteristic of noncrystalline solids.

Section 126 is concerned with the mechanics of particles, rigid bodies, and deformable bodies. It first deals with the principles of classical mechanics and with relativistic mechanics in inertial systems of reference. The section further treats the stress dynamics of elastic materials; vibrations of elastic bodies; fluid mechanics, including gas dynamics; and rheological phenomena of deformation and flow.

Section 127 is concerned with electricity and magnetism. The section first treats the static electric charge and moving charges and electric currents. It goes on to deal with the phenomena and theories of magnetism. After treating the theory of fields in physics, it deals with the electromagnetic field and the theory of electromagnetic radiation and with relativistic electrodynamics.

Section 128 first deals with general wave phenomena and the theory of wave motion. It then treats electromagnetic waves, including separate coverage of light waves; the focussing and imaging of waves; and sound waves.

Section 121. Chemical elements: periodic variation in their properties

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 121 deal with the chemical elements—the substances that cannot be decomposed into simpler substances by ordinary chemical processes. They treat four main subjects: A, the periodic law of the elements; B, the groups of elements in the long form of the periodic table; C, other classifications of the elements; and D, the occurrence and abundance of the elements in nature.

The outline of subject A begins with the discovery in the mid-19th century of the fact that the chemical elements show a periodic recurrence of properties when they are arranged in an order approximating that of increasing atomic weight. It goes on to the 20th-century discovery that the order of the elements in the periodic system is that of their atomic numbers—the integers characteristic of the elements that are equal to the positive electrical charges of the atomic nuclei expressed in electronic units. The outline next deals with the early and the current tabular arrangements based on the periodic law, which brings elements with similar properties into juxtaposition. Finally, it treats developments in modern atomic physics and in the theory of quantum mechanics that yield an understanding of the electronic structure of atoms and an explanation of the periodic law in such terms.

The outline of subject B first involves separate treatments of each of the groups of chemical elements in the long form of the periodic table: hydrogen, the alkali metals, the alkaline-earth metals, the boron group elements, the carbon group, the nitrogen group, the oxygen group, the halogen elements, the noble gases, the zinc group, the transition elements, the rare-earth elements, and the actinide elements.

The outline of subject C deals with other classifications of the elements or groups of them, such as their division into metals, semimetals, and nonmetals, stable and radioactive elements, or native and combined elements. It then deals with the man-made elements called transuranium elements.

The outline of subject D treats estimates, obtained primarily from spectroscopic evidence and from chemical analysis of meteorites and terrestrial matter, of the relative abundance of the elements.

A. The periodic law of the elements: the systematic classification of the elements on the basis of their chemical and physical properties and atomic structures

1. Historical development of the periodic law: the grouping of the elements in the order of their atomic weights; in the order of their atomic numbers
2. The arrangement of the elements in various forms of the periodic table; the usefulness of the long form of the table
3. The relationship of the electronic structure and configuration of the atoms to the periodic table
4. Periodicity in properties of the elements: the metals, the semimetals, the nonmetals, the transition elements, the transuranium elements

articles	article sections	other references
PERIODIC LAW **14**:75–81		**4**:116c–h
	14:75c–77b	**2**:334a–c/**11**:900c–e
	14:77b–79c/ **4**:173c–f	**4**:85d–g/**15**:515a–c/ **18**:600g–h
	14:79d–80a/ **3**:839g–841a/ **17**:463e–465c	**1**:64g–65c/**3**:44e–f/**8**:561d–g/ **13**:122d–h/**16**:524h–525c
	14:80a–81b/ **1**:65h–67a/ **1**:580h–582g/ **1**:589g–590d/ **3**:44h–46h/ **13**:122d–124f/ **13**:138h–139g	

	articles	article sections	other references
5. Extension of the periodic table: possible existence of superheavy elements		**18**:681h–684b	
B. The groups of the chemical elements in the long form of the periodic table: their occurrence, history, physical and chemical properties, principal compounds, production, and uses	CHEMICAL ELEMENTS **4**:114–118		
1. Hydrogen: its forms, isotopes, and compounds	HYDROGEN AND ITS COMPOUNDS **9**:93–97	**7**:927a–f	
a. Orthohydrogen and parahydrogen		**9**:94a–c	
b. Hydrides; *e.g.*, metal hydrides, volatile hydrides, boron hydrides		**9**:94g–95e	**3**:47e–48d/**3**:849f–850a/**4**:91h–92b
c. Acids		**9**:95f–g/**3**:863e–871c/**7**:733f–734a/**13**:711g–712h	**1**:45d–47g *passim*/**8**:568c–569f/**8**:571f–572b/**8**:574c–g/**13**:123h–124a/**13**:128a–b
d. Deuterium and tritium		**9**:96b–g	
e. Water: its structure, forms, and physical and chemical properties	WATER **19**:633–637	**1**:1029c–g/**9**:177b–178c/**13**:488c–491a/**13**:814g–815b	**8**:869d
2. The alkali metals, or the Group Ia elements of the periodic table	ALKALI METALS AND THEIR COMPOUNDS **1**:580–588		
a. Comparative chemistry of the alkali metals		**1**:580h–582g	
b. Individual alkali metals		**1**:582g–588a	
i. Lithium		**1**:582g–583h	**13**:761e–f
ii. Sodium		**1**:583h–585g	**16**:1005e–1007h *passim*
iii. Potassium		**1**:585h–586g/**4**:133e–f	**5**:506c–g/**16**:1005e–1007h *passim*
iv. Rubidium		**1**:586h–588a	**5**:506g–507c
v. Cesium		**1**:586h–588a/**18**:287h–288c	
vi. Francium		**1**:588a	
3. The alkaline-earth metals, or the Group IIa elements of the periodic table	ALKALINE-EARTH METALS AND THEIR COMPOUNDS **1**:589–595		
a. Comparative chemistry of the alkaline-earth metals		**1**:589g–592g	
b. Individual alkaline-earth metals		**1**:592h–595a	
i. Beryllium		**1**:592h–593c	
ii. Magnesium		**1**:593c–g/**11**:302d–g	**6**:714f–h
iii. Calcium		**1**:593g–594c	**3**:586a–f/**6**:714c–f
iv. Strontium		**1**:594c–d	**6**:714h–715b
v. Barium		**1**:594d–f	
vi. Radium		**1**:594g–595a	**15**:465e–f
4. The boron group of the elements, or the Group IIIa elements of the periodic table	BORON GROUP ELEMENTS AND THEIR COMPOUNDS **3**:44–50		
a. Comparative chemistry of the boron group elements		**3**:44e–46h	
b. Individual boron group elements		**3**:46h–50f	
i. Boron		**3**:46h–48g	**8**:844g–h/**9**:95g–96a/**12**:238c–d/**13**:716g–h
ii. Aluminum		**3**:48h–49g	**1**:643h–644d/**1**:646e–647a/**7**:736d–e/**13**:716h–717b
iii. Gallium		**3**:49g–50b	
iv. Indium		**3**:50b–c	
v. Thallium		**3**:50c–f	

	articles	article sections	other references
5. The carbon group of the elements, or the Group IVa elements of the periodic table	CARBON GROUP ELEMENTS AND THEIR COMPOUNDS **3**:838–852		
a. Comparative chemistry of the carbon group elements		**3**:839f–845a	
i. Electronic structure		**3**:839g–841a	**16**:524f–g
ii. General properties of the group; *e.g.*, crystal structure, atomic size, catenation reactions		**3**:841a–845a	
b. Individual carbon group elements		**3**:845a–852f	
i. Carbon		**3**:845a–848g / **4**:107b–c	**2**:1040b–e / **3**:817f–820c *passim* / **3**:820d–823a *passim* / **3**:860h–863d *passim* **9**:80f–g / **12**:856b–h
ii. Silicon		**3**:848h–850e / **16**:752a–d	**6**:578g–579b / **7**:736b–d / **15**:396d–e / **16**:514c–d
iii. Germanium		**3**:850e–851c	
iv. Tin		**3**:851d–h / **18**:432a–433c	**18**:426f–g
v. Lead		**3**:852a–f / **10**:727f–728b	
6. The nitrogen group of the elements, or the Group Va elements of the periodic table	NITROGEN GROUP ELEMENTS AND THEIR COMPOUNDS **13**:120–135		
a. Comparative chemistry of the nitrogen group elements		**13**:122d–124f	
b. Individual nitrogen group elements		**13**:124f–135b	
i. Nitrogen		**13**:124f–129a / **2**:1040f–1041d / **4**:134c–135f / **7**:925c–f / **13**:820d–h	**13**:693g–700h *passim*
ii. Phosphorus		**13**:129b–131g / **4**:133f–134b	**6**:715c–d / **13**:701a–706d *passim* / **13**:815h–816b **14**:288h–290d *passim*
iii. Arsenic		**13**:131g–133c / **12**:855f–h	
iv. Antimony		**13**:133c–134d	
v. Bismuth		**13**:134d–135b	
7. The oxygen group of the elements, or the Group VIa elements of the periodic table	OXYGEN GROUP ELEMENTS AND THEIR COMPOUNDS **13**:809–824		
a. Comparative chemistry of the chalcogens, or the oxygen group elements		**13**:812a–813d	
b. Individual chalcogen elements		**13**:813d–818b	
i. Oxygen		**13**:813d–816b / **2**:308d–309f / **3**:846h–848b / **3**:852d–e / **7**:924e–925b	**1**:591e–g / **3**:844g–h / **4**:100h–101d / **13**:127d–128a / **13**:130d–h
ii. Sulfur		**13**:816c–817c / **2**:1041d–g / **7**:928g–929a / **13**:707f–708b / **17**:791f–h	**3**:844h–845a / **12**:855h–856b / **12**:858a–b
iii. Selenium		**13**:817c–h	**12**:856h–857b
iv. Tellurium		**13**:817h–818a	**12**:856h–857b
v. Polonium		**13**:818a–b	
c. Chalcogen compounds: oxides, halides, oxyacids, oxyhalides, hydrogen chalcogenides, metal chalcogenides		**13**:818c–824b	**13**:706e–714a *passim*

	articles	article sections	other references
8. The halogen elements, or the Group VIIa elements of the periodic table	HALOGEN ELEMENTS AND THEIR COMPOUNDS **8**:560–575		
a. Comparative chemistry of the halogen elements		**8**:561c–563d	**13**:683d–685c
b. Individual halogen elements		**8**:563d–575g/ **4**:136c–137c/ **5**:139e–g/ **13**:682c–692c	**13**:124b–d/**13**:131a–d
i. Fluorine		**8**:563d–566d/ **4**:137a–f	
ii. Chlorine		**8**:566d–570e/ **4**:136c–137a/ **7**:929a–c	**3**:49c–e/**3**:872f–h
iii. Bromine		**8**:570e–572e/ **4**:137f–h	
iv. Iodine		**8**:572e–575c/ **4**:138a/ **13**:691h–692d	**6**:715e–f
v. Astatine		**8**:575c–g	
9. The noble gases, or the Group 0 elements of the periodic table, formerly called the inert gases	NOBLE GASES AND THEIR COMPOUNDS **13**:137–142		
a. Comparative chemistry of the noble gases		**13**:137g–139g	
b. Individual noble gases		**13**:139g–140g/ **7**:925h–926h	
i. Helium		**13**:139g–140b/ **11**:163f–h	**2**:310h–311b/**7**:926a–c
ii. Neon		**13**:140b–c	
iii. Argon		**13**:140c–d	**7**:926c–f
iv. Krypton		**13**:140d–e	
v. Xenon		**13**:140f	
vi. Radon		**13**:140g	
c. Compounds of the noble gases: the stability of and bonding in noble gas compounds; compounds of the individual noble gases		**13**:140h–142f	**13**:816b
10. The zinc group elements, or the Group IIb elements of the periodic table	ZINC GROUP ELEMENTS AND THEIR COMPOUNDS **19**:1143–1146		
a. Comparative chemistry of the zinc group elements		**19**:1143d–1144g	
b. Individual zinc group elements		**19**:1144h–1146g	
i. Zinc		**19**:1144h–1145b/ **19**:1145g–h/ **19**:1146c–e/ **19**:1146h–1147e/ **19**:1150b–d	
ii. Cadmium		**19**:1145b–c/ **19**:1146a–b/ **19**:1146e–f	
iii. Mercury		**19**:1145c–d/ **19**:1146b–c/ **19**:1146f–g	**11**:921h–922b
11. The transition elements: elements with partly filled *d* or *f* orbitals occupying the middle portion of the periodic table	TRANSITION ELEMENTS AND THEIR COMPOUNDS **18**:600–627	**11**:309a–b	
a. The transition elements as a group: their physical and chemical properties as related to their electronic structures; general compounds formed; comparison with other group elements in the periodic table		**18**:601b–609h/ **13**:717f–721h	**4**:87f–88d/**9**:95b–c/ **11**:1090h–1091c/**13**:715c–f/ **14**:80c–e
b. Theories of transition metal complexes: crystal field and ligand field theories; molecular orbital theory		**18**:609h–611e/ **4**:101h–103b	**5**:137c–f/**13**:715c–f
c. Individual elements of the first transition series		**18**:611e–619f	**4**:102c–103b

	articles	article sections	other references
i. Titanium		**18**:612b–g	**18**:456d–g
ii. Vanadium		**18**:612b–613d	
iii. Chromium		**18**:613d–614e / **4**:570c–571b	
iv. Manganese		**18**:614f–615b	
v. Iron		**18**:615c–616g / **7**:1032h–1033d	**7**:736f–737b / **9**:894a–895b / **12**:857g–h
vi. Cobalt		**18**:616g–617e	**4**:808a–809f *passim*
vii. Nickel		**18**:617f–618g / **13**:72g–73h	
viii. Copper		**18**:618g–619f / **5**:151d–152a	
d. Individual elements of the second and third transition series		**18**:619f–627e	
i. Zirconium and hafnium		**18**:620b–621b	
ii. Niobium and tantalum		**18**:621b–622a	
iii. Molybdenum and tungsten		**18**:622b–623d	**18**:736c–d
iv. Technetium and rhenium		**18**:623d–624a	
v. Ruthenium and osmium		**18**:624a–h	
vi. Rhodium and iridium		**18**:624h–625d	
vii. Palladium and platinum		**18**:625d–626d	**12**:855b–c / **12**:857f–g / **14**:529g–530h *passim*
viii. Silver and gold		**18**:626d–627e / **8**:239e–g / **16**:776d–777a	**12**:853h–854h / **12**:857c–e
e. The lanthanide elements [see B.12., below]			
f. The actinide elements [see B.13., below]			
12. The rare-earth elements of the periodic table: the lanthanide elements	RARE-EARTH ELEMENTS AND THEIR COMPOUNDS **15**:515–521		
a. Comparative chemistry of the rare-earth elements		**15**:517c–521b	
i. Electronic structure		**15**:517c–518g	**14**:80e–g / **18**:620a–b
ii. Chemical properties		**15**:518h–519f	
iii. Physical properties		**15**:519f–521a	
iv. Nuclear properties		**15**:521a–b	
b. Production and processing of rare-earth metals [see 724.C.3.u.]			
c. Individual rare-earth elements		**15**:515a–517b	
i. Scandium			**15**:515a–517b *passim*
ii. Yttrium			**15**:515a–517b *passim*
iii. Lanthanum			**15**:515a–517b *passim*
iv. Cerium			**15**:515a–517b *passim*
v. Praseodymium			**15**:515a–517b *passim*
vi. Neodymium			**15**:515a–517b *passim*
vii. Promethium			**15**:515a–517b *passim*
viii. Samarium			**15**:515a–517b *passim*
ix. Europium			**15**:515a–517b *passim*
x. Gadolinium			**15**:515a–517b *passim*
xi. Terbium			**15**:515a–517b *passim*
xii. Dysprosium			**15**:515a–517b *passim*
xiii. Holmium			**15**:515a–517b *passim*
xiv. Erbium			**15**:515a–517b *passim*
xv. Thulium			**15**:515a–517b *passim*
xvi. Ytterbium			**15**:515a–517b *passim*
xvii. Lutetium			**15**:515a–517b *passim*

	articles	article sections	other references
13. The actinide elements of the periodic table	ACTINIDE ELEMENTS AND THEIR COMPOUNDS **1**:64–70		
a. Comparative chemistry of the actinide elements		**1**:64g–68b	**14**:80g–81b
b. Individual actinide elements		**1**:68c–70h	
i. Actinium		**1**:68b–c	
ii. Thorium		**1**:68c–f	
iii. Protactinium		**1**:68f–h	
iv. Uranium		**1**:68h–69c / **7**:1033d–g	**18**:1034e–1035b
v. Neptunium		**1**:69c–f	
vi. Plutonium		**1**:69f–h	
vii. Americium		**1**:69h–70b	
viii. Curium		**1**:70b–c	
ix. Berkelium		**1**:70c–d	
x. Californium		**1**:70d–e	
xi. Einsteinium		**1**:70e–f	
xii. Fermium		**1**:70f	
xiii. Mendelevium		**1**:70g	
xiv. Nobelium		**1**:70g	
xv. Lawrencium		**1**:70h	
C. Other classifications of the elements or groups of them			
1. Metals, semimetals, or metalloids, and nonmetals		**11**:1086b–g	**3**:840c–d / **4**:116h–117a
2. Stable and radioactive elements			**4**:117d–e / **9**:1055d–1057c
3. Native and combined elements		**12**:236f–239f	**12**:853f–858e *passim*
4. Noble metals, including the platinum group of the metals		**18**:624a–626d	
5. Synthetic elements: transuranium elements	TRANSURANIUM ELEMENTS **18**:677–684		
6. Biologically active or essential elements [see 335.A.4.b.]			
7. Technologically significant elements [see 724.C.3.]			
D. The occurrence and relative abundance of the elements in nature		**4**:117f–g / **6**:701c–712a / **13**:809h–810e / **15**:516e–517b	
1. On Earth			
a. In the crust [see also 214.C.]		**3**:848h–849a / **3**:851d–e / **3**:852a–b / **6**:703h–709c / **8**:563d–f / **8**:566d–e / **9**:201h–202c / **12**:857b–858e / **15**:521b–f / **18**:604c–e / **18**:1034h–1035b	**3**:850e–g / **9**:894f–895b / **16**:1005h–1006b / **19**:1147c–d
b. In the hydrosphere [see also 222.B.1. and C.1.]		**6**:709c–710f / **7**:734a–735a	**13**:484h–486b
c. In the atmosphere [see also 221.A.1.c.]		**2**:308d–g / **6**:710g–712a	
d. In the biosphere		**2**:1039g–1042h / **16**:766c–g	**6**:713d–715h *passim*
2. In the solar system, especially in the Sun and in meteorites		**4**:119g–120d / **6**:701d–702h / **12**:43d–44h / **12**:429h–431b / **17**:802c–803d	**10**:900f–901b / **17**:602a–b

	articles	article sections	other references
3. In the stars		**4**:119d–g/ **6**:701d–h	
4. In the rest of the universe		**9**:799d–f/ **12**:932e–f	**5**:202g–203d

Section 122. Chemical compounds: molecular structure and chemical bonding

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 122 deal with five main subjects: A, molecular structure; B, chemical bonding; C, classifications of chemical compounds; D, inorganic chemical compounds; and E, organic chemical compounds.

The outline of subject A treats the history, development, and experimental and theoretical bases of the theory of molecular structure. The outline first deals with early concepts of molecular structure and with quantum-mechanical and electrostatic approaches to the theory of molecular structure. It goes on to treat molecular bonds and shapes, the time-dependency properties of molecules, and the relation of molecular structure to the properties of bulk matter. After dealing with the procedures for the determination of molecular structures, the outline treats the theory and the types of molecular spectra.

Subject B is the chemical bonding that holds atoms together in various kinds of associations, such as those in molecules, crystals, and metals, and which results when the electron structure of an atom is altered sufficiently to link it with the electron structure of another atom or atoms. The outline first deals with the general development of the theory of valence, or chemical bonding, covering the early electronic theory of valence and the later quantum-mechanical treatment of bonding. It deals next with other bonding effects such as hydrogen bonding and bonds in electron-deficient compounds. It goes on to the development of techniques for experimental observations of chemical bonding. Special treatment is then given to various kinds of anomalous molecular structures and molecular fragments with apparently anomalous valences, such as free radicals, carbenes, carbanions, and carbonium ions.

Subject C is the various systems of classification of chemical compounds—pure substances made up of identical molecules containing atoms of two or more elements. The article referred to deals with the methods chemists have devised for rationally organizing the mass of information about the millions of known chemical compounds. It treats, among the most useful schemes for their classification, those based on the elemental composition of the compound; those based on the types of bonds that exist in molecules between their component atoms; and those based on the varieties of chemical reactions they undergo. It also refers to other classifications—one based on the physical state of a pure substance—as gas, liquid, or solid; and one based on the source of a compound—as natural or synthetic.

Subject D is inorganic chemical compounds, defined as compounds of the chemical elements other than carbon. The outline first deals with the nomenclature of binary, ternary, and coordination compounds. It goes on to treat the structural classification of inorganic compounds; methods of preparing inorganic compounds; and reactions of inorganic compounds.

Subject E is organic chemical compounds. Articles are first referred to that separately treat the properties of twenty-one major groups of organic compounds. The outline then covers the preparation and purification of organic compounds; their general physical properties; and the reactions of organic compounds.

	articles	article sections	other references
A. The theory of molecular structure: its history, development, and experimental and theoretical bases	MOLECULAR STRUCTURE **12**:309–318		
1. Early concepts of molecular structure		**12**:309d–g	
2. Quantum mechanical and electrostatic approaches to the theory of molecular structure		**12**:309g–310/ **3**:817h–819b/ **3**:820g–821d/ **4**:88d–93c	**4**:169h–170f
3. Molecular bonds and shapes		**12**:310c–313e	
a. Spatial arrangement of atoms: chains, rings, chelates, polymers		**12**:310c–312c/ **3**:825g–826h/ **9**:81h–83h/ **9**:1044b–1045a/ **14**:768h–769d	**4**:172d–f/**13**:694e–695a/ **13**:701e–h/**17**:678d–f/ **19**:633e–h
b. Isomers: substances having the same composition and molecular weight but different molecular structures	ISOMERISM **9**:1032–1043	**12**:312d–313e/ **5**:138b–f	**4**:84h–85c
i. Structural isomers: functional group isomers; positional isomers		**9**:1033f–1035d/ **12**:312e–313a/ **9**:81b–e	**1**:49c–d/**4**:108b–d
ii. Stereoisomers: cis-trans isomers; optical isomers		**9**:1035d–1043a/ **12**:313a–e/ **3**:825a–c	**4**:85b–c/**4**:102f–h/ **4**:108f–109a/**4**:1089d–e/ **5**:138d–f/**9**:85d–f/ **18**:605f–606d
iii. The effects of stereoisomerism in chemical reactions		**9**:1043b–e	**4**:150f–g/**4**:155g–h
4. Time-dependency properties of molecules		**12**:313f–315a/ **7**:916f–917a	**17**:466e–f
5. Molecular structure and its relation to the properties of bulk matter		**2**:315h–316c/ **1**:460d–461c	**13**:524h–525g

	articles	article sections	other references
a. The physical properties of matter as affected by molecular size, shape, and interactions, and interactions of molecules with radiations and fields		**12**:315b–316a / **1**:452e–g / **1**:460g–h / **4**:111d–112c / **4**:914c–g / **5**:1107h–1110h / **9**:82c–e / **13**:684f–685c / **14**:773b–d / **16**:1052h–1054a	**3**:866g–h / **4**:98c–99a / **4**:172b–f / **6**:557h–558c / **8**:835c–g / **17**:470f–471a
b. The chemical behaviour of matter as determined by the nature of molecular bonds		**12**:316a–c / **1**:460h–461g / **13**:702a–d	**3**:865h–866f / **13**:129g–130b
c. The chemical, physical, and biochemical properties of a substance inferred from its known or postulated molecular structure		**9**:80b–c	
6. Experimental and theoretical procedures for the determination of molecular structures	CHEMICAL ANALYSIS **4**:76–84	**1**:588b–e / **3**:873f–874c / **4**:170f–173c / **14**:768a–769h	**1**:598h–599h / **4**:111a–d
a. The separation, isolation, and purification of chemical substances based on chemical equilibria and rate phenomena	CHEMICAL SEPARATIONS AND PURIFICATIONS **4**:156–161	**1**:598c–g / **4**:165b–d / **4**:78g–79g / **15**:85d–86e / **15**:521f–523f	**4**:171c–e / **9**:1045h–1046d / **13**:693b–c
		4:158e–h / **14**:181d–182b	
i. By volatility differences: distillation, sublimation, evaporization	CHROMATOGRAPHY **4**:565–569	**4**:159a–d	**2**:997a–b / **4**:79c–f / **9**:801g–802a / **12**:321a–b / **17**:680c–d
ii. By chromatography: liquid phase, gas phase, thin layer		**4**:159d–160a / **15**:521g–522a / **15**:523c–f	**1**:598c–d / **4**:78h–79b
iii. By solubility differences: precipitation, crystallization, zone melting, solvent extraction	ION-EXCHANGE REACTIONS **9**:800–804	**4**:160a–c / **15**:522b–523c / **19**:1141f–h	**18**:684b–d
iv. By ion-exchange reactions		**4**:160e–g	**4**:157e–f / **6**:606d–607e / **15**:87d–f
v. By electrophoresis and electrolytic methods		**4**:160g–161f / **19**:1142a–c	**3**:1144b–c
vi. By mechanical methods: filtration, sedimentation, sieving, flotation, centrifugation		**4**:79h–80h / **1**:457h–458a / **8**:566c–d / **8**:570c–e / **8**:572c–e / **8**:575a–c	**1**:599b–h / **4**:146g–h / **9**:97f–g
b. Classical methods of qualitative and quantitative analysis		**4**:80h–83h	**13**:693c–e
c. Instrumental methods used to identify functional groups, molecular sub-units, and structural features		**4**:81c–82b	**8**:835h–836b / **12**:316h–317g / **13**:693c–e / **14**:295e–f / **15**:88e–f
i. Spectrochemical methods: microwave, infrared, ultraviolet, Raman spectroscopy, colorimetry, atomic absorption spectroscopy		**4**:82b–c	**2**:344h–345d / **11**:609d–h / **12**:320a
ii. Mass spectrometry		**4**:82d–f / **11**:306e–308d	**12**:317h–318a / **15**:423e–g
iii. Magnetic resonance spectrometry		**4**:82f–g	
iv. Thermometric methods: thermogravimetry, calorimetry, cryoscopy		**4**:82h–83b	**14**:368b–d
v. Radiochemical methods: radiometric analysis, activation analysis, isotopic dilution		**4**:83b–h	**15**:87c–d
vi. Electrochemical methods: potentiometry, polarography, electrodeposition, oscillometry		**12**:316e–h	
d. Diffraction methods for determining molecular structures		**12**:316e–f	
i. Electron diffraction		**12**:316f–h / **12**:1074c–e / **15**:87g–88e / **17**:474b–c	**8**:208f–209d
ii. X-ray and neutron beam diffraction		**4**:83h–84a	**3**:831g–832a / **15**:423d–e
e. Physical methods used to determine optical activity, magnetic susceptibility, calorific values, heat of combustion, activation energy, and reaction rates			

	articles	article sections	other references
f. The synthesis and characterization of derivatives, or specifically modified molecules		**1**:455c–d / **1**:601c–602b	**1**:457h–458a / **9**:1046g–1047a
g. The determination of molecular weight based on thermodynamic theory, on transport phenomena, and on known spatial arrangements of atoms in the solid state	MOLECULAR WEIGHT **12**:318–321	**14**:768c–h / **15**:86b–c / **16**:1051a–h	
h. The principles of conformational analysis as related to molecular structure	CONFORMATIONAL ANALYSIS, PRINCIPLES OF **4**:1089–1091		**9**:81h–83h *passim* / **9**:1038e–1039b
i. Scattering of molecular beams and its usefulness in the study of molecular interactions	MOLECULAR AND ATOMIC BEAMS **12**:304–309	**17**:472c–g	
7. Spectra of molecules		**17**:466a–473a	
a. The theory of molecular spectra		**17**:466d–467c / **2**:341d–e / **11**:799b–800b / **12**:305h–306c	**2**:234a–c / **12**:315h–316a / **14**:293b–d
b. Types of molecular spectra		**17**:467e–471h	
i. Microwave spectra		**17**:467e–468e	
ii. Infrared spectra		**17**:468f–469e	**2**:241d–f / **12**:317f–g
iii. Raman spectra		**17**:469e–g	
iv. Visible and ultraviolet spectra		**17**:469g–471h	**12**:317e–f
c. The interpretation of molecular band spectra in determining molecular structure		**17**:467d–e	**8**:835h–836c
B. The theory of chemical bonding: its development and experimental bases	CHEMICAL BONDING **4**:84–94		
1. Nonquantum treatments of chemical bonding		**4**:84d–88d / **1**:460d–f / **2**:340b–341c / **13**:694d–695a	**13**:811d–h
a. Early ideas and concepts of chemical bonding		**4**:84d–85d	**9**:90b–d / **9**:1044b–e / **18**:601h–602c
b. The early electronic theory of bonding		**4**:85d–86h / **4**:97c–99a / **4**:106e–107b / **6**:670a–e / **9**:804e–h / **9**:1032f–1033a / **13**:694a–d	**13**:138f
i. The nature of ionic bond: shell theory, ion pairs		**4**:85g–86b / **4**:98a–99a	**3**:818h–819b / **4**:106f–h / **9**:1032f–g
ii. The nature of covalent and coordinate bond: the octet		**4**:86c–h / **4**:97d–98a	**3**:46e–h / **4**:106h–107b / **5**:137a–c / **6**:670a–c / **9**:1032h–1033a / **13**:707a–c / **16**:1034a–d / **17**:678c–e / **18**:605a–f
c. The theory of bonding based on the quantum-mechanical treatment of atomic structure		**4**:86h–88d / **3**:44g–46h / **3**:841f–843a / **13**:141f–h	**19**:1143d–f
2. Quantum-mechanical treatment of chemical bonding		**4**:88d–93e / **18**:609h–611e	**4**:169h–170f
a. Atomic and molecular orbital concepts: localized and delocalized orbitals, symmetry characteristics, bonding and antibonding orbitals		**4**:88g–91b	**5**:137e–f / **14**:79d–80a / **17**:469h–470e / **18**:602f–604c
b. Bonding in the hydrogen molecule: the valence-bond method versus the molecular orbital method of calculating energy relations in bonding		**4**:91b–h	**2**:340e–341a
c. Bonding in simple polyatomic molecules		**4**:91h–92e	
d. Quantum-mechanical calculations: empirical and nonempirical methods of determining electron energy correlations		**4**:92f–93c	

	articles	article sections	other references
3. Other bonding effects: hydrogen bonding; metallic bonds in metals, intermetallic compounds, and coordination compounds; bonds in crystals, in weak associations, and in electron-deficient compounds		**4**:93c–e / **4**:101h–103h / **13**:714h–715f / **19**:633c–634h	**3**:47e–48d / **8**:562g–563a / **9**:804e–g / **9**:95b–96a / **11**:1086b–f / **12**:315g–h / **16**:1053g–1054a / **16**:1055c–e / **18**:606g–607a
4. Experimental observation of chemical bonding		**4**:93f–94a	**8**:834f–835b
5. Anomalous molecular structures, or molecular fragments with apparently anomalous valences			
a. Free radicals: molecular fragments that arise from the cleavage of a chemical bond producing two separate entities each of which contains a single unpaired electron from the broken bond	RADICALS, FREE **15**:421–423		**11**:309c–d / **13**:686f–h / **14**:771e–772b
b. Carbenes: highly reactive molecules containing carbon atoms that form only two of the four bonds that they normally form with other atoms	CARBENES **3**:820–823		
c. Carbanions: carbon-containing molecules with negative charges	CARBANIONS **3**:817–820		
d. Carbonium ions: carbon-containing molecules with positive charges	CARBONIUM IONS **3**:860–863		
C. Systems of classification of chemical compounds or substances	CHEMICAL COMPOUNDS, CLASSIFICATIONS OF **4**:94–96		
1. By their elemental composition or molecular structure: organic, inorganic, organometallic, nonstoichiometric compounds		**4**:94e–95e	
2. By their bond type: ionic, covalent, and coordination compounds		**4**:95e–96a	**4**:84g–85b / **16**:1047g–1048b
3. By their chemical reactivity: acids, bases, and salts; oxidizing and reducing agents		**4**:96b–f / **1**:45d–47g	**9**:95f–g
4. By their physical state: gas, liquid, and solid		**7**:914a–e / **10**:1024a–g	**4**:172b–c / **8**:207c–d / **16**:1032d–g
5. By their origin: natural and synthetic		**14**:764h–768a	
D. Inorganic compounds	CHEMICAL COMPOUNDS, INORGANIC **4**:96–106		**4**:94h–95c
1. Nomenclature of binary, ternary, and coordination compounds		**4**:99a–100d **5**:136d–137a	
2. Structural classification of inorganic compounds		**4**:100e–106a	
a. Salts		**4**:100e–h	
b. Oxides, anhydrides, acids, and bases		**4**:100h–101h / **3**:872c–f	**4**:96b–e / **13**:815e–816b / **13**:818h–824b *passim*
c. Coordination compounds	COORDINATION COMPOUNDS **5**:134–143	**4**:100b–d / **4**:101h–103b / **4**:155d–h / **18**:605a–607f	**1**:592e–f / **3**:46d–f / **4**:95h–96a / **19**:635f–636b
d. Organometallic compounds [see E.l.c., below]		**4**:103h–104e	**13**:812d–e
e. Catenates		**4**:104f–105c / **14**:767f–768a	
f. Inorganic polymers		**4**:105c–106a	
g. Special nonmetallic derivatives		**5**:140e–h / **18**:432c–h	**14**:195h–196b
3. Methods of preparation of inorganic compounds		**5**:141a–142d	**13**:818e–g
4. Reactions of inorganic compounds; *e.g.*, acid–base, substitution, isomerization, oxidation–reduction, addition			
E. Organic compounds	CHEMICAL COMPOUNDS, ORGANIC **4**:106–113		**4**:162d–f / **4**:94e–h

	articles	article sections	other references
1. The major groups of organic compounds: their nomenclature, chemical and physical properties, synthesis, occurrence, reactions, and analysis		**4**:107e–110g / **13**:330f–331a	**4**:80e–h / **13**:522d–523b
a. Hydrocarbons: aliphatic and aromatic	HYDROCARBONS **9**:79–92	**4**:107g–110f / **4**:128h–129d / **4**:130h–131e / **7**:928d–f / **14**:167c–f	**8**:833b–c / **12**:310d–311d / **13**:683b–d / **14**:180h–181c
b. Organic halogen compounds: alkyl, alkenyl, and alkynyl halides; aryl halides	ORGANIC HALOGEN COMPOUNDS **13**:682–693	**3**:872f–h	
c. Organometallic compounds	ORGANOMETALLIC COMPOUNDS **13**:714–721	**4**:103b–h / **5**:140a–e / **18**:433a–c / **18**:607f–608d	**1**:592d–e / **3**:49e–f / **4**:95c–d
d. Alcohols, phenols, and ethers	ALCOHOLS, PHENOLS, AND ETHERS **1**:450–459	**4**:135f–136b	**9**:1033h–1034a
e. Carboxylic acids and their derivatives	CARBOXYLIC ACIDS AND THEIR DERIVATIVES **3**:863–874	**2**:1017a–1021e	
f. Aldehydes, ketones, and their derivatives	ALDEHYDES AND KETONES **1**:459–463	**3**:825g–827f	**1**:49c–e / **15**:421g–422a
g. Organic nitrogen compounds	ORGANIC NITROGEN COMPOUNDS **13**:693–700	**3**:873b–f / **1**:597e–598c	**4**:918a–923g *passim* / **8**:833h–834d
h. Organic sulfur compounds	ORGANIC SULFUR COMPOUNDS **13**:706–714		
i. Organic phosphorus compounds	ORGANIC PHOSPHORUS COMPOUNDS **13**:701–706		
j. Organic silicon compounds			**14**:767g–768a
k. Heterocyclic compounds	HETEROCYCLIC COMPOUNDS **8**:832–844	**4**:110f–g / **1**:602c–605d	**12**:311e–g
l. Oils, fats, and waxes	OILS, FATS, AND WAXES **13**:522–527	**11**:1040b–1041d	**2**:1015h–1022d *passim* / **3**:867d–868e / **13**:532e–f
m. Carbohydrates	CARBOHYDRATE **3**:823–832		**8**:839h–840b
n. Amino acids, proteins, and peptides	PROTEIN **15**:81–98	**2**:1021f–1022c / **6**:897f–h / **11**:1041d–h	**4**:859f–860a / **12**:312b–c / **18**:609a–e
o. Isoprenoids and terpenes	ISOPRENOIDS **9**:1043–1049		
p. Steroids and their derivatives	STEROIDS **17**:677–686		**1**:604f–h / **8**:1082b–1084g *passim*
q. Nucleotides and nucleosides	NUCLEOTIDES **13**:330–333	**10**:902b–f / **11**:1041h–1043f	**13**:703e–f
r. Nucleic acids: DNA and RNA	NUCLEIC ACID **13**:328–330	**11**:1044h–1046e / **19**:164d–165c	**8**:843a–e / **10**:895b–d / **12**:316b–c / **13**:332b–333a
s. Alkaloids	ALKALOIDS **1**:595–607	**5**:1052f–h / **5**:1055c–d	**14**:192d–e
t. Dyestuffs and pigments	DYESTUFFS AND PIGMENTS **5**:1105–1117	**4**:914c–923g / **5**:1100a–1102a	**4**:860g–861a / **13**:888d–889e
u. Organic polymers	POLYMERS **14**:764–774	**4**:858d–859d	**4**:129f–g / **12**:311h–312a / **13**:889h–890d / **14**:512d–517b *passim*
2. Preparation and purification of organic compounds		**4**:110g–111d / **13**:715g–716d / **13**:718c–719e / **17**:679h–680b	**3**:831f–g / **9**:1045h–1046d / **13**:685c–692d *passim*

articles	article sections	other references
3. Physical properties of organic compounds	**4**:111d–112c/ **13**:684f–685c	**1**:460g–h
4. Reactions of organic compounds; *e.g.*, addition, substitution, displacement, hydrolysis, pyrolysis, condensation, polymerization, molecular rearrangement	**4**:112c–113d/ **1**:454d–h/ **1**:457c–e/ **1**:458f–g/ **1**:462c–463e/ **9**:84c–f/ **13**:699d–h/ **13**:700d–h/ **13**:716d–717c/ **13**:719f–721c/ **14**:770e–771a	**3**:827c–828g/ **9**:86a–89f *passim*/ **13**:685c–692c *passim*/ **14**:194c–196g *passim*

Section 123. Chemical reactions

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 123 deal with eight main subjects: A, general considerations regarding chemical reactions; B, energy changes in chemical reactions; C, the rates of chemical reactions; D, the mechanisms of chemical reactions; E, acid–base reactions and equilibria; F, oxidation–reduction reactions; G, photochemical reactions; and H, chemical reactions and chemical theory in the synthesis of chemical compounds.

The outline of subject A begins with basic concepts and major theories concerning chemical reactions—processes of change during which either two or more substances change or one substance changes into at least two other substances. It then deals with the methods of classifying chemical reactions. The articles referred to here treat the principal kinds of chemical reactions, classified according to the relationship between the starting materials and the final product. Articles referred to at B, C, and D treat the reactions that are classified according to the energy changes involved, to the rates involved, and to the mechanisms involved.

The outline of subject B treats the classification of chemical reactions according to the energy changes involved; the significance of activation energy in chemical reactions; and the thermodynamic relations in chemical reactions.

The outline of subject C first treats the factors that affect the rates or direction of chemical reactions; the factors that affect the kinetic order of the reaction; the factors that affect the extent of the reaction; and complex reactions. It further covers the experimental methods for studying chemical kinetics and kinetic studies as a means of elucidating reaction mechanisms.

Subject D involves detailed studies of the changes in bonding patterns of molecules involved in chemical reactions. The outline covers the factors that influence the course or overall route of change in the reaction; the energy changes through single-stage and multi-stage processes; the factors that reveal the mechanism of a reaction; the classification of reaction mechanisms; and selected mechanisms of the principal types of reactions.

The outline of subject E begins with the general properties of acids and bases and with theoretical approaches to the definition of these compounds that react to form salts. It goes on to the detailed studies of acid–base reactions and of the quantitative aspects of acid–base equilibria. The outline ends with the experimental study of acid–base reactions and equilibria.

Subject F is oxidation–reduction reactions—a large and diverse body of processes, some as common and familiar as fire, the rusting of metals, respiration, and photosynthesis. The outline first deals with major classifications of oxidation–reduction reactions. It then treats definitions of oxidation and reduction and theoretical aspects of these reactions. After treating electrochemical reactions, it deals with oxidation–reduction reactions in biological systems and in combustion and flames.

Subject G is photochemical reactions—chemical processes initiated by visible, infrared, or ultraviolet radiation. The outline covers the photochemical process, beginning with the absorption of a quantum of electromagnetic energy by an atom or molecule; the experimental methods used in photochemistry; and the applications of photochemical processes in synthetic chemistry, in radiation chemistry, and in the studies of the atmosphere and of biological processes.

Subject H is chemical synthesis, the construction of complex chemical compounds from simpler ones. The outline deals with factors involved in the technique of chemical synthesis. It first treats factors that affect the choice of a specific synthetic path and the factors that affect the choice of reaction conditions. The outline then indicates that the isolation, purification, identification, characterization, and analysis of products are treated in Section 122.

articles	article sections	other references
CHEMICAL REACTIONS **4**:142–146		
A. General considerations of chemical reactions	**4**:142g–143c	**4**:166c–e/**8**:833f–h
1. Basic concepts involved in the study of chemical reactions; *e.g.*, transformation, conservation of mass and energy, law of simple multiple proportions in compounds	**4**:143d–144d	
2. Growth of major theories concerning chemical reactions		
3. Classification and nomenclature of the principal kinds of chemical reactions	**4**:145c–146f/ **3**:822b–h/ **4**:112c–113d/ **13**:699d–h	**13**:719f–g/**13**:813g–814a
a. According to the relationship involved between the starting materials and the final products		
i. Decomposition reactions	**4**:145g–h/ **14**:770e–771a	**3**:1003b–e/**4**:113b–c/ **9**:86f–87b/**14**:196c–e/ **14**:511g–512a
ii. Polymerization reactions	**4**:145h–146a	**14**:294g–295a/**15**:423a–c
iii. Chain reactions		

	articles	article sections	other references
iv. Substitution reactions		**4**:151f–153h/ **5**:141c–g	**3**:871d–h/**13**:685h–686c/ **13**:719a–c/**13**:721a–c
v. Addition and elimination reactions		**4**:146b–c/ **4**:153h–155d	**1**:462d–g/**2**:1018h–1019a/ **9**:88a–c/**13**:686c–f
vi. Oxidation–reduction reactions [see F., below]			
vii. Acid–base reactions [see E., below]			
b. According to the energy changes involved [see B.1., below]			
c. According to the reaction rates or chemical kinetics involved [see C.6., below]			
d. According to the reaction mechanism involved [see D.4., below]			
B. Energy changes in chemical reactions		**4**:148e–149e/ **4**:174b–f	
1. The classification of chemical reactions according to energy changes involved: exothermic and endothermic		**16**:1048f–h	**4**:144d–f/**4**:174b–c
2. The significance of activation energy in chemical reactions			**4**:144d–h/**4**:164c–e/ **4**:174h–175b
3. Thermodynamic relations in chemical reactions	THERMODYNAMICS, PRINCIPLES OF **18**:306–307	**4**:138d–139a	
a. Chemical equilibrium		**18**:306e–307c/ **4**:173h–174b/ **6**:898d–f/ **9**:803d–804c/ **13**:808c–e/ **15**:589e–590b	**3**:46a–b/**4**:138e–g/ **15**:591a–d
b. Free energy changes and entropy changes in chemical reactions		**18**:306a–e/ **7**:1029e–1030a	**4**:138d/**4**:144h–145a/ **4**:174c–f
C. Rates of chemical reactions	CHEMICAL KINETICS, PRINCIPLES OF **4**:138–142	**5**:741c–d/ **13**:808e–h	
1. Factors that affect the rate or direction of chemical reactions		**4**:139a–140a/ **4**:164c–165a/ **4**:174f–175e	**4**:112c–e
a. Solvents		**4**:139b–c/**4**:148b	**19**:637e–g
b. Temperature			**4**:955d–f/**14**:995h–996a
c. Pressure		**4**:139d–e	**14**:994f–g
d. Catalysts	CATALYSIS **3**:1000–1005	**18**:608d–h	**4**:164f–g/**4**:175c–d
i. Homogeneous catalysis		**3**:1001c–1002c/ **1**:48h–49g	
ii. Heterogeneous catalysis		**3**:1002c–1004f/ **6**:641f–h	**13**:721d–f/**14**:771e–772h
iii. Theories of catalytic action		**3**:1002d–1004f/ **6**:898f–900c	**3**:1004h–1005b
iv. Enzymes as biological catalysts [see 321.B.7.]			
e. Collisions		**4**:139f–140a	
f. Light		**14**:367b–c/ **15**:410g–411a	**3**:821d–h/**14**:293g–294d
g. Isotopic substitution		**9**:1058b–e	**3**:1002h–1003b/**4**:150g–h
h. Molecular structure; *e.g.*, steric hindrance, inductive effects		**4**:1091e–f/ **6**:900g–901b	**3**:861h–862c/**4**:150e–g/ **4**:164g–165a/**5**:141e–g
2. Factors that affect the kinetic order of chemical reactions: concentration of reactants, mechanism of reaction, conditions of the reaction		**4**:140a–d	
3. Factors that affect the extent of chemical reactions: equilibrium constant		**4**:140d–g/ **18**:306g–307c	**4**:174a–b/**7**:1028f–h/ **9**:803d–804c
4. Complex reactions: reactions governed by more than one reaction rate		**4**:140g–141e	**15**:423a–c
5. Experimental methods for studying chemical kinetics		**4**:141e–142b	**4**:150a–b/**12**:308a–b

	articles	article sections	other references
a. Measurement of reaction rates		**4**:141e–g / **6**:641c–f	**4**:174f–h
b. Determination of the order of reactions		**4**:141g–142b	
c. Relaxation methods	RELAXATION PHENOMENA **15**:589–592		
6. Kinetic studies as a means of elucidating reaction mechanisms		**4**:142b–e	**4**:150c–d
D. Mechanisms of chemical reactions	CHEMICAL REACTIONS, MECHANISMS OF **4**:147–155		
1. Factors influencing the course of a reaction: reactants, transition state, solvent, catalysts, products, reaction conditions		**4**:147f–148e	**1**:462c–d / **13**:689h–690f
2. Energy changes through single-stage and multi-stage processes		**4**:148e–149e	
3. Factors that reveal the mechanism of a reaction: chemical and stereochemical nature of the reactants, intermediates, and products; kinetics of the reaction		**4**:149e–150h	**3**:1002h–1003e / **4**:140a–b / **4**:1091a–e
4. Classification of reaction mechanisms based on the nature of electron pairing in the transition state, on the nature of the attacking species, on the nature of catalysis, on the number of components of the transition state		**4**:150h–151f / **1**:48h–49g / **3**:1001c–1004f	**4**:955d–956b / **8**:833f–h / **13**:686a–f
5. Mechanisms of the principal types of reactions		**4**:151f–155h / **3**:862c–863d / **8**:836d–837h / **13**:808h–809f	
a. Nucleophilic substitution		**4**:151f–153b / **4**:155d–h / **5**:141b–g	**3**:820b / **3**:866d–f / **13**:683f–h / **13**:686a–c / **13**:702c–703d / **18**:606c
b. Electrophilic substitution		**4**:153c–h	**13**:684d–f / **13**:704e–h
c. Addition reactions		**4**:153h–154h	**1**:462d–f
d. Elimination reactions		**4**:154h–155d	**9**:85g–h / **13**:686c–f
E. Acid–base reactions and equilibria	ACID–BASE REACTIONS AND EQUILIBRIA **1**:45–53		
1. General properties of acids and bases		**1**:45d–g	**4**:96b–e / **4**:101c–d
2. Theoretical approaches to acid–base concepts		**1**:45g–47g	
a. The definition of an acid as a substance that gives rise to hydrogen ions and a base as a substance that gives rise to hydroxyl ions in aqueous solutions		**1**:45g–46e	**3**:866b–d / **9**:95f–g
b. The Brønsted–Lowry concept defining an acid as a proton donor and a base as a proton acceptor		**1**:46e–47c	**3**:1001f–h / **4**:101f–g
c. The Lewis electronic theory defining an acid as an electron acceptor and a base as an electron donor		**1**:47c–g	**4**:101g–h / **5**:137a–c
3. Acid–base reactions		**1**:47h–49g	
a. Proton-transfer reactions		**1**:47h–48e	**4**:112e–f / **4**:146e–f
b. Lewis acid reactions		**1**:48e–h / **3**:862c–863a / **5**:139a–e	**3**:1004e–f
c. Acid–base catalysis		**1**:48h–49g / **3**:871d–872c	**1**:453f–454a / **3**:1001f–h
4. Quantitative aspects of acid–base equilibria		**1**:49h–53c	
a. Equilibria in aqueous solutions		**1**:50e–51d	**3**:819d–820a / **19**:636f–h
b. Equilibria in nonaqueous solvents		**1**:51d–52e	
c. Equilibria involving Lewis acids		**1**:52e–g	
d. The effect of molecular structure on acid–base equilibria		**1**:52g–53c	**3**:819d–820a / **5**:141a–b
5. The experimental study of acid–base reactions and equilibria		**1**:53c–h	

	articles	article sections	other references
F. Oxidation–reduction reactions	OXIDATION–REDUCTION REACTIONS **13**:803–809		
1. Major classes of oxidation–reduction reactions: oxygen atom transfer, hydrogen atom transfer, electron transfer		**13**:803d–g / **5**:141h–142b / **6**:640b–e	**1**:463a–b / **4**:146d–e / **8**:561c–d / **13**:811f–g
2. Definitions of oxidation and reduction based on the reaction's stoichiometry, which provides the characteristic combining property of elements and compounds, and on oxidation-state changes		**13**:803g–804a	**1**:460b–d / **4**:96e–f / **4**:954e–f
3. Theoretical aspects of oxidation–reduction processes			
a. The concept of oxidation state		**13**:805g–809f	
		13:805g–806h	**1**:66d–e / **3**:840d–841a / **5**:138g–h / **13**:141a–c / **18**:683c–e
b. Half reactions and the determination of redox potentials		**13**:806h–808b	
c. Oxidation–reduction equilibria and reaction rates		**13**:808c–h	**6**:640g–641a
d. Mechanisms of redox reactions		**13**:808h–809f / **6**:640e–641a	
4. Electrochemical reactions: chemical changes associated with the passage of an electrical current	ELECTROCHEMICAL REACTIONS **6**:638–644		**13**:804d–e
a. The electrochemical process: types of reaction		**6**:638h–641a / **11**:1070h–1071f / **11**:1076e–1077b	**6**:606a–d
b. Complex electrochemical reactions		**6**:641a–643d	
c. The Nernst and Butler–Volmer equations, which relate electrode potentials to current densities and concentration of reacting species		**6**:643h–644g / **7**:1030a–d	**13**:808c–e
5. Oxidation–reduction reactions in biological systems		**11**:1026e–1037d / **14**:370d–373e / **18**:608h–609h	**10**:896c–h / **11**:884d–e / **13**:808f–h
6. Oxidation–reduction reactions in combustion and flames	COMBUSTION AND FLAME **4**:954–958		**9**:80c–d
G. Photochemical reactions	PHOTOCHEMICAL REACTIONS **14**:291–296		**3**:821d–h
1. The photochemical process		**14**:292d–295a / **7**:109b–110a / **14**:370d–371b / **15**:410g–411a	**17**:471b–e
2. Experimental methods used in the study of the photochemical process and photochemical reactions		**14**:295a–296d	
3. The application of photochemical processes		**14**:296e–g / **2**:316g–317d	
H. Chemical reactions and chemical theory in the synthesis of chemical compounds	CHEMICAL SYNTHESIS, PRINCIPLES OF **4**:161–165		
1. Factors that affect the choice of a specific synthetic path		**4**:162f–165d	
2. Factors that affect the choice of reaction conditions			**4**:148d–e
3. The separation and purification of reaction products [see 122.A.6.a.]			
4. The identification, characterization, and analysis of reaction products [see 122.A.6.b. through i.]			

Section 124. Heat, thermodynamics, and the nonsolid states of matter

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 124 deal with eight main subjects: A, the principles of thermodynamics; B, the gaseous state; C, the liquid state; D, solutions and solubility; E, physical effects at surfaces; F, the plasma state of matter; G, the properties of matter at extreme conditions; and H, transport phenomena. The solid state of matter is dealt with in Section 125.

The outline of subject A, after dealing with the first and second laws of thermodynamics, treats heat, covering the definition and theories of heat, heat transfer in matter, and the relation of heat to entropy, work, and changes of energy in a system. The outline of A further treats thermodynamic relations in simple systems; the third law of thermodynamics; the effects of applied forces on simple systems; steady rate processes; and statistical thermodynamics.

The outline of subject B begins with the nature and properties of a gas. It then treats the thermodynamic approach to gases in terms of bulk measurable properties, and the particle-description approach, which deals with how the individual properties of the particles collectively give rise to the observed behaviour of a gas.

The outline of subject C treats the behaviour and properties of liquids at equilibrium, the molecular structure of liquids, and then the transport and the acoustical, electrical, magnetic, thermodynamic, optical, and surface-tension properties of liquids.

The outline of subject D treats the general classes of solutions; the composition ratios of solutions and the equilibrium, colligative, and transport properties of solutions; the thermodynamic and molecular aspects of solvent and solute interactions; general theories of solution; and the effects of temperature and pressure on the solubility of solids and gases.

Subject E is the physical effects that occur at surfaces. The outline deals first with phenomena of tension at the surfaces of liquids and with phenomena of adsorption, in which substances attract to their surfaces molecules of gases or of solutions with which they are in contact. It goes on to the tribological phenomena of friction and lubrication. Finally, it deals with colloids, treating irreversible colloidal systems, including such things as emulsions, foams, and pastes; and reversible colloidal systems, including solutions of soaps and dyes.

The outline of subject F, the plasma state of matter, begins with basic plasma properties and parameters. It goes on to treat elastic and inelastic collisions of plasma particles; radiation from plasmas; the formation of plasmas; the behaviour of plasmas in magnetic and electric fields; and the fluidlike behaviour of plasmas. Finally, it treats the existence of natural plasmas in intergalactic space, in the Sun and stars, and on Earth.

The outline of subject G treats the properties of matter at low temperatures; the special properties of matter at high temperatures; and the effects of high pressure on the physical, chemical, electronic, and magnetic properties of matter.

The outline of subject H begins with the kinetic molecular theory of the transport properties of gases, liquids, suspensions, and polymers. It goes on to treat the equations relating transport properties and the rates at which mass, energy, and momentum are transported; the hydrodynamic aspects of transport; and transport in macrosystems.

	articles	article sections	other references
A. The principles of thermodynamics	THERMODYNAMICS, PRINCIPLES OF **18**:290–315		
1. The description of physical phenomena based on the concepts of system, state of a system, and changes of state		**18**:291h–292e	**11**:161d–e
2. The first law of thermodynamics		**18**:292f–293b/ **8**:704b–c	**11**:782f–h/**14**:102f–h
3. The second law of thermodynamics		**18**:293b–294g/ **18**:307f–308a/ **8**:704f–g/ **10**:894c–f	**11**:782h–783c/**12**:871b–g/ **14**:104a–b
4. Stable equilibrium		**18**:294g–297g	
a. Equations relating properties of systems that are in, or are passing through, stable equilibrium states		**18**:294h–295b	**7**:917h–918b
b. Temperature considered as the potential governing the flow of energy between systems		**18**:295e–g	**18**:321c–d
c. Heat	HEAT **8**:700–706		
i. The definition of heat as a form of energy transferred from one body to another under the influence of a difference in temperature		**8**:700h–701e	
ii. Theories regarding heat: the phlogiston theory, the caloric theory, the kinetic molecular theory		**8**:701e–h/ **8**:702g–705a	**3**:332c–e/**18**:291a–b
iii. Heat transfer in matter: heat conductivity in solids, convection in liquids and gases, heat transfer in boiling liquids, evaporation and condensation		**8**:705a–b/ **6**:25a–e/ **6**:61f–62a/ **8**:707c–708b/ **11**:1089d–f/ **18**:317h–318e	**4**:956b–c/**9**:807f–808a/ **16**:1052b–c/**17**:598d–f
iv. Technical applications of heat energy [see 721.B.7. and 725.A.5.a.]			
v. Heat and its relation to entropy, work, and change of energy		**18**:295g–297a	**4**:144h–145a
5. Thermodynamic relations in simple systems		**18**:297a–308f	
a. The Carnot cycle: a system that is free from internal irreversibility and is undergoing a sequence of isothermal and adiabatic processes		**18**:297a–g/ **8**:704c–e	**17**:629e–f/**18**:323b–d

	articles	article sections	other references
b. Maxwell's equations relating entropy to pressure, volume, and temperature for closed systems that assume only stable equilibrium states		**18**:298h–299a	
c. Phase changes and equilibria	PHASE CHANGES AND EQUILIBRIA **14**:204–210	**10**:1024g–1026b/ **7**:1023c–1026g	
i. General considerations: phase number, component number, degree of freedom, critical point, the phase rule		**14**:204f–205h/ **18**:299a–d/ **7**:1023c–1024c	**10**:1024g–h
ii. Phase relations and phase diagrams of unary, binary, ternary, and higher order systems		**14**:205h–210c/ **5**:336h–337a/ **7**:216h–218c/ **7**:1024c–1026g/ **8**:868d–869h/ **9**:209e–210a	**1**:582e–g/**1**:585c–e/ **10**:1024h–1026c/ **15**:321b–322b/ **17**:658h–660b
d. Simple one-component systems: processes at constant volume and at constant pressure; the equation of state, which relates pressure, volume, and temperature for stable equilibrium states		**18**:299d–302b/	**14**:206b–f
e. Simple multicomponent systems: Gibbs equation for entropy change: the Gibbs–Dalton rule for mixture of gases; Raoult's law and Henry's law for ideal solutions		**18**:302b–305c/ **8**:868e–g	**16**:1050d–1057b *passim*
f. Bulk flow		**18**:305c–306a	
g. Equilibrium in chemical reactions [see 123.B.3.]			
6. The third law of thermodynamics		**18**:308a–f/ **11**:161g–162b	
7. The effects of applied force fields on simple systems		**18**:308f–309b	
8. Steady rate processes; *e.g.*, systems approaching stable equilibrium; flow of a substance through a barrier		**18**:309b–311a/ **7**:920a–g/ **18**:676a–g	
9. Statistical thermodynamics		**18**:311b–315c/ **10**:1026c–1027b/ **14**:402b–408b	
a. The laws of thermodynamics that consider the detailed microscopic structure of physical systems and the states of such systems		**18**:311b–313c/ **7**:917h–921c/ **14**:402b–403d	
b. Statistics of grand systems		**18**:313d–315b	
i. The one-particle approximation and fundamental equations for one-component grand simple systems		**18**:313f–314f	
ii. Electronegativity of atoms and molecules treated as a grand system with the electron as its only component particle		**18**:314f–315b	
B. The gaseous state of matter	GASEOUS STATE **7**:914–922		
1. The nature and properties of a gas		**7**:914a–d/ **12**:305a–c/ **12**:859c–h/ **18**:303c–304a	
2. The thermodynamic approach to gases: the macroscopic view that deals with bulk measurable properties		**7**:914e–916f/ **11**:782d–783e	
a. The simple gas laws		**7**:914g–915a	**18**:322g–323b
b. The thermal equation of state for perfect gases		**7**:915a–916b/ **11**:783d–e	**12**:319a–c/**12**:859c–e/ **18**:300d–301c
c. Empirical equations of state for real gases		**7**:916b–f	**18**:301d–h
3. The particle-description approach to gases: the microscopic view that deals with the individual properties of the particles and how these properties collectively give rise to the observed behaviour of a gas		**7**:916f–922c	**6**:852g–h
a. The distribution function, which determines how many particles in the system have positions and velocities within well-defined limits		**7**:917b–g	
b. The Boltzmann transport equation and the single-particle distribution function		**7**:917h–920g/ **14**:403d–404f	

	articles	article sections	other references
i. The link between thermodynamic properties and microscopic properties of gases: the partition function		**7**:918f–919b	
ii. Determination of the equilibrium properties and transport properties of gases in terms of virial coefficients and partition functions		**7**:919b–920a	**18**:675d–f
c. The N-particle distribution function and the thermodynamic-equilibrium properties and transport properties of dense gases		**7**:920h–921c	
d. The behaviour of a gas at the hydrodynamic and thermal relaxation stages		**7**:921d–922c / **15**:589e–590b	
C. The liquid state of matter	LIQUID STATE **10**:1024–1028		
1. The behaviour and properties of liquids at equilibrium		**10**:1024g–1026c / **16**:1049g–1051a	**4**:158e–f / **14**:205h–210c *passim*
2. The molecular structure of liquids based on distribution functions, which measure the probable distribution of some property of molecules through the liquid		**10**:1026c–1027b	
3. Properties of liquids		**10**:1027c–1028e	
a. Transport properties		**10**:1027c–g / **16**:1051h–1052e	**11**:879c–881g *passim* / **18**:675f–g
b. Acoustical properties: propagation of sound waves		**10**:1027g–1028a / **13**:490f–491a / **17**:2b–e	**17**:21h–22c
c. Electrical and magnetic properties		**10**:1028a–d / **6**:572c–h	**6**:638d–e
d. Thermodynamic properties		**11**:782d–783c / **13**:489b–h	
e. Optical properties		**13**:489h–490f	
f. Surface tension		**10**:1026b–c / **11**:782b–c	
D. Solutions and solubility	SOLUTIONS AND SOLUBILITIES **16**:1047–1057		
1. General classes of solutions: electrolytes and nonelectrolytes, solutions of weak electrolytes, endothermic and exothermic solutions		**16**:1048c–h	**6**:638d–e / **15**:519c–d
2. Properties of solutions		**16**:1048h–1052e	
a. Composition ratios: molarity, molality, mole fraction		**16**:1048h–1049f	
b. Equilibrium properties: correlation of the vapour pressure of a solution to its composition		**16**:1049g–1051a	**4**:158e–f / **14**:208b–d
c. Colligative properties: rise in boiling point, decrease in freezing point, osmotic pressure		**16**:1051a–h / **7**:1034g–1035a / **12**:320b–f	**11**:879e–g
d. Transport properties: viscosity, thermal conductivity, diffusivity		**16**:1051h–1052e / **10**:1027c–g / **11**:880e–884e	**4**:157f–g
3. Thermodynamic and molecular aspects of solvent and solute interactions		**16**:1052f–1054a	
a. Energy considerations: entropy, enthalpy, Gibbs free energy		**16**:1052f–h / **8**:868e–g	
b. Effects of molecular structure and weak intermolecular forces		**16**:1052h–1053f / **4**:111h–112b / **15**:86f–87b	
c. Effects of chemical interactions; *e.g.*, hydrogen bonding, chemical combinations		**16**:1053f–1054a	**12**:315g–h / **13**:126f–127a
4. General theories of solution: the prediction of solubility and solution properties		**16**:1054b–1056d	
a. Solutions of nonelectrolytes: Raoult's law and Henry's law for ideal solutions; theoretical expressions for the excess properties of regular athermal, associated, and solvated solutions		**16**:1054b–1055f / **18**:304d–305c	
b. Solutions of electrolytes: Debye–Hückel theory and modifications, Arrhenius dissociation theory		**16**:1055g–1056d	**1**:46a–b
5. Effects of temperature and pressure on the solubility of solids and gases		**16**:1056e–1057b / **11**:781f–g	

	articles	article sections	other references
E. Physical effects at surfaces			
1. Surface tension and surface energy: cohesion and adhesion		**1**:88g–89a / **11**:782b–c	**1**:998b–c / **18**:708c–f
2. Adsorption on liquid and solid surfaces		**3**:1002c–1004f / **5**:1110a–e / **15**:89f–h	**4**:568b–d / **14**:182d–e
3. Mechanical and physical effects at interfaces: tribological phenomena	TRIBOLOGICAL PHENOMENA **18**:705–709		
a. Friction: its mechanisms and consequences and the parameters influencing it		**18**:706c–708f / **11**:765g–767a	
b. Lubrication: the reduction of friction		**18**:708f–709a / **11**:169b–e	
4. Colloids: the kinds of dispersions, their properties, and their preparation	COLLOIDS **4**:853–861		**13**:890e–f
a. Irreversible colloidal systems: lyophobic sols, emulsions, foams, pastes, gels		**4**:855b–858c	**12**:321c / **14**:198h–199a
b. Reversible colloidal systems: solutions of polymers and proteins; solutions of soaps and dyes		**4**:858c–861a / **15**:86f–87b / **16**:914h–915d	**14**:770c–e
F. The plasma state of matter: completely ionized gases interacting with magnetic and electric fields	PLASMA STATE **14**:505–510		
1. Basic plasma properties and parameters: electrical quasi-neutrality, electron density, kinetic temperature, particle velocities, magnetic and electric field strengths		**14**:505f–506a / **9**:799f–800a	**13**:308h–309b / **17**:598a–d
2. Elastic and inelastic collisions of plasma particles		**14**:506a–c	
3. Radiation from plasmas; *e.g.*, X-rays, synchrotron radiation, excitation radiation		**14**:506d–f / **19**:1058f–1061b	**17**:806g–807c / **15**:467h–468b
4. The formation of plasmas		**14**:506g–h / **13**:311f–313h	**6**:669f
5. The behaviour of plasmas in magnetic and electric fields		**14**:506h–507d / **13**:311b–313h	
6. The determination of plasma variables		**14**:507d–f	
7. Fluidlike behaviour in plasmas: hydromagnetic waves and magnetohydrodynamic, universal, and dissipative instabilities in plasmas		**14**:507f–508f	
8. Applications of plasmas; *e.g.*, power production, jet propulsion [see 111.G.4., 721.B.8.a.iii., and 721.C.3.]			
9. The existence of plasmas in nature		**14**:509c–510e	
a. In the extraterrestrial medium: interplanetary and interstellar		**14**:509c–e / **9**:786e–h / **9**:788h–789b / **9**:794a–e / **17**:804h–805a	**12**:928h–929c
b. In the Sun and stars		**14**:509f–510a	
c. On Earth		**14**:510b–e	**2**:326c–e
G. The properties of matter at extreme conditions			
1. Properties of matter at low temperatures	LOW-TEMPERATURE PHENOMENA **11**:161–164		
a. Effects of low temperature on entropy, heat capacity, magnetic properties, and conductivity		**11**:161g–163b / **5**:319d–e	
b. Special physical phenomena at very low temperatures: superconductivity, superfluidity		**11**:163b–h / **5**:321f–g	**17**:811h–815f *passim*
c. Special methods for obtaining and characterizing low temperatures: adiabatic cooling, adiabatic dilution		**11**:163h–164g	
2. Special properties of matter at high temperatures		**7**:922b–c / **15**:448e–h	**11**:1087e–h / **13**:308g–310c *passim* / **14**:505a–510e *passim*
3. Effects of high pressure on the physical, chemical, electronic, and magnetic properties of matter	HIGH-PRESSURE PHENOMENA **8**:867–871	**6**:53e–54c / **7**:1026h–1027g	**6**:51f–h / **6**:55b–c

H. Transport phenomena

1. The kinetic molecular theory of the transport properties of gases, liquids, suspensions, and polymers
2. Phenomenological expressions of transport: equations relating transport properties and the rates at which mass, energy, and momentum are transported
3. Hydrodynamic aspects of transport phenomena: equations of change expressing the laws of conservation of mass, energy, and momentum; transfer coefficients at boundary surfaces
4. Transport phenomena in macrosystems: mass, energy, and momentum balance

articles	article sections	other references
TRANSPORT PHENOMENA **18**:674–677		
	18:675b–676a	**4**:956b–c/**10**:1027d–g/ **16**:1052c–e
	18:676a–h/ **7**:920a–h/ **18**:309b–311a	
	18:676h–677e/ **11**:790d–791b	
	18:677f–g/ **11**:881h–884e	

Section 125. The solid state of matter

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 125 deal with six main subjects: A, crystals and crystallography; B, the theory of the crystalline solid state; C, ionic crystals; D, metals; E, semiconductors and insulators; and F, the glassy or amorphous state of matter.

The outline of subject A treats crystal symmetry and classification in terms of the patterns of atoms in crystals; the diffraction of X-rays, electrons, and neutrons by crystal structures; the processes of crystal growth; the effects on the properties of crystals of imperfections and dislocations in their structures; and the effects of temperature, pressure, and alloying on the strength and hardness of crystals.

The outline of subject B first deals with the classification of solids based on their electronic structure and bonding, and with the elastic, plastic, and thermodynamic properties of solids. It next treats the electronic structure of solids. Finally, it treats the principal types of magnetic behaviour exhibited by solids, and the interaction of light with solids.

Subject C is ionic crystals, crystals composed of ions so arranged that the positive and negative charges alternate and balance one another, so that the overall charge of the crystal is zero. The outline covers the bonding in ionic crystals; the principles and methods that are used in the study of their structure; and the thermal, dielectric, electrical, and optical properties of ionic crystals.

The outline of subject D begins with structural aspects of metals and alloys, the explanation of the thermal and electrical conductivity of metals in terms of the free-electron model, and the effects of interaction of the conduction electrons with the crystal lattice. It goes on to lattice vibrations, which affect many of the properties of a metal, and to phenomena at the surface of metals that involve an understanding of the forces that hold electrons within metals. It next deals with superconductivity in metals, covering the thermal, magnetic, and electromagnetic properties of superconductors. Finally, it treats magnetic phenomena in metals.

Subject E is semiconductors and insulators, which offer more resistance than metals to electric charges moving through them. The outline first deals with the general properties of semiconductors and insulators and with the mechanisms of conduction. It next treats the chemical and physical approaches to electrical conduction in semiconductors. Finally, it deals with the principles involved in semiconductor applications, including optical and electrical effects.

Subject F is the glassy or amorphous state of matter characteristic of noncrystalline solids, such as glass, plastics, and gels, which do not have a definite lattice pattern of their atoms and molecules. The outline covers the effects of temperature and composition on the properties of glasses; their structure and their mechanical, chemical, optical, and electrical properties.

A. Crystals and crystallography

1. Patterns of atoms in crystals

   a. The three-dimensional periodic arrangement of atoms in crystals: crystal planes and their notation

   b. Symmetry considerations in the classification of crystal systems: symmetry element—*i.e.*, a point, an axis, or a plane about which an operation is performed; symmetry operations—*e.g.*, rotation, reflection, inversion, translation

2. Diffraction of X-rays, electrons, and neutrons by crystal structures

articles	article sections	other references
CRYSTALLOGRAPHY **5**:339–347		
	5:340b–344a/ **7**:213a–215a/ **16**:752d–754g/ **16**:1035c–1036c	
	5:340c–341a/ **1**:707f–709a/ **7**:219b–221b/ **12**:234a–235f/ **15**:319c–320b/ **16**:756f–h	**3**:845g–846a/**11**:1087a–d/ **16**:1035c–f
	5:341b–343g/ **5**:33g–h/ **13**:561g–562a	**14**: 284e–287d *passim*
	5:344a–346c/ **12**:1074c–e/ **17**:474b–c	**9**:805b–c/**12**:316f–h/ **16**:523h–524a/ **19**:1059f–1060a

	articles	article sections	other references
3. Processes of crystal growth	CRYSTALLIZATION AND CRYSTAL GROWTH **5**:333–339		
a. Theoretical aspects of crystal growth: energy considerations, growth of eutectics, constitutional supercooling, nucleation		**5**:335b–337c / **8**:210a–d	**6**:642d–g
b. Preparation of crystals		**5**:337d–339f	
i. Monocomponent crystal growth: crystal pulling, zone melting, flame fusion, and other methods		**5**:337d–339a / **19**:1058g–1059g	**7**:250e–f / **16**:514e–h
ii. Polycomponent crystal growth: solvent evaporation, temperature differential, chemical reaction, slow cooling		**5**:339a–f / **7**:979g–h	**4**:159d–f
4. Imperfections and dislocations in crystalline materials and their effects on the properties of the crystals		**5**:346c–347b / **9**:806c–807b	**5**:334b–d / **11**:309b–c / **11**:1087h–1088f / **16**:1036b–c / **17**:658f–g / **18**:318b–c
5. Effects of temperature, pressure, and alloying on the strength and hardness of crystals		**17**:660b–661b	**8**:870g–h / **11**:1088c–f
B. The theory of the crystalline solid state	SOLID STATE OF MATTER **16**:1032–1044		
1. The classification of solids according to their electronic structure and bonding		**16**:1033c–1035b / **2**:341f–h	**4**:84g–85b / **12**:234b–235b
a. Ionic solids		**16**:1033d–1034a / **9**:804g–805a	**4**:84g–h
b. Covalent solids		**16**:1034a–e	**4**:84h–85b / **16**:524f–g
c. Metallic solids		**16**:1034e–g	**11**:1086b–d
d. Molecular solids		**16**:1034h–1035a	
e. Hydrogen-bonded solids		**14**:769d–h	**4**:93c–d / **19**:633c–g
2. The arrangement of atoms in crystalline solids [see A.1.a., above]			
3. The elastic and plastic properties of solids		**16**:1036d–g / **5**:556h–557b	**6**:519d–520c / **15**:953g–958f *passim*
4. The thermal and thermodynamic properties of solids: specific heat, thermal conductivity		**16**:1036g–1037b / **15**:960a–h / **17**:813b–f	**11**:162e–f / **11**:1089d–f / **11**:1091c–f / **18**:317h–318c
5. The electronic structure of solids		**16**:1037c–1040f	
a. The nature and mobility of electrons in conductors, insulators, and semiconductors		**16**:1037d–1039g / **6**:671d–e / **16**:523e–524d	**11**:1089c–d / **15**:395g–h
b. Electron emission: thermionic emission, photoelectric emission, field emission		**16**:1040c–e / **6**:671f–g / **14**:297f–298f	**11**:1091g–1092a / **16**:528d–f
c. The nearly free electron approximation		**11**:1088f–1089b	**16**:1037e–1038a
d. The energy-band theory of the solid state		**2**:341h–342c / **9**:807b–e	**16**:525f–526b
6. The principal types of magnetic behaviour exhibited by solids: paramagnetism, diamagnetism, and ferromagnetism		**16**:1040g–1042b / **2**:342g–343a / **11**:323h–327h / **15**:962a–c	**7**:251b–252a / **11**:162g–h
7. The interaction of light with solids		**16**:1042b–1044a / **9**:808g–809g	
a. The behaviour of solids illuminated with radiation: reflection, absorption, or transmission of photons		**16**:1042d–1043a / **10**:943h–944e	**2**:342e–f / **9**:808d–809c / **11**:1092b–c / **12**:240c–h / **15**:402d–h
b. The generation of electromagnetic radiation from the energy supplied to the solid		**16**:1043b–1044a	**2**:342f–g / **9**:809d–f
c. The photoelectric effect	PHOTOELECTRIC EFFECT **14**:296–300	**6**:653g–654a / **10**:947a–b	**15**:404e–g
C. Ionic crystals	IONIC CRYSTALS **9**:804–809		

	articles	article sections	other references
1. Bonding in ionic crystals		**9**:804e–h / **16**:1033d–1034a	**4**:98a–b
2. The structure of ionic crystals		**9**:805b–807b	**4**:100f–h
a. Perfect ionic crystals		**9**:805b–806c	**6**:559d–f
b. Defects in ionic crystals: Frenkel defect, Schottky defect, colour centres		**9**:806c–807b	
3. Properties of ionic crystals		**9**:807b–809g	**4**:106f–h
a. Vibrational and electronic properties		**9**:807b–e	
b. Thermal properties		**9**:807f–808b	
c. Polarizing and diffusion properties and the nature of ionic conduction		**9**:808b–g / **16**:523f–g	
d. Optical properties		**9**:808g–809g	**2**:342d–f / **11**:180f–181e / **16**:527d–f
D. Metals	METALS, THEORY OF **11**:1086–1092		
1. Structural aspects of metals and alloys		**11**:1087a–1088f / **17**:658f–g	**6**:519g–520c / **11**:1076a–b
2. Elementary description of metals: the use of the free electron model to explain thermal and electrical conductivity of metals		**11**:1088f–1089f / **6**:572h–578a / **6**:670d–671a / **16**:1034e–g	**16**:1037e–1038a
3. The electronic structure of metals and related effects		**11**:1089f–1090g	
a. The interaction between the periodic lattice and the conduction electrons: the weak pseudopotential		**11**:1089g–h	**16**:523h–524a / **6**:577f–g
b. Electron motion in a magnetic field and conduction-related effects		**11**:1089h–1090g / **11**:330f–331a / **18**:316h–317b	**16**:527a–c
4. Band structure and properties of metal groups: alkali metals, semimetals, noble metals, transition metals		**11**:1090h–1091c / **6**:671c–e	
5. Lattice vibrations: interaction between ions, interaction between electrons, phonons, and dispersion		**11**:1091d–g	**6**:577g–578a / **9**:809d–f / **11**:307b–c / **16**:526b–c
6. Metal surface phenomena: thermionic and field emission of electrons, electron tunnelling, photoemission, free carrier absorption and interband transitions		**11**:1091g–1092c / **6**:565a–d / **6**:580f–582c / **6**:671f–g / **14**:297f–298f / **16**:1040c–e	**18**:287a–c
7. Many-body effects: plasma oscillations, spin waves, Fermi liquid theory, dynamic effects and shake-off electrons		**11**:1092c–e	
8. Superconductivity in metals	SUPERCONDUCTIVITY **17**:811–815	**6**:671a–c / **11**:163c–f	
a. Thermal properties of superconductors: transition temperature, specific heat and thermal conductivity, energy gaps		**17**:812e–814a	
b. Magnetic and electromagnetic properties of superconductors: critical field, Meissner effect, phase coherence effects		**17**:814a–815d	**5**:78f–g / **6**:577g–578a / **11**:163c–d
9. Magnetic phenomena in metals: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, nuclear magnetic resonance		**11**:323h–327h / **16**:1040h–1041d	**7**:251a–254e *passim* / **11**:307g–h / **15**:520g–h
E. Semiconductors and insulators	SEMICONDUCTORS AND INSULATORS, THEORY OF **16**:522–529		
1. General properties of semiconductors and insulators		**16**:522g–523b / **6**:671d–e / **8**:870c–f / **16**:1038h–1039g	**6**:578b–e / **14**:298c–d
2. Mechanisms of conduction: mobility of charged particles and electrons in solids		**16**:523e–524d / **9**:808d–g / **16**:1038h–1039e	**6**:578e–579d / **6**:605f–606a / **15**:395f–h / **18**:316h–317b

	articles	article sections	other references
3. Electrical conduction in semiconductors			
a. Chemical approach: impurity conduction, hopping process		**16**:524e–527d **16**:524f–525e	**16**:512f–513c
b. Physical approach: energy band and gaps, lattice vibrations, statistical properties		**16**:525e–526h/ **2**:341h–342c	**14**:298g–299a/**15**:395h–396b
c. Extrinsic and intrinsic semiconductors		**16**:526h–527a	**3**:849b–c/**16**:1039e–g
d. Measurement of conductivity and of energy gaps		**16**:527a–d	
4. Principles involved in semiconductor applications		**16**:527d–529b	**9**:659d–g
a. Optical effects: photoelectric effect, photovoltaic effect, luminescence		**16**:527d–f/ **13**:817f–h/ **14**:299b–c/ **14**:335b–c	**6**:682c–d/**9**:581e–f/ **11**:181h–185a *passim*/ **17**:461e–g
b. Electrical and related effects: hot electron effects, thermoelectric effects		**16**:527g–528a/ **6**:579d–580e/ **18**:315f–317g	
c. Junction effects		**16**:528a–g/ **16**:513d–h	
d. Pressure and stress effects		**16**:528g–h	**8**:870e–f
F. The glassy or amorphous state of matter	GLASSY STATE **8**:207–211		
1. Effects of temperature and composition on glass properties		**8**:207d–208e/ **8**:198a–c	
2. The structure of glass		**8**:208f–210d	**8**:196f–197a
3. General properties of glasses		**8**:210d–211h/ **8**:197c–198g/ **16**:515e–f	
a. Mechanical properties		**8**:210d–g/ **8**:197e–198a	
b. Chemical properties		**8**:210g–211a/ **8**:197c–e	
c. Optical properties		**8**:211a–f/ **8**:198d–g	
d. Electrical properties		**8**:211f–h	

Section 126. Mechanics of particles, rigid bodies, and deformable bodies: elasticity, vibrations, and flow

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 126 deal with six main subjects: A, the principles of classical mechanics; B, relativistic mechanics in inertial systems of reference; C, the stress dynamics of elastic materials; D, vibrations of elastic bodies; E, fluid mechanics, including gas dynamics; and F, rheological phenomena—deformation and flow.

The outline of subject A deals first with the fundamental parameters and concepts of classical mechanics—matter, space, motion, and time. It goes on to treat its three branches—statics, concerned with systems of objects in equilibrium; kinematics, concerned with the description of motions apart from considerations of mass and force; and kinetics, concerned with a particle's motion in relation to forces acting on it, and involving Newton's laws of motion, the concepts of impulse, momentum, work, and power, and the concepts of energy, energy conservation, and the conservation of momentum. It then treats the mechanics of nonrigid bodies; motion in a rotating frame of reference, such as the Earth; and the mechanics of complex systems, exemplified by the rotation of spinning tops and gyroscopes.

The outline of subject B deals with relativistic mechanics in inertial systems of reference. It begins with the mechanical foundations of special relativity and goes on to relativistic kinematics. It then treats the relationship between gravitational mass and inertial mass.

The outline of subject C begins with the stress–strain relationships involved in the phenomenon of elasticity. It then treats the different character of elasticity in viscous and crystalline bodies; the elastic constants; and the mathematical theory of elasticity.

The outline of subject D, vibrations of elastic bodies, treats the nature of vibrations; the sources of energy of vibrators; the types of vibrational waves; and the behaviour of materials undergoing vibration.

Subject E is fluid mechanics, the science concerned with gases and liquids at rest or in motion. The outline begins with the mechanical and thermodynamic properties of fluids. After dealing with the basic equation of fluid statics, which deals with forces exerted on a fluid to hold it at rest, the outline goes on to hydrodynamics and aerodynamics, treating first the simple case of frictionless (nonviscous) one-dimensional fluid flow, and then proceeding to the more general cases of the flow of a viscous fluid and flows in which the compressibility of a fluid exerts influence on the character of the flow.

Subject F is rheological phenomena and involves general studies of deformation, changes in bodily size or shape, and general studies of flow, the continuous change of deformation with time. The outline begins with continuum mechanics, covering the kinematics of deformation and flow and the balance of forces and torques they involve. It goes on to mathematical accounts of stress-deformation relations in different media and of the strength of materials against fractures. Finally, it treats the application of molecular theories in explaining the rheological phenomena of deformation and flow.

	articles	article sections	other references
A. The principles of classical mechanics	MECHANICS, CLASSICAL **11**:762–779		
1. The fundamental parameters and concepts of classical mechanics		**11**:762e–763g	**11**:793f–794a
a. Matter			**11**:703c–705f *passim*
b. Space		**14**:410h–412e	**15**:582g–584e *passim*
c. Motion		**11**:763c–g	
d. Time		**18**:413c–e	**15**:582g–584e *passim*
2. Statics: equilibrium of systems at rest		**11**:763g–767a	
a. Force		**11**:764a–765g / **11**:783g–786b	**1**:790e–h / **7**:543b–c
b. Friction		**11**:765g–767a / **18**:706d–708f	
3. Dynamics: motion of systems		**11**:767a–774f	
a. Kinematics: motion of particles and rigid bodies without consideration of the forces producing the motion		**11**:767a–769h	
i. Velocity and acceleration		**11**:767a–h / **8**:291a–c	**1**:781c–g / **15**:584h–585b
ii. Rotation about a fixed axis		**11**:767h–768b	**11**:243c–e
iii. Motion in a circular path		**11**:768b–f	
iv. Simple harmonic motion		**11**:768f–769d	**19**:99h–100b / **19**:667d–f
v. Relative motion		**11**:769d–h	
b. Kinetics: motion of bodies under the action of forces upon them		**11**:769h–772g / **14**:392f–396a	
i. Newton's laws of motion: the law of inertia, the law of force, the law of action and reaction		**11**:769h–770d / **14**:392b–393d	**2**:655h–656a / **2**:658c–d / **3**:1143h–1144a / **7**:542h–543a / **11**:758a–b / **15**:581h–582a
ii. Motion under a constant force		**11**:770d–h	
iii. Ballistics: phenomena and laws of projectiles; their propulsion, flight, and impact	BALLISTICS **2**:654–660	**11**:770h–771c	**12**:49g–50d
iv. The pendulum		**11**:771d–g	
v. Newton's law of universal gravitation		**8**:287c–288e	**6**:19c–e / **6**:851a–c / **11**:758b–c / **12**:418a–b / **13**:1026c–d
vi. Kepler's laws of planetary motion			**11**:757e–758a
c. Impulse and momentum		**11**:772h–773f / **14**:394c–395a	
d. Work and power		**11**:773f–774d / **18**:292c–e	**1**:790e–g / **11**:232b–f
e. Energy	ENERGY **6**:849–854		
i. The concepts of energy and energy conservation		**6**:849c–850b	**6**:855d–e / **13**:1028c / **18**:292g–293b
ii. Forms of energy and examples of energy transformations associated with each energy form		**6**:850b–852e / **11**:322e–g	**6**:854h–855c / **11**:773h–774d
iii. The equivalence of mass and energy		**6**:853d–f	
f. The conservation of momentum		**10**:947b–f / **14**:393d–394c	
4. Mechanics of nonrigid bodies		**11**:774g–776a	
a. The collision of bodies or particles: centre of mass system, elastic collisions, inelastic collisions		**11**:774g–775f / **14**:506a–c	**7**:917f–g
b. Stiffness in mechanical vibrations		**11**:775f–776a	**19**:100c–f
5. Motion in a rotating frame of reference: inertia forces and Coriolis forces		**11**:776a–777a / **13**:438c–g	**2**:657g–h / **10**:161f–162a
6. Mechanics of complex systems		**11**:777a–779e	
a. The principle of virtual work		**11**:777a–g	
b. The rotation of spinning tops and gyroscopes		**11**:777g–778e	**8**:525h–526c
c. The precession and nutation of rotating bodies		**11**:320f–h	**8**:526d–f
d. Lagrange's and Hamilton's equations of motion		**11**:778f–779e / **6**:853f–854a	

	articles	article sections	other references
B. Relativistic mechanics in inertial systems of reference	RELATIVITY **15**:581–585	**14**:410e–414a	
1. Mechanical foundations of special relativity		**15**:581h–583d / **14**:415c–416c / **18**:417f–418d	**11**:744f–g / **12**:869g–h
2. Relativistic kinematics		**15**:583e–584e / **5**:33h–34e / **6**:853d–f	
3. The relationship between gravitational mass and inertial mass		**15**:584h–585c	**8**:289h–290b
C. The stress dynamics of elastic materials	ELASTICITY **6**:518–522		
1. The phenomenon of elasticity: stress-strain relationships		**6**:518h–519c / **6**:366b–e / **14**:398h–401c / **15**:914c–h / **17**:21h–23a	**11**:258d–f / **11**:775d–f / **15**:953g–955h *passim* / **19**:667d–e
2. Elasticity in viscous and crystalline bodies		**6**:519d–521a / **16**:1036d–g	**6**:603a–b
3. Elastic constants		**6**:521a–e / **5**:556h–557b	
4. The theory of elasticity: mathematical expressions defining elastic properties		**6**:521e–522c	**11**:781h–782a / **15**:954g–955b
D. Vibrations of elastic bodies	VIBRATIONS **19**:99–103		
1. The nature of vibrations: natural or free vibrations; damped and forced vibrations		**19**:99d–101d / **6**:851c–g / **19**:667c–h	
2. Vibrators and their sources of energy		**19**:101d–g / **17**:29a–c	**19**:667g–h / **19**:668h–669a
3. Types of vibrational waves: their properties and modes of propagation		**19**:101h–102c	**6**:72c–73e *passim* / **15**:955b–h
4. The behaviour of materials undergoing vibration		**19**:102c–103a	**19**:667h–668b
5. Detection and utilization of vibrations [see 723.F.6. and 735.K.2.b.]			
E. Fluid mechanics, including gas dynamics	MECHANICS, FLUID **11**:779–793		
1. General properties of fluids, ideal and actual		**11**:781d–783g	
a. Mechanical properties		**11**:781f–782c / **5**:556e–h / **5**:557d–e / **10**:1027c–1028d	
b. Thermodynamic properties		**11**:782d–783g / **18**:305c–306a	**18**:676h–677b
2. Fluid statics and equilibrium		**11**:783g–786f	
a. The basic equation of fluid statics		**11**:783g–784f	
b. Fluid forces on plane and curved surfaces: analysis of forces, buoyancy, stability of floating and submerged bodies		**11**:784f–786f / **16**:689g–690e	**18**:677c–d
3. Fluids in motion: hydrodynamics and aerodynamics		**11**:786f–793a / **8**:437h–438e	
a. Frictionless one-dimensional fluid flow		**11**:786g–788d	
b. Flow in pipes and channels: laminar flow, turbulent flow, special types of flow		**11**:788d–789e / **7**:438b–440c	**8**:707f–708b
c. General two- and three-dimensional flow: mathematical conditions, vorticity, boundary layers, drag		**11**:789f–791b / **13**:438g–439d / **14**:396c–398g / **18**:385d–387f	
d. Compressible fluid flow: isentropic flow, shock waves		**11**:791c–793a	**2**:657b–d / **7**:921d–922a

F. Rheological phenomena: deformation and flow

1. Continuum mechanics
   a. Kinematics of deformation and flow: strain, shear, compression, elongation
   b. Dynamics: balance of forces and torques
2. Constitutive equations: stress-deformation relations in different media
3. Yield strength of materials: fracture and fatigue
4. The application of molecular theories to explain rheological phenomena

articles	article sections	other references
DEFORMATION AND FLOW **5**:553–558		
	5:554h–556e	
	5:555a–556a / **15**:914h–916a	**11**:781d–781e
	5:556a–e	
	5:556e–557g / **15**:957h–958f	
	5:557g–558a / **15**:956c–957h	
	5:558a–d	

Section 127. Electricity and magnetism

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 127 deal with six main subjects: A, the static electric charge; B, moving charges and electric currents; C, magnetism; D, the theory of fields in physics; E, the electromagnetic field and the theory of electromagnetic radiation; and F, relativistic electrodynamics.

The outline of subject A begins with the general phenomena of static electricity, treating the basic laws of electrostatics; the electrostatic field; the electric dipole; electrostatic energy and force in nuclear and atomic structure and in chemical bonding; and electricity in the atmosphere. It next deals with the electrostatics of dielectrics and capacitors, with high-voltage phenomena, and with electrical fields and potential distributions in two and three dimensions. At the end, indication is made of the sections in Part Seven that treat the measurement of electrostatic forces and fields and the application of electrostatics in science and technology.

Subject B is moving charges and electric currents. The outline treats direct electric current; the conduction of electricity; alternating electric currents; the primary effects and properties of electric fields and currents; and the effects of electricity on matter.

The outline of subject C, magnetism, begins with the general phenomena of magnetic systems. It goes on to treat the magnetic effects of steady electrical currents; the motions of charged particles in magnetic and electrical fields; and the magnetic effects of varying currents. Finally, it treats the general properties of magnetic materials and the classification of substances as either permanent magnets or as substances varyingly susceptible to magnetization.

Subject D is the theory of fields in physics—a field being defined as a continuous distribution of some observable and measurable quantity in space and time controlled by a law that permits calculation and prediction. The outline begins with general considerations about the mathematics of field theory. It goes on to the distinction between material and nonmaterial fields and the distinction between scalar, vector, and tensor fields. It next gives examples of fields in ordinary space from various branches of physics, such as mechanics, electromagnetics, and hydrodynamics. Finally, it treats fields with distributions in more than three dimensions, dealt with in thermodynamics, the theory of general relativity, and quantum mechanics.

Subject E is electromagnetic radiation—the propagation of energy through space by means of time-varying electric and magnetic fields. The outline begins with the classical theory of radiation. The major article referred to carries the history from early theories of light to James Clerk Maxwell's electromagnetic wave concept; it then goes on to the orderly arrangement of radiation, called the electromagnetic spectrum, according to wavelength or frequency, the spectrum ranging from the longest known radio waves, through microwaves, light, and X-rays, to extremely short-wavelength gamma rays and cosmic rays. The outline then treats the quantum theory of radiation, covering the evidence for the particle nature of electromagnetic radiation; the wave–particle duality of the photon; the interaction of electromagnetic radiation with atomic and molecular structure; and the relation of electromagnetic radiation to quantum theory and relativity. The outline concludes with the mathematical formulation of electromagnetic theory, covering Maxwell's equations for electromagnetic fields and radiation; the transmission of radiation in free space; wave equations in space bounded by conductors; the scattering of electromagnetic waves; electromagnetic waves in material media; and antennas.

The outline of subject F, relativistic electrodynamics, treats electrodynamics in four-dimensional notation and applications of relativistic principles in the treatment of electromagnetic and nuclear force fields of relativistic particles.

A. The static electrical charge

1. General phenomena of static electricity
   a. The basic laws of electrostatics that relate the interaction of charged bodies at rest
   b. The electrostatic field
   c. The electric dipole: a system of two equal but opposite charges at a fixed separation from each other
   d. Electrostatic energy and force: in nuclear and atomic structure; in chemical bonding
   e. Electricity in the atmosphere: atmospheric currents, thunderstorms, lightning
      [see also 212.C., 221.A.4., and 224.B.2.b.iv.]

articles	article sections	other references
ELECTRICITY **6**:537–562		
	6:544b–551e	
	6:544d–547e / **5**:753c–d	**6**:649c–d / **6**:851g–852a / **13**:1023g–1024a
	6:547e–548c	
	6:549b–550e	**6**:650h–651b / **10**:944e–f / **12**:305g–h
	9:805d–g	**5**:35d–e / **16**:1033g–1034a
	6:30f–31d / **10**:966d–968g / **18**:519f–g	**2**:325g–h / **2**:376h–377b / **9**:814c–d

	articles	article sections	other references
2. Electrostatics of dielectrics and capacitors		**6**:551e–561a	
a. Capacitors		**6**:551e–553e / **6**:681b–d / **6**:852c–e	
b. Dielectrics		**6**:553e–557h	**6**:663b–e
c. Polarization		**6**:557h–561a / **9**:808b–c	**10**:1028b–c
3. Electrostatic potential		**6**:561a–562c	
a. High-voltage phenomena: generation, breakdown, and discharge; field emission		**6**:561a–e	**11**:322b–c
b. Electrical fields and potential distributions in two and three dimensions		**6**:561e–562c	
4. Measurement of electrostatic forces and fields [see 723.D.1.e.]			
B. Moving charges and electric currents	ELECTRICITY **6**:562–609		
1. Direct electric current: current that flows in one direction		**6**:562c–568f	
a. General phenomena of moving electrical charges: definitions of electrical quantities and their units		**6**:562c–564g / **11**:317g–318c	
b. Electromotive force		**6**:564g–566c / **11**:321d–f	
c. Behaviour of direct currents in electrical circuits		**6**:566c–568f	
i. Ohm's law and the definition of resistance		**6**:566c–e	
ii. Kirchhoff's laws concerning the sum of electromotive forces in a closed circuit		**6**:567c–g	
iii. Principles of devices that measure or indicate the presence of current, potential difference, and resistance		**6**:567g–568f	
2. The conduction of electricity		**6**:568g–582c	
a. The motion of charged particles in an electric field		**6**:568g–569h / **16**:523f–g	
b. The mechanisms of the conduction of electricity		**6**:569h–579d	
i. Conduction of electricity in a vacuum		**6**:569h–570h / **6**:687a–e / **18**:287f–h	
ii. Ionic conduction in gases		**6**:570h–572b / **18**:287h–288c	**14**:505e–f / **15**:394a–395f
iii. Ionic conduction and migration in liquids and solids		**6**:572c–h / **6**:639b–640a / **9**:808d–g	**6**:638d–e / **12**:971b–972g *passim*
iv. Conduction in metals and semiconductors by movement of electrons and holes		**6**:572h–579d / **11**:1089c–d / **16**:523h–527a	**8**:211g–h / **15**:395f–396e / **15**:520h–521a
c. Thermoelectric effects: phenomena in which electrical energy is transformed into thermal energy or vice versa; *e.g.*, Seebeck effect, Peltier effect, Kelvin effect		**6**:579d–580e / **15**:566h–567a / **16**:528h–529b / **16**:1039g–1040b / **18**:316d–317b	
d. Electron emission: thermionic emission, secondary emission, photoelectric emission		**6**:580f–582c / **6**:687h–688c / **14**:297f–298f / **16**:1040c–e	**18**:287a–c
3. Alternating electric currents: current that reverses itself with uniform frequency		**6**:582c–597d	
a. Faraday's law of electromagnetic induction concerning changing currents in nearby circuits		**6**:582h–583d / **11**:321d–f	**6**:649f–h
b. The mathematical and graphical representation of alternating currents		**6**:583e–585e	
c. Basic laws of alternating current circuits		**6**:585e–586c	
d. The detection and measurement of alternating currents and voltages [see 723.D.1.e.]			
e. Parallel resonant circuits		**6**:587c–589b	

	articles	article sections	other references
f. Alternating current bridges for determining impedance		6:589b–590b	
g. Propagation of electric waves in cables		6:590e–592f	
h. Filters that select signals		6:592f–593e	
i. Transient phenomena of alternating circuits		6:593f–594e	
j. Eddy currents and skin, or surface, effects		6:594e–595g	
k. Principles of generation and transmission of ac single and multiphase power		6:595g–597d / 6:625f–626b	
4. Primary effects and properties of electric fields and currents		6:597d–602f	
a. Magnetic effects of steady electric currents [see C.2., below]			
b. Magnetic effects of changing currents [see C.4., below]			
c. Force, energy, and power associated with electromagnetic fields		6:599d–600h	
d. The generation of electromagnetic radiation by the changing of currents in circuits		6:600h–602e	
5. Effects of electricity on matter		6:602f–609b	
a. Piezoelectricity and applications of the phenomenon		6:602f–604a	14:461b–463h *passim*
b. Optical effects: electroluminescence, Kerr effect, Stark effect		6:604a–h	14:463e–f
c. Thermal effect: resistance heating		6:604h–605c	
d. Chemical effects: electrolysis, electro-osmosis, electrophoresis		6:606a–607e / 6:638a–e	
e. Bioelectric effects: effects associated with nerve, brain, and muscle action in which potential differences occur and can be influenced by applied potential		6:607e–609b	2:998a–1000h *passim*
C. Magnetism	MAGNETISM 11:309–328		
1. General phenomena of magnetic systems		11:312c–315c	
2. Magnetic effects of steady electrical currents		11:315c–317e / 6:597e–598e	
a. The magnetic field of steady currents: Ampère's law, the law of Biot and Savart		11:315d–316g	6:649e–f
b. The magnetic moment of a current loop		11:316h–317c	
c. The magnetic field of a solenoid		11:317c–e / 11:337d–g	
3. Motion of charged particles in magnetic and electric fields		11:317e–320h / 14:506h–507d	19:21e–h
a. The force on a moving charge		11:317g–318c	
b. Motion of charges in uniform flux density		11:318c–319a	13:311b–e / 14:506h–507a
c. Motion of charges in combined electric and magnetic fields		11:319b–h	11:607b–608e *passim*
d. Magnetic dipole moments: atomic moments, nuclear moments, magnetic resonance		11:319h–320h / 13:336c–337b	4:82d–e / 6:558d–f / 11:305b–306a / 12:305d–g / 15:590d–e
4. Magnetic effects of varying currents		11:321a–322g / 6:598e–599d	
a. The laws of electromagnetic induction		11:321d–f	6:649f–h
b. Inductance and magnetic energy		11:321f–322g / 6:681d–g	
5. Properties of magnetic materials		11:322g–328g	
a. The classification of magnetic substances		11:322g–323c / 16:1041d–1042b	7:251b–252a / 11:333a–b / 15:962a–c
b. Induced and permanent atomic magnetic dipoles		11:323c–h	7:252a–c
c. Magnetism of matter		11:323h–327h / 7:248e–f	11:162g–h / 15:943c–944e *passim*
i. Diamagnetism		11:323h–324d / 16:1040h–1041a	
ii. Paramagnetism		11:324d–325a / 15:423d–g / 16:1040h–1041a	

	articles	article sections	other references
iii. Ferromagnetism	FERROMAGNETISM 7:251–254	**11**:325a–326d / **16**:1041b–d	**11**:333g–334a
iv. Antiferromagnetism		**11**:326d–327c	**7**:251f–252a
v. Ferrimagnetism		**11**:327c–h	
vi. Terrestrial magnetism [see also 212.B.]		**6**:26g–30f / **6**:61c–f	
d. Atomic structure and magnetism		**11**:327h–328g / **2**:342g–343a	
D. The theory of fields in physics	FIELDS, THEORY OF, IN PHYSICS 7:293–295		
1. The definition of a field in physics: the scope of field theory		**7**:293d–e	
2. Mathematical treatment of fields		**7**:293e–f	
3. Classification of fields		**7**:293g–294c	
a. Material and nonmaterial fields		**7**:293g–294a / **6**:650g–651b	
b. Scalar, vector, and tensor fields		**7**:294a–c / **1**:795c–h	**1**:796h
4. Examples of scalar, vector, and tensor fields in ordinary space: examples in mechanics, electromagnetics, hydrodynamics		**7**:294c–h / **6**:544b–d / **6**:657g–661h / **15**:401f–402a	**12**:868c–869a
5. Fields with distributions in more than three dimensions: examples in thermodynamics, in the theory of general relativity, and in quantum mechanics		**7**:294h–295b / **8**:289b–290b / **18**:311c–g	
E. The electromagnetic field and the theory of electromagnetic radiation	ELECTROMAGNETIC RADIATION 6:644–664	**14**:408c–410e	
1. The classical theory of radiation		**6**:646b–653a	
a. The development of concepts and theories concerning the nature of light		**6**:646b–648e / **2**:334h–335c / **10**:928g–930b / **11**:794b–795g	**15**:401d–e / **19**:665f–666a
b. Semiquantitative treatment of electromagnetic radiation: Maxwell's equations that show the electromagnetic nature of light		**6**:648e–651b / **14**:408d–f	
c. The electromagnetic spectrum: the orderly arrangement of radiation according to wavelength or frequency		**6**:651c–653a / **15**:402a–b	
2. The quantum theory of radiation		**6**:653a–657e / **10**:946d–949c	
a. Evidences of the particle nature of electromagnetic radiation: Compton effect, photoelectric effect, Raman effect		**6**:653a–654d / **10**:947a–948b	**11**:795c–g / **14**:297c–g
b. The wave–particle duality of the photon		**6**:654d–655d / **10**:948b–f / **11**:795b–g / **19**:1059e–1060c	**2**:338b–d / **15**:401e–f
c. The interaction of electromagnetic radiation with atomic and molecular structures: absorption, emission, and scattering processes		**6**:655d–656c / **10**:944e–945e / **10**:947a–b / **11**:181h–185c / **13**:344f–345c / **15**:403c–406c / **17**:472g–473a	**7**:249h–250a / **9**:808g–809c / **14**:296h–300d *passim*
d. The relation of electromagnetic radiation to quantum theory and relativity		**6**:656d–657e / **14**:420f–422a	
3. The mathematical formulation of electromagnetic theory		**6**:657e–664h	
a. Maxwell's equations for electromagnetic fields and radiation		**6**:657e–658g / **6**:600h–602e / **10**:942g–943h / **14**:408f–410b	**12**:868g–h

	articles	article sections	other references
b. Transmission of radiation in free space		**6**:658g–661h / **14**:410b–e	**19**:669a–c
c. Wave equations in space bounded by conductors		**6**:662a–c	
d. Scattering of electromagnetic waves		**6**:662d–663b / **10**:944e–945f	
e. Electromagnetic waves in material media; *e.g.*, polarization of matter; waves in a dielectric; frequency approximations		**6**:663b–664b	
f. Antennas: directional characteristics, impedance, ground wave propagation, sky wave propagation		**6**:664b–h / **1**:966d–968b	**6**:601c–e / **15**:428f–h
F. Relativistic electrodynamics			
1. Electrodynamics in four-dimensional notation		**15**:585c–g	**15**:584d–e
2. Applications of relativistic principles in the treatment of electromagnetic and nuclear force fields of relativistic particles		**6**:668a–f / **13**:1023d–g / **15**:587g–588b	**2**:339c–g / **12**:869d–e

Section 128. Waves and wave motion

[for Part One headnote see page 20
for Division II headnote see page 29]

The articles and parts of articles referred to in Section 128 deal with five main subjects: A, general wave phenomena and the theory of wave motion; B, electromagnetic waves; C, light waves; D, the focussing and imaging of waves; and E, sound waves.

The outline of subject A begins with the general properties of waves and then deals with their types, classified principally by the medium supporting the transmission of wave motion and by the motion of particles in a wave. After treating the general theory of waves, the outline covers the principle of superposition of waves; the behaviour of waves at boundaries or interfaces; the diffraction and interference of waves; and the interaction of waves with matter.

The outline of subject B begins with the general properties of electromagnetic waves and with the properties of waves according to regions in the electromagnetic spectrum. It goes on to the sources of incoherent electromagnetic waves—of radio waves; of microwaves; of infrared, visible, and ultraviolet waves; of X-rays; and of gamma rays. It next treats the sources of coherent electromagnetic waves, covering the types of lasers and the types of masers. Finally, it deals with the transmission of electromagnetic waves through matter, through space, and by wave guides and transmission lines.

The outline of subject C begins with the analysis of light as a wave motion. It goes on to the measurement of the velocity of light; to the interference of light; to diffraction phenomena; and to polarization, the properties of light that depend on the vectorial character of the amplitude of the wave. It next treats the properties and behaviour of light waves based on James Clerk Maxwell's equations of electromagnetic theory; the interaction of light with matter; and the quantum theory of light. Finally, it treats the separation of light into its constituent wavelengths and the analysis of light spectra, and the sources of light.

The outline of subject D, the focussing and imaging of waves, begins with geometrical optics, covering reflection and refraction, the tracing of a refracted ray at a surface, the optical properties of lenses, and image brightness. Dealing with optics and information theory, the outline treats the characterization of an optical system by impulse responses and transfer functions; the concept of partially coherent light; optical processing; and holography, an image-formation process using the principles of interference.

The outline of subject E first treats the general nature and properties of sound waves, the characteristics of shock waves, the many sources of sound waves, and the instruments for the detection and reception of sound. It then indicates the sections in Part Seven that treat the applications of acoustics. Finally, it gives separate treatment to the physical aspects of musical sound, covering the special properties of musical sound and the production of sound waves by the various types of musical instruments.

	articles	article sections	other references
A. General wave phenomena and the theory of wave motion	WAVE MOTION **19**:665–673		
1. General properties of waves: frequency, amplitude, wavelength, phase		**17**:21b–f	**10**:930c–e / **11**:794d–e
2. Classification of waves		**19**:666a–667b	
a. Waves classified by the medium supporting the transmission of wave motion: water waves, sound waves, electromagnetic waves		**19**:666a–b / **13**:493c–495a / **17**:20f–21b	**6**:649a–b / **19**:654d–659g *passim*
b. Waves classified by the motion of particles in a wave; *e.g.*, transverse, longitudinal, torsional, and cylindrical waves		**19**:666b–h	**19**:102a–b
c. Other classifications: bow waves and shock waves		**19**:666h–667b / **11**:792d–793a / **17**:28e–f	**12**:50b–d
3. The theory of waves		**19**:667c–669d	**1**:779b–780a / **13**:493h–494f
a. General characteristics of vibratory motion: periodicity, group velocity, energy content		**19**:667c–h / **19**:99g–100f	**6**:648e–649a / **19**:657e–h

	articles	article sections	other references
b. The velocity of waves: factors affecting wave velocity, functional forms of phase velocity, constancy of the speed of light in free space		**19**:667h–668f / **19**:656f–657d	
c. The wave equation: the space-time description of wave motion		**19**:668f–g / **5**:753e–754c / **10**:933b–c / **17**:21f–h	
d. Transport of energy and momentum		**19**:668h–669d / **6**:853b–d	
4. The principle of superposition of waves		**19**:669d–671c	
a. Standing waves: waves with stationary nodes		**19**:669f–670d / **17**:27d–28c	
b. Modulation of waves		**19**:670d–e	**10**:937h–938c
c. Pulse and wave trains		**19**:670e–671c	
5. The behaviour of waves at boundaries or interfaces		**19**:671d–672e / **10**:943h–944e / **17**:24g–25c	
a. Reflection		**19**:671d–672b	**17**:23c–h
b. Transmission		**19**:671d–672b	
c. Refraction		**19**:672c–e / **13**:609h–610c / **17**:23c–24c	
6. The diffraction and interference of waves		**19**:672f–673e / **10**:931b–932d	**17**:27a–c
7. The interaction of waves with matter: absorption, dispersion		**10**:944e–945f / **17**:26e–27a	**15**:403g–404c
B. Electromagnetic waves	ELECTROMAGNETIC RADIATION **6**:644–653		
1. General properties of electromagnetic waves		**6**:648e–651b / **6**:600h–602e	**15**:401h–402b / **16**:1042b–c / **19**:666a–b
2. The properties of waves according to regions in the electromagnetic spectrum		**6**:651c–653a	
a. Electric current waves		**6**:651c–f	
b. Radio waves		**6**:651g–h / **15**:423h–424g / **15**:467h–468c	**7**:841d–f / **15**:373c–e
c. Microwaves		**6**:651h–652b	**17**:467e–h
d. Infrared waves		**6**:652b–c	**17**:468f
e. Visible light [see C., below]			
f. Ultraviolet waves		**6**:652e	
g. X-rays [see 112.D.]			
h. Gamma radiation [see 111.E.1.a.i.]			
3. Sources of incoherent electromagnetic waves			
a. Sources of radio waves; *e.g.*, oscillators, antennas		**7**:832b–833d / **7**:841d–842c / **9**:794f–797d	**15**:376b–g / **15**:468c–475h *passim*
b. Sources of microwaves; *e.g.*, klystrons, travelling wave tubes		**6**:688g–689c	**6**:680a–b / **15**:375b–f
c. Sources of infrared, visible, and ultraviolet waves		**6**:604d–606a / **9**:582a–583c	**4**:957c / **7**:842d–g / **17**:468f–g
i. Black-body radiation			**2**:335b–c / **9**:582a–b / **18**:323h–324a
ii. Luminescence, fluorescence, and phosphorescence	LUMINESCENCE **11**:178–185	**2**:1031e–1032c / **12**:241h–242f	**2**:342e–f / **15**:409d–f / **16**:527e–f
iii. The passage of electrical current through a resisting medium; *e.g.*, incandescent lamps, gas discharge tubes		**10**:958d–959g	**17**:459b–f
d. Sources of X-rays			
i. X-ray tubes		**17**:473h–474b	**11**:795d–e / **15**:459b–f / **15**:465a–c
ii. Nuclear sources			**19**:1061a–b

	articles	article sections	other references
iii. Astronomical sources		**19**:1064c–1068c	**7**:842b/**17**:806g–807a
e. Sources of gamma rays			
i. Nuclear sources		**15**:460c–d	**15**:465c–f
ii. Mössbauer radiation: the recoilless radiation and absorption of gamma radiation	MÖSSBAUER EFFECT **12**:491–493		**18**:615d–e
4. Sources of coherent electromagnetic waves: lasers and masers	LASER AND MASER **10**:686–689		**2**:342f–g
a. Types of lasers; *e.g.*, optically pumped lasers, liquid lasers, gas lasers		**10**:686f–687e	
b. Masers; *e.g.*, solid-state masers, gas masers		**10**:687f–688b	
c. Laser applications; *e.g.*, interferometry, cutting and welding [see 722.C.7.b., 725.B.6.g., and 735.G.3.]			
d. Safety considerations		**10**:689b–d	
e. Future prospects; *e.g.*, the development of devices to produce coherent waves at additional wavelengths		**10**:689d–g	
5. The transmission of electromagnetic waves			
a. Through matter			**2**:321c–d/**12**:119g–h/**16**:264d–h
b. Through space: the effects of dilute plasma and magnetic fields		**9**:788f–h	**9**:815g–816a
c. By wave guides and transmission lines		**1**:968b–f	**1**:28a–c/**14**:362a–d
C. Light waves	LIGHT **10**:928–949		
1. Light as a wave motion: the wave theory of light		**10**:930b–934a	
a. The properties of light consistent with the wave theory: diffraction, interference, polarization, dispersion		**10**:930b–933f/**4**:913e–h	**2**:334h–335a/**6**:652c–e/**11**:794b–f/**15**:402b–d
b. The spectrum of light: the description of colour in terms of wavelengths		**10**:933f–934a/**4**:913d–f/**17**:456b–f	**7**:106e–g/**13**:887h–888c
2. The velocity of light and its measurement		**10**:934a–935c/**5**:76g–77a	**12**:103f–104d/**15**:582e–f
3. Interference of light: the superposition of waves from different sources or from the same source with different optical paths		**10**:935d–938g	**17**:460h–461d
4. Diffraction phenomena: the spreading of light that occurs at the edges of geometrical shadow when a beam of light is restricted by holes or slits that block out part of the wave front; Fresnel and Fraunhofer diffraction		**10**:938g–940b	**11**:794c–f/**17**:460d–h
5. Polarization: the properties of light that depend on the vectorial character of the amplitude of the wave		**10**:940c–942g/**9**:792h–793b	**15**:402e–h
a. Superposition of polarized beams: plane, circularly, or elliptically polarized light		**10**:940d–g	**15**:402e–f
b. Double refraction: waves in anisotropic media		**10**:940g–941f	**3**:833f–834f/**14**:363b–c/**15**:402d–e
c. Characterization of polarized light by Stokes's parameters and Poincaré sphere		**10**:942a–c	
6. Properties and behaviour of light waves based on Maxwell's equations of electromagnetic theory		**10**:942g–943h	
7. The interaction of light with matter		**10**:943h–946d/**13**:489h–490f/**16**:1042d–1043a	
a. Reflection and refraction		**10**:943h–944e/**8**:198d–g	**12**:119g/**15**:402c–e/**17**:459g–460c/**19**:668e–f
b. Dispersion and scattering		**10**:944e–945f	**15**:402d–403c
c. Absorption			
i. Mechanical effects of light		**10**:945g–946d	
ii. Chemical effects of light			**14**:291g–292b/**15**:415f–h
8. The quantum theory of light: the photon		**10**:946d–949c	
a. Observed photon phenomena: photoelectric effect, Compton scattering, Rayleigh scattering		**10**:946d–948b/**6**:653g–654d	**11**:795c–g/**14**:296h–297f

	articles	article sections	other references
b. The uncertainty principle in relation to the study of the phenomena of light		**10**:948b–h / **11**:794b–795a	
c. The detection and counting of photons		**10**:948h–949c	
9. The separation of light into its constituent wavelengths and the analysis of light spectra	SPECTROSCOPY, PRINCIPLES OF **17**:455–462	**2**:334c–h / **12**:305h–306c	**2**:232e–g
10. Sources of light		**17**:459b–g / **6**:605d–606a / **10**:958d–959g / **14**:295b–d	
11. The focussing and imaging of light waves [see D., below]			
12. The biological effects of light, including photosynthesis [see 322.A. and 351.A.3.b.]			
D. The focussing and imaging of light waves	OPTICS, PRINCIPLES OF **13**:608–621		
1. Geometrical optics: the geometry of light rays and their image-forming properties through optical systems		**13**:608f–616e	
a. Reflection and refraction		**13**:609h–610h / **10**:930g–931a / **10**:943h–944e	
b. Tracing a refracted ray at a surface		**13**:610h–611f	
c. Paraxial imagery: rays that make very small angles with the axis		**13**:611f–615f	
i. Magnification		**13**:611h–612b	
ii. Lenses and combination of lenses		**13**:612b–613a / **12**:130d–132f / **14**:333d–335a	**8**:198f–g / **10**:954b–e / **12**:544d–h / **13**:604b–c
iii. Lens aberrations: spherical aberration, coma, astigmatism, Petzval curvature, distortion, chromatic aberration		**13**:614c–615f / **7**:100b–d	**12**:130d–g / **13**:604d–e / **14**:334a–b / **18**:98b–f
d. Applications of lenses and mirrors in optical systems [see 723.E.1.]			
e. Image brightness		**13**:615f–616e	
2. Optics and information theory		**13**:616f–621f	
a. The characterization of an optical system by impulse responses and transfer functions		**13**:616f–618b	
b. The concept of partially coherent light		**13**:618b–619a / **10**:936b–f	
c. Optical processing: the manipulation of the information content of the image in coherent optical systems		**13**:619a–620b	
d. Holography: an image formation process using the principles of interference	HOLOGRAPHY **8**:1007–1010	**13**:620c–621f	**17**:34d–e
E. Sound waves	SOUND **17**:19–34		
1. The nature of sound waves		**17**:20f–21f	**1**:54c–e / **17**:36a
2. Properties of sound waves		**17**:21f–28e / **10**:1027g–1028a / **13**:490f–491a / **17**:2b–e / **18**:841d–f	**11**:791d–e
3. Shock waves and their characteristics		**17**:28e–f / **11**:792d–793a	**4**:141b–e
4. Sources of sound waves		**17**:28f–30g	**14**:278f–g
5. The reception of sound		**17**:30g–32b	**17**:39g–h
6. Applications of acoustics			
a. Recording and reproduction [see 735.F.]			
b. Architectural and acoustical design [see 733.A.8.]			
c. Speech and music [see 442.B.1.a. and 624.B.]			

	articles	article sections	other references
d. Military acoustical detectors [see 735.J.2.]			
e. Noise control [see 733.A.8.b.]			
7. Physical aspects of musical sound	SOUND, MUSICAL **17**:34–39		
a. The special properties of musical sound		**17**:34h–35g / **18**:741a–f	
i. Pitch, timbre, and loudness		**17**:34h–35c	
ii. Fundamentals and overtones		**17**:35c–h	**15**:324f–g
b. The production of sound waves by musical instruments; *e.g.*, by percussion, string, and wind instruments		**17**:38c–39a / **12**:729b–e / **13**:677d–678h / **14**:63f–64a / **19**:848c–849b	**17**:740b–f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ALEMBERT, JEAN LE ROND D' **1**:464
ARCHIMEDES **1**:1087
ARISTOTLE **1**:1162
ARRHENIUS, SVANTE AUGUST **2**:39
BERNOULLI FAMILY **2**:867
BOYLE, ROBERT **3**:96
BRAGG, SIR LAWRENCE **3**:101
BRAGG, SIR WILLIAM **3**:102
BRIDGMAN, PERCY WILLIAMS **3**:191
CARNOT, SADI **3**:945
CAVENDISH, HENRY **3**:101
CURIE FAMILY **5**:371
DALTON, JOHN **5**:439
DAVY, SIR HUMPHRY **5**:523
EINSTEIN, ALBERT **6**:510
FARADAY, MICHAEL **7**:173
FOURIER, JEAN-BAPTISTE-JOSEPH, BARON **7**:577
GALILEO **7**:851
GAY-LUSSAC, JOSEPH-LOUIS **7**:968
GAUSS, CARL FRIEDRICH **7**:966
GIBBS, J. WILLARD **8**:155
HABER, FRITZ **8**:529
HAMILTON, SIR WILLIAM ROWAN **8**:588
HELMHOLTZ, HERMANN VON **8**:751
HUYGENS, CHRISTIAAN **9**:74
KELVIN, LORD **10**:414
LAVOISIER, ANTOINE-LAURENT **10**:713
LIEBIG, JUSTUS VON **10**:888
MAXWELL, JAMES CLERK **11**:718
MENDELEYEV, DMITRY IVANOVICH **11**:899
MICHELSON, A.A. **12**:103
NEWTON, SIR ISAAC **13**:16
PASTEUR, LOUIS **13**:1066
PAULING, LINUS **13**:1094
PRIESTLEY, JOSEPH **14**:1012
RAYLEIGH, JOHN WILLIAM STRUTT, LORD **15**:538
SEABORG, GLENN THEODORE **16**:442
STAHL, GEORG ERNST **17**:566
THOMSON, SIR JOSEPH JOHN **18**:348
WÖHLER, FRIEDRICH **19**:905
WOODWARD, ROBERT BURNS **19**:925

Division III. The universe: galaxies, stars, the solar system

[for Part One headnote see page 20]

The outlines, and the articles and parts of articles referred to, in the three sections of Division III deal with the subject matter of cosmology and cosmogony, of astronomy, and of astrophysics.

Accounts of the complex instrumentation involved in these disciplines are set forth in Section 723 of Part Seven. Historical and analytical studies of the nature and scope of astronomy and astrophysics are set forth in Section 10/32 of Part Ten.

The outline and the articles referred to in Section 131 first treat the structure, properties, and basic data of the universe, and the known and postulated components of the universe. After dealing with the phenomena and theories of gravitation, the section covers celestial mechanics and the treatment of the space-time continuum in the special and general theories of relativity. Finally, it treats theories about the origin and dynamic evolution of the universe as a whole; theories about the formation and evolution of the components of the universe; the time scale of the universe; and speculations about the possible fate of the universe.

Section 132 deals first with the external galaxies, treating their classification and distribution, their physical properties, and their radio and X-ray emissions. It goes on to separate treatment of the Milky Way system, of star clusters and stellar associations, and of stars.

Section 133, after a general survey of the solar system, separately treats the Sun, the planets, including the Earth as a planet, and the Moon.

Section 131. The cosmos 64
132. Galaxies and stars 66
133. The solar system 70

Section 131. The cosmos

[for Part One headnote see page 20
for Division III headnote see page 63]

The articles and parts of articles referred to in Section 131 deal with five main subjects: A, the structure and properties of the universe; B, gravitation; C, celestial mechanics; D, properties of the space-time continuum; and E, the origin and evolution of the universe.

The outline of subject A begins with basic data for the universe, treating estimates of its chemical composition; the overall structure and behaviour of the universe, especially evidence that it is expanding; the age of the universe; the structure, number, and distribution of galaxies; and the description of the universe in terms of the space-time continuum. It next deals with the components of the universe: with distant galaxies, the Local Group of galaxies, and intergalactic space, treated in detail in Section 132; with quasi-stellar sources (quasars), pulsars, and X-ray sources, separately treated in articles referred to in this section; and with postulated or hypothetical components of the universe, such as neutron stars, black holes, and objects composed of antimatter.

The outline of subject B, gravitation, begins with developments leading to gravitational theory and to Newton's law of gravity. It goes on to the later introduction of potential theory, which allows practical as well as theoretical investigation of gravitational variations in space and of anomalies owing to the irregularities and shape deformations of the Earth. It next treats modern field theories of gravity and gravitational fields in the general theory of relativity. Finally, it treats the acceleration of gravity on the Earth's surface and the methods of measuring the gravitational constant, G.

The outline of subject C begins with the scope and history of celestial mechanics, covering Kepler's laws of planetary motion and Newton's general laws of motion and gravitation in classical astronomy; modern mathematical methods; and the use of electronic computers and of space probes and satellites to perform experiments in celestial mechanics. It goes on to the problem of the motions of two gravitationally attracting bodies and to various kinds of perturbations that cause the orbits of natural and artificial satellites to deviate from ellipses. It concludes with the classical problem of three bodies—the problem, for example, of determining the motion of the Moon in the gravitational fields of the Sun and the Earth—and with its modern generalization, the *n*-body problem, where *n* may have any integral value.

Subject D is relativity theory, concerned with measurements of the laws of nature made by different observers moving relative to one another. The outline deals first with the theories and experiments in electromagnetism that led to Einstein's special theory of relativity, and with the consequences of that theory. It goes on to Einstein's later general theory of relativity, which arose from the need to extend the new space and time concepts of the special theory from the domain of electric and magnetic phenomena to all of physics and, particularly, to the theory of gravitation. The outline treats the various kinds of experimental confirmation of the general theory and the further modification of classical concepts of space and time entailed by the general theory of relativity.

Subject E is cosmogony—that is, theories of the origin and evolution of the cosmos, or universe. The outline begins with different theories about the origin and evolution of the universe as a whole. It goes on to theories about the formation and evolution of components of the universe—of galaxies, of stars, and of the solar system. It concludes with a consideration of the methods for determining the time scale of the universe and with speculations about the remote future of the universe.

	articles	article sections	other references
A. The structure and properties of the universe	UNIVERSE, STRUCTURE AND PROPERTIES OF **18**:1011–1018		
1. Basic data for the universe		**18**:1013h–1015f	**12**:872b–d
a. The estimated chemical composition of the universe [see also 121.D.]		**4**:119c–120g	**5**:202g–203d/ **14**:121g–123d *passim*
b. The overall structure and behaviour of the universe: evidence that the universe is expanding; Hubble's law and the theory of the red shift		**18**:1013h–1014b	**18**:1007d–1008b
c. The age of the universe		**18**:1014b–e	**18**:1011b–c
d. The structure, number, and distribution of galaxies		**18**:1014e–1015d/ **7**:828g–830c	
e. Space-time: a four-dimensional continuum used to describe the universe		**18**:1015d–f	**12**:867e–868b
2. Cosmological models: theoretical representations of the behaviour of the universe [see E.1., below]			
3. The known and postulated components of the universe			
a. Distant galaxies [see 132.A.]			
b. The Local Group of galaxies [see 132.A.1.c.]			
c. Quasi-stellar sources: quasars	QUASI-STELLAR SOURCES **15**:327–330	**2**:244d–g/ **18**:1018a–b	**11**:705e–f/**15**:475d–h
d. Pulsars	PULSAR **15**:266–270	**17**:603f–604a	**2**:243f–h/**19**:1066f–1067a
e. X-ray sources	X-RAY SOURCES, ASTRONOMICAL **19**:1064–1069		**7**:842h
f. Postulated or hypothetical components of the universe			
i. Neutron stars		**15**:269a–h	**19**:1066b–h
ii. Black holes		**8**:290f–h	
iii. Objects composed of antimatter		**11**:705c–f	

B. Gravitation: a universal force of mutual attraction that is postulated as acting between all matter

1. Development of gravitational theory

a. Early concepts: the Aristotelian viewpoint; contributions of Kepler and Galileo

b. Newton's law of gravity
[see also 126.A.3.b.]

2. Interpretation of gravity measurements

a. Potential theory: mathematical representation of the gravitational fields of irregular mass distributions
[see also 10/22.D.2.c.]

b. Effects of local mass differences: measurement of small gravity anomalies

3. Modern gravitational theory and its relation to other aspects of physical theory

a. Field theories of gravity: their general properties and predictions

b. Gravitational fields and the general theory of relativity: principles and consequences
[see D.2., below]

4. Acceleration of gravity on the Earth's surface
[see 212.A.]

5. The gravitational constant, G: methods of measurement; possible variation in time and space

C. Celestial mechanics
[see also 126.A.]

1. The scope and history of celestial mechanics: Kepler's laws of planetary motion; Newton's laws of motion and gravitation; modern mathematical methods; the experimental use of electronic computers and of space probes and satellites

2. The two-body problem and perturbations that cause the orbits of planets and satellites to deviate from ellipses

3. The unsolved three-body problem: modern mathematical methods for approximating solutions

4. The general *n*-body problem

D. Properties of the space-time continuum: the astronomical implications of relativity theory

1. The special theory of relativity

a. Historical background: the search for the ether

b. Relativity of space and time: the concepts of length contraction, time dilation, and universal simultaneity; comparison of physical measurements made by observers moving relative to one another

c. Consequences of the special theory: the limiting character of the speed of light, relativistic mass, invariant time intervals, the twin paradox, four-dimensional space-time

2. The general theory of relativity

a. Use of relativity to interpret gravitational phenomena: the equivalence of gravitational and inertial mass; the curvature of space-time in the presence of matter as an alternative to the concept of gravitational force

b. Experimental confirmation of the theory: the advance of Mercury's perihelion, the gravitational red shift, the gravitational deflection of light, gravitational waves

c. Implications of general relativity: inhomogeneity of the space-time continuum; the properties of strong gravitational fields

articles	article sections	other references
GRAVITATION **8**:286–294		
	8:286h–288e	
	8:268h–287b	**7**:853c–f/**10**:432h–433b
	8:287c–288e	**6**:19c–e/**6**:851a–c/**8**:556f–h/**11**:758b–c/**13**:19d–g
	8:288e–289b/**12**:418a–419a	
	8:288e–289a/**6**:20g–h	**1**:730f–731a
	8:289a–b/**12**:418e–419a	**6**:20h–23h *passim*
	8:289b–290f	
	8:289c–g	
	8:292g–294h/**5**:77c–e	
MECHANICS, CELESTIAL **11**:756–761	**2**:224c–225e/**2**:250d–g	**10**:352c–e
	11:757c–759d/**4**:969h–971a/**12**:963b–h/**18**:1037d–f	**3**:103b–104b *passim*/**7**:966h–967a/**10**:431g–433e *passim*/**10**:680f–681c/**13**:19a–g/**14**:386c–g/**14**:387b–d/**14**:388c–389a/**14**:605e–f
	11:759d–760e/**4**:971g–972c/**6**:21e–f	
	11:760e–761e/**12**:416f–417e	
	11:761e–g	
RELATIVITY **15**:581–588	**14**:426g–427b	
	15:581h–584e	**6**:656d–g
	15:581h–582g	**6**:649a–b/**12**:103g–104b
	15:582g–583d/**14**:410e–416c	**9**:869g–h/**11**:744f–g
	15:583e–584e/**18**:417f–418d	**19**:668d–f
	15:584f–587e/**8**:289h–290h/**18**:1015d–f	**6**:657c–e
	15:584f–585g/**6**:853d–f/**8**:289h–290b	**12**:867e–868b
	15:585g–586e/**8**:290c–f/**11**:916g–917a	**6**:193e–f/**12**:492b–c
	15:586e–587e/**8**:290f–h/**18**:418d–419b	

E. The origin and evolution of the universe	articles	article sections	other references
	UNIVERSE, ORIGIN AND EVOLUTION OF	**18**:1007–1011	
1. The evolution of the universe as a whole		**18**:1007d–1008h / **4**:121h–122d / **12**:871g–872d / **15**:588b–f	
a. Alternative theories of evolution: big-bang versus steady-state models of the universe		**18**:1007d–1008d	**4**:122a–d
b. The early universe: extrapolations backward in time to the beginning of the universe		**18**:1008d–h	
2. The formation and evolution of components of the universe: galaxies, stars, and the solar system [see also 132.B., 132.D., and 133.A.]		**18**:1008h–1011a	
a. Galaxies		**18**:1008h–1009f / **7**:847d–849b	
i. Origin of galaxies: theories concerning the fragmentation and condensation of an initially homogeneous gas cloud		**18**:1008h–1009c / **7**:847d–g	
ii. Protogalaxies: gravitational condensation of stars; origin of galactic rotation and magnetic fields		**18**:1009c–e	
iii. Evolution of galaxies: evidence concerning a possible relation between galactic structure and evolution		**18**:1009e–f / **7**:846e–849b	
b. Stars		**18**:1009f–1010d / **17**:600b–604b	
i. Formation and evolution of stars: gravitational collapse of protostars; initiation of nuclear reactions that convert hydrogen to helium		**18**:1009f–1010a / **7**:848g–849b / **17**:600c–g	
ii. Advanced stages of stellar evolution: initiation of helium burning and other reactions; formation of white dwarf stars, supernovae, and neutron stars		**18**:1010b–d / **17**:600g–601a / **17**:603d–604b	
c. The solar system		**18**:1010d–1011a / **16**:1031f–1032c	
i. Theories of origin from a chance encounter of stars		**18**:1010e–f	**16**:1031h–1032b
ii. Theories of origin from a single star		**18**:1010f–1011a	**6**:55d–56g *passim* / **16**:1031f–h
3. Time scale of the universe: dating of significant events in the history of the universe		**18**:1011a–c	
4. Possible fate of the universe according to the steady-state and evolutionary cosmologies		**18**:1011d–f	

Section 132. Galaxies and stars

[for Part One headnote see page 20
for Division III headnote see page 63]

The articles and parts of articles referred to in Section 132 deal with four main subjects: A, galaxies in general; B, the Galaxy, or Milky Way system; C, star clusters and stellar associations; and D, the stars.

The outline of subject A begins with the statistical properties of galaxies, treating their classification, by structure or by the type of stars providing most of their light; their distances from Earth; and their distribution over the sky and in space. Dealing with the physical properties of galaxies, the outline treats their stellar populations and the variation of stellar properties with location in galaxies; the rotation of spiral galaxies; and the masses of galaxies. Finally, it treats radio emissions from galaxies and evidence of X-ray emissions from galaxies.

The outline of subject B begins with basic data about the Milky Way—the galaxy in which the solar system and all stars visible to the naked eye are located. It covers such things as methods for measuring galactic distances, stellar velocities, and the ages of the Galaxy's components; nebulae as components of the Galaxy; the interstellar medium and matter; the sources of radio waves, of infrared radiation, of X-rays, and of gamma radiation; and the properties of galactic and solar cosmic rays and their interactions with the interstellar medium, the solar wind, and the Earth's geomagnetic field. The outline deals next with galactic structure and dynamics, covering the geometry of the Galaxy, its spiral structure, the magnetic fields in it, and its rotation. Finally, the outline treats cosmological theories about the formation and evolution of the Galaxy.

Subject C is star clusters, organizations of stars held together by the mutual gravitational attraction of the members, which are physically related through common origin; and, related to star clusters, groups called stellar associations, which are loose groupings, in space, of stars of common origin, without sufficient total mass in the group to remain together as an organization. The outline deals first with the two general classes of star clusters—globular clusters, which are old systems containing thousands to hundreds of thousands of stars closely packed in a symmetrical, roughly spherical form; and open clusters, containing from a dozen to many hundreds of stars, usually in an asymmetrical arrangement. It goes on to the characteristics of stellar associations and then to the relationships and significance of the clusters and associations in the Galaxy as a whole. Finally, it treats what is known of star clusters in galaxies external to the Milky Way system.

Subject D is stars—massive, self-luminous objects, emitting

radiation derived from internal energy sources. The outline begins with the identification and nomenclature of the stars and with modern astronomical maps and catalogs. Dealing with observable stellar characteristics, the outline covers stellar positions and motions; the apparent luminosity of the stars; and a star's spectrum as containing information about its temperature, chemical composition, and intrinsic luminosity. Dealing with derived, or calculated, stellar characteristics, it covers intrinsic stellar brightness; stellar masses, diameters, and temperatures; and the average characteristics of main-sequence, or dwarf, stars. The outline goes on to variable stars—geometric variables, stars from which the amount of light reaching the observer alters because of changes in the stars' positions; and intrinsic variables, stars that have total energy outputs that fluctuate with time. The outline next deals with important generalizations concerning the nature and evolution of stars, made from correlations between observable properties and from certain statistical results. Dealing with stellar structure, it treats the variations of temperature with depth in stellar atmospheres; calculations of the internal structure of stars; and calculations of energy generation in stars. Finally, dealing with stellar evolution, the outline treats the life history of a typical star, together with estimates of stellar ages; the formation of chemical elements in stars; and the probable fate of a star—as white dwarf, pulsar, or black hole.

A. Galaxies in general

1. Statistical properties
   a. Classification of galaxies
   b. The extragalactic distance scale: observational methods of determining the distances to galaxies
   c. Distribution of galaxies: counts per unit area of sky; numbers and distribution in depth; clusters of galaxies; the Local Group
2. Physical properties
   a. Galactic stellar populations and evolution: variations of stellar properties with location in galaxies
   b. Rotation of spiral galaxies: the direction of rotation and the persistence of spiral structure
   c. Masses of galaxies
   d. Peculiar galaxies: galaxies with unusual structure or properties
3. Radio emissions from galaxies
   a. Line radiation from sources in nearer galaxies
   b. Continuum radiation: thermal radiation produced by hot gas clouds; synchrotron radiation produced by charged particles accelerated in magnetic fields
   c. Radiation from violent events in the nuclei of galaxies
4. X-ray emissions from galaxies

B. The Galaxy: the Milky Way system

1. Distance determinations in the Galaxy: the parsec, the basic unit of measure of galactic distances
2. Stellar velocities: the motions of stars with respect to the Sun and the motion of the Sun with respect to the Local Standard of Rest (LSR)
3. The stars and star clusters nearest the Sun: the Galaxy in the neighbourhood of the Sun
4. The classification of stars according to Hertzsprung–Russell diagram: the concept of stellar populations; the ages of components of the Galaxy
5. The galactic composition: the stars and interstellar material; sources of electromagnetic and particulate radiation
   a. The stellar populations: extreme population I, older population I, the disk population, intermediate population II, halo population II
   b. Nebulae
      i. Structure, physical properties, and spectra of nebulae
      ii. Diffuse, dark, and reflection nebulae

articles	article sections	other references
GALAXIES, EXTERNAL **7**:828–833	**18**:1014e–1015d	
	7:828g–830c	
	7:828g–829b	**2**:244b–d
	7:829b–d / **13**:997b–c	
	7:829d–830c / **18**:1014h–1015d	**17**:608f–609a
	7:830d–832b / **2**:244a–d / **18**:1014e–g	
	7:830d–831b / **7**:837g–840d	
	7:831b–e / **7**:846b–847d / **7**:848c–e	
	7:831f–832a	
	7:832a–b	
RADIO SOURCES, ASTRONOMICAL **15**:474–476	**7**:832b–833d / **7**:841d–842c	
	7:832c–d	
	7:832d–g	**7**:841d–f
	7:832h–833d	**15**:329g–330b
	19:1067f–1068b	**7**:842h
GALAXY, THE **7**:833–849		
	7:835e–836b / **12**:933b–c	
	7:836c–g	
	7:836g–837c	**9**:797h–798a
	7:837c–f / **12**:933e	**7**:830d–831a / **17**:592e–f
	7:837g–843a	
	7:837g–840d	
NEBULA **12**:926–935	**9**:792a–794e	
	12:926f–930e / **2**:242e–244a / **19**:1065h–1067a	**7**:832f–g / **9**:582g–583b
	12:930e–932f	**7**:840h–841a

	articles	article sections	other references
iii. Planetary nebulae		**12**:932g–934f	
iv. Filamentary bright nebulae: supernova remnants		**12**:934f–935e	
c. The interstellar medium and interstellar matter	INTERSTELLAR MEDIUM **9**:790–800	**5**:205f–h	**12**:926f–935e *passim*
i. Optical observations of interstellar matter: absorption, emission, and polarization of light		**9**:791f–794e / **7**:840d–841d	**2**:238h–239b
ii. Radio observations of the interstellar medium [see d., below]			
iii. The structure of the interstellar medium: distribution of matter in the various galactic regions		**9**:797d–798c	
iv. Interrelation between stars and the interstellar medium; *e.g.*, the association of T Tauri stars with circumstellar dust, evidence for star formation from interstellar matter		**9**:798d–799c	**9**:582c–f / **18**:1009g–1010a
v. Chemical composition, temperature, and density of the interstellar medium		**9**:799d–800a	**14**:509d–e
d. Radio sources	RADIO SOURCES, ASTRONOMICAL **15**:470–474	**7**:841d–842c / **2**:244h–245d / **9**:788f–h / **9**:794f–797d	
i. The radio continuum: contributions from various kinds of emission		**15**:470g–471b / **9**:794f–h	**7**:841d–f
ii. Atomic hydrogen: the 21-centimetre emission		**15**:471c–d / **9**:794h–796c	**2**:244h–245c / **7**:841g
iii. Interstellar molecules; *e.g.*, hydrogen, hydroxyl radicals, water, carbon monoxide, formaldehyde		**15**:471d–472b / **9**:796c–797c	**7**:841h–842c
iv. Discrete sources; *e.g.*, the galactic centre, supernova remnants, pulsars		**15**:472c–474b / **9**:797c–d / **12**:934f–935e / **15**:266d–267g	**2**:243f–244a
e. Sources of infrared radiation; *e.g.*, T Tauri stars, planetary nebulae	INFRARED SOURCES, ASTRONOMICAL **9**:580–583	**7**:842d–g	
f. Sources of X-rays and gamma rays		**7**:842h–843a / **19**:1065c–1067f	
g. Cosmic rays: possible galactic sources	COSMIC RAYS **5**:200–208		
i. Detection of cosmic rays		**5**:201b–202g	
ii. Properties of galactic and solar cosmic rays		**5**:202g–205a / **9**:787d–g	
iii. Origin of cosmic rays		**5**:205b–e	
iv. Interactions of cosmic rays with the interstellar medium, the solar wind, and the Earth's geomagnetic field [see also 221.A.4.b.iv.]		**5**:205f–206e	**9**:794g–h
v. Bombardment of the atmosphere and other matter by cosmic rays: the production of secondary particles and radioactive isotopes; the decay of unstable particles; the occurrence of air showers		**5**:206f–208f	**19**:21h–22c
6. Galactic structure and dynamics		**7**:843a–847d	
a. The spatial structure of the Galaxy: the galactic coordinate system and the dimensions of the Galaxy		**7**:843a–c	
b. Regions of the Galaxy: the galactic plane, the galactic halo, the galactic centre, and the spiral arms		**7**:843d–844e / **9**:797d–798c / **12**:932c–e	
c. Magnetic fields in the Galaxy: their origin and their effects on cosmic rays, radio waves, and light		**7**:844f–845b / **5**:204a–c / **9**:796a–c	**10**:794g–h
d. The structure of the Galaxy as a whole: the distribution and motions of clouds of neutral hydrogen		**7**:845b–846a	**9**:795b–g
e. The rotation of the Galaxy: the differential rotation of stars and gas about the galactic centre		**7**:846b–847d	
7. The origin and evolution of the Galaxy [see also 131.E.2.]		**7**:847d–849b	
a. Formation of the Galaxy: evidence concerning the alternative cosmological theories		**7**:847d–g	

b. Galactic evolution

i. Hydromagnetic and gravitational theories of the formation of spiral structure

ii. Chemical evolution: the problem of the distribution of heavy elements

iii. Star formation: theories concerning the gravitational condensation of galactic dust and gas clouds

C. Star clusters and stellar associations

1. Globular clusters: systems containing thousands to hundreds of thousands of old stars in a symmetrical, roughly spherical form

2. Open clusters: systems containing a dozen to hundreds of stars, usually in an unsymmetrical arrangement

3. Stellar associations: systems containing a few dozen to hundreds of stars of similar type and common origin

4. Relationship of clusters to the Galaxy: the formation and dispersion of clusters and their locations in the Galaxy

5. Clusters in external galaxies

D. Stars

1. The identification and nomenclature of the stars

a. The celestial sphere and celestial coordinate systems

b. The constellations and other sky divisions

c. Star names and designations

d. Modern star maps and catalogs

2. Observable stellar characteristics

a. Stellar positions and motions

b. The apparent brightness or apparent luminosity of the stars: the UBV and other systems

i. Stellar colours

ii. Stellar magnitude systems

c. Stellar spectra
[see also 112.C.]

i. The general nature of stellar spectra: spectral lines and bands, continuum spectra, physical principles of spectrum formation

ii. Spectral classes: their relation to stellar temperature and chemical composition

iii. Effects of density, luminosity, and other factors on stellar spectra: unusual stellar spectra

3. Derived, or calculated, stellar characteristics

a. Intrinsic stellar brightness: absolute magnitudes and total luminosities

b. Stellar masses

c. Stellar diameters

d. Stellar temperatures

e. The average characteristics of main-sequence, or dwarf, stars

articles	article sections	other references
	7:847g–849b	
	7:848c–e	**9**:797g–h
	7:848f–g	
	7:848g–849b / **9**:798d–799b	**9**:792e–f / **12**:931d–g / **18**:1009g–1010a
STAR CLUSTERS AND STELLAR ASSOCIATIONS **17**:604–609	**7**:836h–837c	**6**:852f–g / **17**:601a–f
	17:605a–606g / **13**:996h–997a	**7**:839h–840c
	17:606g–607g	**9**:791g–h
	17:607g–608c	**7**:838f–839a / **12**:931h–932b
	17:608c–f	
	17:608f–609b	
STAR **17**:584–604		
ASTRONOMICAL MAPS **2**:223–231	**17**:586c–e	
	2:224c–225e / **11**:675g–676g	
	2:225e–228d	
	2:228g–229h	
	2:229h–231c	
	17:586h–589c	
	17:586h–587e / **7**:836c–g / **13**:995e–996h	**2**:240a–c
PHOTOMETRY, ASTRONOMICAL **14**:346–352	**17**:587e–588b	
	17:587g–588a	**13**:996f–g
	17:588a–b / **14**:347h–348b	
ASTRONOMICAL SPECTROSCOPY, PRINCIPLES OF **2**:232–241	**17**:588c–589c	
	2:232h–234h / **17**:801h–802c	
	2:239d–240e / **17**:588c–589a	**13**:996d–e
	2:240e–241c / **17**:589a–c / **9**:793b–f	
	17:589d–590h	
	17:589d–h	
	17:589h–590c	
	17:590c–e	
	17:590e–f / **2**:240c–e / **17**:801e–g	
	17:590g–h	

	articles	article sections	other references
4. Stellar variability		**17**:590h–594d	**14**:351a–c/**18**:391g–h
a. Geometric variables; *e.g.*, eclipsing binaries		**17**:590h–592a/ **6**:194h–195c	
b. Intrinsic variables		**17**:592b–594d	
i. Pulsating stars; *e.g.*, Cepheid, RR Lyrae, and Beta Canis Majoris variables		**17**:592e–593g	**7**:839a–b/**14**:351a–b
ii. Explosive variables; *e.g.*, novae, supernovae, and novalike variables		**17**:593h–594d/ **7**:839d–f/ **19**:1065h–1067f	**4**:122f–g/ **18**:1010b–c
5. Statistics of stars		**17**:594d–596e	
a. Correlations between luminosity, spectrum, mass, and radius: the Hertzsprung–Russell diagram and other relations		**17**:594d–595f/ **7**:837c–f	
i. Relation between the number of stars and their luminosities		**17**:595c–e	
ii. Mass–luminosity correlation		**17**:595e–f	
b. Statistics of binary star systems		**17**:595f–g	
c. Statistics of special types of stars; *e.g.*, white dwarfs, T Tauri stars, flare stars, radio and X-ray stars		**17**:595g–596e/ **9**:798f–h	**2**:241a–c
6. Stellar structure		**17**:596e–600a	
a. Stellar atmospheres		**17**:596e–597h	
b. Internal structure of stars		**17**:597h–600a	
i. Relationships obtained from physical laws: theoretical determination of the variation of pressure, temperature, and density with depth		**17**:597h–598f	
ii. Energy generation in stars: thermonuclear reactions in stellar interiors		**17**:598f–600a/ **4**:120g–121g/ **17**:807h–808d	**3**:848f–g/**13**:309e–310c
7. Stellar evolution [see also 131.E.2.]		**17**:600b–604b/ **9**:798d–799c	**2**:251c–e
a. The life history of a typical star		**17**:600c–601h/ **18**:1009f–1010d	
i. Formation of a protostar by gravitational contraction		**17**:600c–d/ **7**:848g–849b/ **9**:798d–799b	**9**:792e–f/**12**:931d–g/ **18**:1009g–1010a
ii. Attainment of the main sequence: the hydrogen-burning stage of stellar development		**17**:600d–g	**13**:309e–h
iii. Evolution away from the main sequence: helium burning and other reactions		**17**:600g–601a	**4**:121b–g
iv. Estimates of stellar ages: differences in the terminal stages of stellar evolution caused, for example, by differences in stellar mass, rate of rotation, chemical composition		**17**:601a–h/ **7**:830d–831b/ **18**:1010b–d	**4**:122g–123a/**12**:934a–d/ **18**:1011b–c
b. Formation of chemical elements in stars	CHEMICAL ELEMENTS, ORIGIN OF **4**:120–123	**17**:602a–603d	**13**:309e–310a/**17**:808a–d
c. Probable fate of a star: white dwarfs, pulsars, and black holes		**17**:603d–604b/ **15**:268d–269h	**2**:241b–c/**4**:122f–g

Section 133. The solar system

[for Part One headnote see page 20
for Division III headnote see page 63]

The articles and parts of articles referred to in Section 133 treat five main subjects: first, A, a survey of the solar system as a whole; and then, separately, B, the Sun; C, the planets and their satellites; D, the Earth as a planet; and E, the Moon.

The outline of subject A begins with the size of the solar system, which is defined as extending to the orbit of the outermost known planet, Pluto, and with a comparison of distances within the solar system to interstellar distances. It goes on to a general comparison of the properties of the nine major planets and of the thirty-one satellites of six of them. It next covers other constituents of the solar system: the minor planets, or asteroids; the comets; meteors, meteorites, and tektites; and the components of the interplanetary medium. It next treats the regularities and the interactions among various bodies in the solar system and concludes with the two general types of theories about the origin of the solar system.

The outline of subject B begins with the Sun's surface layers and their features that are characteristic of the quiet Sun. It treats the photosphere, the visible luminous surface of the Sun; the chromosphere, the Sun's inner atmosphere, forming a transition zone

between the photosphere and the corona; and the corona, the luminous, high-temperature, rarefied gas envelope of the Sun. The outline goes on to the active Sun, to solar features that occur with increased frequency during the active phase of the solar cycle. It treats centres of activity, areas of localized strong magnetic fields at the Sun's surface; the nature of sunspots and sunspot cycles; and such other features as faculae, prominences, flares, and coronal condensations. In conclusion, the outline treats energy generation in the solar interior and the evolution of the Sun, the various kinds of solar radiation, and solar–terrestrial relationships and interactions.

Subject C is the planets and their satellites. The articles referred to separately treat Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. The Earth as a planet is subject D.

The outline of subject D begins with the distance of the Earth from the Sun, the orbital motion of the Earth around the Sun, and the rotation of the Earth on its axis. It then deals with the effects of the Earth's orbital position and speed on astronomical observations, articles being referred to that separately treat astronomical parallax and the aberration of light. Finally, indication is made of the sections in Part Two that treat the Earth's origin; its atmosphere, hydrosphere, and surface features; the structure and composition of its interior; and its physical properties.

The outline of subject E begins with the basic data for the Moon—its shape, radius, mean density, and varying brightness. After dealing with the apparent and actual motion of the Moon, it treats the basic gravitational properties and gravity anomalies of the Moon. It goes on to the physical nature of the Moon, covering knowledge of lunar craters, lunar lineaments, lunar soil and other surface material—knowledge gained by observations from Earth and space vehicles, from remote lunar photography, from manned lunar landings, and from close-up photographs. It next treats evidence concerning, and theories about, the origin and evolution of the Moon. Finally, it deals with the Sun–Earth–Moon system, covering the relative motions of the Sun, Earth, and Moon; eclipses of the Sun and Moon and the related phenomena of occultation and transit; and the causes and character of tides in the Earth's hydrosphere, atmosphere, and lithosphere.

articles	article sections	other references
A. A survey of the solar system		
SOLAR SYSTEM **16**:1028–1032		
1. The Sun [see B., below]		
2. Size of the solar system: the astronomical unit and the comparison of distances within the solar system to interstellar distances	**16**:1029d–g	**13**:994a–995e *passim*
3. The major planets and their satellites: their sequence; comparison of their properties [see also C., below]	**16**:1029g–1030c / **2**:241c–242a / **2**:326g–327d / **11**:759d–761e / **15**:469c–470f	
4. Other constituents of the solar system	**16**:1030c–g	
a. Minor planets, or asteroids		
PLANET, MINOR **14**:491–493	**12**:47b–48a	**11**:761a–c
i. History of discoveries up to the early 1970s	**14**:491g–492g	
ii. Naming of minor planets	**14**:492h–493a	
iii. Statistics of minor planets	**14**:493a–e	**10**:352c–e
iv. Theories of origin	**14**:493f–h	
b. Comets		
COMET **4**:969–978		**16**:1030d–e
i. History of observations of comets	**4**:969g–971g	
ii. Comet orbits	**4**:971g–973d	**12**:37b–c
iii. Observed characteristics and structure	**4**:973d–978a / **2**:242a–c / **10**:788d–e	
iv. Theories of the origin and evolution of comets	**4**:978a–f	
c. Meteors and meteoroids		
METEOR **12**:36–39	**2**:242c–e / **9**:785h–786e	**4**:977d–e / **16**:1030e–f
d. Objects recovered on the Earth that have either a certainly extraterrestrial or a possibly extraterrestrial origin		
i. Meteorites: objects of stone and nickel-iron that originate in interplanetary space		
METEORITE **12**:39–48	**12**:36f–g	**10**:907e–g / **12**:244d–f
ii. Tektites: glassy objects that are probably of lunar or terrestrial origin		
TEKTITE **18**:59–63		
e. The interplanetary medium		
INTERPLANETARY MEDIUM **9**:785–790		
i. Its components; *e.g.*, dust particles, electromagnetic fields, cosmic rays	**9**:785h–787g	
ii. Phenomena caused by the interplanetary medium; *e.g.*, zodiacal light, gegenschein, noctilucent clouds	**9**:787h–789b	
iii. The direct detection of interplanetary components	**9**:789c–790a	
5. Regularities of the solar system: the distances of the planets from the Sun and the distribution of natural satellites .	**16**:1030g–1031c	**18**:1010d–e
6. Interactions among various bodies in the solar system: gravitational perturbations and actual physical encounters	**16**:1031c–d / **18**:390d–391f	**12**:48d–e

	articles	article sections	other references
7. Theories of the origin of the solar system [see also 131.E.2.]		**16**:1031f–1032c / **18**:1010d–1011a	
a. Origin by an orderly process of evolution; *e.g.*, Laplace's nebular hypothesis		**16**:1031f–h / **10**:352f–h / **18**:1010f–1011a	**4**:978c–d / **6**:55c–56g *passim*
b. Origin by catastrophe; *e.g.*, by the encounter of the Sun and another star		**16**:1031h–1032b / **18**:1010e–f	
B. The Sun			
1. The Sun's surface layers and their features: the quiet Sun	SUN **17**:798–808	**16**:1028h–1029d	
a. Solar data derived from observations of the photosphere, the visible luminous surface of the Sun		**17**:801a–805a / **15**:468c–f	**6**:192d–193d / **17**:596e–597a
i. Granulation and limb darkening		**17**:801a–803d	
ii. The Sun's temperature, rotation, and sphericity		**17**:801d–e	
iii. The chemical composition and spectrum of the Sun		**17**:801e–h	
b. The chromosphere, the relatively transparent layer that forms a transition zone between the Sun's photosphere and corona: the flash spectrum, spicules, and supergranulation		**17**:802c–803d / **2**:237h–238g	
c. The corona, the luminous, high-temperature, rarefied gas envelope of the Sun		**17**:803d–804c	
i. Form, structure, and physical properties		**17**:804c–805a / **5**:205h–206c	**14**:509g–510a / **19**:22h–23e
ii. The solar wind		**17**:804d–h	
2. Solar features that occur with increased frequency during the active phase of the solar cycle: the active Sun		**17**:804h–805a	**4**:977b–c
a. Centres of activity: areas of localized strong magnetic fields at the Sun's surface		**17**:805a–807g	
b. Sunspots: their physical nature and the sunspot cycle of about 11 years		**17**:805b–d	
c. Other features; *e.g.*, faculae, prominences, flares, coronal condensations		**17**:805d–806b	**4**:739d–g
3. The solar interior: energy generation and the evolution of the Sun [see also 132.D.7.]		**17**:806b–807g	**5**:204e–205a / **9**:814h–815b / **15**:468g–469c
4. Solar radiation, including light, radio waves, and particles		**17**:807h–808d / **13**:309e–310c	**17**:598f–600a *passim*
5. Solar-terrestrial relationships and interactions		**5**:204e–205a / **9**:786e–h / **15**:468c–469c	**4**:739d–e
		2:310c–h / **2**:326a–e / **2**:373h–374g / **4**:714g–715c / **4**:739d–g / **9**:788h–789b / **9**:814h–815f / **14**:509f–510a	**6**:27e–g / **19**:22f–23e
C. The planets and their satellites			
1. The terrestrial planets			
a. Mercury	MERCURY **11**:915–921		
i. Its orbit, mass, and radius		**11**:915h–916g	
ii. Effects of its proximity to the Sun: the advance of its perihelion and its transits		**11**:916g–917d	
iii. Its rotation and the apparent motion of the Sun in its sky		**11**:917d–920g	
iv. Its surface conditions and possible surface material		**11**:920g–921e	
v. Its synodic period and the length of its solar day		**11**:921e–g	
b. Venus	VENUS **19**:77–82		**6**:194b–d
i. Its period of rotation		**19**:77g–78d	
ii. Its atmosphere and clouds		**19**:78d–80b	**2**:241g–h / **2**:326h–327d
iii. Its magnetic field, radiation belts, and ionosphere		**19**:80b–c	

	articles	article sections	other references
iv. Its microwave emissions and their observation and interpretation		**19**:80d–81g/ **15**:469g–h	
v. Its surface conditions and their relation to possible life		**19**:81g–82b	**10**:909b–c
c. Earth [see D., below]			
d. Mars	MARS **11**:518–530		
i. Its basic phenomena: orbital motion and general appearance, diurnal and seasonal activity		**11**:519d–522d	
ii. Its surface: topographic features, physical properties, and possible composition		**11**:522f–525b	
iii. Its polar caps: seasonal behaviour and possible composition		**11**:525c–526d	**2**:241d–f
iv. Its atmosphere		**11**:526d–528h	**2**:326h–327d
v. Its interior		**11**:528h–529c	
vi. Its satellites		**11**:529c–e	
vii. Its possible suitability for life		**11**:529f–530f	**10**:908c–909b
2. The minor planets, or asteroids [see A.4.a., above]			
3. The giant planets and Pluto			
a. Jupiter	JUPITER **10**:346–352	**15**:470b–e	
i. Its outer layers: the atmosphere, clouds, and Great Red Spot		**10**:347d–350d	**10**:909d–e
ii. Its interior		**10**:350d–h	
iii. Its satellite system		**10**:350h–352c	**6**:189h–190d
iv. Its gravitational influence		**10**:352c–e	**11**:761a–c
v. Theories of the origin of the Jovian system		**10**:352f–h	
b. Saturn	SATURN **16**:272–275		
i. Its orbit		**16**:273c–e	
ii. Its surface		**16**:273e–274a	
iii. Its mass, density, and probable composition		**16**:274a–b	
iv. Its rings		**16**:274c–g	**18**:391d–f
v. Its satellites		**16**:274g–275c	
c. Uranus	URANUS **18**:1037–1038		
i. Its discovery		**18**:1037d–f	
ii. Its orbit		**18**:1037f–g	
iii. Its visual appearance and spectrum		**18**:1037g–1038d	
iv. Its mass, radius, density, and probable composition		**18**:1038d–f	
v. Its satellites		**18**:1038f–g	
d. Neptune	NEPTUNE **12**:963–965		
i. Its discovery		**12**:963b–h	
ii. Its appearance and constitution		**12**:963h–964c	
iii. Its rotation and diameter		**12**:964d–h	
iv. Its satellites		**12**:964h–965c	
e. Pluto	PLUTO **14**:580–581		
i. Its discovery		**14**:580b–e	
ii. Its orbit and variable brightness		**14**:580f–581b	
iii. Its mass, diameter, density, and possible atmosphere		**14**:581b–g	
D. The Earth as a planet	EARTH AS A PLANET **6**:57–62		
1. The distance of the Earth from the Sun: the astronomical unit and solar parallax		**13**:994h–995e	

	articles	article sections	other references
2. The orbital motion of the Earth around the Sun and the rotation of the Earth on its axis: the year, the day, the precession of the equinoxes [see also E.6.a., below]		**6**:59b–f	**2**:246a–c/**3**:596e–f/**4**:740c–d/**5**:512d–e/**8**:529a–b
3. Effects of the Earth's orbital position and speed on astronomical observations			
a. Astronomical parallax	PARALLAX, ASTRONOMICAL **13**:993–997	**17**:586b–c	**10**:949f–h
b. Aberration of light	LIGHT, ABERRATION OF **10**:949–951		
4. The Earth's magnetism, temperature, and other physical properties [see 212]			
5. The structure and composition of the Earth's interior [see 213]			
6. The origin of the Earth, its atmosphere, hydrosphere, and surface features [see 232, 241]			
E. The Moon	MOON **12**:415–432	**18**:390f–391a	
1. Basic data for the Moon: its shape, radius, mean density, and varying brightness		**12**:415a–d	
2. The motion of the Moon		**12**:415f–417h	**18**:390f–h
a. The apparent motion		**12**:415f–416c/**13**:994d–g	**13**:995d–e
i. The month: the sidereal and synodic periods of the Moon [see 6.a.ii., below]			
ii. Optical and physical librations		**12**:416b–c	
b. The actual motion		**12**:416d–417h	
i. Analytical and numerical lunar theory: the mathematical treatment of the Moon's geocentric motion		**12**:416f–417e	
ii. Interpretation of small irregularities in the motion		**12**:417e–h	
3. The mass and gravitational field of the Moon		**12**:417h–419a	
a. Underlying theory: basic gravitational properties of the Moon		**12**:418a–e	
b. Discovery of lunar mascons: gravity anomalies on the Moon		**12**:418e–419a	
4. The physical nature of the Moon: selenology		**12**:419b–429c	
a. Observations from Earth and from space vehicles: results of remote lunar photography, manned lunar landings, and close-up photography [see also 738.C.3.]		**12**:419b–420g	
b. Types of lunar feature		**12**:420g–427h	
i. Lunar craters		**12**:420g–423a/**12**:53h–54b	
ii. Lunar lineaments; *e.g.*, mare ridges, the lunar grid system, rilles		**12**:423a–425d	
iii. Temporary or transient features		**12**:425d–f	**18**:390h–391a
iv. The lunar soil and other surface material: analysis of reflected and emitted radiation		**12**:425g–427h	
c. Theories of origin of the Moon's surface features: the volcanic and impact theories		**12**:427h–429c	
5. The origin and evolution of the Moon		**12**:429c–432b	**18**:1010h–1011a
a. Probable development of the Moon's orbit		**12**:429c–h	**10**:625g–626b
b. Evidence from the composition and physical properties of the Moon: interpreting the lunar geological record		**12**:429h–432a/**5**:513d–g	**12**:244b–d
c. The "circumterrestrial swarm" theory: the theory that the Moon accreted from silicate material that condensed in the Earth's early atmosphere		**12**:432a–b	

	articles	article sections	other references
6. The Sun–Earth–Moon system			
a. Relative motions of the Sun, Earth, and Moon		**13**:994a–995e	
i. The geometry of the Sun–Earth–Moon system: the celestial equator; the apparent motion of the Sun along the ecliptic; the inclination of the Earth's axis to its orbit		**2**:224c–225a	
ii. Motions of the Sun–Earth–Moon system as the astronomical basis of chronology: the day, month, and year; the Sothic cycle, Metonic cycle, and other complex cycles	CALENDAR **3**:595–598	**12**:415f–416a / **6**:190f–191b	
b. Eclipses of the Sun and Moon	ECLIPSE, OCCULTATION, AND TRANSIT **6**:188–197		
i. Phenomena observed during eclipses		**6**:188e–189c	
ii. Geometry of eclipses, occultations, and transits		**6**:189d–190d	
iii. Frequency of solar and lunar eclipses		**6**:190d–192d	**3**:597f–g
c. Tides	TIDES **18**:383–392		**12**:429c–f
i. Causes of tides		**18**:383e–384b	
ii. Tides in the Earth's hydrosphere, atmosphere, and lithosphere [see also 223.B.3.]		**18**:384b–390d	**6**:30h–31d / **9**:814c–e / **10**:625g–626a
iii. Tides in the Moon and other astronomical bodies and systems		**18**:390d–392a	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AMBARTSUMIAN, VIKTOR A. **1**:656
ARISTOTLE **1**:1162
BESSEL, FRIEDRICH WILHELM **2**:869
BRADLEY, JAMES **3**:100
BRAHE, TYCHO **3**:103
COPERNICUS **5**:145
EDDINGTON, SIR ARTHUR STANLEY **6**:297
EINSTEIN, ALBERT **6**:510
GALILEO **7**:851
HALLEY, EDMOND **8**:556
HERSCHEL FAMILY **8**:824
HIPPARCHUS **8**:940
KEPLER, JOHANNES **10**:431
LAGRANGE, JOSEPH-LOUIS, COMTE DE **10**:597
LAPLACE, PIERRE-SIMON, MARQUIS DE **10**:680
LOVELL, SIR BERNARD **11**:131
NEWCOMB, SIMON **12**:1083
NEWTON, SIR ISAAC **13**:16
POINCARÉ, HENRI **14**:604
PTOLEMY **15**:179
RUSSELL, HENRY NORRIS **16**:37

Introduction to Part Two: **The great globe itself**

by Peter J. Wyllie

We all have a sense of awareness and appreciation of the Earth; we all admire the scenery. One of the rewards of studying and understanding the Earth is the development of this sense to a greater extent. This development brings us closer to nature, closer to an awareness of some transcendental power, closer to God if we choose to define God in these terms. To "commune with nature" is to seek peace, but of course the Earth is not always peaceful and benevolent; sometimes it is powerful and savage. Even cities, the culmination of man's domination of the landscape, are not immune to the ravages of nature. They have been devastated by floods, wracked and ripped by tornadoes and hurricanes, ruined by ash or lava from volcanoes, and demolished by earthquakes. These events, too, we wish to understand.

Man's appreciation of the Earth begins with physical contact. This immediate experience of the senses is followed by the spiritual desire and need to understand where the Earth and its human observers came from, and why. The third stage of appreciation comes from scientific analysis and interpretation. Before we examine the relationship between man and the Earth in more detail, we should consider our position in the solar system and the universe.

Human civilization has developed and flourished in a small niche in space. Our home is perched on the surface of a sphere, enormous to us but tiny compared to the universe, that spins around its axis once each day while moving at a fantastic speed around the Sun, completing an orbit once each year. Although normally unaware of it, we too are spinning and moving at the same speed as the Earth, but we are held securely on the surface by the gravitational attraction of the mass of rocks beneath us.

The Sun, a huge globe of burning gas, provides the energy that fuels the activities and processes of our immediate environment, the boundary layer between the rocky surface of the Earth and the fluid envelope of air and water that separates the Earth from the starkness of space. The air and water nurture life and simultaneously protect it from the potentially damaging radiation and particles that approach the Earth from other parts of the solar system and beyond.

A view of the Earth from space differs markedly from what we see from within our own restricted environment at the Earth's surface. From where we stand, it appears that the Sun, the Moon, and the stars are moving in great arcs around the Earth, and it was once believed that this was the way of the universe. Man on his world was surely the centre of all things. But we know now that this is only a relative picture; although the Moon does orbit the Earth, the Earth-Moon system moves around the Sun, which is itself speeding through the universe.

We exist because the Earth exists, and we claim the Earth as our own by referring to it as Mother Earth, the universal provider. The Earth provides all of our material needs and satisfies some of our spiritual needs: "I will lift up mine eyes unto the hills, from whence cometh my help." A day in the mountains, at the seashore, or in the countryside sharpens that sense of awareness of the Earth which was compared above with an awareness of God.

Since he first appeared on Earth, man has wondered at nature's awesome beauty, and trembled at its indomitable power. The dread engendered by the physical experience of nature on the rampage, in storms, floods, or earthquakes, has shaped the development of primitive religions. Mystical or sacred attributes were assigned to natural objects and phenomena, and ceremonies were devised to honour and placate the unknown powers. Modern man has become increasingly insulated from his natural surroundings, partly because he is separated from them by masses of concrete, partly because scientific investigation tends to dispel the mystery of nature. This is not to imply that no problems remain to be solved, but we have learned enough to be reasonably sure that all are ultimately explicable in terms of rational science. Therefore, we no longer feel the need to populate the sky, mountains, trees, and winds with gods, spirits, and souls. But we can still enjoy the sensuous and spiritual appreciation of the Earth, and retain or rediscover the intimacy with our natural surroundings that was experienced by primitive man.

One of the appealing aspects of Earth study is that wherever we go, our favourite subject is right there with us. There is always something new to be seen, to be admired, or to be examined in detail. While travelling in a commercial airliner, a meteorologist can examine the upper portions of the clouds as a change from his normal ground-based view and can track the flight right through the fronts and the high- and low-pressure regions charted on the newspaper weather map in his lap. An oceanographer flying over the coastline can see at a glance the large-scale patterns in the waves rolling shoreward, and the effect of coastal prominences on these patterns. A geologist peering through the plane window can examine the distribution of hills and valleys laid out below him, gaining a bird's-eye view to supplement the pattern of features that he had previously seen only on maps. These pleasures are not reserved for the professional Earth scientist. Anyone can observe the Earth and Earth processes in action, almost anywhere.

Man is a curious species; he needs to know how and why things happen. The simple, visual pictures of nature are beautiful, awe-inspiring, and on occasion terrifying, but they can be more satisfying if they invoke a series of additional images. Just as one's appreciation of any work of art is enhanced by knowing something of the artist and his position in art history, so one's appreciation of nature's pictures is enhanced by knowing something about natural history. For a full appreciation of the splendour of mountain peaks rising abruptly from the plains, reaching for the puffs of cloud that ride above them, we need to know something of the processes that raise mountains—or were they always there? We need to know something of the winds that carry moisture from the oceans to the skies, because we see that the clouds come, change their shapes, and then disappear. We can gain a great deal by learning a little about the scientific approach to appreciation of the Earth. And it is not at all difficult for the nonprofessional to read about and to understand many of the necessary concepts.

Two of the most troublesome concepts are time and size —dimensions that distinguish the Earth sciences from any other Earth-bound subject. It is very difficult for us to grasp the meaning of the statement that the Earth formed 4,600,-

000,000 years ago. Similarly, the enormous volume of water in the oceans or the volume of rocks in a mountain range almost defy comprehension. We have been considering the Earth and scenery as it is exposed to us at the present. But when we study the Earth, we realize that the present scenery is merely a transient feature in the immense span of geological time. Early students of the Earth were hampered by the belief that the Earth was only a few thousand years old. Many of them were seeking answers to two recurrent questions that we find throughout human history. How and when was the Earth formed? How and when was man formed? Attempts to answer these questions are responsible for many myths and religions in various cultures, both ancient and modern.

In the early part of the 19th century the study and interpretation of rocks led geologists to conclude that the Earth must be of far greater antiquity than the age implied by a literal interpretation of the Bible. They realized that the layers of rock now exposed at the surface contain records of the history of the Earth during the times that each layer was formed. One major branch of the Earth sciences is devoted to the discovery, translation, and interpretation of the "record of the rocks." Many rock layers enclose fossils, and these remnants of animals and plants serve as illustrations in the historical book of nature, making it possible to trace the development and changes of species through time.

Fossil hunting has been a popular pastime for many generations. With a little experience and a little knowledge, an amateur fossil hunter can add interpretation to his discoveries. From a few fossil shells and corals in a limestone, he can reconstruct in his mind's eye the whole flourishing community of life that once existed on a coral reef, now frozen into the rock record. A piece of coal, with fossil imprints of leaves, ferns, and other plant remains from which the coal was formed, can conjure up a picture of a luxuriant swamp of 300,000,000 years ago, populated by strange beasts long since vanished from the Earth. The history of the Earth, the evolution of life, and the origin of man, at least in part, are preserved in the rocks. It is here that fundamentalists still supporting "creationism" will find much evidence for the evolution of life forms, if they care to examine it. This aspect of Earth study has almost universal appeal. Earth history and human history overlap in archaeology, and the records of early civilizations exposed in excavation sites always excite public curiosity.

The scientific approach to the appreciation of nature informs us that the key to interpretation of the past history of the Earth from the record of the rocks lies in processes occurring at the present time. These processes have been grouped into great cycles. Two of the most important are the hydrologic cycle, concerned with the circulation of water, and the mountain-building cycle.

The oceans constitute a vast reservoir for the hydrologic cycle. The atmosphere and the oceans are in constant motion, driven by the energy from the Sun and the rotation of the Earth. Masses of humid air, carrying water that has evaporated from sun-drenched tropical oceans, migrate to cooler latitudes where the water is precipitated as rain or snow, and thus returned to the ocean reservoir either directly or indirectly, over or through the ground. The moving air masses and ocean currents bring to the continental masses rain or drought, heat or cold, making them hospitable, habitable, or uninhabitable for human colonies. Minor changes in atmospheric circulation have converted fertile plains to barren deserts and caused major changes in the development of ancient civilizations.

The hydrologic cycle shapes our local environment. The features that we know collectively as scenery are produced mainly by flowing water, although ice, wind, and solar energy also contribute. The force of gravity and the rivers together carry the products of weathering downhill to the ocean reservoir. The average rate at which the surface of the land is being worn down and the land dispersed into the oceans is a trivial 1.5 inches per 1,000 years, but the dimension of geological time gives significance to small numbers. At this rate, all of the continents would be worn down to sea level within 20,000,000 years. This means that during the 4,600,000,000 years since the Earth was formed, the continents could have been worn down to sea level at least 200 times. By now there should be no land rising above sea level, but we still see high mountains.

The mountains exist and persist because the effects of the hydrologic cycle are offset by the mountain-building cycle. Forces within the Earth cause large regions of the surface to rise very slowly, imperceptibly in human terms. Imperceptible, that is, until an earthquake signals an abrupt movement in the continuing process of mountain building. While some parts of the Earth rise other regions sink. This slow rhythm has been termed "the pulse of the Earth." Although we do not understand the details of what is happening within the Earth, we are now confident that internal forces are responsible for shaping the major features of the Earth's surface, such as the distinction between continents and ocean basins, and the persistence of mountain ranges on the land and beneath the ocean. The detailed sculpture of the surface results from the conflict between the mountain-building cycle and the hydrologic cycle.

The internal forces do more than cause the land surface to rise and fall; they cause the land to move sideways, as well. It is now generally believed by most scientists that the continents drift. There is persuasive evidence that the surface of the Earth is covered by a small number of very large shell-like plates, about 60 miles thick, across which the continents are scattered rather like logs frozen into the ice on a lake. The rigid shells of rock slide over the Earth's interior, carrying the continents with them, and grinding against each other along their edges like ice floes. The plate boundaries are sites of geological activity: earthquakes and volcanoes are concentrated along them. Because of these movements, supercontinents have been rifted apart, and ocean basins have opened, expanded, and closed again as continents collided. Continental collisions have thrust up great mountain ranges such as the Himalayas. The continents are drifting still at rates of an inch or two per year: the Atlantic Ocean is increasing in size, and the Pacific Ocean is becoming smaller. Most people are fascinated by the theory of continental drift. The theory is aesthetically pleasing, and it also has practical applications.

What stokes the subterranean fires that drive the Earth's engine, causing continental drift, mountain building, volcanic eruptions, and earthquakes? We have no satisfactory answer to this question, but we do know that an enormous amount of energy is involved in the activity along the plate margins. One major earthquake releases more energy than a hydrogen bomb. Modern man is a powerful animal, thanks largely to his exploitation of the Earth for materials

and energy, and he dominates the landscape like no species before him. He feels reasonably secure in his command of the environment while sitting in the city, because the landscape is largely a product of his industry, and it is clearly subservient to his wishes and his computer-operated control panels. But when the Earth releases a minute fraction of its internal energy in a major earthquake, man becomes helpless. All control is lost while the surface of the Earth rises and falls in solid waves.

Man cannot live in harmony with his environment during an earthquake. It has become clear, however, that he must learn to do so at other times if he is to avoid the dire predictions of those who evaluate such factors as projected world populations, the material and energy resources of the Earth, projected rates of consumption of these resources, and the volume and toxicity of waste materials discarded. We live in a restricted environment with finite space and resources, and we have become a force producing major modifications in the environment at rates very rapid compared with normal rates of Earth evolution. Social decisions about the continued exploitation of the Earth should be made with full information about the problems, and social decisions are based on votes, in theory at least. This alone is sufficient reason for any intelligent person to inform himself about the Earth, quite apart from the fascination of the subject, because his future depends upon it.

Part Two. The Earth

The outlines, and the articles and parts of articles referred to, in the thirteen sections, grouped in four divisions, of Part Two treat the Earth's properties, structure, and composition; its atmosphere and hydrosphere; its surface features; and its history.

Several points about the relations of this part to other parts should be noted. The consideration here of the Earth's physicochemical properties presupposes the physical and chemical knowledge and theories set forth in Part One. Knowledge of the Earth is in turn presupposed by Parts Three, Four, and Five, which are concerned with Life on Earth, Human Life, and Human Society, respectively. The several Earth sciences have themselves been the objects of historical and analytical studies concerned with their nature, scope, methods, and interrelations. These studies are set forth in Section 10/33 of Part Ten. The instrumentation used in the Earth sciences is dealt with in Section 723 of Part Seven.

The outlines and the articles referred to in the four sections of Division I treat the orbital motions and the figure of the Earth; its physical properties; the structure and composition of the Earth's interior; and the Earth's constituent minerals and rocks.

In Division II the subjects are the Earth's atmosphere; its hydrosphere; the motions of the sea; and weather and climate.

In Division III the subjects are the basic physical features of the Earth's surface and the features produced by geomorphic processes acting on the Earth's surface.

In Division IV the subjects are the origin and development of the Earth and its envelopes; the interpretation of the geological record; and the eras and periods of geological time.

Division I. The Earth's properties, structure, and composition 79
II. The Earth's envelope: its atmosphere and hydrosphere 92
III. The Earth's surface features 104
IV. The Earth's history 115

Division I. The Earth's properties, structure, and composition

The outlines, and the articles and parts of articles referred to, in the four sections of Division I treat the Earth as a planet; the Earth's physical properties; the structure and composition of the Earth's interior; and the Earth's constituent minerals and rocks.

The outline and the articles referred to in Section 211 deal with the orbital motions of the Earth and with the figure of the Earth.

Section 212 treats the Earth's gravitational properties; the Earth's magnetic, electrical, thermal, and mechanical properties; and the properties of Earth materials and their deformation.

Section 213 treats the basic divisions of the solid Earth; the causes, distribution, magnitude, motion, and energy of earthquakes; and the geophysical and geochemical evidence used to infer the structure and composition of the Earth's interior.

Section 214 treats the mineral constituents of the Earth; the rocks that comprise the Earth's crust; and the geochemical distribution of elements in the Earth.

Section 211. The planet Earth 79
212. The Earth's physical properties 80
213. The structure and composition of the Earth's interior 84
214. The Earth's constituent minerals and rocks 85

Section 211. The planet Earth

The articles and parts of articles referred to in Section 211 deal with two main subjects: A, the orbital motions of the Earth; and B, the figure of the Earth.

The outline of subject A treats the orbital motions of the Earth —the revolution of the Earth about the Sun and the rotation of the Earth on its axis. The outline goes on to treat the forces and dynamical effects related to the rotation of the Earth.

The outline of subject B begins with the definition of the figure

of the Earth as the size and shape of a hypothetical surface, called a geoid, the mean sea-level surface and its continuation under the land. It goes on to the historical development of improved approximations to the Earth's figure. It next deals with the methods used before and since satellite measurements for establishing a world geodetic system. Finally, it treats current definitions and values in international reference systems, and recent developments in geodesy.

	articles	article sections	other references
A. The orbital motions of the Earth			
1. The revolution of the Earth about the Sun and the rotation of the Earth on its axis		**6**:59b–f	**3**:596e–597a/**8**:529a–b
2. Forces and dynamical effect related to the rotation of the Earth		**11**:776a–777a	
a. The Coriolis force that modifies the atmospheric and oceanic circulations		**9**:59e–g/ **13**:438c–439a	**2**:677e–h/**10**:161g–162a/ **11**:776c–777a/**13**:496c–d/ **19**:699a–c/**19**:864d–865c
b. The centrifugal force that produces the Earth's equatorial bulge		**6**:19e–f	
c. Deceleration of the Earth's rotation as a result of tidal friction			**5**:512d–e/**6**:197a–b/ **6**:59b–d/**12**:429c–f/ **18**:416f–h
B. The figure of the Earth	EARTH, FIGURE OF **6**:1–8	**6**:39h–40c	
1. The conventional definition of the figure of the Earth: the geoid		**6**:1a–f/ **7**:1059f–h	
2. Reference figures or models of the Earth: the historical development of improved approximations to the Earth's size and shape		**6**:1g–4b	
a. The spherical model		**6**:1g–2e	
b. The ellipsoidal model		**6**:2e–3c/ **6**:19e–g	
c. The geoidal model		**6**:3c–4c	
3. The world geodetic system: the measurement of geodetic parameters		**6**:4d–6h	**17**:832b–d
a. The astrogravimetric method: the use of gravity data and the Geodimeter		**6**:4d–5c	
b. Satellite measurements: analysis of satellite orbits; satellite triangulation		**6**:5d–6g	**11**:759d–760b/**17**:372e–f
c. Correlation of data from different methods		**6**:6g–h	
4. International reference systems		**6**:7a–8a	
a. Current definitions and values: the adoption of standard reference figures		**6**:7a–f	
b. Recent developments: precision measurements and their implications concerning global structure and processes		**6**:7g–8a	

Section 212. The Earth's physical properties

[for Part Two headnote see page 79
for Division I headnote see page 79]

The articles and parts of articles referred to in Section 212 deal with six main subjects: A, the Earth's gravitational properties; B, the Earth's magnetic properties; C, the Earth's electrical properties; D, the Earth's thermal properties; E, the Earth's mechanical properties; and F, the properties of Earth materials and their deformation.

The outline of subject A begins with the factors that determine the gravitational field at the Earth's surface, especially the effects of the Earth's rotation and of its increase in density toward its centre. After dealing with the three principal systems for measuring the gravitational acceleration of the Earth, the outline goes on to inferences about the properties of the Earth's interior based on interpretations of gravity data. Here, it first treats the theory of an isostatic balance between the elevation of the Earth's surface and the density of the rocks below. It then deals with local, regional, and large-scale irregularities in the gravitational field.

The outline of subject B begins with the mapping of the Earth's main magnetic field in terms of the elements of intensity, dip, and declination, and with the secular variations in that field. It goes on to treat the periodic solar and lunar daily magnetic variations; the geomagnetic disturbances of large amplitude called magnetic storms; and transient variations caused by electric currents on or near the Earth's surface. It next deals with theories of the origin of the main geomagnetic field, theories that also try to account for its secular variation. It concludes with efforts to determine the behaviour of the Earth's magnetic field through geological time, from the study of ferromagnetic rocks.

The outline of subject C, the Earth's electrical properties, treats the currents produced by the motion of charged particles in the Earth's ionosphere; the variation with depth of the electrical properties of the solid Earth; and electric currents within the Earth, those induced by variations in the geomagnetic field and those generated by the Earth's core.

The outline of subject D, the Earth's thermal properties, first deals with the sources of the Earth's heat, the heat generated at the time of the Earth's formation and the heat produced by radio-

active decay. It goes on to the transmission of heat from the Earth's interior to its surface and to the geological aspects of heat flow, with emphasis on volcanic activity.

The outline of subject E begins with the indirect evidence used to determine the basic internal mechanical properties of the Earth—density, pressure, incompressibility, rigidity, and gravitational intensity. It goes on to the Earth's departures from spherical symmetry and from perfect elasticity. Finally, it treats the response of the Earth to stresses of long duration, involving possible large-scale flow of Earth materials.

A. The Earth's gravitational field
[see also 131.B.]

1. Definition of gravity: the factors that determine the gravitational field at the Earth's surface
   a. The hydrostatic figure of the Earth: effects of the Earth's rotation and density distribution on gravity
   b. The reference ellipsoid and standard gravity: approximations to the Earth's average gravitational field
   c. Gravity anomalies: free-air, Bouguer, and isostatic anomalies
   d. Harmonic analysis of gravity: the mathematical representation of the Earth's gravitational field
2. Measurement of gravity: the methods of gravimetry and astrogeodesy; analysis of perturbations of the orbits of artificial satellites
   [see also 723.D.2.d]
3. Interpretation of gravity data: inferences about the Earth's interior
   a. Isostasy: the approximate balance between the elevation of the Earth's surface and the density of the rocks below
   b. Variations in the gravitational field
      i. Local irregularities: their relation to small-scale density differences and their use in geophysical prospecting
      ii. Regional irregularities; their relation to crustal structure
      iii. Large-scale irregularities: their relation to global tectonics

B. The Earth's magnetic properties
[see also 127.C.]

1. The Earth's main magnetic field
   a. Elements of the geomagnetic field: definition of magnetic intensity at the surface of the Earth
   b. World magnetic surveys and magnetic observations
   c. Variations in the main magnetic field: the geomagnetic secular variation
      [see 4.b., below]
2. Transient and short-term geomagnetic fields
   a. Solar and lunar daily magnetic variations
   b. Magnetic storms and substorms: large-amplitude geomagnetic disturbances caused by increased solar activity
   c. Electromagnetic induction and telluric currents: geomagnetic field variations caused by electric currents induced within the Earth
3. Origin of the geomagnetic field
   a. The main geomagnetic field: evidence that the Earth's core is the source of the geomagnetic field

Subject F is the properties of Earth materials and their deformation. The outline first deals with the properties of rocks determined from empirical observation and laboratory tests, covering volumetric, mechanical, thermal, electrical and magnetic, hydraulic, and optical properties. Dealing with the deformation of materials in the Earth's crust, the outline treats stress and strain in rocks; the various types of rock folding; fracture in rocks, including various kinds of faults; the superposition of strains produced by the tectonic events of different ages; and the deformation of ice in ice sheets and glaciers.

articles	article sections	other references
EARTH, GRAVITATIONAL FIELD OF **6**:19–23	**8**:291a–292g	
	6:19c–20h	
	6:19e–f	**6**:3c–d / **8**:291c–d
	6:19f–20a	**6**:3e–4c
	6:20a–g	**8**:292d–g
	6:20g–h / **8**:288e–289a	
	6:20h–21g / **8**:291e–292g	**6**:4d–6b *passim* / **11**:759d–760b
	6:21g–23h	
	6:21g–22f / **6**:62b–c / **8**:166h–167d / **14**:563e–564b	**5**:122g–123a / **6**:3h–4a
	6:22g–23h	**8**:289a
	6:22g–h	
	6:22h–23e	**15**:844f–g
	6:23e–h	
EARTH, MAGNETIC FIELD OF **6**:26–35	**5**:206d–e / **6**:61c–f	
	6:28a–30f / **11**:314c–e	
	6:28a–e	**19**:22h–23e
	6:28e–29h	
	6:30f–32h	
	6:30f–31d	
	6:31d–32e / **2**:376a–377g	
	6:32e–h	
	6:32h–35c	**6**:61c–e
	6:32h–33d	**5**:512a–b

	articles	article sections	other references
b. The dynamo theory of the geomagnetic field: theoretical models of electromagnetic induction processes in a highly conductive fluid core		**6**:33d–34h	**6**:54g–55a / **6**:61d–e
c. The theory of secular variation: interpretations based on the dynamo theory		**6**:34h–35c	
4. Rock magnetism [see also 127.C.5.]	ROCK MAGNETISM **15**:942–947	**6**:61e–f / **15**:962a–g	
a. Magnetization of rocks: induced and remanent magnetism		**15**:943c–945b / **15**:962a–c	
b. The Earth's paleomagnetic field: the record of variation and polar reversal through geological time		**15**:945b–947f / **15**:962d–g	**6**:29h–30f / **13**:910d–h / **17**:724h–725c
i. Geomagnetic polarity reversals		**15**:945c–946c	**16**:444f–g
ii. Polar wandering		**15**:946e–h / **5**:112c–f	**6**:30d–f
iii. Magnetic anomalies over the continents and the oceans		**15**:946h–947f	**16**:444c–446a
C. The Earth's electrical properties [see also 127.B.]	EARTH, MAGNETIC FIELD OF **6**:32		
1. Atmospheric electric current systems: currents produced by the motion of charged particles in the Earth's ionosphere [see also 221.A.4.]		**6**:30f–31d	**2**:325g–h / **2**:376h–377b / **9**:814c–d
2. Electrical conductivity and dielectric behaviour of the Earth's rocks and minerals: variation with depth of the electrical properties of the solid Earth		**15**:962h–963h	**8**:870c–d
3. Electric currents within the Earth: currents induced by variations in the geomagnetic field and currents generated by the Earth's core			**6**:32e–g / **6**:54g–55a / **6**:61d–e
D. The Earth's thermal properties [see also 124.A.4.c.]	EARTH, HEAT FLOW IN **6**:24–26		
1. Sources of the Earth's heat: original heat of formation and radioactive decay [see also 111.C.5.]		**6**:24d–25a / **15**:961b–d	**6**:61g–h
2. Transmission of heat from the Earth's interior to its surface: thermal conductivity and gradients, and heat flow data		**6**:25a–g / **6**:50b–d / **6**:61f–62a / **15**:960d–h	**5**:123a–c / **16**:444a–c
3. Geological aspects of heat flow: convection currents in the Earth, rock metamorphism, and mountain building		**6**:25h–26f / **6**:41e–g / **13**:667d–669d / **15**:950f–951a	**5**:114d–f / **12**:2e–h / **16**:446h–447c
4. Surface manifestations of heat flow: volcanoes and volcanism	VOLCANOES **19**:502–508		
a. General aspects of heat flow: association of volcanoes with localized areas of high heat flow; distribution of volcanoes; catastrophic eruptions; generation of geothermal power		**19**:502e–503a / **6**:26e–f / **9**:214h–215d / **9**:1028d–h	**6**:1017e–h / **9**:227d–g / **19**:20d–e / **19**:98f–99a
b. Volcanic activity: discharge of geysers and other hot springs; ejection of fragments; effusion of lava		**19**:503b–505a / **8**:133g–135b / **9**:214f–g / **9**:227h–232b / **15**:844b–d	**3**:1022d–g
c. Volcanic structure and form: shield volcanoes and stratovolcanoes; monogenetic, composite, and submarine volcanoes		**19**:505b–507d	
d. The origin of volcanoes: formation and movement of magma		**19**:507d–508b / **9**:208e–209d / **13**:667d–h / **15**:961d–h	**9**:227c–d
E. The mechanical properties of the Earth	EARTH, MECHANICAL PROPERTIES OF **6**:35–41		

	articles	article sections	other references
1. General considerations: the fundamental mechanical properties of the Earth's body and the indirect evidence used to determine them		**6**:35d–36b	
2. Nature of deformable media: stress and strain; models of the stress-strain behaviour of materials; seismic waves [see also 126.C. and F.]		**6**:36b–37a	
3. The basic internal mechanical properties of the Earth: density, pressure, incompressibility, rigidity, and gravitational intensity		**6**:37b–39g	
4. The Earth's departures from spherical symmetry: oblateness, lateral variations associated with crustal structure, and isostasy and its effects [see also 211.A.2.b]		**6**:39h–40d / **6**:19e–f	**6**:44b–c / **8**:1002c–1003c / **14**:434d–f
5. Anelasticity in the Earth: departures of the Earth from perfect elasticity		**6**:40d–41c	
6. Response of the Earth to stresses of long duration: possible large-scale flow of Earth materials [see also 241.G.]		**6**:41c–g / **6**:50d–e / **15**:958f–959g	
F. Properties of Earth materials and their deformation			
1. The properties of rocks determined from empirical observations and laboratory tests	ROCKS, PHYSICAL PROPERTIES OF **15**:952–964		
a. Volumetric properties: rock density and porosity		**15**:953a–g	
b. Mechanical properties [see also 126.C., D., and F.]		**15**:953g–960a / **15**:914c–916a	
i. Elasticity: compressibility and the propagation of elastic waves		**15**:953h–955h	**6**:72c–g
ii. Nonelastic properties: compaction, brittle rupture and failure, and brittle-ductile transitional behaviour		**15**:955h–957h	
iii. Plasticity: dislocations and slip		**15**:957h–958f	
iv. Time-dependent deformation: creep		**15**:958f–959g / **16**:196h–197a	
v. Response to shock waves: meteorite impacts		**15**:959g–h / **12**:50h–52a	
vi. Hardness and friability		**15**:959h–960a	
c. Thermal properties		**15**:960a–961h	
i. Specific heat and thermal conductivity		**15**:960a–h / **6**:25a–b	
ii. Thermal expansion and rock melting		**15**:960h–961h / **9**:208e–209d / **9**:222g–223d	
d. Electrical and magnetic properties			
i. Magnetic susceptibility and remanent magnetization of rocks [see B.4., above]			
ii. Electrical conductivity and dielectric behaviour [see C.2., above]			
e. Hydraulic properties: porosity and permeability; the capacity to store and transmit fluids		**15**:963h–964c / **8**:435h–436e / **12**:860f–h / **14**:169c–170a	
f. Optical properties: colour and lustre		**15**:964c–e	
2. The deformation of materials in the Earth's crust	ROCK DEFORMATION **15**:913–923		
a. Stress and strain of rocks		**15**:914c–916a / **15**:914c–h / **12**:50h–52a	**6**:36b–37a
i. Response to stress		**15**:914h–916a	
ii. Elastic and plastic deformation: reversible and irreversible displacements			
b. Folding of rocks		**15**:916a–918h / **5**:122d–g / **12**:584b–e	**12**:589c
i. Types of tectonic folding; *e.g.*, flexure, slip, and flexural-slip folding		**15**:916a–917f / **12**:579e–h	

	articles	article sections	other references
ii. Foliation and lineation: linear features in rocks subjected to stress		**15**:917g–918c	**12**:6a–d
iii. Nappes: large rock sheets that have moved over the rock formations beneath and in front of them		**15**:918c–e	**1**:633h–634c
iv. Diapiric structures; *e.g.*, salt domes [see also 724.B.1.c.ii.]	SALT DOMES **16**:195–199	**15**:918e–f	
v. Nontectonic folding; *e.g.*, slumping of recently deposited sediments		**15**:918g–h / **16**:470f–471a	
c. Fracture in rocks		**15**:918h–922h	
i. Joints, joint sets, and joint patterns		**15**:919a–920f	**8**:876f–g / **19**:703e–h
ii. Faults and faulting; *e.g.*, normal, transcurrent, and thrust faults		**15**:920f–922h / **15**:843g–844b	**6**:68e–h / **16**:446b–e
d. Structural interference: the superposition of strains produced by the tectonic events of different ages		**15**:922h–923g	
e. The deformation of ice in sheets and glaciers: flow and fracture of ice [see also 222.A.3.a.]		**9**:177f–178a / **9**:179a–d / **9**:182b–d / **9**:184c–g	**12**:154g–155c

Section 213. The structure and composition of the Earth's interior

[for Part Two headnote see page 79
for Division I headnote see page 79]

The articles and parts of articles referred to in Section 213 deal with four main subjects: A, the Earth's concentric layers; B, earthquakes; C, the distribution of elements in the Earth's interior; and D, the indirect evidence used to infer the structure and composition of the Earth's interior.

The outline of subject A begins with the basic physical properties and zonal structure of the Earth. It goes on to treat the basic divisions of the solid Earth, covering the different composition of the markedly differentiable shells, called the crust, the mantle, and the core, and of the transitional zones between them.

The outline of subject B treats the natural and artificial causes of earthquakes; the distribution of earthquakes; and the magnitude, motion, and energy of earthquakes.

Subject C, the distribution of elements in the Earth's interior —in its core, mantle, and crust—is dealt with in detail in the next section, Section 214.

Subject D involves the indirect evidence used to infer the structure and composition of the Earth's interior. The outline deals first with geophysical evidence, especially that afforded by seismic wave velocities, but also other geophysical evidence, such as the Earth's moment of inertia and its density distribution. It then deals with geochemical evidence, covering investigations of geochemical equilibria at high temperatures and pressures; the composition of meteorites that may correspond to rocks forming the Earth's interior; and evidence from crustal igneous rocks derived from the upper mantle.

	articles	article sections	other references
A. The Earth's concentric layers	EARTH, STRUCTURE AND COMPOSITION OF **6**:48–57		
1. Physical properties and zonal structure of the Earth: the variation with depth of seismic wave velocities, density, pressure, temperature, electrical conductivity, and elastic and rheological properties [see also 212]		**6**:49d–50e / **6**:10b–c	**6**:702h–703a
2. The basic divisions of the solid Earth		**6**:50e–55c	
a. The crust: the Earth's outer layer, which may be differentiated into continental and oceanic crust		**6**:50e–51e / **5**:120b–f / **6**:703h–709c / **13**:433h–434d	
b. The Mohorovičić Discontinuity: the zone that separates crust from mantle		**6**:51e–h	
c. The mantle: the layer between crust and core that comprises the bulk of the Earth's volume		**6**:51h–54f / **6**:703d–h / **16**:764a–d	
i. The upper mantle		**6**:51h–53e / **5**:120f–h / **9**:222g–223d	**5**:114d–f / **6**:703f–g / **12**:8f–g / **13**:562h–563c
ii. The transition zone		**6**:53e–54c	
iii. The lower mantle		**6**:54c–f	
d. The core: the Earth's innermost region, assumed to be liquid except for a probably solid inner core		**6**:54f–55c / **6**:703c–d	
3. The development of the Earth's structure and composition [see 241.A.]			

	articles	article sections	other references
B. Earthquakes: sources of seismic waves within the Earth	EARTHQUAKES 6:68–73		14:434b–c
1. Causes of earthquakes		6:68e–69b	
a. Natural causes: rock fracture and volcanism		6:68e–h	15:957d–f
b. Artificial causes; *e.g.*, nuclear explosions, filling of reservoirs		6:69a–b	
2. Distribution of earthquakes		6:69c–70h	5:113e–114b
a. Geographic and geologic occurrence: confinement of major earthquake activity to narrow belts		6:69c–70a	12:579b–c / 15:844e
b. Deep-focus earthquakes: occurrence of earthquakes in the Earth's mantle		6:70b–h	9:1029b–e
3. Magnitude, motion, and energy of earthquakes [see also 126.C. and 128.A.]		6:70h–73e / 6:8e–f	
a. Seismic intensity and magnitude scales		6:70h–72b	
b. Seismograms and their interpretation: the physical characteristics of seismic waves [see also 723.F.6.]		6:72c–73e / 6:36g–37a / 16:491e–492b	15:955b–h
C. Distribution of elements in the Earth's core, mantle, and crust [see 214.C.]			
D. The indirect evidence used to infer the structure and composition of the Earth's interior			
1. Geophysical evidence, mainly from earthquake analyses [see also 212.E.]		6:37b–39b	13:562h–563c
a. Seismic wave velocities		6:37e–38b / 6:59f–60a	6:50e–55c *passim* / 11:499f–h
b. Other geophysical evidence; *e.g.*, the Earth's moment of inertia, density distribution		6:61c–e	6:37b–39b *passim*
2. Geochemical evidence		6:60e–61a	
a. Investigations of geochemical equilibria at high temperatures and pressures: phase transitions in the Earth's interior [see also 214.A.5.a.]		7:1026h–1027a	6:51e–54f *passim*
b. The composition and mineralogy of meteorites that may correspond to rocks forming the Earth's interior [see also 133.A.4.d.i.]			6:56b–d / 13:563c–d
c. Evidence from crustal igneous rocks that are derived from the upper mantle; *e.g.*, andesite lava flows, peridotite and eclogite inclusions in lava flows and some igneous rocks			6:52d–53a / 9:221c–e / 12:8f–g

Section 214. The Earth's constituent minerals and rocks

[for Part Two headnote see page 79
for Division I headnote see page 79]

The articles and parts of articles referred to in Section 214 deal with three main subjects: A, the mineral constituents of the Earth; B, the rocks that comprise the Earth's crust; and C, the distribution of elements in the Earth.

The outline of subject A begins with the chemical composition, internal structure, and external morphology of crystals, subjects that involve major means for determining the identity of mineral species and varieties. It goes on to the classification of minerals in terms of structure and composition, the physical properties of minerals, and the occurrence of minerals in nature. It concludes with the responses of the Earth as a chemical system to change in physical factors, covering geochemical equilibria at high temperatures and pressures and geochemical equilibria at low temperatures and pressures.

Subject B is the rocks that comprise the Earth's crust. The outline first covers the three broad classes of rocks—the igneous rocks that have crystallized from molten silicate solutions within or above the Earth's crust; the sedimentary rocks deposited by glaciers and ice sheets, wind, or water, or produced by biogenic processes; and the metamorphic rocks of the Earth's crust which formed by the physicochemical alteration of pre-existing rocks. For each of these classes of rocks, the outline treats the modes of formation, the physical and chemical properties, the principal types, and their distribution. It concludes with the rock associations formed in different environments of the Earth's crust: in the oceanic regions, in the stable continental regions, in the continental borderlands, in the island arcs, in the major mountain ranges, and in the piedmont regions adjacent to mountain regions.

Subject C involves the determination of the relative and absolute abundances of the chemical elements in the Earth and its various parts. The outline first deals with estimates, made from the studies of the composition of the Sun, other stars, and the Moon, about the overall abundances of the elements in the universe. Treating the terrestrial abundances, the outline covers the distribution of chemical elements in the Earth's core; in its mantle; in the Earth's crust, with particular reference to the various kinds of mineral fuels (coals, petroleum, oil shales, and natural gas); in soils; in the hydrosphere; and in the atmosphere. An article referred to deals separately with the physiological concentration of elements,

defined as the accumulation of an element in concentrations greater than those in the surrounding environment as a result of the physiological processes of plants and animals. At the end, it treats the geochemical cycle, an overall concept of the migration of elements throughout the atmosphere, the hydrosphere, and the solid Earth.

	articles	article sections	other references
A. The mineral constituents of the Earth	MINERALS **12**:233–245		
1. Crystallography: the chemical composition, internal structure, and external morphology of crystals	CRYSTALLOGRAPHY **5**:339–347	**12**:234a–236a / **1**:707f–709a / **7**:213a–215a / **7**:219b–221b / **12**:94f–95c / **13**:561c–562a / **15**:319c–321b / **19**:1139h–1140f	**3**:833f–836d *passim* / **3**:845g–846a / **4**:700d–703c *passim* / **5**:333h–334d / **14**:284d–287d *passim* / **16**:752a–754g *passim*
2. Classification of minerals in terms of crystal structure and chemical composition [see also 122.D.]		**12**:236b–239f	
a. The principal nonsilicate minerals			
i. Native elements	NATIVE ELEMENTS **12**:853–858	**12**:236f / **3**:845c–846c / **7**:971b–h	**8**:237a–c
ii. Sulfides, including arsenides and antimonides [see also 4.c., below]	SULFIDE MINERALS **17**:785–791	**12**:236g–h	
iii. Sulfosalts		**12**:236h–237a	
iv. Oxides and hydroxides		**12**:237a–g / **7**:970c–971b / **7**:975b–c	
v. Halides		**12**:237g–238a	
vi. Carbonates	CARBONATE MINERALS **3**:833–838	**12**:238a–b	**3**:1023f–1024c
vii. Nitrates and iodates		**12**:238b	
viii. Borates		**12**:238c–d	
ix. Sulfates		**12**:238d–g	**6**:1133h–1134h *passim*
x. Chromates		**12**:238h	
xi. Phosphates, including vanadates and arsenates	PHOSPHATE MINERALS **14**:284–288	**12**:238h–239a / **7**:976a–b / **13**:129b–c / **14**:289b–g	
xii. Tungstates and molybdates		**12**:239a	
b. The silicate minerals	SILICATE MINERALS **16**:756–764	**12**:239b–f	
i. Silicate structure and composition: the basic structural units, the silica tetrahedra and octahedra; the substitution in silicate structures of ions other than silicon		**16**:756f–757b	
ii. Isolated or double tetrahedral group silicates: minerals with silicate tetrahedra that are unconnected or connected by groups of two		**16**:757h–759b / **13**:561g–562a	
iii. Chain silicates: minerals with silica tetrahedra that are connected together in single or double chains		**16**:759b–761a / **1**:707f–709a / **15**:319c–320b	
iv. Sheet silicates: minerals with silica tetrahedra that are connected together in two-dimensional sheets		**16**:761a–g / **12**:94f–95c	
v. Framework silicates: minerals with silica tetrahedra that are connected together in three-dimensional frameworks		**16**:761h–763e / **7**:213a–d / **19**:1139h–1140g	**7**:219b–221b *passim*
3. The physical properties of minerals; *e.g.*, hardness, cleavage, specific gravity, and magnetic, electrical, optical, and thermal properties		**12**:239f–242f / **4**:704c–f / **7**:215b–216h / **7**:221c–f / **13**:562a–c / **19**:1141c–f	**7**:969d–976e *passim* / **12**:93f–94d / **14**:284d–287d *passim* / **16**:752a–754g *passim* / **17**:786g–789g *passim*

	articles	article sections	other references
4. The occurrence of minerals in nature		**12**:242f–244f	
a. The major rock-forming mineral groups		**16**:636h–637c	**16**:757h–763e *passim*
i. The olivines; *e.g.*, forsterite, fayalite	OLIVINES **13**:560–564	**7**:973d	**16**:757h–758a
ii. The pyroxenes; *e.g.*, augite, jadeite	PYROXENES **15**:318–322		**7**:972h–973a / **16**:759b–760c
iii. The amphiboles; *e.g.*, hornblende, tremolite	AMPHIBOLES **1**:707–710		**7**:972g–h / **16**:760e–761a
iv. The micas: *e.g.*, muscovite, biotite	MICAS **12**:93–96	**16**:761a–g	
v. The feldspars; *e.g.*, orthoclase, albite	FELDSPARS **7**:212–218	**7**:971h–972c	**16**:762a–e
vi. The feldspathoids; *e.g.*, nepheline, leucite	FELDSPATHOIDS **7**:218–222	**7**:973b–c	**16**:762f–g
vii. The silica minerals; *e.g.*, quartz, tridymite	SILICA MINERALS **16**:751–756	**7**:973e–975b	**12**:52g–53c / **16**:761h–762a
viii. The clay minerals; *e.g.*, kaolinite, illite	CLAY MINERALS **4**:700–706	**7**:1033g–1034f / **16**:1018g–1020c	
ix. The carbonates; *e.g.*, calcite, dolomite [see A.2.a.vi., above]			
x. The zeolites; *e.g.*, natrolite, heulandite	ZEOLITES **19**:1139–1143		**16**:763a–e
b. The occurrence of mineral associations		**12**:243b–244f / **13**:562d–563h / **14**:287a–288d / **16**:754h–756a / **16**:763e–764g	
i. In igneous and metamorphic rocks		**12**:243b–e / **3**:836h–837a / **9**:202c–203c / **12**:4f–g / **13**:562d–h / **15**:949f–950a / **19**:1142d–e	**1**:709a–710a / **7**:221f–222h *passim* / **9**:220d–g / **9**:229f–g / **11**:486e–487a / **16**:763e–764d *passim*
ii. In ore deposits		**12**:243e–g / **13**:666d–g / **17**:790a–c	
iii. In sedimentary rocks and precipitates		**12**:243g–244b / **3**:837b–f / **4**:705b–e / **8**:296d–297b / **19**:1142f–g	**11**:24g–25b / **16**:469a–c / **16**:763f–g
iv. In the Moon, planets, and meteorites		**12**:244b–f / **12**:44h–45c / **13**:562h–563d / **16**:764d–g	
c. Ore deposits: concentrations of metals and metalliferous minerals [see also 724.C.3.]	ORE DEPOSITS **13**:661–671		
i. The nature, genesis, and classification of ore deposits		**13**:663b–667d / **12**:243e–g / **17**:790a–c	**6**:706f–707d / **9**:225b–c
ii. Earth processes involved in the formation and distribution of ore deposits; *e.g.*, magmatic concentration; hydrothermal processes		**13**:667d–671e	**6**:706h–707d / **9**:224h–225c
iii. Metallogenic epochs and provinces: the occurrence of episodes of mineralization throughout geological time		**13**:671e–h / **6**:13a–b	
iv. The occurrence and distribution of ore deposits		**1**:641g–642b / **4**:570d–f / **9**:894f–895b / **10**:728a–b / **11**:922b–c / **15**:521b–f / **18**:455f–g / **18**:1034h–1035b / **19**:1147c–e	**4**:808c–d / **8**:237b–c / **13**:71e–h / **16**:776h–777a
d. Minerals of gem quality; *e.g.*, beryl, corundum, diamond	GEMSTONES **7**:969–976	**10**:164g–165c	**3**:845d–846b *passim* / **16**:754d–f

	articles	article sections	other references
5. Geochemical equilibria			
a. Geochemical equilibria at high temperatures and pressures	GEOCHEMICAL EQUILIBRIA AT HIGH TEMPERATURES AND PRESSURES **7**:1022–1028		**12**:244f–245d *passim*
i. Relevant thermodynamic principles: *e.g.*, phase diagrams, the phase rule [see also 124.A.]		**7**:1023c–1024c / **8**:868d–870c / **14**:204f–205h / **15**:949d–f	
ii. Phase equilibria in mineral systems; *e.g.*, equilibria in systems of one, two, or more components		**7**:1024c–1026g / **3**:838a–c / **9**:209e–210a / **9**:210h–211e / **14**:205h–210c / **15**:321b–322e	**12**:1b–2a
iii. Areas of application of high-temperature–high-pressure studies; *e.g.*, phase transitions in the Earth's interior; geological thermometry and barometry		**7**:1026h–1028a / **1**:710b–e / **7**:216h–218c / **9**:210a–h / **12**:95f–96b / **13**:563h–564e / **14**:288d–g / **15**:949f–950a	**3**:846a–c / **6**:50e–55c *passim* / **7**:221f–222h *passim* / **9**:223h–224b / **12**:52d–53d / **13**:665e–669g *passim* / **16**:757a–b / **16**:764a–d
b. Geochemical equilibria at low temperatures and pressures	GEOCHEMICAL EQUILIBRIA AT LOW TEMPERATURES AND PRESSURES **7**:1028–1035		**12**:244f–245d *passim*
i. Principles and techniques: thermodynamic fundamentals and geochemical diagrams [see also 124.A.]		**7**:1028f–1032b / **14**:204f–210c	
ii. Geochemical equilibria of significance in nature; *e.g.*, equilibria of carbonates in water		**7**:1032b–1035c / **3**:836d–h / **3**:838d–f / **6**:1133d–1135a / **7**:735b–737h	**3**:1023f–1024d
		16:763e–764a	
B. The rocks that comprise the Earth's crust			
1. The igneous rocks: the predominant solid constituents of the Earth that form through the cooling of molten or partially molten material at or beneath the Earth's surface	IGNEOUS ROCKS **9**:201–213		**13**:909h–910b
a. Properties of igneous rocks		**9**:201f–206d	**7**:1055c–f
i. Chemical composition		**9**:201h–202c	**6**:704b–705g
ii. Mineral composition		**9**:202c–203c	**12**:243b–c
iii. Textures and fabrics		**9**:203c–204g	
iv. Structural features; *e.g.*, clastic structures, flow structures, fractures, inclusions		**9**:204g–206b	**15**:918e–f / **15**:920c–f
v. Colour and specific gravity		**9**:206b–d	
b. Classification of igneous rocks		**9**:206d–208d	
i. According to mineralogy and texture		**9**:206d–208b	
ii. According to chemical composition		**9**:208c–d	
c. Formation of igneous rocks [see also 212.D.4.]		**9**:208e–211e	
i. The nature of magmas		**9**:208e–209a / **9**:222g–224h / **19**:507d–508b	**9**:227c–d
ii. Crystallization from magmas: influence of melt temperature and pressure; phase equilibria in silicate melts; Bowen's reaction series		**9**:209a–210h / **7**:1027c–g	
iii. Effects of volatile constituents and late magmatic processes		**9**:210h–211e / **9**:224h–225e	**15**:961f–h
d. Occurrence of igneous rocks		**9**:211e–213e	
i. Distribution and abundance of igneous rocks		**9**:211h–212b	
ii. Rock kindreds, or associations, and petrographic provinces: groups of rocks of similar mineralogy and chemical composition		**9**:212b–f	

	articles	article sections	other references
iii. Diversification of magmas: mechanisms of magma generation		**9**:212f–213e	
e. Principal families of igneous rocks			
i. The intrusive igneous rocks that result when magma cools and solidifies below the surface of the Earth; *e.g.*, granite, gabbro, diorite	IGNEOUS ROCKS, INTRUSIVE **9**:219–227		**6**:50f–51h *passim* / **15**:920c–f
ii. The extrusive igneous rocks that form from magma that erupts at the surface of the Earth; *e.g.*, basalt, rhyolite, andesite	IGNEOUS ROCKS, EXTRUSIVE **9**:213–219	**19**:504d–505a	**14**:528f–h
iii. The pyroclastic igneous rocks that form from deposits of explosive volcanic eruptions; *e.g.*, pumice, tuff, scoria	IGNEOUS ROCKS, PYROCLASTIC **9**:227–233	**19**:503f–504d	**9**:208b
2. The sedimentary rocks of the Earth's crust: rocks that were deposited by or precipitated from ice, wind, or water, or produced by biogenic processes	SEDIMENTARY ROCKS **16**:463–474	**13**:479h–480f	**7**:1056a–b / **13**:909c–f
a. Classification systems		**16**:464d–467b	
i. Clastic rocks		**16**:464h–466c / **16**:214g–216d	
ii. Nonclastic rocks		**16**:466c–467b	
b. Properties of sedimentary rocks		**16**:467c–469e / **4**:1110c–1111e / **8**:295e–298b / **10**:980b–982a / **11**:24f–25d / **16**:635b–636e / **16**:765e–766a	
i. Texture		**16**:467c–468e / **10**:980d–982a / **16**:213g–214e	**4**:1110c–g
ii. Mass properties; *e.g.*, cementation, colour, density, elasticity, porosity		**16**:468f–469a / **16**:635g–h	**4**:1111c–d / **16**:765e–g
iii. Geochemical properties		**16**:469a–c / **3**:837b–f / **8**:296d–298b / **10**:980b–d / **16**:214e–f	**6**:705h–706d / **11**:24h–25b / **16**:635d–g / **16**:763f–g
iv. Fabric		**16**:469d–e / **16**:636c–e	
c. Sedimentary structures		**16**:469e–471a / **16**:635h–636b / **16**:766a–c	**8**:295f–296c
i. External stratification		**16**:469e–g	**16**:766a–b
ii. Bedding and bedding planes		**16**:469g–470e / **16**:213c–g	**8**:295f–296b
iii. Deformation structures		**16**:470f–471a / **15**:918g–h	
d. Sedimentary environments		**16**:471b–472h / **10**:983a–984b / **16**:636e–g / **16**:766c–767d	**16**:459d–461d *passim*
i. Marine environment		**16**:471e–472a / **6**:1135h–1137g / **8**:298d–299e	**10**:983h–984b / **11**:499e–f
ii. Mixed marine and nonmarine environment		**16**:472a–c	**10**:983d–g
iii. Nonmarine environment		**16**:472c–472h / **6**:1135c–h	**4**:1111e–1112f *passim* / **10**:983c–d
e. Distribution of sedimentary rocks through time		**16**:472h–474b / **6**:1138h–1139e / **16**:767e–h	
i. Rock type variation		**16**:472h–473d / **16**:637c–e	
ii. Rates of accumulation		**16**:473d–f	
iii. Sedimentary models: inferences concerning the mode of emplacement and the sources of sedimentary deposits		**16**:473f–474b / **6**:1135b–1138g	**16**:766c–767d *passim*
f. Principal types of sedimentary rocks			
i. Conglomerates, tillites, and other heterogeneous clastic rocks	CONGLOMERATES AND BRECCIAS **4**:1109–1113		**16**:465b–e

	articles	article sections	other references
ii. Quartzose sandstones and arkoses	SANDSTONES **16**:212–216	**4**:731h–732b	**16**:465e–466b
iii. Graywackes	GRAYWACKES **8**:295–299		
iv. Shales	SHALES **16**:634–638	**13**:536c–539g	
v. Loess	LOESS **11**:24–28		**8**:176d–e/**19**:844g–h
vi. Limestones and dolomites	LIMESTONES AND DOLOMITES **10**:979–985		**3**:837b–e/**16**:466c–h
vii. Evaporites [see also 724.B.1.c.ii.]	EVAPORITES **6**:1132–1139	**4**:731f–g/ **5**:1091b–c/ **16**:193h–194b/ **16**:195h–196a/ **19**:34h–35b	**13**:669f–g/**14**:553h–555c
viii. Siliceous rocks	SILICEOUS ROCKS **16**:765–767		
ix. Phosphorites	PHOSPHORITES **14**:288–290		
x. Coals [see C.4.a., below]			
3. The metamorphic rocks of the Earth's crust: rocks that have formed by the physicochemical alteration of pre-existing rocks	METAMORPHIC ROCKS **12**:1–10		**7**:1056f–1057a/**13**:910b–d
a. Formation and classification of metamorphic rocks	ROCK METAMORPHISM, PRINCIPLES OF **15**:947–952	**12**:2e–4e	
i. Types of metamorphism; *e.g.*, contact, regional, hydrothermal, progressive and regressive		**15**:948c–g/ **12**:3a–e/ **6**:26c–d/ **12**:52d–53g	**12**:243d–e
ii. Grades of metamorphism: the degree to which metamorphic changes have occurred		**15**:948g–950e	
iii. Temperature and pressure of metamorphism		**15**:950e–951b/ **7**:1027a–c	
iv. The origin of metamorphic texture and structure		**15**:951b–952b	
v. Metamorphic differentiation		**15**:952b–c	
vi. The alteration of limestones and dolomites to form marbles	MARBLES **11**:486–487		
vii. Types of metamorphic rocks; *e.g.*, schist, slate, gneiss, hornfels		**12**:3f–4e	
b. Physical and chemical characteristics of metamorphic rocks		**12**:4f–6g	
i. Metamorphic minerals		**12**:4f–g/ **15**:949f–950a	**16**:763g–764a
ii. Rock composition		**12**:4g–5e	**6**:706e–f
iii. Metamorphic facies		**12**:5e–6a/ **15**:950a–e	
iv. Textures and fabrics		**12**:6a–g/ **15**:917g–918c	
c. Rocks of the principal facies		**12**:6g–9d	
i. Facies associated with contact metamorphism; *e.g.*, sanidinite facies, pyroxene–hornfels facies		**12**:6g–7d	
ii. Facies associated with regional metamorphism; *e.g.*, zeolite facies, greenschist facies, amphibolite facies		**12**:7d–8e	
iii. The eclogite and granulite facies		**12**:8f–9d	
d. Distribution of metamorphic rocks		**12**:9d–10c	
4. The rock associations formed in different environments of the Earth's crust		**9**:217a–219e/ **16**:767e–h	
a. In the oceanic regions: basaltic lavas, reef limestones, and abyssal sediments of the deep oceans		**6**:1137c–g/ **9**:215d–h/ **9**:217b–218d/ **11**:498d–h	**10**:983h–984b

	articles	article sections	other references
b. In the stable continental regions: conglomerates, sandstones, evaporites, and coal measures		**4**:793a–c / **4**:1112f–1113d / **5**:396c–397f / **6**:1135c–h / **9**:219c–e	**10**:983c–d / **11**:25d–h / **16**:215c–e
c. In the continental borderlands: sandstones, shales, and limestones		**6**:1135h–1137c	**10**:983d–g / **12**:583b–d / **16**:215g–216a / **16**:634d–g
d. In the island arcs: andesite and spilite lavas, ultrabasic intrusive rocks, graywackes, and shales		**8**:298b–d / **9**:215h–216e / **9**:1027h–1028d	**8**:299c–e / **12**:581g–583b
e. In the major mountain ranges: regionally metamorphosed rocks, granitic batholiths, early-stage basalts and peridotites, and late-stage andesite lavas		**9**:211h–212f / **9**:218d–219b / **12**:7d–8e / **12**:579h–580c	**12**:590d–592d *passim*
f. In the piedmont regions that are adjacent to mountain ranges: gabbros, basalts, and arkoses		**9**:216e–217a	**16**:215e–f
C. Distribution of elements in the Earth: comparison of terrestrial abundances of the elements with absolute, or cosmic, abundances [see also 121.D.2.]	ELEMENTS, GEOCHEMICAL DISTRIBUTION OF **6**:700–713	**4**:117f–g	
1. In the core		**6**:703c–d	**6**:54h–55c
2. In the mantle		**6**:703d–h	
3. In the crust		**6**:703h–709c / **3**:845b–c / **3**:848h–849a / **3**:850e–f / **3**:851d–e / **15**:516e–517b	
a. Igneous rocks		**6**:704b–705g / **9**:201h–202c	
b. Sedimentary rocks		**6**:705h–706d	
c. Metamorphic rocks		**6**:706e–f	
4. In mineral fuels		**6**:707d–708e	
a. Coals [see also 724.B.1.c.i. and C.2.]	COALS **4**:790–795		**14**:739c–d
i. Classification of coals		**4**:790d–791e / **4**:773f–g	
ii. Physical and chemical characteristics of coals		**4**:791e–792h / **13**:536h–537f	
iii. Origin of coals		**4**:793a–795a / **4**:732b–c	**6**:707e–708b / **17**:839h–840d
b. Petroleum [see also 122.E.1.a. and 724.B.2. and C.1.]	PETROLEUM **14**:164–175		**6**:708b–c
i. Physical and chemical characteristics of petroleum		**14**:166e–167f / **14**:180h–181c	
ii. Origin of petroleum		**14**:167g–169b	
iii. Migration and accumulation of petroleum in porous rocks		**14**:169b–172e / **8**:438f–439c	
iv. Occurrence and distribution of petroleum		**14**:172e–175g	**14**:175h–177a
c. Oil shales [see also 122.E.1.a. and 724.B.2. and C.1.]	OIL SHALES **13**:535–539		
i. Organic content of oil shales		**13**:536c–f	
ii. Properties of oil shales and related coals		**13**:536h–537f	
iii. Origin of oil shales		**13**:537f–538g	
iv. Occurrence and distribution of oil shales		**13**:538g–539g	
d. Natural gas	NATURAL GAS **12**:858–863	**7**:923d–924b	**6**:708d–e
i. Physical and chemical characteristics of natural gas		**12**:859a–860b	
ii. Origin of natural gas		**12**:860b–h / **14**:169a–b	
iii. Occurrence and production of natural gas [see 724.B.2.]			
5. In soils		**6**:708e–709c	**16**:1018h–1021g *passim*

6. In the hydrosphere
[see 222.B.1. and C.1.]
7. In the atmosphere
[see 221.A.1.c.]
8. The selective concentration of elements by plants and animals
9. The geochemical cycle: the primary geochemical differentiation of the Earth; the migration of elements throughout the atmosphere, hydrosphere, and solid Earth

articles	article sections	other references
ELEMENTS, PHYSIOLOGICAL CONCENTRATION OF **6**:713–715	**5**:164d–e / **16**:766c–g	**2**:1040f–1041g *passim* / **11**:497c–d
	6:712a–713c / **6**:56g–57d / **12**:242f–243b	**2**:1039g–1042h *passim* / **6**:52f–53a

Division II. The Earth's envelope: its atmosphere and hydrosphere

[for Part Two headnote see page 79]

The outlines, and the articles and parts of articles referred to, in the four sections of Division II treat the Earth's atmosphere; its hydrosphere; the motions of the sea; and weather and climate.

The outline and the articles referred to in Section 221 treat the structure, composition, and physical properties of the atmosphere; and the large-scale motions of the atmosphere.

Section 222 treats the types and the distribution of waters in the Earth's hydrosphere; the physical and chemical properties of seawater; the geochemistry of freshwater; and the hydrologic cycle, the group of paths through which the water in nature circulates and is transformed from one state to another.

Section 223, on the motions of the sea and the forces that cause them, treats the interactions between ocean and atmosphere; the kinds of waves in the hydrosphere; and the distribution and causes of surface and subsurface ocean currents.

Section 224, on weather and climate, treats the condensation of water in the atmosphere, producing clouds, fogs, and precipitation; weather disturbances—cyclones and anticyclones, thunderstorms, and lightning, tornadoes, hurricanes, and typhoons; weather forecasting; and the statistical aggregates of weather called climates.

Section 221. The atmosphere 92
222. The hydrosphere: the oceans, freshwater bodies, and ice masses 94
223. The motions of the sea and the forces that cause them 97
224. Weather and climate 99

Section 221. The atmosphere

[for Part Two headnote see page 79]

The articles and parts of articles referred to in Section 221 deal with two main subjects: A, the structure, composition, and physical properties of the atmosphere; and B, the large-scale motions of the atmosphere.

The outline of subject A begins with a general description of the regions of the atmosphere, the several layers that are characterized by the pattern of vertical distribution of temperature. It goes on to the chemical reactions and physical processes that occur in the homosphere, the layer of generally uniform composition below an altitude of about 60 miles, and in the heterosphere, above an altitude of 60 miles, where diffusive separation results in a variation of chemical composition with height. An article referred to gives separate treatment to the ionosphere, the upper region that overlaps the mesosphere, thermosphere, and exosphere, in which most of the atoms and molecules have become ionized or electrically charged. The outline next deals with the exosphere, the outermost layer of the atmosphere that grades into interplanetary space, and gives separate treatment to the Van Allen radiation belts, zones of charged particles trapped in the magnetic field of the Earth, which were discovered after the first Earth satellite and space probes.

The outline of subject B—winds and storms—begins with the resolution of winds into zonal (east–west), meridional (north–south), and vertical components and with the relation of winds to pressure, temperature, and the Earth's rotation. After dealing with jet streams, which are high-velocity, narrow air currents in the upper troposphere and the stratosphere, the outline covers the westerlies of mid-latitudes, tropical wind systems, including trade winds and tropical disturbances such as hurricanes and typhoons; stratospheric and mesospheric wind systems; and the mean meridional circulations of the atmosphere. It concludes with broad causal questions about the driving mechanisms for the general circulation of the atmosphere: the energy balance and the transport of heat and momentum.

	articles	article sections	other references
A. The structure, composition, and physical properties of the atmosphere [see also 241.B. and 723.G.5.]	ATMOSPHERE **2**:307–313	**2**:321e–322a	**19**:698h–699c
1. Regions of the atmosphere: the atmospheric layers characterized by the pattern of vertical distribution of temperature		**2**:307d–308g/ **4**:718b–e	
a. The lower atmosphere: the troposphere, the stratosphere, and the mesosphere		**2**:307d–h	
b. The upper atmosphere: the thermosphere and the exosphere		**2**:307h–308c	
c. The composition of the atmosphere: the gross composition and regional variations [see also 224.A.1. and D.2.c.ii.]		**2**:308d–g/ **6**:710g–712a/ **9**:108d–109a	
2. The homosphere: the layer of the atmosphere below an altitude of about 60 miles (100 kilometres) that maintains a generally uniform composition		**2**:308g–309d	
a. The effects of ultraviolet radiation: photodissociation of molecules		**2**:308h–309c	
b. Mechanisms of air mixing: molecular and turbulent diffusion		**2**:309c–d	
3. The heterosphere: the layer of the atmosphere above an altitude of about 60 miles (100 kilometres) where diffusive separation results in variation of composition with height		**2**:309d–312a	
a. Oxygen dissociation in the lower thermosphere		**2**:309e–f	
b. Effects of vertical transport: the distribution of atmospheric constituents		**2**:309g–310b	
c. Variations in atmospheric densities		**2**:310c–h	
d. The escape of helium and hydrogen from the upper atmosphere		**2**:310h–311e	
e. Ionization mechanisms [see also 4.b., below]		**2**:311e–312a	
4. The ionosphere: the upper region of the atmosphere that overlaps the mesosphere, thermosphere, and exosphere, and in which most of the atoms and molecules have become ionized, or electrically charged [see also 127.B.2.]	IONOSPHERE **9**:809–816		
a. The gross features of the ionosphere		**9**:810c–g	
b. Formation and characteristics of the ionosphere		**9**:810h–814b/ **2**:325e–326a	
i. Ionospheric processes: production and loss of ions		**9**:810h–812d/ **2**:311e–312a	
ii. The vertical structure of the ionosphere		**9**:812d–814b	
c. Ionospheric variations and disturbances of atmospheric origin; *e.g.*, effects of atmospheric tides and gravity waves		**9**:814b–g/ **6**:30f–31d	**2**:325g–h
d. Ionospheric variations and disturbances of solar origin: magnetic and auroral storms; Northern Lights [see also 133.B.]	AURORAS **2**:373–377	**9**:814h–815f/ **2**:326e–g/ **6**:31d–32e **9**:815g–816d/ **15**:425g–426a	**19**:22f–h
e. Probing the ionosphere: the effects of the ionosphere on radio waves [see also 735.I.4.]		**2**:312a–313f/ **9**:788h–789b	**2**:321f–h
5. The exosphere: the outermost layer of the atmosphere that grades into interplanetary space		**2**:312b–g	
a. Effects of low particle density on the properties of the exosphere: the temperature of gases in the exosphere; the vertical gradation of particle collisions		**2**:312g–313a	
b. Determination of the critical zone, the layer above which the number of particle collisions is negligible		**2**:313a–f	
c. Particle trajectories in the exosphere: particles with ballistic trajectories, entrapped particles, particles with escape velocities, extraterrestrial particles			
d. The Van Allen radiation belts: zones of charged particles trapped in the magnetic field of the Earth [see also 212.B.]	VAN ALLEN RADIATION BELTS **19**:21–23		
i. Characteristics of the belts: constituent particles and their trajectories		**19**:21f–22h	

ii. Their relation to the magnetosphere and the solar wind
[see also 133.B.]

B. The large-scale motions of the atmosphere
[see also 224, 232.A.4., and 723.G.5.]

1. The general nature and relative scales of atmospheric motions: the resolution of winds into zonal (east–west), meridional (north–south), and vertical components
2. The relation of wind to pressure and temperature: the cause of winds, the effect of Coriolis force, and idealized winds derived from simplified models—the geostrophic and thermal winds
[see also 211.A.2.a.]
3. Jet streams: high-velocity, narrow air currents in the upper troposphere and the stratosphere
   a. The cause and formation of jet streams: transport of heat from the Equator to the poles; effects of the Earth's rotation
   b. Occurrence and behaviour of jet streams in atmospheric models: laboratory studies of jet streams
   c. Mean and eddy transports in the jet stream region: the relation between jet streams and the general circulation of the atmosphere
   d. Occurrence and distribution of jet streams: the westerly Polar-Front, Subtropical, and Stratospheric Polar-Night jet streams; the easterly Tropical jet stream
4. The westerlies of mid-latitudes
   a. Standing waves of the mid-latitude westerlies and related systems: differences between the Northern and Southern hemispheres
   b. Mid-latitude travelling disturbances, or cyclones and anticyclones, that are the surface expression of waves in the westerlies
   [see also 224.B.1.]
5. Tropical wind systems
   a. Trade winds: the Northeast and Southeast Trade Winds, and the Intertropical Convergence Zone
   b. Tropical disturbances
      i. Noncyclonic storms; *e.g.*, easterly-wave systems, shear-line storms
      ii. Cyclonic storms: hurricanes and typhoons
   c. Monsoons
6. Stratospheric and mesospheric wind systems
   a. Polar Night Westerlies: their mean flow, wave disturbances, and sudden warmings
   b. Summer Easterlies of the mesosphere and stratosphere: the 26-month cycle in the equatorial stratosphere
7. The mean meridional circulations of the atmosphere
8. The driving mechanism of the atmosphere: the energy balance and the transport of heat and momentum

articles	article sections	other references
	19:22h–23g / **2**:326a–e	**2**:376h–377g / **6**:27e–g
WINDS AND STORMS **19**:862–875		
	19:862h–864c / **2**:322d–e	
	19:864c–865h / **4**:718f–719c / **10**:161a–162a	
JET STREAMS **10**:160–164	**19**:869f–h	
	10:161a–162a	
	10:162a–f	
	10:162f–163f	
	10:163f–164b	
	19:865h–872c	
	19:867h–868h	**10**:162f–163a
CYCLONES AND ANTICYCLONES **5**:392–395	**19**:868h–872c	**4**:719c–e / **10**:163a–f
	19:872c–873f	
	19:872d–h	**13**:837d–842b
	19:872h–873f	
	19:872h–873c	**12**:390d–e / **18**:364h–365a
HURRICANES AND TYPHOONS **9**:58–64	**19**:873d–f	
MONSOONS **12**:389–394	**19**:868d–f	**2**:160h–161a / **4**:725b–c / **13**:842d
	19:873h–874e	
	19:874b–d	**10**:164a–b
	19:874d–e	
	19:874e–875a	
	19:875a–e / **10**:162b–f	**5**:392h–393a

Section 222. The hydrosphere: the oceans, freshwater bodies, and ice masses

[for Part Two headnote see page 79
for Division II headnote see page 92]

The articles and parts of articles referred to in Section 222 deal with four main subjects: A, the distribution of water in the hydrosphere; B, the physical and chemical properties of seawater; C, the geochemistry of freshwater; and D, the hydrologic cycle.

The outline of subject A covers all the types of waters in the hydrosphere, the Earth's aqueous envelope: saltwater bodies;

freshwater bodies, including groundwater contained within the pores of rocks; and the various kinds of ice formations. Articles are referred to that give separate treatment to gulfs and bays, to groundwater, to ice sheets and glaciers, to icebergs and pack ice, and to river and lake ice.

The outline of subject B treats the dissolved inorganic and organic substances that are the principal constituents of oceans and seas; and the physical properties of seawater.

The outline of subject C treats the geochemical processes that determine the composition, properties, and changes in the freshwater on and below the Earth's land surfaces.

Subject D is the hydrologic cycle—a group of paths through which the water in nature circulates and is transformed from one state to another, and consisting of various complicated processes of precipitation, evaporation, interception, transpiration, infiltration, percolation, retention, detention, overland flow, throughflow, and runoff. The outline first deals with the role of evaporation in the hydrologic cycle, covering evaporation from water surfaces, soils, snow, and ice, and from transpiration—the evaporation of water from the leaf cells of plants. Dealing next with the role of water vapour in the hydrologic cycle, the outline covers the distribution of water vapour in the atmosphere; vapour release by condensation; and precipitation and its distribution. It next treats the factors that affect the surface runoff cycle and the groundwater cycle, and the role of ice in the hydrologic cycle. Finally, an article is referred to that deals separately with the practical uses of the hydrologic sciences in determining the available water resources and the global annual water balance, and in the development, management, and protection of water resources in the light of demographic trends.

	articles	article sections	other references
A.	The distribution of water in the hydrosphere		
1.	Saltwater bodies		
a.	Oceans and marginal seas	**1**:1030f–1031d / **13**:482c–484c	
b.	Gulfs and bays		
		GULFS AND BAYS **8**:481–486	
i.	Factors that influence the nature of gulfs and bays	**8**:481e–482c	
ii.	Classification of gulfs and bays	**8**:482d–483d	
2.	Freshwater bodies		
a.	Rivers, lakes, and marginal bodies such as estuaries and swamps [see 232.C.1., 2., and 3.]		
b.	Groundwater contained within the pores of rocks		
		GROUNDWATER **8**:432–440	
i.	Origin and occurrence of groundwater	**9**:113g–114g	
ii.	Fluctuations in groundwater levels	**8**:435c–436h	
iii.	Movement of groundwater	**8**:437a–h	
		8:437h–440f / **9**:114b–c / **15**:963h–964c	**3**:1024f–1025d
3.	Ice [see also 212.F.2.e.]	**9**:114g–116c / **14**:92b–93c	
a.	Ice sheets and glaciers [see also 232.C.6.]	ICE SHEETS AND GLACIERS **9**:175–186 **8**:165d–166g	**1**:955b–f / **9**:115h–116a / **12**:154f–155d
b.	Icebergs and pack ice	ICEBERGS AND PACK ICE **9**:154–160 **4**:720e–721b / **13**:491b–g	**1**:1122d–f / **2**:295d–f
c.	River ice and lake ice	ICE IN RIVERS AND LAKES **12**:165–170	**7**:446a–b
4.	Water in the biosphere [see 351]		
B.	The physical and chemical properties of seawater		
		OCEANS AND SEAS **13**:484–491	
1.	The composition of seawater: dissolved inorganic and organic substances	**13**:484h–486g / **6**:709c–710f / **6**:713h–715h / **9**:124f–125a / **13**:481a–482b / **16**:193b–c	**7**:1032f–h / **13**:478a–c / **16**:461a–c / **16**:766f–g
2.	The chemical evolution of oceans and seas [see 241.C.]		
3.	The physical properties of seawater	**13**:487d–491g	
a.	Salinity and temperature variation in the oceans in relation to depth and latitude	**13**:487d–489b / **5**:590d–f / **10**:592h–593c	**2**:302a–f / **9**:123e–f / **9**:311d–h / **13**:842e–f
b.	Thermal properties of seawater; *e.g.*, specific heat	**13**:489b–e	
c.	Water density: effects of pressure, temperature, and salinity	**13**:489e–g	

	articles	article sections	other references
d. Pressure in the oceans		**13**:489g–h	
e. Optical properties of seawater; *e.g.*, absorption and scattering of light		**13**:489h–490f	
f. Acoustical properties of seawater: underwater sound transmission		**13**:490f–491a / **17**:2b–e	
4. Ice in the sea [see A.3.b., above]			
C. The geochemistry of freshwater [see also 214.A.5.b.]	FRESHWATER, GEOCHEMICAL PROPERTIES OF **7**:732–737	**10**:605d–606e	
1. Freshwater composition: concentrations of dissolved substances		**7**:732g–735a	
a. Dependence of initial freshwater composition on precipitation and infiltration processes		**7**:732g–733e	**6**:709g–h
b. Effect of hydrogen ion concentration (pH) on the geochemical reactions that control freshwater composition		**7**:733f–734a	
c. Composition generalizations: occurrence and sources of common cations (negative ions) and anions (positive ions)		**7**:734a–735a / **8**:133a–e / **17**:517a–h	**6**:709g–710b
2. Chemical reactions in freshwater		**7**:735b–737h	
a. Cation exchange: reactions that remove or add solutes to freshwater		**7**:735b–g / **7**:1034g–1035c	
b. Boundary reactions: reactions that occur at the boundaries of geochemical environments		**7**:735g–736b	
c. Precipitation reactions: deposition of minerals from supersaturated solutions		**7**:736b–737b / **7**:1032b–1033d	**3**:1023f–1024c
d. Bacterial reduction: production of sulfide deposits by bacteria		**7**:737b–d	
e. Changes in water character: reactions controlled by variations in dissolved oxygen content		**7**:737d–h	
D. The hydrologic cycle: the group of paths through which the water in nature circulates and is transformed from one state to another	HYDROLOGIC CYCLE **9**:102–116	**2**:1041h–1042e / **10**:610g–612c / **12**:118c–g	**9**:117c–119a *passim*
1. The general nature of the hydrologic cycle: the types of processes involved and their complex interaction; scales of magnitude of the interrelated components of the global hydrologic system; influences of climate and other factors		**9**:102e–103g	
2. The role of evaporation in the hydrologic cycle		**9**:104d–108d	**2**:1042b–e / **10**:339c–340a / **12**:118c–e
a. Evaporation from water surfaces		**9**:104d–106e	**10**:611e–h
b. Evaporation from soils, snow, and ice		**9**:106e–107c	**14**:554f–555b
c. Transpiration by plants [see also 336.D.]		**9**:107c–108d	**2**:1042d–e / **13**:731e–g / **14**:502f–g
3. The role of water vapour in the hydrologic cycle [see also 224.A. and D.1.e.]		**9**:108d–111d / **4**:721c–d / **19**:644f–645f	**5**:607g–608b
a. Distribution in the atmosphere		**9**:108d–109a	
b. Vapour release by condensation		**9**:109b–d	**12**:118e–g
c. Precipitation and its distribution		**9**:109d–111d / **14**:963a–h	**9**:117c–118a / **14**:960d–e / **19**:645c–d
4. Runoff and subsurface water		**9**:111d–114g / **19**:645f–646b	**3**:1024f–1025d / **9**:118d–119a *passim*
a. The surface runoff cycle		**9**:111d–112e / **5**:608c–609a / **8**:435c–h / **10**:611a–e / **14**:964a–b	
b. Factors affecting runoff [see also 232.A.3.]		**9**:112f–g / **15**:877h–879c	**10**:340a–c / **14**:432e–f / **16**:477b–d
c. Analysis of runoff		**9**:112h–113g	**19**:645f–646a

	articles	article sections	other references
d. Groundwater		**9**:113g–114g / **5**:609a–f / **8**:435c–440f / **9**:118e–g / **17**:516c–517a	
5. The role of ice in the hydrologic cycle [see also A.3., above]		**9**:114g–116c	
a. Distribution, accumulation, and ablation		**9**:114g–115f / **9**:181c–182b / **9**:183g–184c	**9**:185d–g
b. The ice cycle		**9**:115f–116c	
6. Water resources and supply [see also 737.A.1.]	WATER RESOURCES **19**:643–648	**9**:103g–104c / **9**:900g–901d / **19**:649g–650b	
a. Available water resources			**1**:201d–203a / **2**:172h–173b / **2**:397h–398c / **6**:1050h–1051b / **15**:876a–d
i. Surface water			**1**:201e–h / **6**:1050h–1051a / **10**:600–601a
ii. Groundwater		**17**:518g–519c	**1**:201h–202h
iii. Frozen water		**9**:154a–e	**14**:92d–e / **9**:179h–182b
b. The global water balance: the distribution of water between the land, the ocean, and the atmosphere		**19**:643f–646b / **8**:432g–433d	
i. Stability of the balance		**19**:643g–644f	
ii. Role of atmospheric moisture		**19**:644f–645f	
iii. Cyclicity of runoff and long-range runoff forecasting		**19**:645f–646b	
c. Future water consumption: utilization and protection of water resources [see 355.D.5.a.ii.]			

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

Oceans
ARCTIC OCEAN **1**:1118
ATLANTIC OCEAN **2**:294
INDIAN OCEAN **9**:307
PACIFIC OCEAN **13**:836

Seas (marginal and inland seas)
ADRIATIC SEA **1**:97
AEGEAN SEA **1**:123
ANDAMAN SEA **1**:839
ARABIAN SEA **1**:1059
AZOV, SEA OF **2**:547
BALTIC SEA **2**:667
BARENTS SEA **2**:721
BEAUFORT SEA **2**:781
BERING SEA AND STRAIT **2**:845
BLACK SEA **2**:1096
CARIBBEAN SEA **3**:906
CHINA SEA **4**:405
GREENLAND SEA **8**:414
IRISH SEA **9**:893
JAPAN, SEA OF **10**:92
KARA SEA **10**:404
LAPTEV SEA **10**:681
MEDITERRANEAN SEA **11**:854
NORTH SEA **13**:249
OKHOTSK, SEA OF **13**:541
RED SEA **15**:544
ROSS SEA **15**:1161
SCOTIA SEA **16**:403
WEDDELL SEA **19**:721
WHITE SEA **19**:819
YELLOW SEA **19**:1078

Gulfs and bays
ADEN, GULF OF **1**:85
BAFFIN BAY **2**:582
BENGAL, BAY OF **2**:835
BISCAY, BAY OF **2**:1076
CARPENTARIA, GULF OF **3**:951
FUNDY, BAY OF **7**:780
GUINEA, GULF OF **8**:471
HUDSON BAY **8**:1131
MEXICO, GULF OF **12**:77
PERSIAN GULF **14**:106
SAINT LAWRENCE, GULF OF **16**:172

Other features
COLUMBIA ICEFIELD **4**:929
DRAKE PASSAGE **5**:979
ENGLISH CHANNEL **6**:873
GULF STREAM **8**:486
MALACCA, STRAIT OF **11**:359
NORTHWEST PASSAGE **13**:257
ROSS ICE SHELF **15**:1158

Section 223. The motions of the sea and the forces that cause them

[for Part Two headnote see page 79
for Division II headnote see page 92]

The articles and parts of articles referred to in Section 223 deal with three main subjects: A, ocean–atmosphere interaction; B, waves in the hydrosphere; and C, the circulation of the oceans.

The outline of subject A begins with basic quantities involved in ocean–atmosphere interaction—the supply of energy to the ocean by direct and scattered solar radiation, the amount of heat flow from the interior of the Earth through the ocean floor, and the water budget comprised of the various items of input, output, and water storage of the hydrologic system. It goes on to air–sea transfer processes—the vertical transport of water vapour and heat at the sea surface. Finally, it treats oceanic turbulence, the random motions distinguished from and superposed on waves or ocean currents.

The outline of subject B first deals with surface waves, waves at the air–sea interface, covering the theory of simple shallow-water and deep-water waves and the properties of complex wind-generated ocean waves and tsunamis, or seismic sea waves. It goes on to internal waves, which are not noticed at the surface but occur at sharp internal interfaces or gradual transition zones between layers of water of different densities. Finally, it deals with tides—the daily fluctuation of elevation of the water surfaces of oceans, seas, and the larger lakes of the world. The outline covers the causes of tides; the mathematical and dynamical analyses of tidal motion; and the methods of tidal prediction that are useful to navigation and coastal engineering.

Subject C is the system of ocean currents through which the great water masses on the Earth's surface are interconnected. The outline first deals with the distribution or general pattern of currents throughout the world's oceans. It goes on to the forces that cause ocean currents or modify their motions—wind friction at

the sea surface, pressure gradients, and the Coriolis effect of the Earth's rotation. It next deals with systems of surface currents in different regions of the Earth and with subsurface currents dependent on differences of temperature, salinity, or sediment concentration. Finally, it treats the influence of ocean currents on weather and climate.

A. Ocean–atmosphere interaction
[see also 222]

1. Radiation, heat, and water budgets of the oceans; gains and losses of mass and energy
2. Air–sea transfer processes: the role of atmospheric turbulence in the vertical transport of heat and water vapour at the sea surface
3. Turbulence in the sea: turbulent transport of mass, heat, and momentum; definition of eddy diffusivity, eddy conductivity, and eddy viscosity

B. Waves in the hydrosphere
[see also 126.E., 128.A., and 232]

1. Surface waves: waves at the air–sea interface
   a. Theory of simple waves
      i. Shallow-water waves: waves with wavelengths that are long with respect to water depth
      ii. Deep-water waves: waves with wavelengths that are short with respect to water depth
   b. Ocean waves: the generation of waves by wind
   c. Tsunamis, or seismic sea-waves, and standing waves in bays and marginal seas
2. Internal waves: waves at sharp internal interfaces or gradual transition zones between layers of water of different densities
3. Tides: the daily fluctuation of elevation of the water surfaces of oceans and seas and the larger lakes of the world
   a. The causes of tides: the motions and gravitational interaction of the Sun, Moon, and Earth
   [see 133.E.6.c.i.]
   b. Tidal analysis; tidal harmonics, constituents, and measurements
   c. Tidal dynamics and prediction: prediction using analytical and numerical methods; tidal currents; practical aspects and complicating factors

C. The circulation of the oceans: ocean currents

1. The distribution of ocean currents: horizontal and vertical motions in the sea
2. The forces that cause and affect ocean currents
   a. Pressure gradients: forces resulting from density differences and the tilting of the sea surface
   b. Coriolis force: the effect of the Earth's rotation on all moving objects, causing deflection to the right in the Northern Hemisphere and to the left in the Southern Hemisphere
   [see also 211.A.2.a.]
   c. Frictional forces: generation of wind-driven ocean currents
3. The general surface circulation
   a. The system of surface currents: the large-scale rotational motion of the upper strata of the oceans
   b. Western and eastern boundary currents: intensification of currents along the western boundaries of the oceans; the Gulf Stream and Kuroshio
   c. The equatorial current system that includes the North and South Equatorial currents and the Equatorial Countercurrent

articles	article sections	other references
OCEANS AND SEAS **13**:491–493		**9**:63e–g
	13:491g–492c / **9**:124d–f	**9**:104d–105e
	13:492c–g	**4**:719h–720a
	13:492h–493b	
WATER WAVES **19**:654–659	**13**:493b–495g	**8**:481g–h
	19:654f–659g / **13**:493c–495a	**9**:63e–g
	19:654f–658c	
	19:654f–656e / **10**:609e–610b	
	19:656f–658c	
	19:658c–659g / **10**:609b–e / **13**:493d–494f	
	13:494g–495a	
	13:495a–b	
TIDES **18**:383–390	**13**:495b–g	
	18:384b–385c	**13**:843c–d
	18:385d–390a / **19**:654g–655g	
OCEAN CURRENTS **13**:437–443	**13**:495g–497b	**1**:1030f–h
	13:437e–g	
	13:437g–439d / **13**:496c–g	
	13:437h–438c	**13**:496d–e
	13:348c–g	**13**:496c–d
	13:438g–439d	**13**:496f–g
	13:439d–440h / **13**:496a–c	**2**:301b–g / **9**:312a–c / **13**:842g–843a
	13:439d–f	
	13:439f–440a	**8**:486f–487f
	13:440a–g	

articles	article sections	other references
	13:440g–h	**1**:955f–958g
	13:440h–441f / **13**:496g–497b **18**:387f–388e	**2**:301h–302a / **9**:312c–d / **13**:843a–c
DENSITY CURRENTS **5**:588–591		**3**:786e–f / **3**:788c–790b *passim* / **8**:298d–299c / **11**:497h–498b
	13:442g–443b / **4**:719h–720e	**8**:487g–h

d. The Antarctic Circumpolar Current: the current that links the circulations of the Atlantic, Indian, and Pacific oceans

4. Subsurface ocean currents
   a. The general deep-sea circulation
   b. Tidal currents: periodic currents associated with tides in the sea
   c. Density currents down continental slopes, produced by differences in temperature, salinity, or sediment concentration
   [see also 231.C.4.]
5. The influence of ocean currents on weather and climate
   [see also 224.D.1.d.]

Section 224. Weather and climate

[for Part Two headnote see page 79
for Division II headnote see page 92]

The articles and parts of articles referred to in Section 224 deal with four main subjects: A, condensation of water in the atmosphere; B, weather disturbances and storms; C, weather forecasting; and D, climate.

Subject A involves two processes that return water from the atmosphere to the Earth in the hydrologic cycle. The outline begins with the different indices of the water vapour content in the atmosphere. It then deals with the processes of condensation that change water from its vapour state into a liquid or a solid. Separate articles are referred to that treat dew; frost; and the formation, classification, weather effects, and artificial modification of clouds and fogs. The outline then treats precipitation, covering its origin, its principal types—drizzle, rain, and freezing rain; snow; and sleet and hail—and the world distribution of rainfall. Finally it deals with the effects of precipitation, such as erosion caused by raindrop impact or by surface runoff.

The outline of subject B begins with the formation, structure, and distribution of cyclones and anticyclones and the development of their associated frontal systems. It goes on to treat the causes, types, and physical characteristics of thunderstorms. It concludes with weather disturbances in the tropics, such as monsoon depressions, hurricanes, and typhoons.

The outline of subject C, weather forecasting, begins with the worldwide synoptic weather service, which provides the fundamental information upon which weather maps are constructed, comprising such elements as air pressure, temperature, humidity, wind speed and direction, and cloud heights. It goes on to deal with the physical and dynamical principles involved in relatively reliable short-range weather predictions from such data, and with the methods used to obtain long-range weather predictions. After a review of many important practical applications of weather forecasting, the outline concludes by referring to an article that gives separate treatment to the long history of weather lore.

Subject D is climate, regarded as comprising the total experience of weather and atmospheric behaviour over a number of years in a given region, and specified by the average values of the various climatic elements as well as their extreme ranges. The outline begins with the several factors that generate climate. It then deals with small-scale climatic variation, covering seasonal changes, local effects, and the effects of urban concentration on global climate. It goes on to treat various classifications of climatic types; their distribution in the world; and their effects on marine and terrestrial organisms, on vegetation and crops, and on the life of man. The outline next deals with microclimates—climates in small areas, within a very few feet above and below the Earth's surface and within the canopies of vegetation. It goes on to climatic changes—long-term oscillatory fluctuations and progressive changes. It treats the evidence for the several orders of climatic change through geological time and the characteristics of each such change. Finally, it treats theories of the causes of climatic variation and projections of future climates.

articles	article sections	other references
HUMIDITY, ATMOSPHERIC **9**:1–5	**9**:108d–109a / **18**:1047a–b	
	9:1c–2f	
	9:1c–d	
	9:1d–f	
	9:1f–2a	
	9:2a–f	
	9:109b–d	
	18:361g–362f	**5**:393c–394e / **19**:872f–h

A. Condensation of water in the atmosphere producing clouds, fogs, and precipitation
   1. Moisture in the atmosphere
   [see also 221.A.1.c. and 723.G.5.]
      a. Humidity indices: measures of atmospheric moisture
         i. Absolute humidity
         ii. Specific humidity
         iii. Relative humidity
         iv. Dew-point temperature: the relation between temperature and humidity
      b. Climatic aspects of atmospheric humidity
      [see D.1.e., below]
      c. Effects of atmospheric humidity on the life and health of man and other organisms
      [see D.4., below]
   2. Condensation of atmospheric water vapour
      a. Causes of the vertical motion that leads to condensation: convection, air mass convergence, and other processes
      [see also 221.B.]

	articles	article sections	other references
b. Condensation nuclei: atmospheric ions, salt and dust particles on which water vapour condenses		**14**:960h–961b	**4**:756h–757b/**18**:1049d–g
c. Dew: liquid condensate deposited on exposed surfaces	DEW **5**:679–680		
d. Frost: water vapour deposited as ice on exposed surfaces at subfreezing temperatures	FROST **7**:749–750		
3. Clouds and fogs [see also 723.G.5.]	CLOUDS **4**:756–761	**4**:721d–h	
a. Formation and growth of clouds		**4**:756h–757d/ **14**:960h–961b/ **18**:361g–362f	**2**:322a–b/**19**:708c–e
b. Description and classification of clouds: the relation between visual appearance and cloud altitude and physical processes		**4**:757d–758g/ **9**:788c–d	
c. Clouds and weather: the association of specific cloud types with different weather patterns and atmospheric disturbances		**4**:758h–760c/ **9**:61d–h	**5**:395b–c/**18**:361d–e
d. Fog: clouds near the ground, including advection, radiation, and inversion fogs		**4**:760d–761g/ **19**:709d–f	
e. Artificial modification of clouds and fogs by seeding	WEATHER MODIFICATION **19**:707–711	**1**:359g–h	**2**:328e–h
i. Cloud seeding principles and techniques: the use of Dry Ice, silver iodide smoke, and other substances as seeding agents		**19**:708c–709c/ **14**:961b–e	**2**:328e–g
ii. Weather phenomena amenable to modification: fog, precipitation, and certain storms		**19**:709d–711d	
iii. Large-scale modification of weather and climate: the feasibility of such modification and its ecological, social, and legal implications		**19**:711d–g	**2**:328g–h
4. Precipitation: water that is released from clouds in the form of droplets or ice particles [see also 222.D. and 723.G.5.]	PRECIPITATION **14**:960–964	**19**:709f–710c	
a. Origin of precipitation in clouds		**14**:960h–962b	
i. Cloud formation [see A.3.a., above]			
ii. Mechanisms of precipitation release: formation of precipitation particles by the coalescence process and by ice crystal growth		**14**:961b–e/ **4**:721h–722c	**4**:757c–d/**16**:912g–913c
iii. Precipitation from shower clouds and thunderstorms: generation of heavy rain and hail		**14**:961f–962b/ **18**:361g–364h	**2**:322b–c
b. Types of precipitation		**14**:962d–963a	
i. Drizzle, rain, and freezing rain		**14**:962h–f	
ii. Snow	SNOW AND SNOWFLAKES **16**:910–914	**9**:176e–177b	
iii. Sleet and hail		**14**:962g–963a/ **19**:710f–h	
c. The world distribution of rainfall		**14**:963a–h	
i. Regional and latitudinal distribution		**14**:963a–e	
ii. Average precipitation amounts and the variability of annual rainfall		**14**:963e–h/ **4**:738f–739b	**18**:364f–h
d. Effects of precipitation; *e.g.*, soil erosion caused by raindrop impact, erosion caused by surface runoff		**14**:963h–964b/ **9**:109d–111h	
B. Weather disturbances and storms [see also 221.B.]	WINDS AND STORMS **19**:865–873		
1. Waves in the prevailing westerly winds and the development of cyclones and anticyclones	CYCLONES AND ANTICYCLONES **5**:392–395	**19**:868h–872c	
a. Formation and structure of cyclones: the evolution of cyclonic depressions and their associated fronts		**5**:393f–394h	**4**:758h–759h/**19**:699d–f/ **19**:868h–869h
b. Anticyclones and their formation: cold, warm, and blocking anticyclones		**5**:394h–395c	**4**:719c–e/**19**:871h–872a
c. Distribution of cyclones and anticyclones		**5**:395d–f	**19**:870d–872c

	articles	article sections	other references
2. Thunderstorms: disturbances initiated by the lifting of air by fronts, thermal convection, or other factors	THUNDERSTORMS **18**:361–365		
a. Causes and types of thunderstorms		**18**:361g–363d	
b. Physical characteristics and phenomena of thunderstorms		**18**:363e–364d / **14**:961f–962b / **18**:519c–g	**4**:759g–h
i. Updrafts and downdrafts and the vertical extent of thunderstorms		**18**:363f–364a	
ii. Turbulence		**18**:364b	
iii. Movement of thunderstorms		**18**:364c–d	
iv. Lightning and thunder [see also 127.A. and B.]	LIGHTNING **10**:965–970	**18**:519f–g / **19**:710d–f	**2**:322b–c
			14:962h–963a
c. The weather under thunderstorms: phenomena observed on the ground		**18**:364d–h	
i. Strong winds and heavy rains associated with isolated or local thunderstorms			
ii. Tornadoes, hail, and other severe phenomena associated with organized storms or squall lines	TORNADOES, WHIRLWINDS, AND WATERSPOUTS **18**:514–520		
d. Factors that control the frequency of occurrence of thunderstorms		**18**:364h–365c	
3. Weather disturbances in the tropics [see also 221.B.5.]		**19**:872h–873f	
a. Waves in the easterly trade winds and equatorial trough disturbances including monsoon depressions or weak cyclones			**12**:390d–e
b. Tropical cyclones: hurricanes and typhoons	HURRICANES AND TYPHOONS **9**:58–64		**19**:873d–f
i. Origins: the initiation, self-sustaining character, and dissipation of tropical cyclones		**9**:59e–60g	**19**:873d–e
ii. Physical properties and associated weather features: wind velocity, clouds, precipitation, and storm energy		**9**:60g–61h	
iii. World distribution: variations in occurrence by season and geographical location		**9**:61h–63a	
iv. Storm damage and its prevention		**9**:63a–64c	**19**:710h–711b
C. Weather forecasting: the plotting, analysis, and use of synoptic weather maps and charts [see also 723.G.5.]	WEATHER FORECASTING **19**:697–702		
1. Synoptic weather data: the collection and correlation of meteorological observations		**19**:697d–698h / **1**:357h–358a / **12**:59c–g	
a. Analysis of synoptic charts		**19**:697h–698a	**2**:323a–c / **19**:864d–865d
b. Upper-air observations: charts plotted at standard pressure levels		**19**:698a–d	**12**:58b–f
c. Radar and satellite observations: collection of useful supplementary data [see also 735.J.1. and 738.C.3.b.]		**19**:698d–h	**12**:57h–58b / **12**:58f–h
2. Short-range weather prediction: the construction of prognostic maps representing anticipated future weather patterns		**19**:698h–700h	**2**:327e–328b
a. Physical and dynamical principles that govern the development of weather patterns		**19**:698h–699f	**19**:870d–872c
b. Local weather conditions: consideration of the effects of topography and other factors		**19**:699f–700c	
c. Synoptic forecasting: the sequence of steps for producing a weather forecast		**19**:700c–f	
d. Reliability of short-range forecasts		**19**:700g–h	**2**:327h–328b
3. Long-range weather prediction: forecasting average weather conditions weeks or months in advance		**19**:700h–702a	**2**:328b–d
a. Periods and trends of weather: prediction based on analogy between the development of past and present weather patterns		**19**:701a–e	

	articles	article sections	other references
b. Physical relationships involved: factors that affect climatic variability		**19**:701e–f/ **2**:323d–324b	
c. Future prospects: the establishment of long-range forecasting on a firm theoretical basis		**19**:701g–702a	
4. Practical aspects of weather forecasting: applications in aviation, agriculture, and other fields		**19**:702a–f	
5. Weather lore: forecasts based on proverbs and beliefs concerning the winds and appearance of the sky, weather cycles, the behaviour of plants and animals, and other phenomena	WEATHER LORE **19**:705–707		
D. Climate: the aggregate of weather [see also 133.B.5., 221, and 723.G.5.]	CLIMATE **4**:714–729		
1. Factors that generate climate		**4**:714g–722c	
a. Solar radiation		**4**:714g–716b	**2**:321c–d
i. Variability of incident radiation: the solar constant		**4**:714g–715c/ **4**:739d–g	
ii. Effects of the atmosphere		**4**:715d–f/ **4**:739g–740c/ **18**:1047g–h	**9**:2h–3c
iii. Heating of the Earth's surface		**4**:715f–716b/ **4**:740c–f/ **19**:711c–d	
b. Temperature		**4**:716c–718e/ **18**:1045h–1047a	
i. Variation with latitude		**4**:716c–717g	
ii. Diurnal, seasonal, and extreme temperatures		**4**:717g–718b	
iii. Variation with height		**4**:718b–e	
c. Atmospheric pressure		**4**:718f–719g/ **5**:394f–395f/ **19**:865g–872c	
i. Pressure systems and winds		**4**:719a–c/ **5**:394h–395c	**5**:604d–f
ii. World storm belts and their distribution		**4**:719c–g/ **5**:395d–f/ **9**:61h–63a/ **19**:865h–872c	
d. The world's oceans		**4**:719h–721b/ **19**:701e–f	
i. Circulation, currents, and ocean–atmosphere interaction		**4**:719h–720e/ **13**:442g–443b	
ii. Surface salinities and surface ice		**4**:740h–741a/ **4**:720e–721b	
e. The moisture cycle		**4**:721c–722c/ **9**:2f–4d	
i. Evaporation and condensation		**4**:721c–d	**9**:3h–4d/**19**:644f–645c
ii. World cloudiness and sunshine		**4**:721d–h	
iii. Rain and snow		**4**:721h–722c/ **14**:963a–e/ **18**:364h–365c	
2. Climatic variation		**4**:722c–723d/ **14**:963e–h	
a. Seasonal changes resulting from the north–south migration of belts of cyclonic activity and other cyclic processes		**4**:722c–h	
b. Local effects: modification of climate by local terrain and surface conditions		**4**:722h–723d	
c. The effects of urban concentrations	URBAN CLIMATES **18**:1045–1053		**14**:433c–d
i. Elements of urban climate: effects of cities on temperature, humidity, wind, and other meteorological conditions		**18**:1045h–1049g	
ii. Pollution: concentrations of gaseous and particulate pollutants in urban air [see also 737.C.1.]		**18**:1049g–1051h/ **14**:750e–751a	**5**:49e–h
iii. Effects of man's activities on global climate		**18**:1051h–1053e/ **2**:319d–f/ **14**:756b–d	**5**:49h–50b

	articles	article sections	other references
3. Climatic types		**4**:723d–727g / **2**:324b–e / **5**:604h–607e	
a. The Köppen classification system		**4**:723g–724h	
b. World climates and their distribution		**4**:724h–727g / **8**:280e–g	**1**:187g–189g / **1**:953d–955b / **2**:160c–163b / **2**:390h–392f / **5**:606d–607e / **6**:1042g–1044c / **9**:310h–311c / **13**:186h–187h / **13**:837g–842d / **17**:82c–84a / **18**:733d–f
4. Influences of climate on terrestrial life [see also 351.B.2.b.]		**4**:727g–729h / **9**:4d–5c / **10**:342e–343b	
a. On marine and terrestrial organisms		**4**:727g–728d	**9**:4d–g
b. On vegetation and crops		**4**:728d–h / **1**:358c–360c	**9**:4h–5a / **10**:342f–343b
c. On man		**4**:728h–729h / **5**:395f–h / **9**:58g–59e	**9**:4d–h / **15**:349f–h
5. Microclimate: the climate near the ground	MICROCLIMATES **12**:114–121		
a. Microclimatic conditions		**12**:114f–115h	
i. Temperature and moisture		**12**:114f–115c	
ii. Wind and turbulence		**12**:115d–e	**19**:841d–f
iii. Dew and frost		**12**:115e	**5**:679e–680a *passim* / **7**:749d–750a *passim*
iv. Heat balance and evaporation		**12**:115f–h	**16**:913g–h
b. Factors affecting microclimates		**12**:115h–117e	**1**:358g–360c *passim*
i. Soils and surfaces		**12**:115h–116c	
ii. Vegetative cover and forest canopies		**12**:116d–e	**10**:342f–343b
iii. Topography		**12**:116f–117a	
iv. Shelter and roughness		**12**:117b–c	
v. Advection: horizontal motion of air masses		**12**:117c–e	
c. Relation of microclimates and macroclimates		**12**:117e–118c	
i. Macroclimatic influences		**12**:117e–h	
ii. Microclimatic influences on weather and climate		**12**:117h–118c	
d. Influence of microclimates on the hydrologic cycle, rock weathering, and other processes and phenomena		**12**:118c–121f	
e. Microclimates as an element of the environment of organisms [see 351.B.2.d.]			
f. Measurement of microclimates [see 723.G.5.c.]			
6. Climatic change [see also 242.D.]	CLIMATIC CHANGE **4**:730–741	**2**:324e–325a	
a. Definitions of climatic variability and climatic change: the orders of magnitude and time scales of climatic variations; the distinction between oscillatory fluctuations and progressive changes		**4**:730b–g / **14**:963e–h	
b. Evidence of pre-Pleistocene climatic changes		**4**:730h–732h / **3**:859h–860d	
i. Types of data; *e.g.*, the occurrence and distribution of fossil coral reefs, glacial deposits, evaporites, coal measures		**4**:731b–732e / **5**:252b–c / **10**:984f–g / **14**:99d–g / **18**:155h–160b / **18**:697a–d	**5**:679c–d / **16**:773h–774b
ii. Synopsis of pre-Pleistocene climates		**4**:732e–h	
c. Evidence of Pleistocene climatic changes		**4**:732h–735b	
i. Types of data; *e.g.*, the occurrence and distribution of glaciers and permafrost; fluctuation of stream discharge and lake levels		**4**:732h–734h	**5**:614d–h / **14**:742b–f / **17**:840g–h
ii. Synopsis of Pleistocene climates		**4**:734h–735b	

	articles	article sections	other references
d. Evidence of Holocene climatic changes		**4**:735b–737d / **8**:1004e–1007c	
i. Types of data; *e.g.*, evidence from pollen stratigraphy; the fluctuations of river discharge, lake levels, and glaciers; archaeological and historical data		**4**:735b–737c	**17**:840f
ii. Synopsis of Holocene climatic trends		**4**:737c–d	
e. Modern climatic trends and meteorological records		**4**:737d–739d	
i. Meteorological records and their evaluation		**4**:737d–738a	
ii. Temperature and precipitation fluctuations since the 1870s		**4**:738a–739b / **18**:1052f–1053b	**8**:1007b–c / **14**:433c–d
iii. Synopsis of modern climatic fluctuations		**4**:739b–d	
f. Theories of the causes of climatic variation; *e.g.*, that climatic variations are caused by variations in solar radiation, atmospheric transparency, Earth's orbit		**4**:739d–741d / **18**:1051h–1053e	**1**:955b–e / **2**:324g–h
g. Future climates: short-term and long-term trends		**4**:741d–e / **19**:711d–g	

Division III. The Earth's surface features

[for Part Two headnote see page 79]

The outlines, and the articles and parts of articles referred to, in the two sections of Division III deal with the basic physical features of the Earth's surface and with the features produced by geomorphic processes acting on the Earth's surface.

The outline and the articles referred to in Section 231 treat the vertical relief of the Earth's surface; the stable platform regions of the continents; the continental terrace or continental margins; the oceanic deeps; coral islands, coral reefs, and atolls; mountain ranges and mountain belts; and oceanic ridges.

Section 232 treats the action of the hydrosphere and the atmosphere on the Earth's surface features; the effects of actions from the biosphere, exosphere, and lithosphere on the Earth's surface features; the characteristic features of the Earth's major environments; and basic concepts in the theory of landform evolution.

Section 231. Physical features of the Earth's surface 104
232. Features produced by geomorphic processes acting on the Earth's surface 108

Section 231. Physical features of the Earth's surface

[for Part Two headnote see page 79]

The articles and parts of articles referred to in Section 231 deal with seven main subjects: A, the vertical relief of the Earth's solid surface; B, the stable platform regions of the continents; C, the continental terrace; D, the oceanic deeps; E, coral islands, coral reefs, and atolls; F, mountain ranges and belts; and G, oceanic ridges.

The outline of subject A first deals with the distribution of land and sea on the Earth's surface, the average elevation of the continents, and the classification of coastlines. It then deals with the physiography of the seven continents and four oceans.

The outline of subject B begins with the size, distribution, characteristics, and age of the continental shields, the ancient parts of a continent on which younger sedimentary rocks were deposited. It then covers the distribution and types of plateaus and of basins; the rift valleys produced by faulting (displacement of the Earth's crust); and the several kinds of water bodies occupying fault-bounded structural depressions.

Subject C is the continental terrace, which includes the comparatively shallow submarine plain called the continental shelf and the much steeper zone, called the continental slope, which merges with the deep-sea floor. The outline first deals with the composition, structure, and origin of the continental terrace. It then treats the so-called submarine canyons that incise the continental terrace, covering their nature and distribution and the theories that have been proposed regarding their origin.

Subject D is the ocean basins. The outline treats the composition of the oceanic crust; such features of the ocean floor as mid-ocean ridges, trenches, and fracture zones; and explanations of the origin of ocean basins in terms of new concepts of plate tectonics and sea-floor spreading.

Subject E is coral islands, coral reefs, and atolls. The outline treats the reef-building organisms; modes and geographic distribution of reef accumulation today; reefs of the geological past and their environmental significance; factors involved in reef growth; and the several theories of reef development.

The outline of subject F covers the major types of mountains; the major mountain systems that align to form mountain belts; the geology, structure, and origin of long, curved chains of islands called island arcs; and the rock types comprising the folded mountain ranges and island arcs.

Subject G is oceanic ridges—elongated elevations on the ocean bottom rivalling the subaerial mountain systems in magnitude. The outline covers the classification, properties, origin and growth, and distribution of oceanic ridges.

	articles	article sections	other references
A. Vertical relief of the Earth's surface	EARTH, PHYSIOGRAPHY OF **6**:42–48		**14**:435b–d
1. Hypsography of the Earth's surface		**6**:42f–45b	**13**:433b–e
a. Distribution of land and sea		**6**:43b–44a	**13**:433b–c
b. Average elevation of the continents		**6**:44a–d	
c. Coastlines: their classification and relation to continental shelves and coastal plains		**6**:44d–45b	**5**:117d–f
2. Physiography of the continents		**6**:45b–47a / **14**:527c–528f	
a. Europe		**6**:45b–e	**6**:1041c–1042f / **6**:1044g–1046c / **1**:631h–633b *passim* / **1**:634c–g / **2**:609h–610c / **3**:946f–949h *passim* / **3**:1015f–1016g / **5**:488h–490e *passim* / **10**:353d–g / **14**:527g–h / **15**:315h–316h / **15**:805h–807c / **18**:1032d–f / **19**:172d–173d / **19**:508d–g
b. Asia		**6**:45e–h	**2**:155d–160c / **2**:163c–h / **1**:639h–640a / **1**:716a–717a / **1**:1052a–1054e / **1**:1066b–c / **2**:596b–c / **2**:641a–b / **3**:104c–g / **3**:980g–981b / **3**:1015f–1016g / **6**:523d–f / **7**:879d–g / **8**:219g–220c / **8**:882e–883d / **8**:920h–921f / **8**:1128g–1129g / **9**:492b–f / **10**:402g–403a / **10**:543h–544f / **10**:790g–791a / **11**:860g–862a / **13**:431e–432c / **13**:938g–939b / **14**:527h–528c / **16**:199c–g / **18**:206e–f / **18**:392e–393c / **18**:402b–404a / **18**:1032d–f / **19**:1072d–1074d *passim* / **19**:1089c–h
c. Africa		**6**:45h–46b	**1**:185g–187g / **1**:189g–191f / **2**:304c–e / **4**:17a–c / **4**:1124d–1125c / **6**:116d–117a / **6**:120d–g / **10**:373a–e / **12**:819h–820c / **13**:97a–f / **13**:103d–104f / **13**:640d–641a / **14**:528c–e / **16**:147g–148c / **16**:540b–d / **19**:162e–g / **19**:1127b–e
d. Australia		**6**:46b–c	**2**:388d–390h / **2**:392f–393a / **7**:125d–f / **8**:299g–300a / **12**:1088c–f / **14**:528e–f
e. North America		**6**:46d–f	**13**:183d–185d / **13**:187d–188h / **1**:414a–416a / **1**:1015h–1016b / **2**:749g–750b / **4**:910a–c / **4**:931b–d / **7**:696e–697a / **8**:301a / **11**:265g–266h / **12**:280d–282b *passim* / **13**:203f–204a / **13**:824e–f / **14**:527c–e / **15**:859h–860d / **15**:964g–965f / **16**:172g–173g *passim* / **19**:1107g–1108d
f. South America		**6**:49f–h	**17**:80d–82b / **17**:84a–h / **1**:653a–b / **1**:856d–858g / **2**:254f–g / **13**:737b–738a / **13**:992b–c / **13**:999b–h / **13**:1068c–g / **14**:525f–g / **14**:527e–f / **18**:461g–462a
g. Antarctica		**6**:46h–47a	**1**:949c–953d / **15**:1158h–1159d
3. The oceanic regions		**6**:47b–48b	
a. Principal oceanic features: mid-ocean ridges, continental margins, and abyssal depressions [see also 723.G.3. and 735.J.2.]	OCEAN BASINS **13**:434–436	**6**:47b–d / **13**:472d–473b / **13**:482c–484c	**14**:435e–g

	articles	article sections	other references
b. Summary of submarine physiography		**6**:47d–48b / **13**:474a–475h	
i. Arctic Ocean		**6**:47d–e	**1**:1119g–1120d / **2**:721g–722b / **2**:781d–f / **8**:1131e–h / **10**:404d–f / **10**:681e–f / **19**:819a–c
ii. Atlantic Ocean		**6**:47e–f / **13**:474a–g	**2**:294d–295c / **2**:667g–668f / **2**:1096h–1097c / **3**:907c–f / **11**:854e–855g / **12**:77e–g / **13**:249e–g / **16**:403d–f / **19**:722a–b
iii. Indian Ocean		**6**:47f–g / **13**:475c–h	**9**:307f–310e / **1**:85h–86a / **1**:839c–d / **1**:1060b–c / **2**:835h–836a / **3**:951a–c / **14**:106d–h / **15**:544f–545b
iv. Pacific Ocean		**6**:47g–48b / **13**:474g–475c	**13**:836g–837b / **2**:845a–e / **4**:405e–406h *passim* / **10**:92b–c / **13**:541d–f / **19**:1078d–e
B. The stable platform regions of the continents			
1. The continental shield areas: their age, structure, and constituent rocks [see also 214.B.4.]		**6**:11d–12d / **14**:956b–h	**1**:180e–g / **2**:147e–151e / **2**:384d–e / **5**:121f–g / **6**:1037c–f / **12**:9h–10b / **13**:178f–180e / **14**:953f–954c / **15**:913g–h / **17**:75d–e
2. Uplift, downwarp, and fracture of continental platforms			
a. Plateaus and basins	PLATEAUS AND BASINS **14**:526–529		
i. Occurrence and distribution		**14**:527c–528f	
ii. Specific examples; *e.g.*, lava plateaus, intermontane plateaus, basin and range topography, ice plateaus		**14**:528f–529f / **9**:179h–181b / **9**:216e–217a	
b. Rift valleys	RIFT VALLEYS **15**:841–846		**1**:186h–187g / **12**:579b
i. Their geomorphic characteristics		**15**:842b–843c	
ii. Their geological history and structure		**15**:843c–844g	
iii. Their origin		**15**:844g–846b	
c. Water bodies occupying fault-bounded structural depressions			
i. Lakes and landlocked seas			**1**:187b–f / **6**:116a–117c / **10**:602e–h / **15**:842b–843a *passim*
ii. Inland seas with outlets to the oceans			**2**:547e–f / **2**:1097d–g
iii. Elongated seas formed by crustal separation, such as the Red Sea or the Gulf of California [see also 241.G.]		**8**:484g–485a	**15**:545b–d
C. The continental terrace or continental margins	CONTINENTAL SHELF AND SLOPE **5**:115–119		
1. Definitions and bathymetry [see also 723.G.3. and 735.J.2.]		**5**:115f–116f	
a. The continental shelf: the nearly horizontal strip of seabed that extends from the low-water line to the point at which there is a sharp increase in slope		**5**:115g–116c	
b. The continental slope: the more steeply inclined zone that extends from the shelf break to the ocean floor		**5**:116d–f	**13**:436d–e
2. Composition: evidence from bottom samples and geophysical techniques		**5**:116f–118a	
a. Sediments of the shelf and slope and the currents that deposit them		**5**:117a–d / **19**:34d–h	**10**:983d–g / **11**:497g–498c
b. Influence of the Ice Age: effects of sea level fluctuations on sediment deposition		**5**:117d–118a	
3. Structure and origin		**5**:118a–119e / **6**:44d–45b	

a. Geophysical evidence: the interaction between sediment deposition and crustal subsidence

b. Geological relationships: interpretations based on the theory of continental drift and sea-floor spreading

4. Submarine canyons incising the continental terrace

a. Types of submarine valleys

b. Physical characteristics and geographic distribution of submarine canyons

c. Relation of submarine canyons to adjacent land valleys

d. Transport of sediment through submarine canyons: turbidity currents and graded deposits

e. Origin of submarine canyons

D. The oceanic deeps

1. Components of ocean basins

a. The oceanic crust

b. Major features of the deep-ocean floor

i. Mid-ocean ridges
[see G., below]

ii. Trenches
[see also 241.G.]

iii. Fracture zones

iv. Seamounts and guyots

v. Abyssal hills and plains

vi. Sediments of the ocean floor

c. Basin boundaries

i. The continental slope
[see C., above]

ii. The continental rise

2. The origin of ocean basins

E. Coral islands, coral reefs, and atolls
[see also 351.B. and 354.B.]

1. Fossil reefs and reef-building organisms

2. Present reef accumulation: water conditions, reef geochemistry, biological factors

3. Origins and development of reefs and atolls

F. The major mountain ranges and fracture zones of the Earth's crust on the continents and beneath the oceans

1. Types of mountains; *e.g.*, dome, block, fold, volcanic, alpine

2. The worldwide system of folded mountain ranges, fracture zones, and volcanic island arcs

a. The Circum-Pacific System that includes the North and South American cordilleras and the west Pacific island arcs

b. The Tethyan System that separates the continental platforms of Eurasia from Africa and India

c. Subsidiary mountain ranges: systems associated with regional domes of the continental platforms

articles	article sections	other references
	5:118c–119b	
	5:119b–e	
CANYONS, SUBMARINE **3**:786–791		
	3:786g–h	**5**:115h–116b
	3:786h–787h	
	3:788a–c	
	3:788c–789e / **5**:590b–591h	**8**:298g–299c
	3:789e–791d	
OCEAN BASINS **13**:433–437		
	13:433h–436f	
	13:433h–434d / **6**:51c–e	
	13:434d–436d	
	13:435b–d	**9**:1026g–1027h *passim* / **16**:446g–h
	13:435e–f	**16**:446b–c
	13:435f–436a	
	13:436a–c	**14**:435f–g
MARINE SEDIMENTS **11**:495–500	**13**:436c–d / **9**:1028h–1029b / **16**:636h–637c	**2**:300a–c / **8**:298d–299c / **9**:231g–232a / **9**:310f–g / **10**:983h–984b / **13**:843f–g / **16**:766c–g
	13:436d–f	
	13:436e–f	**8**:298g–299a
	13:436g–437a / **9**:125a–b	
CORAL ISLANDS, CORAL REEFS, AND ATOLLS **5**:162–167		**4**:799d–g
	5:163b–164a / **4**:731b–d / **7**:560d–e	
	5:164a–165f	**10**:591h–593g *passim*
	5:165f–167f	**13**:435g–h
MOUNTAIN RANGES AND MOUNTAIN BELTS **12**:588–592		
	12:588g–590d / **19**:505c–507a	**12**:577h–578g
	12:590d–592d / **12**:578h–580c	
	12:590d–591d	**9**:215a–b / **9**:1028e–h
	12:591d–g	
	12:591h–592d	

	articles	article sections	other references
d. The volcanic island arc systems	ISLAND ARCS 9:1025–1030	19:507a–d	
i. Their geomorphic characteristics		9:1026g–1027h	
ii. Their geology and structure		9:1027h–1030a	6:69e–h / 12:591b–d / 19:507b–d
iii. Their origin		9:1030a–h	19:507a–b
e. The rock types comprising the folded mountain ranges and island arcs; *e.g.*, metamorphosed sediments, basaltic and andesitic lavas [see also 212.F.2. and 214.B.4.]		8:297f–d / 9:217b–219b / 12:579h–580c	9:1028a–d
G. Oceanic ridges: broad, uplifted regions beneath the oceans and their associated fracture zones [see also 241.G.]	OCEANIC RIDGES 13:472–475		13:435e–f
1. Classification of ridges		13:472c–473b	
a. The mid-ocean ridge system		13:472d–h	6:47b–c / 13:434g–435b / 15:841d–e
b. Other ridges: lateral, linear, and boundary ridges; microcontinents		13:472h–473b	
2. Origin and growth of ridges		13:473b–h	
a. General geophysical properties		13:473b–d	
b. The theory of plate tectonics [see 241.G.3.b.]			
3. Occurrence and distribution of ridges [see also A.3., above]		13:474a–475h	13:434h–435a
a. Ridges of the Atlantic Ocean		13:474a–g	2:294f–295b
b. Ridges of the Pacific Ocean		13:474g–475c	13:837a–b
c. Ridges of the Indian Ocean		13:475c–h	9:310b–e

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

Continents
AFRICA 1:177
ANTARCTICA 1:947
ASIA 2:145
AUSTRALIA 2:381
EUROPE 6:1033
NORTH AMERICA 13:174
SOUTH AMERICA 17:73

Mountains and mountain ranges
ALASKAN MOUNTAINS 1:414
ALPS MOUNTAIN RANGES 1:633
ALTAI MOUNTAINS 1:639
ANDES MOUNTAIN RANGES 1:856
APENNINE RANGE 1:1011
APPALACHIAN MOUNTAINS 1:1015
ATLAS MOUNTAINS 2:304
CARPATHIAN MOUNTAINS 3:946
CAUCASUS MOUNTAINS 3:1015
EAST AFRICAN MOUNTAINS 6:120
ELBURZ MOUNTAINS 6:523
ETNA (MOUNT) 6:1017
EVEREST, MOUNT 6:1139
HIMALAYAN MOUNTAIN RANGES 8:882
HINDU KUSH (MOUNTAINS) 8:920
JURA MOUNTAINS 10:353
KARAKORAM RANGE 10:403
KUNLUN MOUNTAINS 10:543
NEW GUINEA, MOUNTAIN RANGES OF 12:1088
PACIFIC COAST RANGES 13:824
PAMIR MOUNTAIN AREA 13:938
PYRENEES RANGE 15:315
ROCKY MOUNTAINS 15:964
SALT RANGE 16:199
SIERRA NEVADA RANGE 16:739
TIEN SHAN (MOUNTAINS) 18:392
URAL MOUNTAINS 18:1032
VESUVIUS (MOUNT) 19:98
VIRUNGA MOUNTAINS 19:162

Other features
BASIN AND RANGE PROVINCE 2:749
DEATH VALLEY 5:539
GRAND CANYON 8:277
GREAT BARRIER REEF 8:299
VALLEY OF TEN THOUSAND SMOKES 19:20

Section 232. Features produced by geomorphic processes acting on the Earth's surface

[for Part Two headnote see page 79
for Division III headnote see page 104]

The articles and parts of articles referred to in Section 232 deal with four main subjects: A, the action of the hydrosphere and atmosphere on the Earth's surface features; B, the effects of actions from the biosphere, exosphere, and lithosphere on the Earth's surface features; C, the characteristic features of the Earth's major environments; and D, theories of landform evolution.

The outline of subject A covers the effects on the Earth's surface features of weathering and soil formation; of gravitational processes producing various types of Earth movements, such as rockfalls and landslides; of rivers and the associated drainage systems of streams and their tributaries; of wind transport of rock and mineral material; of marine processes; of glacial processes; and of lacustrine processes.

The outline of subject B begins with the physiographic effects of various biological processes. It covers the effects of plants and organisms on rock weathering and soil formation; the effects of animal trails, tracks, and burrows on the erodability of Earth materials and on sediment yield; the effects of vegetation type and density on sediment yield; the direct and indirect effects of man's action on the Earth's surface features; and the effects of extraterrestrial and volcanic-tectonic processes.

Subject C is the characteristic features of the Earth's major environments. The outline covers the fluvial environment; the lacustrine environment; the estuarine environment; the marine environment; the desert environment; the glacial environment; the polar environment; the tropical environment; the temperate environment; and such aspects of the subterranean environment as geysers, hot springs, fumaroles, and caves and cave systems.

Subject D is theories of landform evolution, a term applied to all changes in the Earth's surface features throughout time, broadly caused by the interaction of the opposing processes of

relative uplift on the Earth's surface and downwearing by weathering and erosion. The article referred to covers basic concepts involved in the theory of landform evolution—the concept of uniformitarianism; the concept of the cycle of erosion; the concept of morphogenetic regions; the concept of dynamic equilibrium; and the concept of entropy.

A. The action of the hydrosphere and atmosphere on the Earth's surface features

1. Weathering: the disintegration and alteration of rocks at or near the Earth's surface

a. Processes involved in weathering

i. Physical processes; *e.g.*, freeze–thaw cycles, crystal-growth pressures

ii. Chemical processes; *e.g.*, solution effects, hydration, hydrolysis, oxidation

b. Factors that control the type and rate of rock weathering; *e.g.*, rock composition and structure, climate

c. Soil formation

i. Processes of soil formation: clay formation, humification, leaching, dispersion of soil constituents, development of soil profiles, and rates of soil formation

ii. Factors involved in soil formation: effects of climate, drainage, topography, living organisms, and parent material
[see also 354.A.2.b.i.]

iii. Classification and nomenclature of soil groups

iv. Geographic distribution of soils

v. Soil crusts

2. Gravitational processes on hillslopes

a. Factors producing earth movements; *e.g.*, slope angle, material type and water content, climate, earth tremors

b. Types of earth movements; *e.g.*, rockfalls, creep, bulging, landslides, debris slides, slumps

c. Characteristics of unstable slopes

3. Fluvial processes
[see also 126]

a. The flow of water in a natural channel

b. Entrainment and transport of sedimentary particles

c. Materials transported by natural rivers

d. Erosion and deposition in natural channels

e. River forms and fluvial processes in different environments

f. The flow of rivers in estuaries
[see C.3.b., below]

g. The flow of ephemeral streams
[see C.1.d.iv., below]

h. The relationship of rivers and groundwater

i. The sediment yield of drainage systems
[see also 731.A.4.]

i. Measurement of sediment yield and sediment load

ii. Sources of sediment and nature of deposition

articles	article sections	other references
WEATHERING **19**:702–705		**5**:609f–610e
	19:703b–705a / **13**:563f–h	**16**:475g–h
	19:703b–704c	
	19:704c–705a / **4**:705f–g / **16**:1018g–1020c	**3**:1023e–1024d / **7**:734c–735a / **7**:1032h–1033c / **12**:94d–f / **13**:563f–h
	19:705a–e / **7**:1033g–1034f / **12**:118g–h	**3**:1024f–1025d / **16**:1022e
SOILS **16**:1018–1028		**5**:46g–47a / **6**:708e–709c
	16:1018g–1022g / **5**:1091d–1092e	**11**:27c–f / **14**:434h–435b / **19**:704d–705a
	16:1022g–1024a / **5**:1092e–1093b / **8**:281d–h / **16**:1014h–1018a	**7**:537b–e / **7**:733c–e / **16**:467a–b
	16:1024a–1025d	
	16:1025d–1028b	**1**:191f–193c / **2**:163h–167b / **2**:393a–b / **6**:1046c–h / **13**:189d–190c / **17**:84h–85g
DURICRUSTS **5**:1088–1093	**10**:340e–341c	**5**:610c–e / **19**:704d–f
EARTH MOVEMENTS ON SLOPES **6**:63–67		
	6:63d–h	**14**:432a–b
	6:64a–66e	
	6:66e–g	
FLUVIAL PROCESSES **7**:437–446		
	7:438b–440c	**11**:789d–e
	7:440c–441d / **1**:615d–616e	**6**:972d–973b
	7:441d–442c / **1**:613e–614h	**6**:709g–710b / **15**:876e–g
	7:442c–444g / **15**:870d–871d / **15**:881g–883c / **16**:475g–476e	**6**:973b–c / **10**:626d–e / **19**:641e–f / **19**:642c–643a *passim*
	7:444h–446e	**15**:877h–879c *passim* / **15**:867f–h
	15:877h–879c	**8**:435d–h
SEDIMENT YIELD OF DRAINAGE SYSTEMS **16**:474–479	**7**:441d–444h / **7**:532e–533a / **10**:604f–605a	**14**:434g–h
	16:475b–g	**7**:441e–h
	16:475g–476e / **7**:442b–444h	**6**:972f–h

iii. Factors that influence sediment yield

j. The erosion of canyons and valleys

k. The formation of hillslopes

i. Hillslope form

ii. Hillslope processes

iii. Hillslope development

4. Eolian processes

a. Transportation of rock debris by wind: the relation between air flow and the mechanics of particle movement

b. Effects of wind transport: modification of particles; deflation of surfaces; abrasion by sandblasting

c. Deposition by wind: formation and migration of dunes; the role of vegetation

d. Wind action and the works of man: benefits and hazards of dune environments

5. Marine processes

a. Erosion and deposition of coastal materials by waves and currents

b. Transport of sediment by density flows

6. Glacial processes
[see also C.6., below]

a. Glacial erosion

b. Glacial transport

c. Glacial deposition

d. Glacial loading and unloading

e. Periglacial processes: formation of permafrost, development of thermokarst topography, and related processes

7. Lacustrine processes

a. Erosion and deposition by waves and currents

b. Sedimentation in lakes

c. Effects of flora and fauna on lakes and lake systems
[see 354.B.3.a.]

B. The effects of actions from the biosphere, exosphere, and lithosphere on the Earth's surface features

1. Biological processes
[see 351]

a. Effects of plants and organisms on rock weathering and soil formation
[see A.1.b. and A.1.c.ii., above]

b. Effects of animal trails, tracks, and burrows on the erodability of Earth materials and on sediment yield
[see A.3.i.iii., above]

c. Effects of vegetation type and density on sediment yield
[see A.3.i.iii., above]

d. Effects of man on the Earth's surface features
[see also 355, 731, 733.B., 734, and 737]

i. Direct effects; *e.g.*, land cultivation, mining, construction of artificial channels and coastal works

ii. Indirect effects; *e.g.*, land subsidence, slope failure, erosion, sedimentation, earthquakes

articles	article sections	other references
	16:476e–479h	**10**:626b–d
	6:63d–h	
HILLSLOPES **8**:873–880		
	8:874e–875f	
	8:875g–878e	
	8:878e–880e	
WIND ACTION **19**:841–847	**14**:556e–557a	**4**:731h–732a / **5**:611b–f
	19:841d–843a / **9**:229g–230g / **16**:209c–g	
	19:843a–844g	**14**:556f–g
	19:844g–846d / **16**:209g–211h / **19**:35c	**5**:611c–d / **14**:556g–557a
	19:846d–h	
	16:636e–g	
	2:778a–779f / **10**:594a–c / **19**:655h–656e	
	5:590g–591h	**3**:788c–790b *passim* / **8**:298d–299c / **11**:497h–498b
GLACIATION, LANDFORMS PRODUCED BY **8**:165–167	**14**:563c–564b	
	8:165d–g	
	8:165g–166c / **12**:157e–f	
	8:166c–g	
	8:166h–167d / **14**:563e–564b	**8**:1002c–1003c
	8:167g–h / **14**:90h–91e	**14**:93c–94f *passim*
	10:610c–f	
	5:589g–590c / **10**:604d–605c / **19**:32a–34d	
PHYSIOGRAPHIC EFFECTS OF MAN **14**:429–433		**7**:437g–438a
	14:430g–431f / **3**:759f–362d / **4**:807d–f / **6**:975d–g	**8**:641a–643e *passim*
	14:431f–433g	**2**:779f–780f / **6**:970g / **15**:903d–e / **16**:476d–477e *passim*

2. Extraterrestrial processes
[see also 133.A.4.d.]

a. The occurrence of meteorite craters and the concept of the astrobleme: the number of known or suspected terrestrial impact structures

b. The impact cratering process: evidence from field studies and from theoretical and experimental investigations

c. Criteria of impact origin of landforms; *e.g.*, crater geometry, shock metamorphism of rocks

3. Volcanic-tectonic processes

a. The effect of volcanic eruptions on the Earth's surface features
[see 212.D.4. and 231.F.]

b. The effect of uplift and other tectonic movements on the Earth's surface features
[see also 212.F.2. and 241.E.]

C. The characteristic features of the Earth's major environments

1. The fluvial environment

a. Distribution of rivers in nature: comparative data on major world rivers; principles governing river distribution and flow

b. Drainage patterns: Horton's laws of drainage composition; the relation between streamflow and basin geometry; evolution of drainage systems

c. The geometry of river systems

i. Hydraulic geometry: variations in channel characteristics in relation to discharge

ii. River channel patterns; *e.g.*, straight, meandering, braided

d. Streamflow and fluvial landforms

i. Peak discharge and flooding: frequency of occurrence of floods

ii. River floodplains and terraces

iii. River deltas

iv. Ephemeral streams

v. Waterfalls: the result of discontinuities of river profile

e. The evolution of river systems through geological time

2. The lacustrine environment

a. Lake basins

i. Classification and topography of lake basins

ii. Lake sediments: clastic sediments and chemical precipitates

b. Lake waters

i. Chemical composition: dissolved salts, gases, and other constituents

ii. Thermal properties: vertical mixing and overturn; the heat budget of lakes

c. Lake hydraulics
[see also 223.B. and C.]

i. Lake currents: effects of pressure gradients, wind stress, and stratification

ii. Surface waves: generation of waves by wind

iii. Seiches: long-period lake oscillations

articles	article sections	other references
METEORITE CRATERS **12**:48–54		**12**:43a–d
	12:48c–49f	
	12:49g–52a	**12**:43a–c / **18**:63e–g
	12:52a–54b / **15**:959g–h	**12**:43c–d
PHYSIOGRAPHIC EFFECTS OF TECTONISM **14**:433–435	**14**:556c–e	**5**:121c–e / **10**:602e–h / **15**:913e–g
RIVERS AND RIVER SYSTEMS **15**:874–888	**12**:168a–170b	
	15:876h–879c / **7**:444h–446e	**1**:1033c–e / **5**:608d–f
	15:879c–880f	**10**:633h–634a / **16**:478f–479g *passim*
	15:880g–883c	
	15:880g–881g	**10**:632b–633h
	15:881g–883c	**7**:442c–h
	15:883c–887c / **7**:444h–446e	
	15:883c–884f	**7**:443f–h / **19**:645h–646b
	15:884f–886b	
RIVER DELTAS **15**:867–874	**15**:886c–f / **4**:798g–799d	**5**:116b–c / **17**:838d–e
	15:886g–887c	**5**:608d–f / **6**:610g–611a
WATERFALLS **19**:638–643	**15**:887c–888d	**7**:442h–444g
LAKES AND LAKE SYSTEMS **10**:600–612		**1**:1032c–f
	10:602e–605c	
	10:602e–604d / **8**:171d–172a	
	10:604d–605c / **8**:174f–h / **19**:32a–34d	
	10:605d–608d	
	10:605d–606e	
	10:606f–608d / **12**:166b–168a	**1**:1032d–e
	10:608d–610f	
	10:608d–609b	
	10:609b–e	
	10:609e–610b	**13**:494g–h

	articles	article sections	other references
iv. Effects of wave and current action [see A.7.a., above]			
d. The hydrologic balance of lakes		**10**:610g–612f / **8**:176f–177a	
i. The water budget: water input and output; water-level fluctuations		**10**:610g–612c	
ii. Lake extinction		**10**:612d–f	
e. Lakes in arid regions [see C.5.c.ii., below]			
f. Glacial lakes [see C.6.e.i., below]			
g. Swamps, marshes, and bogs	SWAMPS, MARSHES, AND BOGS **17**:836–840		**4**:799h–800b
3. The estuarine environment	ESTUARIES **6**:968–973		
a. The formation of estuaries		**6**:969c–970g	
i. Effects of changes in sea level		**6**:969c–e	
ii. Factors that control the geomorphology of estuaries		**6**:969e–h	
iii. Factors tending to destroy estuaries; *e.g.*, sediment influx, vegetation encroachment		**6**:970c–g	
b. Hydrologic features of estuaries		**6**:970h–973c	
i. Factors controlling and affecting estuarine circulation; *e.g.*, tides, river discharge		**6**:970h–971b	
ii. Types and examples of estuarine circulation		**6**:971c–972b	
iii. Relation of estuarine circulation and sediment transport		**6**:972c–973c	
4. The marine environment	COASTAL FEATURES **4**:795–802		
a. Coastal features resulting from depositional processes		**4**:796b–800b	
i. Beaches: materials, morphological features, and physical processes	BEACHES **2**:777–781	**4**:796b–797d	
ii. Sand dunes and sandbars		**4**:797e–798g	**2**:780g–h / **16**:208h–212e *passim*
iii. River deltas [see C.1.d.iii., above]			
iv. Coral reefs [see 231.E.]			
v. Lagoons [see also 354.B.]	LAGOONS **10**:591–594	**6**:1135h–1137c	**5**:167d–f / **10**:983d–g
vi. Marshes [see C.2.g., above]			
b. Coastal features resulting from erosional processes; *e.g.*, sea cliffs and related landforms		**4**:800b–801c	**3**:1023b–c
c. Coastal features dependent on bedrock type, bedrock structure, or local topography; *e.g.*, grottoes, spouting holes, fjords, peninsulas, islands		**4**:801d–802h	
d. Submerged coastal features: the continental shelf and slope; submarine canyons [see 231.C.]			
5. The desert environment	DESERTS **5**:602–615		
a. General aspects of deserts: basic types of deserts and their climatic features; areal extent of the major deserts of the world today; economic importance of deserts		**5**:602e–604a	
b. The aridity of deserts: the cause and definition of deserts [see also 224.D.]		**5**:604d–607e	
i. General cause of the arid zone: the pattern of circulation of the atmosphere		**5**:604d–g	
ii. The definition of aridity: indices of aridity; the classification of arid regions		**5**:604h–607e	
c. Hydrologic aspects of deserts		**5**:607e–609f	

	articles	article sections	other references
i. Principal hydrologic factors: effects of climatic, topographic, and geologic features		**5**:607e–608c	
ii. Surface water		**5**:608c–609a	
iii. Subsurface water		**5**:609a–f / **8**:434a–435c	
d. Geomorphic processes that shape desert landforms: weathering, gravitational, fluvial, and eolian processes		**5**:609f–611f / **19**:843a–846d	
e. Surficial features		**5**:611f–613h	
i. Mountains, plateaus, pinnacles, and similar features		**5**:611g–612b	
ii. Alluvial fans: fan-shaped sedimentary deposits bordering highlands from which the sediment was derived	ALLUVIAL FANS **1**:611–617	**5**:612b–c	
iii. Pediments: bedrock surfaces fringing desert highlands	PEDIMENTS **13**:1103–1106		
iv. Desert plains, basins, and depressions		**5**:612d–g	**19**:843d–g
v. Playas, pans, and saline flats	PLAYAS, PANS, AND SALINE FLATS **14**:552–558	**5**:612g–h / **5**:1091b–c / **6**:1135c–h	**14**:565c–566a
vi. Sand sheets and sand dunes	SAND SHEETS AND SAND DUNES **16**:208–212	**5**:613b–h / **19**:844h–845g	
f. The permanence of deserts: evidence concerning the location of arid regions in the geological past [see also 224.D.6.]		**5**:614a–615a	
i. Climatic change: the relation between latitudinal climatic zonation and continental drift		**5**:614a–h	
ii. Desert boundaries: possible future expansion or contraction of desert areas		**5**:614h–615a	
6. The glacial environment [see also 354.A.1.c.i.]	GLACIATION, LANDFORMS PRODUCED BY **8**:164–177		**18**:733c–d
a. Processes of glaciation [see A.6., above]			
b. Landforms produced by glacial erosion		**8**:167h–172a / **10**:603c–g	**19**:641b–d
i. Microrelief and small-scale features; *e.g.*, rock polish, striations, grooves		**8**:168a–g	
ii. Glaciated valleys and associated features; *e.g.*, cirques, arêtes, horns, valley profiles and cross sections, fjords		**8**:168g–171d	
iii. Glacially eroded rock basins in non-mountainous regions		**8**:171d–172a	
c. Landforms produced by glacial deposition		**8**:172a–174h	
i. Nonstratified drift and associated landforms; *e.g.*, glacial till, moraines, drumlins		**8**:172e–173f	
ii. Stratified drift and associated landforms; *e.g.*, ice-contact deposits, kames, eskers		**8**:173f–174f	
iii. Glaciolacustrine sediments and associated landforms		**8**:174f–h / **19**:32a–33e	
d. Landforms produced by periglacial processes		**8**:174h–176e / **14**:561c–g	
i. Permafrost: perennially frozen ground	PERMAFROST **14**:89–95	**8**:175a–d	
ii. Talus, rock glaciers, and blockfields		**8**:175d–g	
iii. Patterned ground, including stone nets, stripes, and polygons, and features related to the melting of buried ice masses; *e.g.*, pingos		**8**:175g–176c / **14**:93c–94f	
iv. Eolian deposits		**8**:176c–e	
e. Modern landforms and former glaciation		**8**:176e–177g / **14**:564c–567h	

	articles	article sections	other references
i. Modern lakes and Pleistocene forerunners		**8**:176f–177a / **14**:565c–566a	
ii. Coastal features and sea-level change		**8**:177a–c / **4**:733b–c / **14**:564c–565c	
iii. Drainage patterns and ice disruption		**8**:177c–e / **4**:733e–f / **14**:566b–g	
iv. Climatic implications		**8**:177e–g / **4**:731d–f / **4**:732h–733b / **4**:736f–737a / **14**:561c–h / **14**:566h–567h	
7. The polar environment [see C.6., above and 354.A.1.d.i.]			
8. The tropical environment [see also 354.A.1.c.iv.]			
a. Varieties and characteristics of rain forests	JUNGLES AND RAIN FORESTS **10**:336–342	**10**:337a–339a / **7**:540c–f	**7**:54d–f
b. Topography and hydrology		**10**:339a–340c	
i. Rock type and landscape		**10**:339a–c	
ii. Precipitation, evapotranspiration, and runoff		**10**:339c–340c	
c. Weathering and soils		**10**:340c–341h	**7**:1034a–f
i. Tropical weathering		**10**:340c–e	
ii. Lateritic soils		**10**:340e–341c	
iii. Erosion in rain forests		**10**:341c–h	**8**:878c–e
d. Geological history of rain forests		**10**:341h–342d	
9. The temperate environment: woodlands and grasslands [see 354.A.1.c.ii., iii., and v.]			
10. The subterranean environment [see also 354.A.1.d.ii.]			
a. Springs and wells		**17**:516b–517h	
b. Geysers, hot springs, and fumaroles	GEYSERS AND FUMAROLES **8**:132–136	**19**:503b–f	
c. Caves and cave systems	CAVES AND CAVE SYSTEMS **3**:1020–1029	**12**:120d–e	**3**:837e–f
i. Their origin, evolution, and features		**3**:1022c–1028h	
ii. Karst topography: hummocky terrain resulting from subsurface cavern development and consequent slumping of the ground surface		**3**:1028h–1029c	
D. Basic concepts in the theory of landform evolution	LANDFORM EVOLUTION **10**:624–634		
1. The concept of uniformitarianism: that the processes operative on the Earth's surface in the geological past did not differ in kind from those that are operative today [see also 242]		**10**:625d–626f / **18**:857d–859f	
2. The concept of the cycle of erosion: that landforms progress through a series of well-defined stages with time, culminating in a planar erosion surface termed a peneplain		**10**:626f–628g	**8**:873h–874c
3. The concept of morphogenetic regions: that the influence of climate on landform development is so profound that regions of similar landforms may be defined solely on a climatic basis		**10**:628g–630b	
4. The concept of dynamic equilibrium: that landforms reflect a balance between the processes now operative upon them and the degree to which their rock type and structure resist these processes		**10**:630b–633a / **14**:434g–435d	
5. The concept of entropy: that landforms reflect the most probable of all possible alternative states in nature; that their development is well matched by stochastic or random-based models [see also 124.A.]		**10**:633a–634e	

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

Rivers and waterfalls
AMAZON RIVER 1:652
AMU DARYA (RIVER) 1:715
AMUR RIVER 1:716
BRAHMAPUTRA RIVER 3:104
COLORADO RIVER 4:910
COLUMBIA RIVER 4:930
CONGO RIVER 4:1123
DANUBE RIVER 5:488
DNEPR RIVER 5:923
DNESTR RIVER 5:925
DON RIVER 5:957
DVINA RIVER, NORTHERN 5:1096
DVINA RIVER, WESTERN 5:1097
ELBE RIVER 6:522
FRASER RIVER 7:696
GAMBIA RIVER 7:865
GANGES RIVER 7:879
GUADALQUIVIR RIVER 8:450
HSI CHIANG (RIVER) 8:1124
HUANG HO (RIVER) 8:1128
IGUAÇU FALLS 9:233
INDUS RIVER 9:492
IRRAWADDY RIVER 9:898
JORDAN RIVER 10:275
LENA RIVER 10:790
LOIRE RIVER 11:87
MACKENZIE RIVER 11:265
MEKONG RIVER 11:860
MISSISSIPPI RIVER 12:280
NIAGARA RIVER AND FALLS 13:57
NIGER RIVER 13:97
NILE RIVER 13:102
OB RIVER 13:431
ODER RIVER 13:506
OKAVANGO RIVER 13:539
ORANGE RIVER 13:640
ORINOCO RIVER 13:737
PARAGUAY RIVER 13:991
PARANÁ RIVER 13:999
PLATA, RIO DE LA 14:525
RHINE RIVER 15:805
RHONE RIVER 15:822
RIO GRANDE 15:859
SAINT LAWRENCE RIVER 16:172
SÃO FRANCISCO RIVER 16:235
SEINE RIVER 16:488
SENEGAL RIVER 16:540
TAGUS RIVER 17:988
TARIM RIVER 17:1069
THAMES RIVER 18:205
TIBER RIVER 18:372
TIGRIS-EUPHRATES RIVER SYSTEM 18:402
VICTORIA FALLS 19:114
VISTULA RIVER 19:172
VOLGA RIVER 19:508
VOLTA RIVER 19:516
WESER RIVER 19:759
YALU RIVER 19:1069
YANGTZE RIVER 19:1072
YENISEY RIVER 19:1089
YUKON RIVER 19:1107
ZAMBEZI RIVER 19:1127

Lakes and landlocked seas
ALPINE LAKES 1:631
ARAL SEA 1:1066
BAIKAL, LAKE 2:596
BALATON, LAKE 2:609
BALKASH, LAKE 2:641
CASPIAN SEA 3:980
CHAD, LAKE 4:17
DEAD SEA 5:524
EAST AFRICAN LAKES 6:116
EYRE, LAKE 7:125
GALILEE, SEA OF 7:850
GREAT LAKES 8:301
GREAT SALT LAKE 8:305
ISSYK-KUL, LAKE 9:1067
KOKO NOR (LAKE) 10:498
LADOGA, LAKE 10:584
NICARAGUA, LAKE 13:63
ONEGA, LAKE 13:570
TITICACA, LAKE 18:461
URMIA, LAKE 18:1084
VAN, LAKE 19:20

Deserts
ARABIAN DESERT 1:1051
ATACAMA DESERT 2:254
GOBI (DESERT) 8:219
KALAHARI (DESERT) 10:373
KARA-KUM DESERT 10:403
NAMIB DESERT 12:819
NORTH AMERICAN DESERT 13:203
PATAGONIAN DESERT 13:1068
SAHARA (DESERT) 16:147
SINAI DESERT 16:779
TAKLA MAKAN DESERT 17:1001
THAR DESERT 18:206

Other features
AMAZON RAIN FOREST 1:650
EVERGLADES 6:1141
GRAN CHACO 8:274
GREAT PLAINS 8:304
ITURI FOREST 9:1176
LLANOS 11:5
PANAMA CANAL 13:945
PRIPET MARSHES 14:1096
RUSSIAN STEPPE 16:100
SAINT LAWRENCE SEAWAY 16:174
SUEZ CANAL 17:766
VELD 19:56

Division IV. The Earth's history

[for Part Two headnote see page 79]

The outlines, and the articles and parts of articles referred to, in the three sections of Division IV deal with the origin and development of the Earth and its envelopes; the interpretation of the geological record; and the eras and periods of geological time.

The outline and the articles referred to in Section 241 treat the origin and development of the lithosphere, of the atmosphere, and of the hydrosphere; the formation and growth of the continents and of the mountain ranges and belts; the theory of continental drift; and the theory of sea-floor spreading.

Section 242 treats the stratigraphic, the paleontological, and the paleogeographical interpretations of the geological record; the relative and absolute dating of the Earth's history; and the reconstructing of the geological history of the Earth.

The articles referred to in Section 243 treat the rocks, the life, and the environments in Precambrian time and in the Lower Paleozoic, Upper Paleozoic, Mesozoic, and Cenozoic eras.

Section 241. Origin and development of the Earth and its envelopes 115
242. The interpretation of the geological record 119
243. The eras and periods of geological time 123

Section 241. Origin and development of the Earth and its envelopes

[for Part Two headnote see page 79]

The articles and parts of articles referred to in Section 241 deal with seven main subjects: A, the origin and development of the lithosphere; B, the origin and development of the atmosphere; C, the origin and development of the hydrosphere; D, the formation and growth of the continents; E, the formation and growth of mountain ranges and belts; F, the theory of continental drift; and G, the theory of sea-floor spreading.

The outline of subject A covers theories of the origin of the Earth and theories about the evolution of the crust, the outer part of the Earth, from the mantle that underlies the crust.

The outline of subject B begins with the relation of the development of the Earth's atmosphere to the origin of the solar system and the development of other planetary atmospheres. It goes on to speculations about the original atmosphere of the Earth and hypotheses about the evolution of the present terrestrial atmosphere. It also deals with the effects of man's activities on the heat balance or composition of the atmosphere.

Subject C is the origin and development of the hydrosphere.

The outline begins with speculations about the early oceans and about the transition stage from about 3,500,000,000 to 1,500,000,000 years ago. It goes on to the modern chemical view of the oceans as a steady-state system in which rates of inflow of materials into the oceans equal rates of outflow, resulting in a nearly fixed seawater composition. It next treats evidence concerning the evolution of the hydrosphere-atmosphere derived from the analysis of the mass and distribution of sedimentary rocks that have been deposited from the oceans during geological time. Finally, it deals with the evidence for limits on past variations of seawater composition.

Subject D is the formation and growth of the continents. The outline begins with the processes that govern crustal development—exogenic processes, including weathering and the formation of sedimentary rocks, and endogenic processes, including magmatism, metamorphism, and tectonism. It goes on to deal with the types and evolution of endogenic regimes, which are regular combinations of endogenic processes, appearing in each interval of geologic time in definite zones, the effects of which characterize the continents. Finally, it treats the various lines of geophysical evidence for a long-term stability in the relations between endogenic regimes and deep-seated Earth processes.

The outline of subject E begins with the relation of the distribution of mountain belts to the movements of large plates of the Earth's crust postulated in the new theory of plate, or global, tectonics. It goes on to such generalizations as are possible about the highly varied composition and structure of the tectonic mountain belts. It next deals with the geosynclinal hypothesis of mountain building—namely, that mountain belts form at the site of long, narrow, sediment-filled troughs called geosynclines. Finally, it treats stages in the development of mountain systems.

Subject F is the theory of continental drift—the theory that the continents have undergone, during geologic time, large-scale horizontal displacements relative to each other and to ocean basins. The outline, after reviewing the history of the controversy about the concept of continental drift, deals with the main lines of evidence, in addition to the apparent matching of continental margins, currently thought to favour the hypothesis of continental drift. It first treats geological data, such as recently discovered matches between ancient rocks on now separated continents, and fossil discoveries showing identical species of plants and animals, strictly adapted to living on land or in freshwater, on both sides of large marine barriers. It goes on to paleomagnetic data that indicate polar wandering and reversals of the geomagnetic field, and to evidence that the ocean floors are geologically young. The outline also treats the claims of the geological theory called plate tectonics to suggest what mechanisms could have generated the displacements of continental drift.

Subject G is the theory of sea-floor spreading—the theory that the ocean basins are expanding or contracting as a result of the outward spreading of a newly generated oceanic crust from the mid-ocean ridges. The outline, after reviewing the development of the concept of sea-floor spreading, deals with the evidence for it, covering the anomalously high values of heat flow over mid-ocean ridges; the linear magnetic anomalies that parallel the mid-ocean ridges and their relation to geomagnetic reversals; and data about the age and distribution of marine sediments. Finally, it treats the structural elements of the sea-floor spreading model and the hypotheses about the causes of sea-floor spreading in plate tectonics theory.

A. The origin and development of the lithosphere
[see also 213.A.]

1. Theories of the origin of the Earth
[see also 133.A.7.]

a. Homogeneous accretion: that the Earth formed slowly from metal and silicate particles and was originally cool and unmelted and of relatively uniform composition

b. Inhomogeneous accretion: that the origin of the Earth was a sequential process, the formation of a metallic core followed by the accretion of an overlying silicate mantle

c. Single-stage accretion from primordial material: that the Earth formed so rapidly that melting of the outer layers occurred with the subsequent gravitational segregation of core from mantle

2. The evolution of crust from mantle: processes involved in the geochemical differentiation of the Earth's outer layers

B. The origin and development of the atmosphere
[see also 133.A.7. and 221.A.]

1. The relation of the development of the Earth's atmosphere to the origin of the solar system and the development of other planetary atmospheres

2. The original atmosphere of the Earth

a. Evidence from the atmospheric abundances of the noble gases and the theory of planetary origins

b. Anoxic state of the original atmosphere: evidence that the Earth's primitive atmosphere was devoid of oxygen

3. Evolution of the present terrestrial atmosphere

a. Additions to the atmosphere: escape of volatile components from the Earth's interior; gases produced by radioactive decay
[see also 111.C.]

articles	article sections	other references
EARTH, STRUCTURE AND COMPOSITION OF **6**:55–57		
	6:55e–56g/ **6**:10g–11b/ **6**:24e–f/**6**:60d–e	**6**:712a–e/**12**:48f–g
	6:55e–h	
	6:55h–56b	
	6:56b–g	
	6:56g–57d	**5**:123d–g/**6**:712e–f
ATMOSPHERE, DEVELOPMENT OF **2**:313–319	**13**:486g–487d	**6**:711a–712a
	2:313h–314f	
	2:314g–316b/ **6**:11b–c/ **6**:711b–c	**13**:476d–f
	2:314g–315b	
	2:315c–316b	**10**:901a–c/**13**:477c–e
	2:316b–319d	**6**:711c–712a
	2:316c–g	

	articles	article sections	other references
b. Changes in composition: reactions that control the production and accumulation of oxygen in the atmosphere [see also 335.B.]		**2**:316g–317d / **2**:310h–311e	**6**:711d–712a / **13**:478g–479e
c. The hypothetical course of atmospheric evolution: evidence from the geological record		**2**:317d–319d	
4. Effects of man's activities: possible changes in the heat balance or composition of the atmosphere as a result of pollution		**2**:319d–f / **14**:756b–d / **18**:1051h–1053e	**5**:49h–50b
5. The present atmosphere [see 221.A.]			
C. The origin and development of the hydrosphere	OCEANS, DEVELOPMENT OF **13**:476–482	**13**:486g–487d	**14**:564c–g
1. The early oceans: condensation of volatile components of the primitive atmosphere as a result of the cooling of the Earth		**13**:476d–477c	
2. The transition stage from about 3,500,000,000 to 1,500,000,000 years ago: reactions between initially acid oceans and the Earth's basaltic crust		**13**:477d–h	
3. The chemical view of the modern oceans: evidence to account for present seawater composition		**13**:478a–479h	
a. Chemical equilibria between minerals and seawater		**13**:478c–f	
b. Mass balance of the oceans: the addition and removal of seawater constituents		**13**:478f–479e / **19**:643g–644f	**6**:709h–710e
c. Experimental evidence based on reactions between clay minerals and seawater solutions		**13**:479e–h	
4. The mass and composition of sedimentary rocks: evidence for recycling of the dissolved constituents of the oceans		**13**:479h–480f / **10**:984d–e	**6**:710f
5. Periodic compositional excursions: evidence for limits on past variations of seawater composition		**13**:480f–481a	
6. The present hydrosphere [see 222 and 223]			
D. The formation and growth of the continents	CONTINENTS, DEVELOPMENT OF **5**:119–123		
1. The Earth's crust and upper mantle		**5**:120b–121e	
a. Composition and structure of the Earth's crust and upper mantle [see 213.A.]		**5**:120h–121e	
b. Processes that govern crustal development: exogenic processes, including rock weathering and the formation of sedimentary rocks; endogenic processes, including magmatism, metamorphism, and tectonism [see also 212.D.2., 214.B.1.c., and 232]			
2. Endogenic regimes of the continents		**5**:121e–122g	
a. Types of endogenic regimes: geosynclines, platforms, rifts, continental margins [see also 231]		**5**:121f–h	
b. Evolution of endogenic regimes: the original differentiation of the crust; tectonic cycles; the role of compressive forces and folding		**5**:121h–122g	
3. The relation between endogenic regimes and deep-seated Earth processes		**5**:122g–123h	
a. The nature of the geophysical evidence: correlations between endogenic regimes and crustal thickness; properties of the asthenosphere; heat flow data		**5**:122g–123c	
b. The vertical-force basis of continent building: gravitational differentiation driven by the internal heat of the Earth; the crustal-sinking hypothesis		**5**:123c–h	
E. Orogenesis: the formation and growth of mountain ranges and belts	MOUNTAIN-BUILDING PROCESSES **12**:577–584	**6**:62d–g	

	articles	article sections	other references
1. The distribution of mountain belts in relation to global tectonics: occurrence of mountain chains along the margins of lithospheric plates		**12**:578h–579d	**14**:434b–c
2. The tectonic mountain belts		**12**:579d–580c / **12**:589f–591g	
a. Fold and fault structures of mountain systems [see also 212.F.2.]		**12**:579e–h / **15**:916a–923g	**12**:589c
b. Rock types of the mountain belts: deformed sedimentary rocks, volcanic rocks, intrusive igneous rocks [see also 214.B. and 231.F.]		**12**:579h–580c / **9**:215h–216e / **9**:218d–219b	
3. The geosynclinal hypothesis of mountain building: that mountain belts form at the site of long, narrow, sediment-filled troughs, or geosynclines		**12**:580d–581g	
4. The development of mountain systems		**12**:581g–584e	
a. The deposition and consolidation of sediments in geosynclinal belts		**12**:581g–583g / **6**:10c–f	**8**:299c–e / **12**:589h–590a
b. Subsequent diastrophism: uplift and deformation of geosynclinal deposits; contemporaneous episodes of magmatism		**12**:583g–584b	
c. Causes of folding: crustal contraction, gravity sliding, and other hypotheses		**12**:584b–g	**15**:921f–922h
F. The theory of continental drift: that the continents have undergone large-scale horizontal displacements relative to each other and to ocean basins during geological time	CONTINENTAL DRIFT **5**:108–114		**6**:41e–g / **14**:98g–99a
1. Historical background		**5**:108g–110e	**6**:86d–f
a. Early theories: speculations initiated by the apparent fit of the bulge of eastern South America into the bight of Africa		**5**:108g–109c	
b. Wegener's hypothesis: the first detailed, comprehensive theory of continental drift		**5**:109c–110e	
2. Evidence for continental drift		**5**:110e–113c	**2**:295g–300a / **13**:927h–929c
a. Geological data: ages of rocks; the distribution of ancient glacial deposits and fossil plants and animals		**5**:110f–112c / **5**:119b–e / **6**:14d–e / **18**:155d–h	**1**:948d–f / **3**:694a–d / **4**:731e–f / **5**:915g–h / **8**:164d–e / **14**:743c–d / **18**:696h–697a
b. Paleomagnetic data: evidence of polar wandering, continental displacement and rotation, and reversals of the geomagnetic field during geological time [see also 212.B.]		**5**:112c–f / **15**:946e–h	**13**:910d–h
c. Oceanic data: ages of sediments; the distribution of magnetic anomalies		**5**:112g–113c	
3. The theory of plate tectonics [see G.3.b., below]			
4. The problem of mechanism: whether thermal motions in the upper mantle suffice to produce continental drift [see G.3.c., below]			
G. The theory of sea-floor spreading: that the ocean basins are expanding or contracting as a result of the outward spreading of newly generated oceanic crust from the mid-ocean ridges [see also 231]	SEA-FLOOR SPREADING **16**:442–447		
1. The development of the concept of sea-floor spreading		**16**:442h–444a	**6**:86f–h
2. Evidence of sea-floor spreading		**16**:444a–446a / **5**:112g–113c / **5**:513b–d	**9**:1029g–1030a / **12**:581d–f
a. Heat flow data: anomalously high heat flow over mid-ocean ridges [see also 212.D.]		**16**:444a–c	
b. Magnetic data: linear magnetic anomalies that parallel the mid-ocean ridges and their relation to geomagnetic reversals [see also 212.B.4.]		**16**:444c–445f	**5**:113b–c / **15**:947b–f
c. Age and distribution of marine sediments		**16**:445g–446a	**5**:112g–113b
3. The nature and cause of sea-floor spreading		**16**:446b–447c / **9**:1030a–h / **15**:845e–846b	

articles	article sections	other references
a. The structural elements of the sea-floor spreading model: transform faults, ridge crests, and trench systems	**16**:446b–e	**11**:499h–500b / **15**:921c–f
b. The theory of plate tectonics: that the Earth's surface is comprised of a small number of rigid lithospheric plates that move and interact with one another through time	**5**:113e–114c / **6**:23e–h / **12**:578h–579d / **13**:436g–437a / **13**:473d–h / **16**:446f–g	**6**:52f–53a / **9**:1030b–e / **15**:845h–846b
c. Possible thermal convection in the mantle	**16**:446h–447c / **5**:114c–h / **6**:26a–c	**6**:41f–g / **6**:53a–c / **13**:473f–h

Section 242. The interpretation of the geological record

[for Part Two headnote see page 79
for Division IV headnote see page 115]

The articles and parts of articles referred to in Section 242 deal with five main subjects: A, the stratigraphic interpretation of the geological record; B, the paleontological interpretation of the geological record; C, relative and absolute age dating; D, the paleogeographical interpretation of the geological record; and E, the reconstruction of the geological history of the Earth.

The outline of subject A begins with descriptions of the layered rocks of the Earth's crust and the general character of the rock record. It goes on to deal with stratigraphic classifications and their historical development, and with the criteria for the correlation of layered deposits. It further treats the problems of stratigraphic nomenclature and problems about stratigraphic boundaries.

The outline of subject B begins with the nature of fossils and of the fossilization process. It goes on to treat the fossil record, first in the Precambrian, and then in the post-Precambrian, wherein the record extends from the occurrence and evolution of the Protista to the occurrence of plants and mammals. The outline next deals with the fossil record as showing the history of most major groups of animals and plants and as affording evidence concerning the causes and principal factors involved in the extinction of certain groups. Finally, it deals with the paleontological criteria for the correlation of layered rocks, treating index fossils, assemblages, and especially pollen stratigraphy, which gives the record of the chronological and geographical distribution of fossil pollen and spores in the Earth's strata.

Subject C is the assignment of a chronology to the Earth's history. The outline begins with relative dating—the determination of sequences in the Earth's history by the correlation of data about rock ages and the fossils contained in rocks. It goes on to deal with the meaning of absolute age and with the requirements for absolute dating. It first treats the principles and methods of radiometric dating and the definition of time zero and the sources of error in radiometric dating. Dealing with non-radiometric dating, the outline treats geological processes taken as absolute chronometers, involving methods based on weathering and erosional processes; and biological processes taken as absolute chronometers, involving methods based on tree rings and corals. Finally, it treats applications of absolute dating for the establishment of the geological time scale, in determinations of the ages of the Earth, meteorites, and the Moon, and in the determination of sea-floor spreading rates.

The outline of subject D treats the factors involved in the reconstruction of former environments, and the use, for such reconstruction, of data supplied by stratigraphy, paleontology and paleoecology, structural geology and geophysics, and petrology and geochemistry.

Subject E is the reconstruction of the geological history of the Earth based on the worldwide correlation of the accumulated evidence from the geological record.

articles	article sections	other references
A. The stratigraphic interpretation of the geological record		
1. The layered rocks of the Earth's crust and their depositional environments: the nature of the rock record [see also 214.B.2.]	**17**:715f–716c / **6**:8h–9g / **16**:469e–472h	
a. Clastic sedimentary rocks	**4**:1109h–1111e / **16**:464h–466c	
b. Carbonate rocks	**10**:983a–984b	**16**:466c–h
c. Volcanic rocks	**9**:232b–233c	
d. Cyclic deposits	**16**:463c–e	**17**:724c–e
i. Cyclothems	CYCLOTHEMS **5**:396–400	**4**:793g–h
ii. Varved deposits	VARVED DEPOSITS **19**:31–36	**5**:511e–g
2. Stratigraphic classifications and their historical development: criteria for the correlation of layered deposits	**17**:716d–719g	
a. The principle of uniformitarianism	UNIFORMITARIANISM **18**:857–859	**10**:625d–626f
b. The principle of superposition of strata	**17**:716d–717e	**5**:497g–498a / **7**:1063d–f
c. The idea of a fossil succession	**17**:717e–718a	**5**:498b–499a
d. The facies concept	SEDIMENTARY FACIES **16**:458–463	**17**:718a–e / **6**:8g–9g
STRATIGRAPHIC BOUNDARIES **17**:715–726		

	articles	article sections	other references
i. The development of terminology to describe lateral changes in sedimentary layers: classical and operational definitions of sedimentary facies		**16**:458f–459c	
ii. Types of facies and the factors that govern them: terrigenous, biogenic, and chemical facies		**16**:459d–461d	
iii. Facies mapping and the analysis of facies variability: principles and applications		**16**:461d–463e	
e. The stage concept		**17**:718e–g	
f. The recognition of zones		**17**:718g–719f	
g. Radiometric dating [see C.2.b., below]			
3. Stratigraphic nomenclature in theory and practice		**17**:719h–726b	
a. Stratigraphic terminology and its standardization: the distinction among rock-stratigraphic, time-stratigraphic, biostratigraphic, and geological-time units		**17**:719h–723a / **7**:1067c–1068c	**5**:499d–g / **7**:1066a–c
b. Stratigraphic boundary problems		**17**:723a–724b / **18**:696b–e	**7**:1068c–d
i. Lower Paleozoic boundaries		**17**:723a–d	
ii. Upper Paleozoic boundaries		**17**:723d–h / **3**:859d–f / **13**:927f–g / **14**:98e–g / **18**:696b–d	
iii. Cenozoic boundaries		**17**:723h–724b / **8**:999h–1000b / **18**:154h–155c	
c. Special stratigraphic terminologies and divisions; *e.g.*, sequences of strata, subdivisions of the Precambrian, correlations based on tree rings		**17**:724c–726b / **7**:1069d–f / **9**:232d–h	
B. The paleontological interpretation of the geological record	FOSSIL RECORD **7**:555–577		
1. The nature of fossils and fossilization processes		**7**:555h–556e / **16**:637e–g	**10**:980e–f
2. The fossil record			
a. Precambrian life: the Cryptozoic fossil record		**7**:556f–557c	
i. The primitive atmosphere and oceans, and the origin of life [see also 241 and 312.A.]		**6**:11b–c / **10**:900f–903c	**2**:315c–f / **7**:17g–18a / **7**:557a–c
ii. Precambrian protists, plants, and animals: the Gunflint Chert deposits, Ediacara fauna, and other remains		**6**:12f–13a / **10**:903c–904b / **14**:377c–379a / **14**:957d–958c	**1**:494g / **7**:10d–f / **7**:556g–557a
b. Post-Precambrian life: the Phanerozoic fossil record [see also 313]		**7**:557c–576a / **14**:379b–383d / **13**:917d–918b / **3**:690g–692a / **13**:658c–659g / **16**:770h–772f / **13**:922h–927e / **5**:675b–679a / **3**:854b–855a / **3**:858h–859d / **14**:97e–98e / **2**:1014h–1016a / **18**:695a–696a / **10**:355f–359e / **5**:251d–252b / **3**:1081h–1083b / **18**:153e–154e / **14**:568b–569e	
i. The occurrence and evolution of the Protista		**7**:557c–558d / **1**:494g–495g / **18**:153f–h	**3**:1082a–c
ii. The occurrence and evolution of the Porifera		**7**:558d–559c / **14**:853g–854c	
iii. The occurrence and evolution of the Cnidaria (Coelenterata)		**7**:559d–560e	

	articles	article sections	other references
iv. The occurrence and evolution of the Mollusca		**7**:560e–562f / **10**:357d–358g / **12**:329b–330d	**3**:691a / **5**:251e–g / **7**:954g–955b / **11**:1015d–f / **18**:153h–154a
v. The occurrence and evolution of the Conodonta	CONODONTS **5**:23–27		
vi. The occurrence and evolution of the Bryozoa		**7**:562g–h / **3**:357e–358a	
vii. The occurrence and evolution of the Brachiopoda		**7**:563b–g / **3**:99d–100a	
viii. The occurrence and evolution of the Arthropoda		**7**:563g–565h / **2**:69b–d / **5**:316g–317b /	**3**:690g–h / **4**:643b–c / **9**:131f–g / **12**:771e–f / **16**:772c–d
ix. The occurrence and evolution of the Echinodermata		**7**:565h–567b / **6**:183g–184f / **10**:358h–359a	
x. The occurrence and evolution of the Graptolithina		**7**:567b–g	**16**:771d–772a
xi. The occurrence and evolution of the fishes		**7**:567g–569c / **5**:814g–815a / **7**:336g–340a / **7**:939c / **8**:1012e–f / **16**:497d–498b	**4**:438b–d / **5**:296h–297g *passim* / **5**:675g–678a / **13**:926b–d / **13**:981h–982b / **14**:488e–h / **16**:185g–h
xii. The occurrence and evolution of the Amphibia		**7**:569c–f / **1**:704g–705h	
xiii. The occurrence and evolution of the Reptilia		**7**:569g–571g / **5**:288h–289a / **10**:359b–c / **15**:736h–737g / **16**:287b–c / **16**:736h–737g	**5**:251h–252a / **11**:1014h–1015c / **13**:926d–e
xiv. The occurrence and evolution of the birds		**7**:571h–572b / **2**:1058h–1060g / **4**:614a–b / **5**:161a–c / **8**:447g–448a / **13**:1057h–1058b / **15**:18c / **15**:140h–141a	**3**:995f–g / **17**:500c–d
xv. The occurrence and evolution of the mammals		**7**:572c–574b / **3**:939h–941c / **9**:626h–627b / **11**:409g–410b / **11**:420g–428a / **11**:542c–544d / **14**:87a–88b / **14**:568d–g / **14**:1025h–1027h / **15**:3f–4c / **15**:976g–977e / **18**:154c–e / **19**:809b–e	**2**:78g–79d / **3**:1082f–1083b / **7**:20a–d / **10**:590d–g / **11**:412h–415g *passim*
xvi. The occurrence and evolution of the plants		**7**:574c–576a / **1**:579a–d / **1**:880h–881f / **3**:1038h–1039b / **3**:1081h–1082a / **5**:6h–8c / **6**:956b–c / **7**:245g–246a / **8**:3g–h / **8**:522h–523h / **10**:341h–342d / **11**:343d–g / **11**:398a–c / **13**:734b–c / **13**:922h–926b / **14**:379b–381a / **14**:592d–h / **15**:509b–e / **16**:182d–g / **16**:242c–e / **16**:298a–f / **18**:691f–692a / **18**:1092b–d	**3**:854b–c / **5**:678a–d / **6**:175f–g / **8**:579c–d / **11**:1015h–1016a / **13**:558e–f / **14**:739d–741g

	articles	article sections	other references
3. The geological range of fossil groups through time		**7**:576b–577a/ **6**:14e–h/ **6**:16d–g/ **6**:18d–f	
a. Development of a group: the appearance and disappearance of groups in the fossil record		**7**:576c–e	
b. The problem of extinction: causes and principal factors involved [see also 312.C.]		**7**:576f–577a/ **14**:569c–e	**14**:98b–e
4. The paleontological criteria for the correlation of layered rocks			**5**:498b–499a/**17**:720h–722h
a. Index fossils		**3**:859a–c/ **5**:26d–27a/ **10**:359e–360a	**3**:692b–e/**5**:498h–499a/ **5**:678d–g/**13**:658g–659b/ **14**:97h–98a/**17**:721d–g
b. Faunal and floral assemblages			**5**:678g–679a/**13**:659b–g/ **17**:721g–722d
c. Organic microfossils: pollen, spores, and tests	POLLEN STRATIGRAPHY **14**:734–743		**17**:840d–h
i. Physical and chemical properties and environments of accumulation		**14**:734g–736d	**11**:498d–f
ii. Stratigraphy and sedimentation: transportation, deposition, preservation, and use in stratigraphic correlation		**14**:736d–742a	**8**:999d–f/**11**:499a–b
iii. Paleoecology and paleogeography: record of changing environmental conditions		**14**:742a–743d/ **4**:735b–f	
C. Relative or absolute age dating: geochronology	DATING, RELATIVE AND ABSOLUTE **5**:496–513		
1. Relative dating		**5**:497c–501f	**7**:1063f–g/ **8**:1051d–1052c *passim*
a. Application to geological problems		**5**:497d–499h	**11**:498h–499b
i. Dating events in the rock cycle and determining the chronological sequence of strata		**5**:497h–498e	
ii. Correlation: establishing equivalent ages for separated rock deposits		**5**:498f–499d	
iii. The relative geological time scale	GEOLOGICAL TIME SCALE **7**:1065–1068	**5**:499d–h	**7**:1063g–1064a
b. Application to archaeological problems [see 10/41.B.2.a.ii.]			
2. Absolute dating		**5**:501f–513g	
a. General considerations: the meaning of absolute age, requirements for absolute dating, and the rate of record accumulation		**5**:501f–502c	
b. Radiometric dating [see also 723.G.8.]		**5**:502c–510f	
i. Radioactivity and radioactive decay [see 111.C.]			
ii. Principles of radiometric dating		**5**:502h–504e	
iii. Definition of time zero and sources of error in radiometric dating		**5**:504f–505f	
iv. Major dating methods; *e.g.*, uranium–thorium to helium–lead, potassium-40 to argon-40, carbon-14		**5**:505f–510c	
v. Minor dating methods		**5**:510c–f	
c. Non-radiometric dating		**5**:510f–512e	
i. Geological processes as absolute chronometers; *e.g.*, methods based on weathering, erosional, or accumulational processes		**5**:510g–512b/ **19**:35d–36a/ **19**:642d–e	**1**:1082b–c/**8**:998h–999d/ **19**:32d–33e
ii. Biological processes as absolute chronometers; *e.g.*, methods based on tree rings and corals		**5**:512b–e	**8**:999d–g/**17**:725c–d
d. Applications of absolute dating		**5**:512f–513g	
i. The absolute geological time scale	GEOLOGICAL TIME SCALE **7**:1068–1070	**5**:512f–h	**8**:998f–h

	articles	article sections	other references
ii. The age of the Earth and the ages of rocks and meteorites		**5**:512h–513b / **7**:1069g–h / **12**:46b–h / **14**:955c–956a	**4**:123d–f / **11**:499b–e
iii. Determination of sea-floor spreading rates		**5**:513b–d	
iv. Lunar history		**5**:513d–g / **12**:431b–c	
D. The paleogeographical interpretation of the geological record	PALEOGEOGRAPHY **13**:906–911		
1. Factors involved in the reconstruction of former environments: the correlation of evidence from stratigraphy, paleontology, and dating		**13**:906e–907c / **4**:730h–731b / **6**:8g–h / **16**:462c–463a	
2. Paleogeographic data and their application: the determination of former climates, the location of ancient land and seas, and other elements of paleogeography		**13**:907d–911e	**14**:560c–569b *passim*
a. Biological information; *e.g.*, evidence from the distribution and ecological requirements of fossil plants and animals		**13**:907d–908e / **14**:560g–561c / **14**:742a–743d	**8**:999d–g / **8**:1000g–1001e / **17**:840d–h
b. Indirect organic information; *e.g.*, evidence from coprolites and from animal tracks, trails, and burrows		**13**:908e–909b	
c. Petrological information; *e.g.*, evidence from the composition, texture, and internal structures of rocks		**13**:909b–910d / **10**:984f–985a / **16**:471b–472h / **19**:846h–847c	
d. Geophysical and geochemical information; *e.g.*, evidence from paleomagnetism, isotope ratios, and trace element concentrations		**13**:910d–911e / **9**:182e–183a / **14**:560c–f	**6**:1132f–1133a / **9**:122g–123a / **15**:962f–g / **16**:757a–b
E. The reconstruction of the geological history of the Earth based on the global correlation of the accumulated evidence from the geological record	EARTH, GEOLOGICAL HISTORY OF **6**:8–18		
1. Factors involved in Earth history: the complex interaction of Earth processes over geological time spans		**6**:8e–10f	
2. Beginnings of Earth history [see 241]			
3. Precambrian history of the Earth [see 243.A.]			
4. Paleozoic, Mesozoic, and Cenozoic history of the Earth [see 243.B., C., D., and E.]			

Section 243. The eras and periods of geological time

[for Part Two headnote see page 79
for Division IV headnote see page 115]

The articles and parts of articles referred to in Section 243 deal with the several periods of geological time in A, Precambrian time; B, the Lower Paleozoic Era; C, the Upper Paleozoic Era; D, the Mesozoic Era; and E, the Cenozoic Era. The rocks, the life, the stratigraphy, and the environments are separately treated for each period.

	articles	article sections	other references
A. Precambrian time: from the time of formation of the oldest rocks to 570,000,000 years ago	PRECAMBRIAN TIME **14**:953–960	**6**:11d–12c	**1**:181d–182c / **6**:1038d–1039a
1. Absolute age determination of Precambrian events		**14**:954h–956a / **7**:1069d–f	
2. Precambrian rocks		**14**:956b–957d / **6**:11d–12e	**2**:384d–385b / **13**:178f–180e
3. Precambrian life		**14**:957d–958c / **6**:12f–13a / **13**:569h–570c	
4. Precambrian environments		**14**:958c–959b	**2**:317e–319a
5. Correlation of Precambrian events		**14**:959c–960b	**17**:724e–f

B. The Lower Paleozoic Era: from 570,000,000 to 395,000,000 years ago

1. The Cambrian Period

a. Cambrian rocks
b. Cambrian life
c. Cambrian stratigraphic correlation
d. Cambrian environments

2. The Ordovician Period

a. Ordovician rocks
b. Ordovician life
c. Ordovician stratigraphic correlation
d. Ordovician environments

3. The Silurian Period

a. Silurian rocks
b. Silurian life
c. World distribution of Silurian deposits
d. Silurian environments

C. The Upper Paleozoic Era: from 395,000,000 to 225,000,000 years ago

1. The Devonian Period

a. Devonian rocks
b. Devonian life
c. Devonian stratigraphic correlation
d. Devonian environments

2. The Lower Carboniferous Period

a. Lower Carboniferous rocks
b. Lower Carboniferous life
c. Lower Carboniferous stratigraphy
d. Lower Carboniferous environments

3. The Upper Carboniferous Period

a. Upper Carboniferous rocks
b. Upper Carboniferous life
c. Upper Carboniferous stratigraphic correlation
d. Upper Carboniferous environments

4. The Permian Period

a. Permian rocks

articles	article sections	other references
PALEOZOIC ERA, LOWER **13**:916–920		**1**:182d–f/**2**:151f–g/**2**:153d–g/**2**:385b–f/**5**:163c–g/**6**:13c–15a *passim*/**6**:1039a–d/**13**:180g–181a/**14**:739d–g/**17**:76d–h
CAMBRIAN PERIOD **3**:689–694		**6**:1039a–b
	3:690c–f	**2**:385b–d
	3:690g–692a	**13**:917e–g
	3:692a–f/**13**:918c–g	
	3:692f–694e	**13**:919c–920f *passim*
ORDOVICIAN PERIOD **13**:656–661		
	13:657c–658b	**2**:385d–e
	13:658c–659g	**7**:336h–337a/**13**:917g–h
	13:659g–660d/**13**:918g–919b	
	13:660f–661c	**13**:919d–920d *passim*
SILURIAN PERIOD **16**:767–776		
	16:769f–770g	
	16:770h–772f	**7**:337a–f
	16:774e–776c	
	16:772f–774d	
PALEOZOIC ERA, UPPER **13**:921–929		**1**:182f–183a/**2**:151g–152b/**2**:153h–154h/**2**:385g–386a/**5**:163e–h/**6**:13c–15a *passim*/**6**:1138h–1139b/**13**:181b–e/**14**:739g–740f/**17**:76h–78c
DEVONIAN PERIOD **5**:671–679		
	5:672c–675b	**2**:385g–h
	5:675b–679a/**7**:568d–569c	**1**:704g–705d/**7**:337f–339b/**14**:488e–h/**14**:739g–h/**16**:497d–498a
	5:671g–672c	
	5:679b–d	
CARBONIFEROUS PERIOD, LOWER **3**:852–856		
	3:853d–854b	
	3:854b–855a	
	3:855a–e	
	3:855e–856b	
CARBONIFEROUS PERIOD, UPPER **3**:856–860	**4**:793a–795a	
	3:856d–858h/**4**:793a–c/**5**:396a–397f/**5**:400a–f	
	3:858h–859d/**4**:793c–g	**14**:739h–740c
	3:859d–g	
	3:856h–857d/**3**:859h–860d/**4**:793g–794e/**5**:397h–400a	**17**:839h–840d
PERMIAN PERIOD **14**:96–99		
	14:96g–97e	

	articles	article sections	other references
b. Permian life		**14**:97e–98e	**14**:740c–f
c. Permian stratigraphic boundary problems		**14**:98e–g	
d. Permian environments		**14**:98g–99g	
D. The Mesozoic Era: from 225,000,000 to 65,000,000 years ago	MESOZOIC ERA **11**:1013–1017	**6**:15a–16h	**1**:183b–d/**2**:152b–c/ **2**:154h–155b/**2**:386a–387f/ **5**:163h–164a/**13**:181e–183g/ **14**:740g–741d/**15**:737a–g/ **17**:78d–79d
1. The Triassic Period	TRIASSIC PERIOD **18**:693–697		
a. Triassic rocks		**18**:693h–695a	**11**:1014a–b
b. Triassic life		**18**:695a–696a	**14**:740g–h
c. Triassic stratigraphic boundary problems		**18**:696b–e	
d. Triassic environments		**18**:696f–697d/ **6**:15a–e	
2. The Jurassic Period	JURASSIC PERIOD **10**:354–360		
a. Jurassic rocks		**10**:354g–355f	**11**:1014b–d
b. Jurassic life		**10**:355f–359e	**14**:740h–741b
c. Jurassic stratigraphy		**10**:359e–360a	
d. Jurassic environments		**10**:360a–e/ **6**:15e–h	
3. The Cretaceous Period	CRETACEOUS PERIOD **5**:246–252		
a. Cretaceous rocks			**5**:246g–251d *passim*/ **11**:1014e–h
b. Cretaceous life		**5**:251d–252b	**14**:592g–h/**14**:740h–741d/ **15**:737b–c
c. Cretaceous stratigraphy		**5**:246g–250b	
d. Cretaceous environments		**5**:246g–251d/ **5**:252b–c/ **6**:15h–16b	
E. The Cenozoic Era: from 65,000,000 years ago to the present	CENOZOIC ERA **3**:1079–1083	**6**:16h–18h	**2**:152c–153c/**2**:387f–388c/ **14**:741d–741g/**16**:473c–d
1. The Tertiary Period	TERTIARY PERIOD **18**:151–160	**15**:976g–977e	**1**:183d–h/**6**:1039e–f/ **17**:79d–80b
a. Tertiary rocks		**18**:151e–153d	
b. Tertiary life		**18**:153e–154e/ **2**:78g–79d/ **3**:939h–941c/ **7**:572f–574b/ **8**:1028h–1029g/ **10**:590d–g/ **11**:421a–422c/ **14**:87a–88b/ **14**:1026a–1027f/ **19**:809b–e	**5**:914h–915f/**8**:1023e–f/ **11**:542f–544d *passim*/ **14**:741d–g/**15**:3f–4b/ **16**:298b–d
c. Tertiary stratigraphic correlation		**18**:154e–155c	
d. Tertiary environments		**18**:155c–160b	
2. The Quaternary Period [see also 411.B., 412, and 413]			
a. The Pleistocene Epoch	PLEISTOCENE EPOCH **14**:558–569	**5**:117d–118a	**1**:183h–185c/**6**:1039g–h/ **17**:80c–d
i. Pleistocene chronology		**14**:559b–560c	**11**:425b–c
ii. Pleistocene climates and climatic change		**14**:560c–562d/ **4**:732h–735b	**10**:342b–c/**17**:840d–h
iii. Direct effects of glaciation: distribution of glaciers, glacial retreat, and crustal recovery [see also 232.A.6.]		**14**:562e–564b/ **4**:732h–733b/ **6**:18c–d	**8**:164f–h/**8**:167a–d/ **14**:434d–e
iv. Indirect effects of glaciation: fluctuation of sea level, lake levels, and stream regime; wind action and direction; soil formation [see also 232.C.6.]		**14**:564c–567h/ **4**:733b–734d/ **8**:176c–177e	**4**:802c–d/**5**:117d–f/ **6**:969d–e/**11**:27f–28a/ **11**:425c–e/**14**:91d–e/ **14**:840g–h

	articles	article sections	other references
v. Pleistocene stratigraphy		**14**:567h–568b	**14**:738h–739a
vi. Pleistocene life: mammalian fauna, migration of plants and animals, and mass extinctions		**14**:568b–569e / **1**:286b–289c / **2**:200g–204e / **2**:436g–440a / **4**:734e–h / **8**:1030a–1034e / **8**:1044f–1051b / **11**:422c–425b / **14**:839f–841a / **14**:1027f–h	**3**:995f–g / **5**:914h–915f *passim* / **8**:606c–609g *passim* / **12**:910h–912h / **15**:4b–c
b. The Holocene, or Recent, Epoch [see also 414]	HOLOCENE EPOCH **8**:998–1007		
i. Holocene stratigraphy		**8**:998f–1000b	
ii. Nature of the Holocene record: fluctuations in climate, glaciation, and sea level		**8**:1000c–1007c / **4**:735b–737d	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AGASSIZ, LOUIS **1**:289
AGRICOLA, GEORGIUS **1**:314
BOWEN, NORMAN LEVI **3**:85
BRAGG, SIR LAWRENCE **3**:101
BRAGG, SIR WILLIAM **3**:102
BRIDGMAN, PERCY WILLIAMS **3**:191
CUVIER, GEORGES, BARON **5**:389
DANA, JAMES DWIGHT **5**:450
DARWIN, CHARLES **5**:492
EKMAN, VAGN WALFRID **6**:517
HUMBOLDT, ALEXANDER VON **8**:1189
HUTTON, JAMES **9**:70
KÖPPEN, WLADIMIR PETER **10**:504
LAMARCK, JEAN-BAPTISTE DE MONET, CHEVALIER DE **10**:616
LYELL, SIR CHARLES **11**:208
NANSEN, FRIDTJOF **12**:824
ROMER, ALFRED SHERWOOD **15**:1133
SIMPSON, GEORGE GAYLORD **16**:778
SMITH, WILLIAM **16**:907
WALLACE, ALFRED RUSSEL **19**:530

Introduction to Part Three:

The mysteries of life

by René Dubos

We take for granted the existence of life on Earth. Yet, as far as we now know, life exists nowhere else in the solar system, its origin is still a mystery, and its effects on our planet have been little short of miraculous. Without life the surface of the Earth and its atmosphere would be very different from what they are now. We are both spectators and actors in a continuing performance where life is both author and producer, and for which the Earth serves as an ever-changing stage.

Cataclysms give us now and then a glimpse of what our planet would look like without life. In 1883, a series of stupendous volcanic eruptions destroyed two-thirds of Krakatoa Island in the Malay archipelago and covered what was left of it with a thick layer of lava. All living things were killed, not only on Krakatoa itself, but also on the neighbouring islands that were in the path of the tidal wave generated by the explosion and of the volcanic fallout. What had once been a luscious tropical forest suddenly became a gray and lifeless landscape, as desolate as the surface of the Moon.

Pictures taken of Krakatoa in the months following the disaster help us to realize that what we regard as the surface of the Earth is less a geological structure than a living mantle. Our planet would be drab and dusty, an insignificant object in space, if it were not for the myriad of living forms that have generated its atmosphere and its soil out of gases and rocks. In fact, the phrase "life on Earth" is somewhat misleading because the surface of the Earth as we experience it, with its entrancing diversity and colourful warmth, is literally a product of biological activities—a creation of life.

Krakatoa remained a desolate landscape for a long time after the 1883 volcanic explosion. But progressively the wind and the sea brought back to its sterilized surface a multiplicity of living things, some of which managed to establish a permanent foothold on the lava. Today, the island harbours once more a rich flora and fauna, not very different from that of the native forest of the Malay archipelago.

There is a paradox in the marvellous resiliency of nature. On the one hand, all individual forms of life are extremely delicate. And yet life itself has been capable of prevailing over brute physical forces for several billion years, and has generated immensely diversified ecosystems that have remained viable even under the most inhospitable conditions. Life probably emerged from inanimate matter, but it is now more powerful than inanimate matter.

All biological phenomena are of practical importance because they determine the characteristics of the Earth's surface and therefore affect the quality of human life. Men have always been concerned with the contributions that living things make to their immediate environment and to the global economy; they have wondered how the flora and fauna become more or less stabilized under normal conditions, and manage to reestablish stable ecosystems after cataclysms; in our times they worry to what extent living things can be disturbed or eliminated by urbanization and industrialization without thereby threatening human welfare.

But the phrase "life on Earth" also raises other questions of a more philosophical character, questions that have been in the minds of humble uneducated people even before they became the preoccupation of scholars. In the universe at large, lifelessness is the rule, life the puzzling exception. How do living things differ from inanimate matter? How did they originate? And can life be created *de novo*? Is man qualitatively different from the rest of the living world or merely a higher, or the highest, specimen in its evolution, the paragon of animals?

It is clear from the geological record that life has been at home on the Earth for immense periods of time. The types of fossils found in rock formations indicate that all major groups of animals and plants were already represented by recognizable ancestors some 400,000,000 years ago. Furthermore, microscopic structures closely related to the present forms of blue-green algae have been found in geologic formations that are even very much older—some 3,000,000,000 years old. Since these fossils of algae-like organisms have a complex cellular organization, it can be assumed that they had been preceded by simpler forms, and that the origin of life is more ancient than the oldest traces of it which have been detected. In fact, there is no way to know when life first appeared on Earth, because its earliest manifestations were certainly so minute, fragile, and undifferentiated that none of them have survived as fossils.

There is a peculiar fascination to the phrase "the origin of life" because it means different things to different men, and reaches into the deepest layers of their beliefs. For the religious man, it implies the mysteries of divine creation—whether expressed as biological species in their final forms, or as the potentialities posited by Aristotelian philosophers and medieval theologians. For the student of myths, it evokes Aphrodite emerging fully developed from the foam of the sea. The myth may have a factual basis if it is true, as it is commonly believed, that the cradle of life was to be found in the primitive oceans. For the modern scientist the phrase "origin of life" refers to the kind of chemical reactions that first generated complex organic molecules and assembled them in such a manner that they could duplicate themselves—thus converting inanimate matter into living substance.

Whatever the mystical or rational basis of a person's beliefs, there is a universal poetic quality in the thought that life once arose from matter, and has been perpetuating itself ever since. But the only real clue to the origin of life is that all its forms—at least all the living things we know—have many physicochemical characteristics in common. In particular, they all transfer their hereditary endowment from one generation to the next through the agency of a peculiar kind of molecule known as nucleic acid, the now famous DNA. This uniformity of fundamental structure holds true irrespective of the size, shape, and complexity of the organism—whether it be microbe, plant, animal, or man. Indeed, the similarity in structure of the genetic apparatus throughout the living world is so perfect that it cannot possibly be a matter of chance. The conclusion seems inescapable that all the living forms that now exist have had a common origin.

The simplest hypothesis to account for the origin and evolution of life is that all biological phenomena are caused by the physicochemical forces that govern the inanimate world. Some scientists believe, indeed, that there is nothing

very unusual in the emergence of a living molecule from matter. According to them, it is probable that life repeatedly emerged *de novo* on Earth and that it is still emerging today somewhere in the cosmos. By making the reasonable assumption that one of the living forms that appeared on Earth proved more vigorous than the others, it is easy to account for the single origin of all surviving species. If an entirely new genetic form of life were to appear today on Earth, it would have no chance of success, because it could not compete with the established form and all its variations.

The hypothesis that life is nothing more than a special manifestation of ordinary physicochemical forces has the merit of being economical of thought; in addition, it is supported by the fact that all biological phenomena go hand in hand with the kind of reactions observed in the inanimate world. But even if we grant that living phenomena always obey physicochemical laws, this does not constitute decisive evidence that life is merely an expression of these laws. Other theories are conceivable. One of them, rarely voiced because it is not scientifically fashionable, is that some unknown principle runs like a continuous thread through all living forms and governs the organization of their physicochemical processes. The illustrious Danish physicist Niels Bohr, for example, suggested that "the very existence of life must be considered an elementary fact, just as in atomic physics the existence of a quantum of action has to be taken as a basic fact that cannot be derived from ordinary mechanical physics."

Uncertainties concerning the fundamental nature of life and its origin would disappear if it were possible to generate at will self-reproducing molecules from inert material. Some experimental findings have recently been quoted as evidence of this possibility.

A fully developed virus, which had been naturally produced by a living organism, was separated into its component parts by chemical procedures. When these separate parts were tested for biological activity, they were found to be inert, that is, they were unable to multiply in a susceptible organism. This biological activity was restored, however, when the parts of the virus were chemically reassembled in the test tube under the proper conditions. Spectacular as this achievement is from the chemical point of view, it does not constitute—as has been claimed—the production of life *de novo*. Since the virus first had to be produced by a living organism, and since its reassembled parts showed activity only when introduced into a living susceptible organism, all the biological machinery essential for its reproduction had to be provided by preexisting life.

In a completely unrelated kind of experiment, several complex molecules similar to those found in living things have been produced in the laboratory by exposing simple chemicals to the kind of radiation that probably existed in the primitive atmosphere. But this chemical feat does not constitute production of life *de novo* because the molecules so produced have not been assembled—*organized*—in a way enabling them to duplicate themselves and to develop. An organic molecule, however complex and similar to the kind found in living things, still belongs to the realm of inanimate matter if it cannot reproduce and evolve.

To become "living," an assembly of biogenic molecules must contain the information needed for its further development and must be able to transmit this information to its progeny. Even in its simplest manifestations, life is historical; it embodies the past and carries instructions for the future.

More than a century ago, the French physiologist Claude Bernard gave a clear formulation of the now classical view that the earmark of a living thing is not the chemical composition of its parts but their organization. He wrote: "Admitting that vital phenomena rest upon physicochemical activities, which is the truth, the essence of the problem is not thereby cleared up; for it is no chance encounter of physicochemical phenomena which constructs each being according to a preexisting plan, and produces the admirable subordination and the harmonious concert of organic activity.

"There is an arrangement in the living being, a kind of regulated activity, which must never be neglected, because it is in truth the most striking characteristic of living beings. . . ."

In this celebrated passage, Bernard used the word "arrangement" to denote the interdependence and integration of the structures and properties of any given living organism. But biological organization applies also to the ecological system of which the organism is a part. All living things, without exception, depend on other living things for their survival and development. Furthermore, the higher the organism is on the evolutionary scale, the more exacting is its dependence on a complex web of life.

One of the major trends of evolution has thus been the emergence of more and more complex ecosystems, exhibiting high degrees of integration. But, paradoxically, an opposite trend can also be detected as one ascends the evolutionary scale—namely, a trend toward freedom or at least toward increasing independence of the individual organism within the constraints of the ecosystem. Freedom becomes more and more apparent as one proceeds from the protoplasmic jelly of biological beginnings to warm-blooded animals roaming in the wild, and finally to man who modifies his environment according to his views of the future. In a real way, evolutionary development is associated with the gradual insertion of more and more freedom into matter and into individual lives.

In the *Outline of Knowledge,* Part Three, concerned with life on Earth, is placed between Parts Two and Four, concerned, respectively, with the Earth itself and with human life. This positioning is reasonable enough, but one could read into it an assumption that reaches far deeper than the logical ordering of concepts and facts. The tacit assumption is that human life has emerged from the inanimate matter of the Earth through the same kind of evolutionary continuum that links all the other living forms in a great chain of being. In reality, the theory of evolution does not provide decisive evidence for this assumption. What is *known* of biological evolution applies only to the anatomical structures and physiological functions of organisms that have lived in the past or are living now. The steps from matter to life, and from life to consciousness, have not yet been shown to have taken place through the kind of mechanisms that account for the evolutionary changes of anatomical structures or physiological functions. There exists a continuum from one form of life to another, but extending this continuum to inanimate matter on the one hand, and to human consciousness on the other, is a matter of faith rather than of scientific knowledge.

Even the most cursory observation of nature reveals that all living forms are conditioned by environmental forces,

and that reciprocally they shape the environment, thereby contributing to the triumph of life. But it must be realized that the word "life" encompasses different kinds of relations to nature. At its lowest level, "life" implies, as mentioned above, the deterministic and blind chemical reactions through which an organism—simple or complex as it may be—transmits its distinctive characteristics to its descendants and reacts adaptively to its environment. At its highest, "life" involves man's consciousness and free will and refers to the deep reality of the world within and the affirmation of the individual self, irrespective of the external world.

There is no way at present to link these two extreme and apparently incompatible manifestations of life—biological determinism and human freedom. Yet both are real, and both have been immensely influential in giving the present characteristics to our planet.

The surface of the Earth reflects the activities of countless living things. Even though these operate chiefly through blind, deterministic mechanisms, life introduces on Earth a degree of order, organization, and diversity not found anywhere else in the cosmos, not even in the movements of the celestial bodies. Man emerged, not on the bare planet, but in this orderly and diversified biological world. As soon as he achieved his identity as *Homo sapiens,* he began to insert his free will into ecological determinism. For good or evil, he has now become the most powerful influence in changing the face of the globe. His conscious choices will determine not only his own fate, but also the fate of life on Earth.

Part Three. Life on Earth

The outlines, and the articles and parts of articles referred to, in the twenty-three sections of Part Three, grouped in five divisions, present results of the studies of life on Earth made in the many complementary biological sciences.

The outlines and the articles referred to in the three sections of Division I deal with the nature, origin, evolution, and classification of living things.

The three sections of Division II deal with the molecular level of biotic organization, treating the chemical transformations and the exchanges of energy that occur in vital processes.

The outlines and the articles referred to in the nine sections of Division III deal first with life at the cellular level, and then with life at the organismic level. The treatment of the latter covers the relation of form and function in organisms; the coordination of vital processes; the several organ systems involved in the performance of fundamental vital functions; biological development; and heredity.

The three sections of Division IV deal with the behavioral responses of organisms. They treat the nature and patterns of behavioral responses; the development and range of capacities for individual behaviour and for group behaviour; and the evolution of behaviour.

The five sections of Division V deal with the biosphere—the world of living things as a single system of biotic and environmental interactions and interdependencies. They treat the basic features of the biosphere—the levels of organization, energy flow, and cycling of matter in the biosphere, and the interactions of the biotic and the abiotic components of an ecosystem; the properties of the biological populations and biological communities, the components of the biosphere; the hazards of life in the biosphere; the patterns of life in the biosphere; and man's place in the biosphere.

Several points about the relations of Part Three to other parts should be noted.

The separation of Part Three from Part One, on matter and energy, and from Part Two, on the Earth, reflects a traditional division of labour among the natural sciences. However, the separation is not rigid. The borderline disciplines of biophysics and biochemistry appear throughout Part Three, especially in Division II, concerned with the molecular basis of vital processes. That the Earth's atmosphere and hydrosphere are favourable to life is reflected throughout Part Three, especially in Division V, which is concerned with the biosphere and with ecosystems.

Some fundamental biological knowledge of man is involved in the treatment throughout Part Three of what is common to all life and to all animals. And Section 355, the last section of Part Three, deals with man's place and activities in the biosphere. However, what is specific to human life, human health, and human behaviour is separately dealt with in Part Four, on human life.

The biological sciences have themselves been the object of historical and analytical studies. Such studies are dealt with in Section 10/34 in Part Ten, which treats the historical development of the biological sciences; the methodology, scope, and conceptual structure of biology as a whole; and the several component disciplines at the different levels of biological research.

The design and operation of observational and experimental instruments are important in the development of the biological sciences. Such scientific instrumentation is dealt with in Section 723 of Part Seven.

Division I. The nature and diversity of living things 130
II. The molecular basis of vital processes 144
III. The structures and functions of organisms 154
IV. Behavioral responses of organisms 182
V. The biosphere: the world of living things 189

Division I. The nature and diversity of living things

The outlines, and the articles and parts of articles referred to, in the three sections of Division I deal with the nature, the origin and evolution, and the classification of living things.

The outline and the articles referred to in Section 311 treat the general conception of life; the distinctive properties of living things; and the investigation of extraterrestrial realms.

Section 312 first deals with hypotheses about the origin of life and with stages in the emergence of life, and with major trends in the phylogeny of plants and of animals. It then treats the theory of evolution, the process of evolution, the process of speciation, and the course of evolution.

Section 313 first deals with the principles, procedures, and criteria for systematically classifying organisms in a hierarchical arrangement. Thereafter, articles are referred to that separately treat major groups of the plant and animal kingdoms.

Section 311. Characteristics of living things 131
312. The origin of life and the evolution of living things 132
313. The classification of living things 135

Section 311. Characteristics of living things

[for Part Three headnote see page 130
for Division I headnote see page 130]

The articles and parts of articles referred to in Section 311 deal with three main subjects: A, the general conception of life; B, life on Earth, the distinctive properties of living things; and C, the investigation of extraterrestrial realms.

The outline of subject A first deals with various approaches to the definition of life. It goes on to issues in the controversy about the adequacy of physics and chemistry to explain living phenomena. Finally, it treats the successive and emergent levels of biotic organization.

The outline of subject B first deals with the common occurrence of nucleic acids and of metabolic and genetic regulators in all living things. It goes on to treat metabolism, the process of self-maintenance; homeostasis, the maintenance of dynamic equilibrium through built-in steady-state controls; and the processes of reproduction and development. It next deals with variation among organisms and the adaptation of organisms through the operation of natural selection. Finally, it treats responsiveness, which is the range of sensory and behavioral reactions to external stimuli.

The outline of subject C treats the notion of extraterrestrial life; the search for life beyond the Earth and its significance; an exobiological survey of the solar system; and speculations about the possible characteristics of intelligent life beyond the solar system.

A. The general conception of life

1. Definitions of life: physiological, metabolic, biochemical, genetic, and thermodynamic definitions
2. Mechanism and vitalism: the adequacy of physics and chemistry for the explanation of living phenomena [see 10/34.C.2.b.]
3. The successive and emergent levels of biotic organization: the molecular, cellular, organismic, individual, and population levels

B. Life on Earth: the distinctive properties of living things

1. The common occurrence of nucleic acids and metabolic and genetic regulators in all living things: the chemical and physical limitations to which all living things are subject
2. Metabolism: the process of self-maintenance
3. Homeostasis: the maintenance of dynamic equilibrium through built-in steady-state controls
4. Reproduction and development: the succession of and the changes in living substance; sex as the basis of variability
   a. Eucaryotic and procaryotic cells: single cells possessing a distinct nucleus (eucaryotes) or lacking one (procaryotes)
   b. Metazoa: many-celled organisms, from slime molds to man
5. Variation among organisms: the adaptation of organisms through the operation of natural selection
6. Responsiveness: sensory and behavioral reactions to external stimuli

articles	article sections	other references
LIFE **10**:893–895		
	10:893c–894f	**2**:994f–996e *passim*/ **2**:1038f–1038h/**7**:542d–g
	2:1014f–g/ **3**:1050f–1051d/ **13**:725b–726a	**14**:381g–h/**15**:676d–678f *passim*
LIFE **10**:894–899	**2**:1015a–h	
	10:895b–896a/ **7**:985h–986f	
	10:896a–897a/ **3**:1054g–1055a/ **11**:1022d–1025d	**13**:401f–402d/**15**:751c–e
	8:1014c–1015d/ **13**:723f–724c	**4**:618e–g/**7**:546b–d/ **8**:1015e–1017f *passim*
	10:897a–h/ **5**:645f–649c/ **15**:676b–677h/ **16**:585d–g	**5**:658g–h
	10:897a–c/ **1**:493e–494a/ **3**:1048d–h/ **5**:645f–g/ **15**:676f–677e	**3**:1060h–1061c
	10:897d–h/ **5**:645h–649c/ **16**:586b–f	**15**:677e–h
	10:897h–899c/ **15**:679b–c	**16**:586f–h
	10:899c–h/ **12**:975c–977b	

C. The investigation of extraterrestrial realms

1. The notion of extraterrestrial life and its chemistry
2. The search for life beyond the Earth: the significance of this search
3. Exobiological survey of the solar system: its physical environments and biological prospects
4. Intelligent life beyond the solar system

articles	article sections	other references
LIFE **10**:904–911		
	10:904c–905g	
	10:905h–907h	
	10:907h–909f/ **11**:529f–530f	**17**:374b–d
	10:909f–911a	**18**:853f–856h *passim*

Section 312. The origin of life and the evolution of living things

[for Part Three headnote see page 130
for Division I headnote see page 130]

The articles and parts of articles referred to in Section 312 deal with five main subjects: A, stages in the emergence of life; B, the theory of evolution; C, the process of evolution; D, the establishment of species and the process of speciation; and E, the course of evolution.

The outline of subject A begins with various hypotheses about the origin of life. It goes on to modern hypotheses, constructed by extrapolations from modern cosmogony, chemistry, molecular biology, and experimental biochemistry. Here, it first treats steps in the production of chemical precursors; the earliest living systems; and evidence in the geological record concerning the antiquity of life. It then deals with the adaptive radiation of organisms, treating the methods of phylogeny; the probable main lines of descent; major trends in the phylogeny of plants; and major trends in the phylogeny of animals.

The outline of subject B begins with the history of evolutionary theory. Dealing with the evidence for evolution, it covers facts explicable by the theory of evolution—similarities among living organisms with regard to structure and function, suggesting descent with modifications from a common ancestor; facts about the spread of organisms from their centres of evolutionary origin; and facts about the fossils in the Earth that suggest the relationships of living organisms during their evolution. Finally, the outline treats generally the modern synthetic theory of evolution, which regards statistical transformations of populations as resulting from complex genetic mechanisms and mutations combined with natural selection of better-fitted variants.

Subject C is the process of evolution. The outline first deals with the mechanism of natural selection, involving individual variation within a population, and with the maintenance of selective advantages through an increase in the capacity for survival and reproduction. It goes on to the theory of gene mutations as providing the heritable variations in the evolutionary process. Articles referred to next separately treat, as instances of natural selection in action, the adaptive and survival functions of biological coloration, of mimicry, and of biological polymorphism, the frequent occurrence of several distinct forms within a population. Finally, it treats, as factors affecting the rate of evolution, the effects of environmental change and of the conquest of a new medium, and the significance of nonadaptive or adaptively neutral features.

Subject D is the establishment of species and the process of speciation. After reviewing the history of various concepts of species, the outline proceeds to the modern biological concept, which has reproductive isolation of a group of organisms, the mechanism by which species integrity is maintained, as the key criterion. It treats various situations in which this species concept is difficult to apply—for example, to asexual species and fossil species, definable only morphologically. It next deals with the properties of species, especially with the various isolating factors that restrict random mating, and with the role played by gene flow in maintaining species characteristics over large areas. Finally, it treats the evolution of species and the relationship between species and other taxonomic categories.

The outline of subject E first deals with the major steps of evolution, the progressive development of life forms, and the spread of organisms from water to land. It then treats various patterns of evolution.

A. Stages in the emergence of life

1. Hypotheses about the origin of life: as a result of a supernatural event; by spontaneous generation from nonliving matter; as co-eternal with matter and having no beginning; by a series of progressive chemical reactions on the early Earth
2. Steps in the production of chemical precursors of life
   a. Formation of the Earth's primitive reducing atmosphere: the cosmic distribution of the elements and the composition of life
   b. Production of simple organic molecules: effects of radiation and lightning on inorganic compounds in the early oceans
   c. Production of long-chain molecules consisting of repeating units; *e.g.*, the joining together of amino acids to form proteinlike molecules
   d. Origin of the genetic code: the first functional relationship between molecules with the ability to replicate themselves (polynucleotides) and molecules with catalytic properties (enzymes)

articles	article sections	other references
LIFE **10**:900–904	**7**:17g–18c	
	10:900a–f/ **2**:1022f–1023c	
	10:900f–902f/ **13**:486g–487d	**2**:1037e–1038a/**7**:17g–h/ **15**:400g–401a
	10:900f–901c/ **2**:313h–316b/ **6**:10g–11c	**2**:317d–g/ **6**:60d–61b *passim*
	10:901c–g	**2**:315e–f/**15**:415f–g
	10:901g–902b	
	10:902b–f	

	articles	article sections	other references
3. The earliest living systems; *e.g.*, evolution of enzymatic reaction chains; origin of procaryotic and eucaryotic cells; evolution of photosynthesis		**10**:902g–903c / **7**:17h–18c / **13**:402d–403a / **14**:366d–f	**2**:317g–319a / **13**:497d–498a / **14**:377c–g
4. The antiquity of life: evidence of biological activity in the geological record		**10**:903c–904b / **7**:556f–557c / **14**:957d–958c	**1**:494g / **2**:317h–319c / **3**:691f–692a / **14**:953d–e
5. Adaptive radiation of organisms: lines of descent	PHYLOGENY **14**:376–383		
a. The basis of phylogeny: use of the fossil record, comparative anatomy, and other evidence to indicate phylogenetic relationships		**14**:376g–377c	**4**:688d–689a / **8**:3g–4d *passim* / **10**:330f–331c *passim*
b. Early stages of phylogeny		**14**:377c–379a	
i. Chemical evolution of early living systems [see A.2. and 3., above]			
ii. The probable main lines of descent		**14**:377h–379a / **2**:576f–g / **3**:1048e–h / **14**:957e–g / **15**:127a–b	**10**:903a–c
c. Major trends in the phylogeny of plants		**14**:379b–381a / **13**:734a–c	
i. Algal predecessors: achievement in eucaryotic algae of multicellularity with minimal specialization of cells		**14**:379b–f / **1**:495c–g	
ii. Land plants: the retention in bryophytes (*e.g.*, mosses and other primitive plants) and tracheophytes (higher plants) of the embryo within the maternal tissue, a prerequisite for exploitation of the land		**14**:379f–380d	**14**:500f–g / **18**:691f–g
iii. Seed plants: seeds as the culmination of the trend toward embryo retention; the origin of gymnosperms (*e.g.*, conifers) and of angiosperms (flowering plants)		**14**:380d–381a / **1**:880h–881e / **8**:522h–523h	**7**:245h–246a / **18**:691h–692a
d. Major trends in the phylogeny of animals		**14**:381a–383d	
i. The problem of the origin of multicellular animals		**14**:381a–c / **13**:725c–726a	**3**:1050f–g / **10**:897d–e / **14**:853g–h / **15**:678h–679a
ii. Changes in the body plan of the lower metazoans: symmetry; development of tissues and organs; head formation and segmentation of the body		**14**:381c–382b / **2**:141e–142b / **12**:641e–643a	**4**:771f–h / **12**:979g–981d *passim*
iii. Phylogenetic lineage among the higher metazoans: theories of linear descent from lower to higher forms and of descent along two principal lines		**14**:382c–383d / **1**:704g–705h / **2**:1058h–1060g / **7**:336g–340a / **11**:409g–410b / **11**:419h–420e / **12**:154c–e / **15**:735h–736e	**4**:451a–c / **16**:939d–h
e. Life as the product of a historical process: the appearance of the first organisms during the Precambrian and the continuing process of diversification throughout succeeding periods of Earth's history [see also 243]		**14**:383e–h / **10**:903c–904b	**6**:8b–c / **11**:421a–h *passim* / **14**:1025h–1027h *passim*
B. The theory of evolution	EVOLUTION **7**:7–10	**7**:12h–14g	
1. History of evolutionary theory: examination of ideas that preceded those of Darwin; the separate formulation of almost identical theories of evolution by Darwin and Wallace		**7**:7e–8f / **7**:23a–c / **2**:1023h–1024c	**5**:493e–494e / **5**:650d–f / **6**:1072a–b / **10**:617f–h / **17**:492h–493a / **19**:530d–531c *passim*
2. The evidence for evolution: facts explicable by the theory of evolution		**7**:8f–10f / **1**:979b–e / **14**:376g–377c	
a. Similarities among living organisms with regard to structure and function, suggesting descent with modification from a common ancestor; indirect evidence from comparative anatomy, embryology, behaviour, and biochemistry		**7**:8g–10b / **7**:995h–996a / **8**:1032b–1033c / **10**:973h–974e / **11**:343b–c / **11**:419a–h / **12**:775d–e / **19**:489c–d	**1**:881b–e / **5**:649h–650a / **12**:452f–g

	articles	article sections	other references
b. Distribution of organisms: the spread of organisms from their centres of evolutionary origin		**7**:10b–c / **5**:914d–916d / **14**:568g–569e	**2**:1052f–g / **13**:498b
c. The geological record: the fossils in the Earth's crust as objective evidence of the course of living organisms during their evolution		**7**:10d–f / **7**:555d–556e	**7**:1063d–1065e *passim* / **11**:420g–421a / **14**:376h–377a
3. The synthetic theory of evolution: genes that mutate occasionally, segregate, and recombine at random as the explanation of evolution by natural selection		**7**:12h–14g / **5**:650a–f	
C. The process of evolution	EVOLUTION **7**:10–17	**8**:811a–815c / **10**:893g–894c	
1. Natural selection: adaptation as the biological process by which selective advantage is conferred upon those organisms having structures and functions that enable them to cope successfully with their environment		**7**:10g–11h / **8**:812c–815c / **11**:428h–429b	
a. The mechanism of natural selection: individual variation within a population		**5**:941e–h	**7**:12h–14g *passim*
b. Maintenance of selective advantage through an increase in the capacity for survival and reproduction		**3**:325a–f / **4**:928g–929d / **5**:649c–650f / **12**:220c–h	**1**:881c–e / **2**:1047g–1048f *passim*
2. Heritable variation: the raw material of evolution		**7**:11h–12g / **11**:428c–h / **15**:678f–679c / **16**:586e–h	
a. Mutation: sudden changes in genes	MUTATION **12**:754–756	**7**:1004e–1005g	**11**:428c–f
i. The nature of mutation		**12**:754c–755a	
ii. Types of mutation		**12**:755a–756a / **15**:379h–381c	**7**:1005b–c / **15**:387a–c / **15**:401a–c
iii. Significance of mutation		**12**:756a–c / **8**:811a–e	**15**:420e–g
b. Recombination: occurrence of either new combinations of genes as a result of fertilization or new combinations of linked genes, as by crossing over of genes or gene segments		**7**:984b–985d / **16**:586b–h	**11**:428f–g / **16**:585e–g / **17**:452c–e
3. The process of natural selection		**7**:14g–16a / **2**:1052a–e	**4**:925d–f / **9**:613h–614a
a. Coloration: general appearance in terms of the quality and quantity of light that is reflected or emitted from the surface of an object	COLORATION, BIOLOGICAL **4**:911–929		**13**:746d–f
i. The expression of colour		**4**:911g–913b	
ii. The structural and biochemical bases for colour		**4**:913b–923g	
iii. The adaptive value of biological coloration		**4**:923g–929d / **16**:563d–f	**1**:1007h–1008b / **10**:823f–h / **14**:775d–g / **16**:398d–f
b. Mimicry: the close resemblance of one organism to another for some advantage	MIMICRY **12**:213–220		
i. General features and the basic types of mimicry		**12**:213h–214h	**4**:923g–924a
ii. Warning systems in noxious organisms		**12**:214h–215g	
iii. Occurrence of mimicry among plants and animals		**12**:215g–219c / **13**:654d–h	**5**:360e–361a / **10**:823h–824b / **14**:775h–776a
iv. The evolution of mimicry		**12**:219c–220h	
c. Polymorphism: the frequent occurrence of several distinct forms within a population	POLYMORPHISM, BIOLOGICAL **14**:774–777		
i. Origin and maintenance of a balanced, or permanent, polymorphism		**14**:774g–775d	
ii. Types of polymorphism		**14**:775d–776g / **16**:483h–484a	**4**:925f–h / **5**:911h–912b / **10**:824c–e
d. Implications of natural selection: the coefficient of selective advantage, imperfect or excessive adaptation, and extinction		**7**:576f–577a / **7**:1007h–1009e / **8**:811e–813e / **11**:429b–430a / **14**:569c–e / **15**:354h–355b	**7**:15c–16a / **8**:816a–c / **14**:98b–e

4. The rate of evolution: effects of environmental change and conquest of a new medium such as air, dry land, or freshwater; significance of nonadaptive or adaptively neutral features

D. The establishment of species and the process of speciation

1. The distinctiveness of species—a group of organisms reproductively isolated from other groups: the classification of a species
2. Species concepts: historical background; the concepts of typological, morphological, nondimensional, and biological species
3. Application of the biological species concept: the criterion of reproductive isolation; examples of situations in which the species concept is difficult to apply
   a. Populations that appear closely related but differ in enough characteristics owing to geographical isolation to be called different species
   b. Hybridization between populations with resulting sterility or reduced fitness
   c. Other problematic situations: variants within a single species; asexual species and fossil species definable only on the basis of structure
4. The properties of species
   a. Distinctiveness that restricts random mating; *e.g.*, behavioral differences, physical differences
   b. Gene flow: relocation of offspring along with their inherited genes
   c. Variability: genetic, environmental, age-related, and geographic variations within a species; the presence of subspecies, called races among animals and varieties among plants; sibling, or cryptic, species that are separate biological species despite looking remarkably similar
5. The evolution of species: gradual speciation in populations
   a. Allopatric speciation: extrinsic barriers to gene exchange
   b. Sympatric speciation: intrinsic barriers to gene exchange
   c. Stasipatric speciation: spread of a chromosomal rearrangement within the range of an existing species
6. The relationship between species and other taxonomic categories—family, order, class, and phylum

E. The course of evolution

1. Major steps of evolution: the progressive development of life forms and the spread of organisms from water to land
2. Patterns of evolution; *e.g.*, improvement and adaptive radiation, mosaic evolution, parallel and convergent evolution

articles	article sections	other references
	7:16b–17c	**1**:880h–881a
SPECIES AND SPECIATION **17**:449–455	**7**:17c–g	
	17:449d–h	
	17:449h–450g	**4**:687b–e
	17:450h–451g	
	17:450h–451b	
	17:451b–d	**8**:815f–g/**8**:817e–g
	17:451d–g	
	17:451g–453b	
	17:451g–452b	
	17:452b–c	
	17:452c–453b/ **8**:815c–816c	**7**:1009g–1010a/ **8**:1090f–1092a *passim*/ **12**:755a–**b**/ **15**:348b–355f *passim*
	17:453b–455b/ **8**:816d–e	**4**:1029c–e/**8**:815c–d
	17:453c–454b	
	17:454b–h	**12**:218a–b
	17:454h–455b	
	17:455b–d	**4**:686a–h *passim*
EVOLUTION **7**:17–19		
	7:17g–18g/ **13**:922h–927e	
	7:18g–19g/ **7**:538a–b/ **7**:546f–547b/ **13**:655b–h	**2**:217f–g/ **8**:1034f–1035h *passim*/ **8**:1044e–f/ **8**:1046c–1048c *passim*/ **10**:897h–898b/**11**:405f–g/ **12**:453e–h/**14**:382h–383d/ **14**:383f–g/ **15**:971e–972g *passim*/ **15**:976f–g/**16**:818g–h

Section 313. The classification of living things

[for Part Three headnote see page 130
for Division I headnote see page 130]

The articles and parts of articles referred to in Section 313 deal with ten main subjects. Subject A is biological classification. The remaining nine subjects, B through J, involve modern taxonomy, the distinguishing, ordering, and naming of living things.

The outline of subject A begins with the objectives and the history of biological classification. Going on to the taxonomic process, it treats the prerequisites of classification; the collecting, preserving, and labelling of suitable specimens; the various cri-

teria for systematic classification; and the steps involved in the construction of a classification. Finally, it treats the concepts and methods involved in current systems of classification.

Subject B is the unique life form called the virus, characterized by relatively small size, simple composition, and the need to grow in a living cell.

The taxonomy of intermediate organisms is set forth in the following subjects: C, the monerans, such as blue-green algae and bacteria, which lack differentiated nuclei; and D, the protists, organisms such as algae, protozoans, slime molds, and fungi.

The taxonomy of the plant kingdom is set forth in the following subjects: E, nonvascular plants, such as mosses, which lack specialized conducting systems; and F, vascular plants.

The taxonomy of the animal kingdom is set forth in the following subjects: G, the invertebrates, or animals without backbones—the lower invertebrates, such as sponges; the lophophorates such as brachiopods; and the schizocoelomates, such as mollusks and annelid worms; H, the arthropods, such as scorpions, spiders, crustaceans, and insects; I, the enterocoelomate invertebrates, such as echinoderms and tunicates; and J, vertebrate animals, or animals with backbones—fishes, bony fishes, amphibians, reptiles, birds, and mammals.

A. Systematic classification of organisms in a hierarchical arrangement

1. The objectives of biological classification: identification and the making of natural groups
2. History of biological classification
   a. From the Greeks to the Renaissance; *e.g.*, the Aristotelian method
   b. The Linnaean system
   c. Classification since Linnaeus: the importance of natural relationships; the influence of Darwin
3. The taxonomic process
   a. Prerequisites
      i. A recognized system of ranks in classifying; *e.g.*, phylum, class, order
      ii. Recognized rules for nomenclature: the naming of organisms
      iii. A procedure for verification and validation of descriptions of organisms by type specimens
   b. Handling of material: the collecting, preserving, and labelling of suitable specimens
   c. Taxonomic characters: criteria for systematic classification; *e.g.*, anatomical, biochemical, physiological, and behavioral characters
   d. Making a classification: fitting the hierarchical system to the group and suggesting its course of evolution
4. Current systems of classification
   a. Division of organisms into kingdoms: problems in classification caused by organisms that do not fit into the traditional plant or animal kingdoms
   b. A classification of living organisms: a contemporary approach consisting of four kingdoms (Monera, Protista, Metaphyta, Metazoa)

B. The viruses: a unique group of infectious agents characterized by small size, relatively simple composition, and the need to grow in a living cell

C. The monerans: the procaryotes

1. Blue-green algae
   [see D.2., below]
2. Bacteria and allies; *e.g.*, actinomycetes, mycoplasmas, rickettsias

D. The protists: the simpler eucaryotes

articles	article sections	other references
CLASSIFICATION, BIOLOGICAL **4**:683–691		**1**:978g–979a/**4**:691e–f
	4:684b–f	
	4:684f–685h/**2**:1021h–1022c/**19**:1165b–e	
	4:684f–685a	
	4:685a–c	**2**:1022b–c/**3**:66g–67a/**10**:1013b–e/**19**:1165b–d
	4:685c–h	**17**:449h–450b/**19**:1165d–e
	4:685h–689e	
	4:686a–687h	
	4:686a–h	**17**:449f–g
	4:686h–687e/**4**:693f–g	**8**:1030d–g/**8**:1044b–f
	4:687e–h	
	4:687h–688c	
	4:688c–689a/**1**:881g–882c/**11**:410b–d/**14**:376f–377c/**16**:106c–e	**3**:974d–e/**8**:1044b–f/**10**:827e–828a/**12**:453a–d
	4:689a–e/**6**:185h–186b/**14**:382c–383d	**2**:70c–d/**4**:451a–c
	4:689e–691c/**14**:377h–379a	
	4:689e–690e/**15**:120d–e	**2**:577c–d/**14**:377h–378f/**14**:379b–e/**16**:883h–884d
	4:690f–691c/**15**:129g–130a	**12**:767f–g/**14**:378f–379a
VIRUS **19**:163–172	**3**:765a–c/**5**:856g–857c/**7**:986b–987f	**3**:1060f–h/**4**:689h–690b/**10**:896h–897a
	3:1048d–f	**10**:897b–c/**14**:377d–379a *passim*
BACTERIA **2**:568–577	**5**:959e–g	**5**:857c–888c *passim*/**5**:889a–890b *passim*/**14**:608a–f

	articles	article sections	other references
1. Characteristics of the protists		**3**:1048g–h / **3**:1050c–d / **7**:557c–558d	**3**:1060h–1061c / **5**:645f–g / **14**:378d–g
2. The algae; *e.g.*, diatoms, seaweeds, pond scums	ALGAE **1**:487–498	**14**:379b–f	**7**:349c–e / **10**:882e–887e *passim* / **13**:733g–h / **14**:494d–495d / **14**:609c–610d
3. The slime molds, *e.g.*, true slime molds, endoparasitic slime molds, cellular slime molds	SLIME MOLDS **16**:883–892		
4. The true fungi; *e.g.*, yeasts, mildews, mushrooms	MYCOTA **12**:756–768		**4**:690c–d / **5**:890b–892c *passim* / **5**:902f–g / **9**:552c–f / **10**:882e–888e *passim* / **14**:608f–609c
5. Algal-fungal partnerships	LICHEN **10**:882–888		**12**:760f–g
6. The protozoans; *e.g.*, amoebas, flagellates, ciliates	PROTOZOA **15**:120–130	**4**:177d–e / **11**:15h–16f / **12**:976c–e	**5**:781d–g / **5**:960f–g / **16**:937a–e
E. The nonvascular plants, or bryophytes			
1. Characteristics of the bryophytes		**9**:665a–b / **15**:718a–719a	**14**:379f–h / **13**:733f–g
2. Liverworts	HEPATOPSIDA **8**:779–781	**15**:718a–d	**14**:379g–h
3. Mosses	BRYOPSIDA **3**:351–354	**15**:718e–719a	**17**:837a–838c *passim*
F. The vascular plants, or tracheophytes			
1. Characteristics of the tracheophytes		**9**:665b–666b / **13**:731h–733f / **15**:719a–724c / **18**:453c–454d	**14**:379h–380d / **18**:451c–d
2. Whisk ferns, or psilopsids	PSILOPSIDA **15**:136–137		**15**:719b–c
3. Club mosses, or lycopsids	LYCOPSIDA **11**:206–208		**15**:719c–h
4. The horsetails, or sphenopsids	SPHENOPSIDA **17**:500–501		**15**:719h–720b
5. The true ferns	FERN **7**:237–247		**15**:720b–e
6. The nonflowering seed plants, or gymnosperms	GYMNOSPERM **8**:518–524		**14**:380d–e / **15**:721b–722a / **16**:481b–d
a. Early gymnosperms; *e.g.*, gnetums, cycads, ginkgoes		**8**:522h–523h	
b. Conifers	CONIFER **5**:1–9	**8**:523f–h	
7. The flowering plants, or angiosperms	ANGIOSPERM **1**:876–885		**11**:343e–g / **14**:380f–381a / **15**:722b–724c / **16**:480d–481a
a. Major groups of dicotyledonous plants in order of presumed evolutionary advance			
i. Magnolia order; *e.g.*, magnolias, custard-apple, nutmeg	MAGNOLIALES **11**:340–344		
ii. Laurel order; *e.g.*, laurels, avocado	LAURALES **10**:709–712		
iii. Pepper order; *e.g.*, pepper, lizard's-tails	PIPERALES **14**:467–468		
iv. Birthwort order; *e.g.*, Dutchman's pipe	ARISTOLOCHIALES **1**:1152–1153		
v. Water lily order; *e.g.*, water lilies, hornworts	NYMPHAEALES **13**:428–431		
vi. Buttercup order; *e.g.*, buttercups, barberry, monkshood	RANUNCULALES **15**:508–511		
vii. Poppy order; *e.g.*, poppies, fumitory	PAPAVERALES **13**:963–966		

	articles	article sections	other references
viii. Pitcher-plant order	SARRACENIALES **16**:252–255		
ix. Witch-hazel order; *e.g.*, witch-hazel, ironwood, plane tree	HAMAMELIDALES **8**:578–580		
x. Nettle order; *e.g.*, figs, elms, true hemp, marijuana	URTICALES **18**:1088–1093	**7**:279a–280d / **7**:756f–h	**5**:1058c–1059c *passim*
xi. Beech order; *e.g.*, beeches, oaks, chestnuts	FAGALES **7**:139–142		
xii. Birch order; *e.g.*, birches, alders, filberts	BETULALES **2**:872–875		**7**:757g–758a
xiii. Walnut order; *e.g.*, walnuts, hickories, pecans	JUGLANDALES **10**:329–333	**7**:758a–c	
xiv. Pink order; *e.g.*, carnations, pinks, beets	CARYOPHYLLALES **3**:973–976		
xv. Cactus order; *e.g.*, prickly pears, barrel cacti, peyote	CACTALES **3**:573–575		
xvi. Tea order; *e.g.*, tea, mangosteen, camellias	THEALES **18**:207–212		
xvii. Violet order; *e.g.*, violets, rock-roses	VIOLALES **19**:148–150		
xviii. Gourd order; *e.g.*, cucumbers, melons, gourds	CUCURBITALES **5**:362–364		
xix. Begonia order; *e.g.*, begonias, durango root	BEGONIALES **2**:801–803		
xx. Caper order; *e.g.*, capers, cabbages, radishes	CAPPARALES **3**:803–806		
xxi. Willow order; *e.g.*, willows, poplars	SALICALES **16**:179–183		
xxii. Heath order; *e.g.*, azaleas, rhododendrons, blueberries, cranberries	ERICALES **6**:954–957		**7**:760a–c
xxiii. Ebony order; *e.g.*, ebony, sapotes	EBENALES **6**:173–176		
xxiv. Primrose order; *e.g.*, loosestrife, cyclamen, primrose	PRIMULALES **14**:1047–1049		
xxv. Mallow order; *e.g.*, mallows, linden, cotton	MALVALES **11**:396–399		**7**:272h–278d *passim*
xxvi. Euphorbia order; *e.g.*, spurge, boxwood, rubber tree	EUPHORBIALES **6**:1027–1030	**15**:1175a–g	
xxvii. Saxifrage order; *e.g.*, saxifrage, hydrangeas, currants	SAXIFRAGALES **16**:291–302		
xxviii. Rose order; *e.g.*, roses, apples, pears, strawberries	ROSALES **15**:1150–1154	**7**:758d–760a	
xxix. Pea order; *e.g.*, legumes, clover, acacia	FABALES **7**:128–132	**7**:280d–f	
xxx. Nepenthes order; *e.g.*, Old World pitcher plants, sundews, Venus's-flytraps	NEPENTHALES **12**:958–962		**12**:216e / **16**:252b–c
xxxi. Myrtle order; *e.g.*, myrtle, pomegranate, mangrove	MYRTALES **12**:772–776		
xxxii. Rue order; *e.g.*, cashew, citrus fruits, mahogany	RUTALES **16**:102–106		
xxxiii. Soapberry order; *e.g.*, maple, horse-chestnut, lychee	SAPINDALES **16**:239–244		
xxxiv. Geranium order; *e.g.*, coca, flax, geraniums	GERANIALES **8**:1–6	**7**:278d–279a	
xxxv. Dogwood order; *e.g.*, dogwood, carrots, celery, ginseng	CORNALES **5**:174–178		
xxxvi. Staff-tree order; *e.g.*, staff-tree, holly	CELASTRALES **3**:1037–1040		
xxxvii. Buckthorn order; *e.g.*, grape, buckthorn	RHAMNALES **15**:794–796		
xxxviii. Olive order; *e.g.*, olive, lilac, ashes	OLEALES **13**:556–559	**7**:756e–f	
xxxix. Sandalwood order; *e.g.*, mistletoes, sandalwood	SANTALALES **16**:227–230		**5**:893f–h
xl. Teasel order; *e.g.*, honeysuckles, teasel	DIPSACALES **5**:815–818		
xli. Gentian order; *e.g.*, coffee, milkweed, madder	GENTIANALES **7**:1017–1020		

	articles	article sections	other references
xlii. Phlox order; *e.g.*, phlox, borage, sweet potato	POLEMONIALES **14**:657–661		
xliii. Figwort order; *e.g.*, potato, tomato, African violets, tobacco	SCROPHULARIALES **16**:412–418		
xliv. Mint order; *e.g.*, verbena, teak, mints	LAMIALES **10**:619–622		
xlv. Bellflower order; *e.g.*, bellflowers, lobelia	CAMPANULALES **3**:704–708		
xlvi. Composite order; *e.g.*, lettuce, ragweed, asters	ASTERALES **2**:213–219		
b. Major groups of monocotyledonous plants in order of presumed evolutionary advance			
i. Water-plantain order; *e.g.*, water-plantain, flowering rush	ALISMALES **1**:576–579		
ii. Lily order; *e.g.*, narcissus, onions, yams	LILIALES **10**:971–976		**7**:282c–283e *passim*
iii. Iris order; *e.g.*, iris, crocus, gladiolus	IRIDALES **9**:890–893		
iv. Ginger order; *e.g.*, banana, ginger, canna	ZINGIBERALES **19**:1150–1154	**7**:281e–282b / **7**:752c–d	
v. Orchid order; *e.g.*, orchids, vanilla, lady's slipper	ORCHIDALES **13**:648–656		**12**:218c–e
vi. Pineapple order; *e.g.*, pineapples, Spanish moss	BROMELIALES **3**:323–327		
vii. Grass order; *e.g.*, cereals, bamboo, turf grasses	POALES **14**:584–595		**8**:282b–f
viii. Palm order	ARECALES **1**:1131–1134	**7**:753d–f	
G. The invertebrates: animals without backbones			
1. Characteristics of the invertebrates		**4**:620d–624a / **5**:782e–783h / **6**:845f–846g / **7**:46e–48c / **9**:666b–667e / **12**:641e–644f / **12**:979a–982a / **14**:381a–382b / **15**:702g–707e / **15**:752h–754c / **16**:820e–822c	**5**:617h–618c / **14**:355e–360h *passim*
2. The lower invertebrates: Mesozoa through Entoprocta			
a. The mesozoans	MESOZOA **11**:1013		
b. The sponges	PORIFERA **14**:848–855	**7**:558d–559c	
c. The coelenterates; *e.g.*, jellyfishes, corals, sea anemones	CNIDARIA **4**:768–772	**4**:177e–g / **7**:559d–560e / **12**:643c–e / **16**:820e–821a	**5**:162b–167f *passim* / **14**:359d–g
d. The ctenophores; *e.g.*, comb jellies, sea walnuts	CTENOPHORA **5**:347–348		
e. The flatworms; *e.g.*, planarians, tapeworms, flukes	PLATYHELMINTHES **14**:545–551	**4**:177g–178b / **12**:980a–b	**12**:216b–d / **15**:703c–d
f. The ribbonworms	NEMERTEA **12**:950–951		
g. The spiny-headed worms	ACANTHOCEPHALA **1**:18–19		
h. The aschelminthes; *e.g.*, rotifers, nematodes, hairworms	ASCHELMINTHES **2**:137–143	**4**:178b–c / **16**:821a–b	**5**:892c–893f *passim* / **15**:683g–h
i. The entoprocts	ENTOPROCTA **6**:895–896		
3. The lophophorates			
a. The "moss animals," or ectoprocts	BRYOZOA **3**:354–358	**7**:562g–h	
b. The phoronid worms	PHORONIDA **14**:283		
c. The lamp shells, or brachiopods	BRACHIOPODA **3**:97–100	**7**:563b–g / **10**:356h–357d	

	articles	article sections	other references
4. The schizocoelomates			
a. The mollusks; *e.g.*, chitons, snails, clams, tusk shells, octopuses *with special attention to*	MOLLUSCA **12**:325–331	**4**:178g–179b / **7**:47d–f / **7**:560e–562f / **10**:357d–358g / **12**:644c–f / **15**:684c–f	**3**:691a / **4**:622c–623a / **5**:251e–g / **11**:17e–f / **12**:980e–981b / **14**:356a–f / **15**:704a–d / **15**:706b–c
i. Gastropods: snails and slugs	GASTROPODA **7**:947–957		**7**:560g–h / **11**:17a–b / **12**:329h–330b
ii. Bivalves: clams, oysters, and scallops	BIVALVIA **2**:1085–1091	**7**:561c–f / **10**:357d–h	**11**:17e / **12**:330b–c
iii. Cephalopods: octopuses, squids, and cuttlefishes	CEPHALOPODA **3**:1149–1154	**7**:561f–562a / **10**:358c–g	**5**:251e–f / **12**:330c–d / **12**:980g–981b / **14**:355e–g / **15**:684e–f
b. The peanutworms	SIPUNCULA **16**:809–810		
c. The annelid worms; *e.g.*, leeches, bristleworms, earthworms	ANNELIDA **1**:927–937	**4**:178d–f / **15**:683h–684c	**4**:621c–f / **5**:23f–27a *passim* / **11**:18h–19c / **12**:980c–e / **15**:703g–704a / **15**:705h–706a
d. The spoonworms	ECHIURA **6**:186–187		
e. The oncopods: tardigrades, onychophorans, and pentastomids	ONCOPOD **13**:568–570		
f. The arthropods; *e.g.*, arachnids, crustaceans [see H., below]			
H. The arthropods: trilobites, horseshoe crabs, sea spiders, crustaceans, and insects *with special attention to*	ARTHROPODA **2**:65–70	**4**:179b–183b / **7**:563g–565h / **12**:643e–644c / **14**:356f–359b / **15**:684g–686g / **15**:704d–705d / **15**:706c–e / **16**:821c–822b	**4**:621g–622c / **9**:666h–667e / **11**:19f–20b / **12**:981b–982a
1. Trilobites		**7**:564b–565a	
2. Arachnids *with special attention to*	ARACHNIDA **1**:1061–1066		**15**:685c–d
a. Scorpions	SCORPIONIDA **16**:401–403		
b. Spiders	ARANEIDA **1**:1066–1074	**17**:42d–h	**14**:356g–h
c. Mites and ticks	ACARINA **1**:19–23		
d. Extinct arachnids		**1**:1064d–1065a	
3. Crustaceans *with special attention to*	CRUSTACEA **5**:310–318	**4**:179d–180c / **6**:846f–g / **7**:47f–h	**12**:643e–g / **15**:684g–685c / **15**:704e–705a
a. Branchiopods	BRANCHIOPODA **3**:114–116		
b. Barnacles	CIRRIPEDIA **4**:641–643		
c. Decapods: true shrimps, crabs, lobsters, and crayfishes	DECAPODA **5**:542–549		**12**:177f–g
d. Extinct crustaceans		**5**:316g–317b / **7**:565c–e	
4. The myriapods; *e.g.*, millipedes, centipedes, symphylans, pauropods	MYRIAPOD **12**:768–772		
5. The insects, or hexapods: major groups	INSECTA **9**:608–621	**4**:180c–183b / **5**:961b–d / **6**:845h–846e / **7**:47h–48c / **12**:177g–178d / **12**:643g–644c / **17**:40b–42d	**1**:33b–c / **11**:23b–c / **15**:685e–686g / **15**:705a–c
a. Apterygote orders; *e.g.*, proturans, silverfishes, springtails	APTERYGOTE **1**:1023–1026		**9**:620b–621e *passim*
b. Mayfly order	EPHEMEROPTERA **6**:903–904		
c. Dragonfly and damselfly order	ODONATA **13**:507–509		

	articles	article sections	other references
d. Orthopteran orders; *e.g.*, grasshoppers, crickets, cockroaches, stick insects	ORTHOPTERAN **13**:742–750		
e. Termite order	ISOPTERA **9**:1049–1054		**16**:938g–h
f. Louse order: chewing lice and sucking lice	PHTHIRAPTERA **14**:373–376		
g. Thrips order	THYSANOPTERA **18**:367–369	**7**:565f–h	
h. Heteropteran order; *e.g.*, bugs, bedbugs	HETEROPTERA **8**:845–852		
i. Homopteran order; *e.g.*, cicadas, leafhoppers, aphids	HOMOPTERA **8**:1036–1043		
j. Neuropteran order; *e.g.*, snakeflies, lacewings	NEUROPTERAN **12**:1067–1070		
k. Caddisfly order	TRICHOPTERA **18**:709–710		
l. Lepidopteran order: butterflies, skippers, and moths	LEPIDOPTERA **10**:820–830	**7**:288a–d	**12**:215h–216a /**14**:746d–e
m. Coleopteran order; *e.g.*, beetles, weevils, wireworms	COLEOPTERA **4**:828–836		**12**:217c–d
n. Hymenopteran order; *e.g.*, ants, bees, wasps	HYMENOPTERA **9**:126–133	**2**:791g–792e	**1**:298h–299a /**10**:345d–e / **14**:745h–746c / **16**:939a–d
o. Fly order; *e.g.*, true flies, gnats, mosquitoes	DIPTERA **5**:819–825		
p. Flea order	SIPHONAPTERA **16**:807–809		
q. Extinct insects		**9**:618d–619e	
I. The enterocoelomate invertebrates: echinoderms through protochordates		**15**:705d–f	
1. Nonchordate enterocoelomates			
a. The arrowworms	CHAETOGNATHA **4**:18–19		
b. The echinoderms; *e.g.*, sea lilies, starfishes, sea cucumbers	ECHINODERMATA **6**:178–186	**4**:178c–d / **7**:565h–567b / **10**:358h–359a / **16**:822b–c	**4**:623a–e /**11**:17c–d
c. The hemichordates; *e.g.*, acornworms	HEMICHORDATA **8**:755–756		
d. The beardworms	POGONOPHORA **14**:603–604		
2. The chordates	CHORDATA **4**:450–451		**4**:623g–624a /**14**:383a–b
a. Tunicates, or urochordates	TUNICATA **18**:738–740		
b. Cephalochordates, or amphioxus	CEPHALOCHORDATA **3**:1147–1149		**4**:450c–e
J. Vertebrates: animals with backbones			
1. Characteristics of the vertebrates		**4**:624b–626b / **5**:783h–787a / **6**:841a–845f / **7**:48c–50d / **9**:667e–668g / **12**:644g–648e / **12**:990a–991f / **15**:707e–715g / **15**:754c–755b / **16**:822d–827f	**4**:450f–h /**14**:354c–355e / **14**:360h–361h /**14**:383b–d
2. Fishes	FISH **7**:330–344	**4**:626b–628c / **9**:668h–669f / **10**:740h–741g / **15**:686g–687c / **15**:755g–757a / **17**:43g–44f / **18**:329g–330a	**1**:33c–d /**4**:185b–g / **5**:675g–678a /**5**:961e–f / **7**:49e–g /**7**:347g–348e / **11**:17g–18a /**14**:995c–f
a. Jawless fishes: lampreys, hagfishes, and ostracoderms	AGNATHA **1**:310–311	**7**:567h–568d	**4**:625b–e /**7**:336h–337f
b. Placoderms: extinct armoured fishes	PLACODERMI **14**:488–490		**7**:337f–h /**7**:568d–g

	articles	article sections	other references
c. Cartilaginous fishes; *e.g.*, sharks, skates, rays	SELACHII **16**:492–500		**7**:337h–338d
d. Bony fishes [see J.3., below]			
3. Bony fishes			
a. Crossopterygians; *e.g.*, osteolepiforms, coelacanths	CROSSOPTERYGII **5**:296–297		
b. Lungfishes	DIPNOI **5**:813–815		**4**:627e–628c
c. Chondrosteans: sturgeon and paddlefish	CHONDROSTEI **4**:436–439		**7**:338g–339b
d. Holosts: gars and bowfins	HOLOSTEI **8**:1011–1013		**7**:339b–c
e. Teleosts: major groups of modern bony fishes in order of presumed evolutionary advance	TELEOSTEI **18**:81–82	**12**:178f–179f	**7**:339c–340a
i. Elopiform order: tarpons and bonefishes	ELOPIFORMES **6**:729–731		
ii. Anguilliform order: eels	ANGUILLIFORMES **1**:898–900		**11**:17g–h/**12**:179c–f
iii. Clupeiform order; *e.g.*, herrings, alewives, anchovies	CLUPEIFORMES **4**:762–767		**12**:178g–h
iv. Osteoglossiform and mormyriform orders	OSTEOGLOSSOMORPHA **13**:763–765		
v. Salmoniform and gonorhynchiform orders; *e.g.*, salmons, trouts, pikes	SALMONIFORMES **16**:185–192		**12**:179a–c
vi. Cypriniform and siluriform orders; *e.g.*, characids, minnows, carp, loaches, catfishes	OSTARIOPHYSI **13**:757–763		
vii. Batrachoidiform, gadiform, gobiesociform, lophiiform, percopsiform, and polymixiiform orders; *e.g.*, toadfishes, cods, clingfishes, anglerfishes, trout-perches, beardfishes	PARACANTHOPTERYGII **13**:979–982		
viii. Atheriniform, beryciform, zeiform, and lampridiform orders; *e.g.*, flying fishes, squirrelfishes, boarfishes, opahs	ATHERINIFORMES **2**:269–274		
ix. Gasterosteiform order; *e.g.*, sticklebacks, pipefishes, sea horses	GASTEROSTEIFORMES **7**:937–939		
x. Scorpaeniform, dactylopteriform, and pegasiform orders; *e.g.*, scorpion fishes, sculpins, flying gurnards, dragonfishes	SCORPAENIFORMES **16**:397–401		
xi. Perciform order; *e.g.*, perches, basses, tuna, swordfish, barracuda	PERCIFORMES **14**:46–58		**12**:216g
xii. Pleuronectiform order; *e.g.*, flatfishes, flounders, soles	PLEURONECTIFORMES **14**:570–571		
xiii. Tetraodontiform order; *e.g.*, filefishes, puffers, molas	TETRAODONTIFORMES **18**:162–164		
4. Amphibians *with special attention to*	AMPHIBIA **1**:703–706	**4**:628c–h/**5**:961e–g/**9**:669g–h/**15**:687d–e/**15**:757b–f/**17**:44f–45e	**4**:185g–186a/**7**:49d–e
a. Salamanders and other tailed amphibians	URODELA **18**:1085–1088		
b. Frogs and toads	ANURA **1**:1003–1009		
c. Extinct amphibians		**1**:704g–705h/**7**:569c–f	
5. Reptiles	REPTILIA **15**:725–739	**4**:628h–629d/**5**:961g–962c/**7**:348h–349a/**9**:669h–670d/**10**:359b–c/**15**:687e–g/**15**:757f–h/**17**:45e–48c	**4**:186a–c/**18**:330a–g

	articles	article sections	other references
a. Turtle order	CHELONIA **4**:72–76	**17**:47c–48a	
b. Tuatara order	RHYNCHOCEPHALIA **15**:824		
c. Squamatan order			
i. Lizards	SAURIA **16**:282–288	**17**:45f–46f	
ii. Snakes	SERPENTES **16**:559–567	**11**:21a–f / **17**:46f–47a	
d. Crocodilian order: alligators, crocodiles, gavials, caimans	CROCODILIA **5**:286–289	**17**:48b–c	
e. Extinct reptiles		**7**:569f–571g	**15**:736e–737c
6. Birds *with special attention to*	BIRD **2**:1053–1062	**4**:629d–630b / **5**:962h–963e / **9**:670d–671c / **10**:741g–744c / **12**:179h–181f / **15**:687g–688e / **15**:757h–758d / **17**:48d–g / **18**:330h–331b	**4**:186d–e / **5**:618f–g / **7**:545b–c / **11**:22e–h / **11**:23c–f / **14**:746h–747a / **15**:712f–g
a. Penguin order	SPHENISCIFORMES **17**:498–500		
b. Casuariiform order: cassowaries and emus	CASUARIIFORMES **3**:994–996		
c. Tinamous order	TINAMIFORMES **18**:425–426		
d. Grebe order	PODICIPEDIFORMES **14**:596–597		
e. Procellariiform order; *e.g.*, albatrosses, shearwaters, petrels	PROCELLARIIFORMES **15**:14–18		**10**:742a–c / **12**:181a–c
f. Pelecaniform order; *e.g.*, pelicans, frigate birds, cormorants	PELECANIFORMES **14**:15–20		
g. Ciconiiform order; *e.g.*, herons, storks, flamingos	CICONIIFORMES **4**:610–615		
h. Anseriform order; *e.g.*, ducks, geese	ANSERIFORMES **1**:938–947		
i. Falconiform order; *e.g.*, vultures, hawks, falcons	FALCONIFORMES **7**:145–152		**7**:152g–153a / **11**:22e–g
j. Galliform order; *e.g.*, megapodes, fowl, hoatzins	GALLIFORMES **7**:854–857		
k. Gruiform order; *e.g.*, cranes, coots, rails	GRUIFORMES **8**:444–449		
l. Charadriiform order; *e.g.*, auks, gulls, shorebirds	CHARADRIIFORMES **4**:33–42		
m. Columbiform order; *e.g.*, pigeons, sandgrouse	COLUMBIFORMES **4**:931–937		**9**:538h–539a
n. Psittaciform order; *e.g.*, parrots, macaws	PSITTACIFORMES **15**:138–141		
o. Cuculiform order; *e.g.*, cuckoos, roadrunners	CUCULIFORMES **5**:358–361		**12**:217f–g
p. Owl order	STRIGIFORMES **17**:734–737		
q. Caprimulgiform order; *e.g.*, oilbirds, goatsuckers, nightjars	CAPRIMULGIFORMES **3**:806–810		
r. Apodiform order: swifts, hummingbirds	APODIFORMES **1**:1012–1015		
s. Coraciiform order; *e.g.*, kingfishers, hornbills	CORACIIFORMES **5**:157–162		
t. Piciform order; *e.g.*, toucans, woodpeckers	PICIFORMES **14**:447–452		**7**:546d–e
u. Passeriform order: passerines, or perching birds	PASSERIFORMES **13**:1052–1066		
v. Extinct birds		**2**:1058h–1060g / **7**:571h–572b	

	articles	article sections	other references
7. Mammals	MAMMALIA **11**:401–415	**4**:630b–d / **5**:963e–966a / **9**:671c–672b / **10**:744c–746e / **12**:181g–182e / **15**:688e–689a / **15**:758d–f / **17**:48g–51f / **18**:331b–332e	**1**:33e–h / **4**:186e–187b / **5**:618g–619c / **7**:48d–49b / **14**:354c–355e *passim* / **15**:712g–713c / **15**:713g–714b
a. Monotremes: egg-laying mammals	MONOTREMATA **12**:384–387		**11**:413a
b. Marsupials: live-bearing pouched mammals	MARSUPIALIA **11**:537–545		**11**:403c–e / **11**:413b–c
c. The live-bearing placental mammals in order of presumed biological advance *with special attention to*			
i. Insectivore order; *e.g.*, shrews, moles, hedgehogs	INSECTIVORA **9**:622–628		**11**:413d–e
ii. Bat order	CHIROPTERA **4**:429–436	**14**:747c–e	**11**:413e–f / **12**:182a–c / **17**:50e–51d
iii. Edentate order; *e.g.*, sloths, anteaters, armadillos	EDENTATA **6**:298–303		
iv. Primate order; *e.g.*, lemurs, monkeys, apes, man	PRIMATES **14**:1014–1030	**11**:419a–421h	**7**:20a–d / **16**:942g–h / **17**:49d–e
v. Rodent order; *e.g.*, rats, lemmings, beaver, squirrels, porcupines	RODENTIA **15**:969–980		**9**:538c–f / **11**:414a–c
vi. Lagomorph order: rabbits, hares, and pikas	LAGOMORPHA **10**:588–591	**11**:20e–21a	**7**:287g
vii. Cetacean order: whales and dolphins	WHALE **19**:805–810	**7**:349a–b	**12**:182c–d / **17**:50c–e
viii. Carnivore order; *e.g.*, dogs, bears, cats, seals	CARNIVORA **3**:926–944		**5**:929c–936c *passim*
ix. Proboscid order: elephants and allies	PROBOSCIDEA **15**:1–4		
x. Sirenian order: sea cows and manatees	SIRENIA **16**:810–811		
xi. Perissodactyl order; *e.g.*, horses, rhinoceroses, tapirs	PERISSODACTYLA **14**:81–89	**8**:1088b–1092a	**7**:13f–14b / **11**:414e–415b
xii. Artiodactyl order; *e.g.*, hippopotamuses, camels, ruminants	ARTIODACTYLA **2**:70–80		**5**:425d–f / **12**:181g–182a / **7**:283f–287h *passim*
d. Extinct mammals		**7**:572c–574b / **14**:568d–g	**11**:409g–415g *passim*

Division II. The molecular basis of vital processes

[for Part Three headnote see page 130]

The outlines, and the articles and parts of articles referred to, in the three sections of Division II deal with the molecular level of biotic organization and set forth theories of the chemical transformations and the exchanges of energy that occur in the distinctively vital processes treated in Section 311 of Division I.

The outline and the articles referred to in Section 321 treat the inorganic milieu of living systems; the organic chemicals that participate naturally in life processes; and substances, such as drugs, alcohol, antiseptics, and biocides, which modify vital processes.

Section 322 treats photosynthesis, which initiates energy conversion in the biosphere; metabolism; and the nitrogen cycle.

Section 323, concerned with vital processes at the molecular level, deals with five main subjects: the biochemical constituents, properties, and functions of cell membranes; bioelectricity, the generation or action of electric currents in biological processes; the nature and transmission of the

Section 321. Chemicals and the vital processes 145
322. Metabolism: bioenergetics and biosynthesis 150
323. Vital processes at the molecular level 152

nerve impulse; muscle contraction, the conversion of chemical energy to mechanical energy; and bioluminescence, the conversion by organisms of chemical energy to light energy.

Section 321. Chemicals and the vital processes

[for Part Three headnote see page 130
for Division II headnote see page 144]

The articles and parts of articles referred to in Section 321 deal with six main subjects that fall into three groups. The first group (subjects A and B) concerns the inorganic chemical milieu of living systems and the organic chemicals participating in life processes. The second group (subjects C, D, and E) concerns the chemical substances, other than food, that can produce significant changes in life processes: drugs; ethyl alcohol; and biocides and biorepellents. The last subject, F, is the selective concentration of chemicals by organisms.

Subject A involves the biochemical significance of inorganic chemicals that are favourable to life and life processes.

The articles referred to in connection with subject B deal with the biological significance and the classification of organic chemicals that are constituents of living matter and active in vital processes. The outline first treats the principal components of living cells—carbohydrates, lipids, and proteins and peptides. It goes on to adenosine triphosphate, the major carrier of chemical energy, and to nucleic acids. It also treats biological pigments and coloration, enzymes, vitamins, hormones, and other chemicals of biological significance—alkaloids, steroids, isoprenoids, and terpenes.

The outline of subject C, drugs, begins with the sources and development of drugs and with the general aspects of drug action. It goes on to treat the absorption, distribution, metabolism, and excretion of drugs. It next treats the classification of drugs in terms of the organ systems they affect, covering drugs affecting the cardiovascular system, the muscle system, the central nervous system, the digestive system, the excretory system, the autonomic nervous system, the reproductive system, the immune response system, and the histamine response system. Finally, it deals with drugs directed against disease-causing organisms—antibiotics and chemotherapeutic drugs.

The outline of subject D first deals with the physiological and psychological effects of alcohol. It then treats the social conditions of alcohol consumption, alcoholism, and other contemporary alcohol problems and controls.

The outline of subject E, biocides and biorepellents, covers antiseptics and disinfectants; biocides directed by man against plant and animal pests; and the biotoxins produced by micro-organisms, animals, and plants.

Subject F is the selective concentration of chemicals by organisms. The outline treats the different kinds of chemicals selected by animals and plants to be constituents of organic compounds or mineralized skeletal materials; and the adaptive significance of metabolic waste products that accumulate within certain plants as the chemical basis for repulsion.

A. The inorganic milieu of living systems; *e.g.*, the necessity for water; the effects of gases

B. Organic chemicals participating naturally in the life processes

1. Carbohydrates

a. Classification and nomenclature of carbohydrates

b. Importance of carbohydrates in the biosphere, in human nutrition, in energy storage, and in plant and animal structure

c. The structural features of carbohydrates

d. Classes of carbohydrates and their preparation and analysis

2. Lipids

a. The biological importance of lipids as food reserves and as structural components of cells

b. Fatty acids

c. Derivatives of fatty acids and other biologically important lipids; *e.g.*, triglycerides, sterols, lipoproteins

3. Proteins and peptides

a. General structure and properties of proteins

i. The amino acid composition of proteins

ii. Other general features of proteins: levels of structural organization, methods of study, physicochemical properties, conformation of globular forms, classification

b. Special structure and function of proteins

articles	article sections	other references
	2:1039g–1042h / **15**:752a–f	**10**:899b–c / **10**:904b–905g *passim* / **13**:497c–498a / **19**:636c–637g *passim*
CARBOHYDRATE **3**:823–832		
	3:823c–g	
	3:823h–825a / **11**:1039b–1040b	**5**:777g–778a / **5**:778f–g / **13**:412e–g
	3:825a–826h	
	3:826h–832e / **11**:1026f–1030b	**11**:1043f–1044c
LIPID **10**:1015–1022		**13**:522a–523b *passim*
	2:1016c–1017a / **11**:877d–e / **13**:405f–g / **13**:523e–524h	**5**:6f–h / **13**:412g–h
	2:1017a–1019c / **3**:867d–868e / **11**:1030f–1031e	**11**:1040b–1041c
	2:1019c–1022c	**5**:778b–c / **5**:779a / **11**:876e–g / **11**:1044d–h / **15**:93g–94a
PROTEIN **15**:81–98	**2**:1122g–1123d	
	15:81f–90c	**2**:994g–h / **3**:1044e–g / **13**:411f–412e *passim* / **18**:608h–609h *passim*
	11:1041d–h / **13**:405c–d / **15**:81f–84e	
	15:84e–90c / **11**:1031f–1033a	**11**:1045h–1046e
	15:90d–98g	

i. Structural proteins; *e.g.*, collagen, muscle proteins, fibrinogen

ii. Albumins, globulins, and other soluble or conjugated proteins; *e.g.*, blood serum proteins, plant proteins, hemoglobins, hormones, antibodies

4. The major carrier of chemical energy: ATP

a. The mechanisms by which adenosine triphosphate (ATP) is synthesized from adenosine diphosphate (ADP) and inorganic phosphate

b. Utilization of ATP in biosynthesis

5. Nucleic acids

a. General features: nucleic acids as long chain compounds consisting of repeating structural units called nucleotides; types of nucleic acids

b. Deoxyribonucleic acid (DNA): a major constituent of the hereditary material of calls

c. Ribonucleic acid (RNA): a substance primarily associated with protein synthesis in cells

6. Biological pigments and coloration

a. The expression of colour: the genetic, physiological, and environmental control of coloration; long-term coloration changes, as in seasonal changes and in changes due to aging

b. The structural and biochemical bases for colour

i. Structural colour: the effects of reflection, interference, and scattering and their reinforcement by the presence of pigment

ii. Pigments; *e.g.*, carotenoids, quinones, flavonoids, porphyrins

c. The adaptive value of biological coloration; *e.g.*, camouflage, advertising coloration

7. Enzymes

a. Historical background and importance

b. General properties: classification, chemical nature, coenzymes, and nature of catalysis

c. The nature of enzyme-catalyzed reactions; *e.g.*, specificity, mechanisms, inhibitors, effects of temperature and pH (a measure of the degree of acidity or alkalinity)

d. Enzyme flexibility and allosteric control; *e.g.*, regulation of enzymatic activity

8. Vitamins

a. General characteristics of vitamins

i. Nomenclature and the biological significance of vitamins; *e.g.*, the regulation of metabolic reactions

ii. Sources of vitamins and vitamin requirements of living things

iii. Results of vitamin deficiencies and the evolution of vitamin-dependent organisms

b. Water-soluble vitamins (vitamin C and the B vitamins): properties, functions, and metabolism

c. Lipid-soluble vitamin groups (the A, D, E, and K vitamins): properties, functions, and metabolism

d. Vitamin-like substances: choline, myoinositol, para-aminobenzoic acid (PABA), carnitine, lipoic acid, and bioflavinoids

articles	article sections	other references
	15:90d–91h / **1**:301h–302b / **11**:877e–g	
	15:91h–98g / **2**:1021f–1022c	**2**:1114g–1115b / **14**:369d–g
	11:1023a–e / **12**:627c–628h	
	11:1035c–h / **12**:627f–628h	**11**:1027g–1028e / **14**:370d–373e *passim*
	11:1037f–h / **12**:627e–f	
NUCLEIC ACID **13**:328–330	**10**:895b–d	**2**:995b–c
	13:328e–g / **7**:985h–986f / **19**:164d–165c	**13**:330e–333h *passim*
	13:328g–329h / **7**:985d–h	**11**:1045a–e
	13:329h–330c	**11**:1045e–h / **19**:166a–c
COLORATION, BIOLOGICAL **4**:911–929		
	4:911g–913b	
	4:913b–923g	
	4:913d–914c	
	4:914c–923g / **14**:363f–364d / **15**:760a–e	**1**:934a–b / **2**:1116d–h / **2**:1123c–d / **3**:974d–e / **14**:369b–370a *passim* / **15**:93e–95c *passim*
	4:923g–929d	
ENZYME **6**:896–902	**3**:1004f–1005b	
	6:896b–897d	
	6:897d–898f / **15**:95d–96e	**13**:333f–g
	6:898f–901c / **2**:1031e–1032b	
	6:901d–902e	
VITAMIN **19**:488–493		**11**:835g–h
	19:488c–489d / **13**:405h–406e	**13**:419d–420d
	19:488c–e	
	19:488f–h	**13**:420d–422a *passim* / **1**:909d–f
	19:488h–489d / **2**:1135e–1136c / **13**:409d–411e	
	19:489e–490f	**2**:1135g–h / **13**:409e–g / **13**:410f–411e
	19:490f–491h	**3**:23b–c / **13**:409g–410f
	19:491h–492c	

	articles	article sections	other references
e. Methods used in vitamin research to determine vitamin requirements and vitamin sources		**19**:492c–493c	
9. Hormones	HORMONE **8**:1074–1087		
a. General features of hormones: relationship between endocrine regulation and neural regulation; the evolution of hormones		**8**:1074c–g / **6**:840d–841a	**2**:996b–c
b. The hormones of vertebrates		**8**:1074h–1085f / **15**:96f–97g	**6**:841a–845f *passim*
i. Hormones of the pituitary gland; *e.g.*, growth hormone, ACTH, TSH, vasopressin		**8**:1074h–1078e / **15**:97b–f	**5**:642b–d / **6**:841a–c
ii. Hormones of the thyroid gland; *e.g.*, thyroxine		**8**:1078f–1079g / **15**:96f–g	**5**:642a–b / **6**:842b–d
iii. Parathormone of the parathyroid glands		**8**:1079g–1080b	
iv. Hormones of the pancreas: insulin and glucagon		**8**:1080c–1081b / **15**:96h–97b	**6**:843g–h
v. Hormones of the adrenal glands; *e.g.*, adrenaline, aldosterone		**8**:1081b–1083c / **17**:682c–d / **17**:684f	**6**:844c–h
vi. Hormones of the reproductive system; *e.g.*, estrogens, androgens		**8**:1083c–1084g / **17**:682a–b / **17**:684c–e	**6**:845c–d
vii. Hormones of the digestive system; *e.g.*, gastrin, secretin		**8**:1084g–1085b / **6**:842h–843f	
viii. Secretions of endocrine-like glands; *e.g.*, kinins, melatonin, thymosin		**8**:1085b–f	
c. The hormones and hormone-like substances of invertebrates: neurohormones, molting hormones, and pheromones		**8**:1085f–1086f	**6**:845f–846g *passim*
i. Hormones of insects		**8**:1085f–1086c / **4**:1012h–1013c / **6**:845h–846e	**5**:641e–642a / **9**:611h–612c / **13**:747c–e
ii. Hormones of crustaceans		**8**:1086c–e / **6**:846f–g	**5**:316d–e
iii. Other invertebrate hormones		**8**:1086e–f	**5**:961d / **6**:845g–h
d. The hormones of plants		**8**:1086g–1087h / **8**:1109f–1110a / **14**:504e–h	**5**:668f–669a / **5**:670c
i. Growth promotors: auxins, gibberellins, and cytokinins		**8**:1086g–1087e	**8**:443b–c
ii. Growth inhibitors: abscisic acid and ethylene		**8**:1087e–h	
10. Other natural products			
a. Alkaloids	ALKALOIDS **1**:595–607		
b. Steroids and sterols	STEROIDS **17**:677–688		**14**:193h–194b
c. Isoprenoids and terpenes	ISOPRENOIDS **9**:1043–1049		
C. Drugs: chemicals administered to an organism to change its physiological state or to combat pathogens	DRUG AND DRUG ACTION **5**:1041–1048		
1. Sources and development of drugs		**5**:1041a–c / **1**:595b–d / **11**:848h–849c	**12**:842a–d / **14**:191a–199d *passim*
2. General aspects of drug action		**5**:1041d–1043d	
a. The relationship between chemical structure and drug receptor interactions		**5**:1041d–g	
b. Mechanisms of drug action		**5**:1041g–1042d / **12**:842e–f / **14**:621f–622c	**1**:867e–f / **8**:558b–d / **16**:456e–g / **17**:693a–e
c. Quantitative evaluation of drug responses and efficacy (intrinsic activity)		**5**:1042d–h	**16**:456g–457a
d. Factors modifying drug responses; *e.g.*, dosage, frequency of administration, physiological variability of the patient, drug combinations		**5**:1042h–1043b	**14**:619h–620b

	articles	article sections	other references
e. Drug interactions and drug toxicity		**5**:1043b–d / **1**:610b–d / **1**:867g	**1**:718c–d / **5**:20h–21a / **5**:852d–g / **8**:558g–559a / **14**:618h–619c / **16**:457c–f / **17**:693h–694a
3. Absorption, distribution, metabolism, and excretion of drugs		**5**:1043d–1044g / **1**:596g–597a / **10**:1270f–g / **12**:842f–g / **18**:595c–g	**1**:867d–e / **8**:558f–g / **14**:621b–f / **16**:456c–e / **17**:693e–f
4. Classification of drugs by organ or organ system of principal effect		**5**:1044g–1047b / **1**:595g–596g / **18**:282f–285b	**12**:992c–e / **17**:686d–688b *passim*
a. Drugs affecting the cardiovascular system; *e.g.*, digitalis		**5**:1044g–1045b / **18**:283d–g	
b. Drugs affecting smooth and skeletal muscle systems; *e.g.*, ergot, vasopressin		**5**:1045b–d	**1**:596e–f
c. Drugs affecting the central nervous system *with special attention to*		**5**:1045d–1046b / **5**:1048e–1049f / **5**:1052f–1059c / **15**:142g–143g	**12**:992d–e / **18**:282g–283a
i. Drugs that prevent the perception of inflicted pain: anesthetics	ANESTHETIC **1**:866–869	**1**:458h / **5**:1057d–f / **13**:1038a–e	**1**:596d–e / **5**:1045d–f / **12**:843d–h
ii. Drugs that reduce pain: analgesics	ANALGESIC **1**:717–719		**5**:1045f–g / **12**:843b–844a *passim*
iii. Drugs that stabilize behaviour and reduce anxiety: tranquillizers	TRANQUILLIZER **18**:595–596	**5**:1058a–c	**15**:143b / **16**:457h–458b
iv. Drugs that quiet and induce sleep: sedatives	SEDATIVE-HYPNOTIC DRUGS **16**:456–458	**5**:1057b–d / **16**:882e–g	**14**:194f–g / **15**:142g–143a
v. Drugs that produce stupor and narcoses: narcotics	NARCOTIC **12**:841–844	**5**:1052f–1054h / **13**:1038a–d	**13**:963f
vi. Drugs that excite or stimulate consciousness: stimulants	STIMULANT **17**:692–695	**5**:1057f–1058a	**15**:143c–d
vii. Drugs that profoundly alter mental and psychic functions: hallucinogens	HALLUCINOGEN **8**:557–560	**5**:1054h–1056g / **5**:1058c–1059c / **14**:200a–g / **9**:246g–247c	**14**:658b–c
d. Drugs affecting the autonomic nervous system and the eyes; *e.g.*, cholinergic drugs, adrenergic drugs		**5**:1046c–e / **1**:868f–g / **12**:1035a–e	**1**:596a–f / **8**:560a–b / **12**:1033f–1035a *passim* / **17**:693a–c / **18**:283b–d
e. Drugs affecting the excretory system; *e.g.*, diuretics, antidiuretics		**5**:1046f / **18**:284d–e	
f. Drugs affecting the digestive system: antacids, emetics, anti-emetics, and laxatives		**5**:1046g / **18**:284a–d	
g. Drugs affecting the reproductive systems: sex hormones and oral contraceptives		**5**:1046h / **17**:686d–687d	**2**:1068e–h / **8**:1083c–1084g *passim*
h. Drugs affecting the immune response system; *e.g.*, purine analogues		**5**:1047a–b / **1**:611c–e / **9**:258a–d / **18**:285a–b	
i. Drugs affecting the histamine response system: antihistamines	HISTAMINE AND ANTIHISTAMINES **8**:944–945	**5**:1046h–1047a	**1**:611f / **9**:561a–b
5. Drugs directed against disease organisms		**5**:1047b–g	**18**:285b–g
a. Drugs derived from living micro-organisms: antibiotics	ANTIBIOTIC **1**:986–990	**5**:1047d–f	
i. General features of antibiotics; *e.g.*, historical background, nature of action, absorption and excretion, toxicity		**1**:986c–987e / **11**:833b–g	**5**:856e–f / **9**:534b–c / **14**:192h–193d
ii. Antibiotics that act on the bacterial cell wall; *e.g.*, the penicillins, cephalosporin derivatives		**1**:987f–988f	
iii. Antibiotics that interfere with protein synthesis; *e.g.*, the tetracyclines, streptomycin, neomycin		**1**:988f–989h	
iv. Other types of antibiotics: antibiotics that affect cell membranes; antibiotics that affect nucleic acid metabolism		**1**:989h–990c	

b. Chemical compounds used to treat infectious diseases: chemotherapeutic drugs

i. General features of chemotherapeutic drugs; *e.g.*, historical background; nature of action; absorption, metabolism, and excretion; toxicity

ii. Chemotherapeutic treatment of parasitic diseases; *e.g.*, anthelmintic drugs, antimalarial drugs, amoebicides, and other drugs that kill protozoans

iii. Chemotherapeutic treatment of microbial diseases; *e.g.*, sulfonamide drugs, antileprotic drugs, antituberculotic drugs

6. Drugs directed at the suppression of cancer

7. Drug use and abuse: the nature of drug addiction and dependence
[see 522.C.9.]

D. Ethyl alcohol: the physiologically active principle of beverages produced by fermentation

1. Physiological and psychological effects of alcohol

a. What the body does with alcohol: the fate of alcohol in the body

b. Intoxication: effects on the brain, on emotional behaviour, and on body organs; acute and chronic diseases associated with intoxication

2. Social conditions of alcohol consumption: history of the various uses of alcohol in different societies; drinking patterns

3. Alcoholism and other contemporary alcohol problems: controls over alcohol use
[see 522.C.9.c.]

E. Biocides and biorepellents

1. Antiseptics and disinfectants: chemical compounds and physical agents that are used to destroy micro-organisms or to prevent their development

2. Biocides directed by man against pests

a. Against animal pests

i. The significance of pest control: the nature of animal pests; the extent of pest damage; pest control programs

ii. Chemical pest control; *e.g.*, insecticides, repellents, antibiotics

iii. Biological pest control; *e.g.*, cultural control involving the environment, the use of resistant plant and animal species, the use of natural enemies

iv. Integrated pest control: the manipulation of populations to maintain them at noneconomic levels of abundance and the eradication of a pest species when this is attainable and desirable

v. Production and utilization of pesticides

b. Against plant pests

i. Importance of weed control; *e.g.*, weeds as health hazards; weeds as the competitors of crop plants

ii. Mechanical weed control; *e.g.*, tillage, crop rotation, use of weed-free seed

iii. Chemical weed control; *e.g.*, selective and nonselective herbicides, contact herbicides

iv. Biological weed control; *e.g.*, insect predators, pathogenic micro-organisms, grazing animals

v. Production and utilization of herbicides

articles	article sections	other references
CHEMOTHERAPEUTIC DRUGS **4**:188–192	**5**:1047f–g	
	4:188h–189e / **11**:832h–833b	
	4:189e–191a	
	4:191b–192e	**15**:771g–772a
	4:192e–f / **5**:1047g–1048a	**3**:769g–770a
ALCOHOL CONSUMPTION **1**:437–450		**1**:451h–455d *passim*
	1:438b–441b / **1**:454h–455b	
	1:438b–h	
	1:439b–441b / **15**:178e–f	**10**:1273d–f
	1:441c–445e	
ANTISEPTIC AND GERMICIDE **1**:995–998	**1**:457e–f / **2**:572g–573c	
PEST CONTROL **14**:139–148	**1**:344f–345h / **1**:353d–354e	**5**:893c–f / **5**:894b–895f *passim*
	14:139d–140c / **9**:610c–611d / **15**:970b–971b	**1**:344f–345b
	14:140d–143e / **1**:353e–g	**1**:345b–e
	14:143f–147d / **1**:353g–354c	**1**:345f–g
	14:147d–148e	**1**:345f–h
	14:148f–h	
WEED CONTROL **19**:722–727	**1**:354e–h / **7**:763b–d	**5**:893g–894b
	19:722e–723b	**2**:1047g–1048b
	19:723b–h	
	19:723h–726h	
	19:726h–727e	
	19:727f–g	

3. Biotoxins produced by micro-organisms, plants, and animals

   a. General features: properties and occurrence of biotoxins; importance to man; historical background

   b. Major categories of biotoxins

      i. Microbial toxins: poisons produced by bacteria, fungi, and various types of algae

      ii. Phytotoxins: poisons produced by higher plants

      iii. Zootoxins: poisons produced by animals

4. Biological and chemical warfare agents
   [see 736.A.2.j.]

F. The selective concentration of chemicals by organisms

1. Elements selected by organisms to be constituents of organic compounds or mineralized skeletal materials

2. The adaptive significance of metabolic waste products that accumulate within certain plants as the chemical basis for repulsion

articles	article sections	other references
POISONOUS ANIMALS AND PLANTS **14**:606–617		
	14:606b–607h	**2**:1048g–h/**12**:215b–c/ **14**:618a–c
	14:607h–616h	
	14:607h–610d/ **12**:1055h–1056c	**9**:553h–554f/**12**:756f–h/ **15**:120f
	14:610d–612h/ **6**:955a–c	**7**:130f–g/**15**:1152h–1153a/ **18**:1091f–g
	14:613d–616h	**1**:1007g–h/**1**:1064b–c/ **1**:1071b–d/**16**:398d–f/ **16**:402g–h/**16**:564h–565c
	5:164d–e/ **6**:713d–h/ **16**:766c–g	**2**:1040f–1041g *passim*/ **6**:713h–715h *passim*/ **11**:497c–d
	12:214h–215c	**1**:597a–e/**14**:606e–g

Section 322. Metabolism: bioenergetics and biosynthesis
[for Part Three headnote see page 130
for Division II headnote see page 144]

The articles and parts of articles referred to in Section 322 deal with three main subjects: A, photosynthesis; B, metabolism; and C, the nitrogen cycle.

The outline of subject A begins with the biological importance of photosynthesis—the photochemical reaction in which green plants capture and use solar light energy to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds. The outline then covers the factors that influence the rate and the energy efficiency of photosynthesis; the site and the mechanism of the photosynthetic process; the photosynthetic pigments; the energetics of photosynthesis; and the metabolic path of carbon in photosynthesis.

Subject B is metabolism, which encompasses all the molecular processes by which an organism acquires, uses, and replaces the energy it needs for growth, for maintenance, and for the activities of life. The outline begins with the catabolic processes by which complex molecules are fragmented. It goes on to the combustion of food materials and the conservation of part of the energy in them, treating the oxidation of molecular fragments and biological energy transduction. The outline next deals with the anabolic processes by which are synthesized chemicals essential to life, such as carbohydrates, lipids, amino acids, nucleic acids, and proteins. Finally, dealing with the regulation of metabolism, the outline treats the sensitive adjustments of the flux of nutrients relative to the needs of cells under relatively constant environmental conditions, and the less immediately responsive adjustments that allow the cell to cope with severe changes in the chemical milieu.

Subject C is the nitrogen cycle—a complex sequence of natural processes, important in the balance of the biosphere, by which inorganic nitrogen is converted to nitrates, consumed and metabolized by organisms, and returned to an inorganic state. The outline refers to nitrogen fixation, the process by which atmospheric nitrogen is converted into the form of nitrogen most available to plants, nitrate; and to micro-organisms that nitrify and denitrify.

A. Photosynthesis: the initiation of energy conversion in the biosphere

1. The biological importance of photosynthesis
   [see 351.A.3.]

2. Factors that influence the rate of photosynthesis and the energy efficiency of photosynthesis

3. Determination of the mechanism of photosynthesis

4. The site of the photosynthetic process in green plants: the chloroplast

5. The photosynthetic pigments; *e.g.*, chlorophylls, accessory chlorophylls, phycobilins

6. The energetics of photosynthesis: photoelectron transfer and photophosphorylation

7. The metabolic path of carbon in photosynthesis: the carbon reduction cycle

articles	article sections	other references
PHOTOSYNTHESIS **14**:365–373		**2**:1038g–1039a/**3**:824a–b
	14:367a–h	**2**:1039b–c/**14**:352c–g
	14:367h–369b	
	14:369b–370d	**3**:1062e–f/**10**:896g–h/ **15**:415a
	4:919a–e	**4**:920a–d
	14:370d–371e	**14**:291e–g/**18**:609d–e
	14:371e–373e	

	articles	article sections	other references
B. Metabolism: the totality of all chemical processes in the living organism	METABOLISM **11**:1022–1048	**10**:896a–897a / **15**:782c–e	**10**:1270c–e
1. The fragmentation of complex molecules: catabolism		**11**:1023a–f / **11**:1026e–1033a / **5**:781h–782d	**6**:896e–897a /**14**:437c–438a
a. The catabolism of glucose: glycolysis and the phosphogluconate pathway		**11**:1026f–1029d / **12**:628b–d	
b. The catabolism of sugars other than glucose		**11**:1029d–1030b	**3**:824d–g /**11**:1050f–h / **11**:1056h–1057b
c. The catabolism of lipids (fats): the fates of glycerol and fatty acids		**11**:1030c–1031e	**2**:1016c–d
d. The catabolism of proteins: the removal and disposal of nitrogen; oxidation of the carbon skeleton		**11**:1031f–1033a	**5**:785d–f /**11**:1051g–1052c / **11**:1054d–1056g *passim*
2. The combustion of food materials and the conservation of part of the energy in them: cellular respiration		**11**:1023f–1024c / **11**:1033b–1037d	**13**:808f–h
a. Oxidation of molecular fragments		**11**:1033d–1035c	**2**:1031e–1032b *passim* / **6**:812c–e
i. The oxidation of pyruvate: the formation of the two-carbon compound acetate in the form of acetyl-coenzyme A		**11**:1033d–1034a	
ii. The tricarboxylic acid (TCA) cycle: the sequence of enzyme-catalyzed steps that effects both the total combustion of the acetyl moiety of acetyl-coenzyme A and the removal of hydrogen atoms or electrons from compounds formed during the cycle		**11**:1034a–1035c	
b. Biological energy transduction: the energy-conserving process in which hydrogen atoms and electrons pass down a chain of respiratory carriers to oxygen, forming water, with concomitant formation of the energy-rich compound adenosine triphosphate (ATP)		**11**:1035c–1037d / **12**:627f–628h / **12**:631e–g	
i. ATP as the currency of energy exchange: ATP and adenosine diphosphate (ADP) as intermediate carriers for the transfer of energy when necessary, ATP being capable of donating energy and ADP of accepting it		**11**:1035c–h	
ii. Energy conservation: the catabolism-linked synthesis of ATP by one mechanism that does not require oxygen (substrate level phosphorylation) and one that does (oxidative phosphorylation)		**11**:1035h–1037d	
3. The biosynthesis of cell components: anabolism		**11**:1024c–f / **11**:1037d–1046e	
a. The nature of biosynthesis: the stages of biosynthesis and the utilization of ATP in the formation of small molecules (building blocks) and in their assembly into larger ones (macromolecules)		**11**:1037d–h / **13**:332h–333h	
b. The supply of biosynthetic precursors: specialized processes (*e.g.*, anaplerotic routes) by which microorganisms effect the formation of components necessary for their growth		**11**:1038a–1039a	
c. The synthesis of building blocks: sugars, the building blocks of carbohydrates; glycerol, fatty acids, and the other building blocks of lipids; amino acids, the building blocks of proteins; purine and pyrimidine nucleotides, the building blocks of nucleic acids		**11**:1039b–1043f	
d. The synthesis of macromolecules		**11**:1043f–1046e	
i. Carbohydrates and lipids: the formation of polysaccharides and phospholipids from their component building blocks		**11**:1043f–1044h	**2**:1016d–f
ii. Nucleic acids and proteins: the formation of deoxyribonucleic acid, ribonucleic acids, and proteins from their component building blocks		**11**:1044h–1046e	
4. Regulation of metabolism		**11**:1024f–1025d / **11**:1046f–1048g / **2**:996a–e	**7**:546b–d
a. Fine control: the sensitive adjustments of the flux of nutrients along metabolic pathways relative to the needs of cells under relatively constant environmental conditions		**11**:1024f–1025a / **11**:1046f–1048b	

articles	article sections	other references
	11:1025a–d / **11**:1048c–g	
	2:1040f–1041d / **16**:1015g–1016a	**2**:572b–c / **13**:125a–b

b. Coarse control: the less immediately responsive adjustments that allow the cell to cope with severe changes in the chemical milieu, as when diet is changed or the hormonal balance altered

C. The nitrogen cycle: the process of nitrogen fixation; the role of micro-organisms in nitrification and denitrification

Section 323. Vital processes at the molecular level
[for Part Three headnote see page 130
for Division II headnote see page 144]

The articles and parts of articles referred to in Section 323 deal with five main subjects: A, the cell membrane; B, bioelectricity; C, the nerve impulse; D, muscle contraction; and E, bioluminescence.

The outline of subject A begins with the biochemical constituents and properties of cell membranes and with their function in the life of the cell. It goes on to treat the movement of water across cell membranes, and the role of selective permeability of membranes in the regulation and control of the movement through them of substances other than water.

Subject B is bioelectricity—the generation or action of electric currents in biological processes. The outline treats the range and types of biopotentials; the factors required to establish a bioelectric potential; the specialized properties of excitable cells; the electrical changes induced in stimulated cells; and the bioelectric effector organs in fishes such as eels, in endocrine systems, and in central nervous systems.

The outline of subject C, the nerve impulse, treats the structure of the nerve cell, or neuron; the characteristics of artificially stimulated nerve fibres; the nature and transmission of the nerve impulse; and the ways by which the nerve impulse is studied.

Subject D is muscle contraction—the conversion of chemical energy to work. The outline begins with contractile or motile activity of some type as a characteristic of all living things. It goes on to deal with the striated, or skeletal, muscle in higher animals, treating the structure and levels of organization of the muscular system; nerve–muscle communication; the physical aspects of muscle contraction; the energy transformations and metabolic pathways supporting energy events; and the molecular basis of contraction. The outline next treats the structure, organization, mechanical properties, and metabolic activities of the involuntary cardiac muscles. Finally, it treats the many nonstriated, or smooth, muscles, which form the visceral musculature of vertebrates, but which perform both bodily and visceral movements in lower animals such as worms.

Subject E is bioluminescence—the conversion by organisms of chemical energy to light energy. The outline first treats the significance of bioluminescence in studies of behaviour and of metabolism, and the use of the luminescent reaction of the firefly in biological research. It then treats the range and variety of bioluminescent organisms and the biochemical events involved in light emission.

articles	article sections	other references
MEMBRANE, BIOLOGICAL **11**:875–884		
	11:876d–878e	**3**:1045d–f
	11:876d–877c	**2**:1016f–g
	11:877d–878e	**2**:998f–h
	11:878f–879c	**3**:1045g–1046b
	11:879c–g / **2**:1122a–g / **7**:45e–46b	**2**:1114d–f / **4**:160h–161a
	11:879h–881g	**5**:1043f–h
	11:879h–880e	
	11:880e–h	
	11:880h–881g	
	11:881h–884g / **14**:501c–e	**12**:970h–972g *passim*
	11:881h–884e	

A. The cell membrane: the barrier between the cell and its environment and between structures within the cell

1. The nature of membranes
   a. Biochemical constituents of membranes
   b. Properties of membranes; *e.g.*, electrical properties
2. Compartmentalization of the cell: protection, by membranes of limited permeability, of internal structures, or organelles, from the activities of other organelles and from the activities of the ground substance of the cell
3. Movement of water across cell membranes: osmosis
4. Movement of solutes through membranes in response to a concentration gradient
   a. Methods of studying permeability: measurement of the rates of uptake or exit of solutes from cells
   b. Factors that influence permeability; *e.g.*, molecular size and electrical charge of the substance being transported; membrane structure
   c. Facilitated diffusion: the concept of a mobile carrier that combines with the substance and carries it through the membrane; exchange diffusion as a special case of facilitated diffusion
5. Movement of solutes through membranes independent of concentration gradients
   a. Active transport: metabolically linked (*i.e.*, energy-requiring) transport across a membrane

b. Pinocytosis: engulfment by a cell of a droplet of the medium surrounding it and the formation of a membrane-bounded body (vesicle) that can be carried into and across the cell

B. Bioelectricity: the range of phenomena that occur in the generation or action of electric currents in biological processes, as signalling in nerves or triggering of physical processes in muscles

1. Range and types of biopotentials (*i.e.*, electrical effects resulting from the ability of opposite sides of the cell membrane to store energy in the form of electrically charged ions)
2. Factors required to establish a bioelectric potential: semipermeable membrane, potassium-ion gradient across the membrane, and energy
3. Specialized properties of excitable cells: depolarization as the transient increase in membrane permeability to sodium ions; sodium equilibrium potential as the approximate value of the potential attained across a depolarized membrane
4. Electrical changes induced in stimulated cells: a stimulus that modifies the permeability of an area of a membrane, and an effect (*e.g.*, muscle contraction, light production)
5. Effector organs and systems: bioelectric organs in fishes including eels, in endocrine systems, and in central nervous systems

C. The nerve impulse: a unit of electrical information conducted along a nerve fibre (an extension of a nerve cell, or neuron)

1. The structure of the neuron
2. Characteristics of artificially stimulated nerve fibres
   a. Effects of stimulation; *e.g.*, all-or-none law, tetanus, refractory periods, latent addition
   b. Strength–duration curve
3. Nature of the nerve impulse
   a. The local-circuit theory of conduction: an explanation for the forward movement of a brief electrical event, the action potential, along a nerve fibre
   b. Electrical events; *e.g.*, the resting potential, a measure of the difference in voltage across an unstimulated membrane; the ionic theory as an explanation of the changes that occur in a nerve fibre during an action potential
   c. Maintenance of ionic concentration gradients by the sodium pump, a mechanism by which sodium ions leave the cell and potassium ions enter it
   d. Accompanying phenomena; *e.g.*, liberation of heat, optical effects
4. Transmission of the nerve impulse: the mechanism involved in transmitting impulses between cells; the synapse
5. Study of the nerve impulse: the prediction of action potential events from voltage clamp data and from artificial and simplified membranes

D. Muscle contraction: the conversion of chemical energy to work

1. Contractile or motile activity of some type as a characteristic of all living things
2. Striated, or skeletal, muscle in higher animals
   a. Structure and levels of organization: the whole muscle, the muscle fibre, the myofibril, and the myofilament

articles	article sections	other references
	11:884e–g	
BIOELECTRICITY **2**:998–1000	**6**:607e–609b	**12**:970a–974b *passim*
	2:998b–e	**3**:879e–f/**14**:364e–f
	2:998f–999a/ **11**:877g–878e	
	2:999a–f/ **12**:971g–972e	**3**:879f–880b
	2:999f–1000a/ **12**:972f–973b	
	2:1000a–h/ **12**:968e–970a	**11**:804a–d/**13**:761f–g/ **13**:764c–e
NERVE IMPULSE **12**:968–975		**15**:159h–160c
	12:969a–970a/ **12**:977b–978f	**12**:996c–997g *passim*
	12:970a–h	
	12:970a–e	**12**:624c–626d *passim*
	12:970e–h	
	12:970h–973b/ **11**:877g–878e	**2**:998b–1000a *passim*
	12:971b–e	
	12:971g–972e	
	12:972f–g	**11**:882f–883b
	12:972g–973b	
	12:973b–974b/ **12**:978f–979a/ **12**:1033f–1035d	
	12:974c–975a	**2**:1036b–c/ **12**:624c–625d *passim*
MUSCLE CONTRACTION **12**:620–633		
	12:620h–621g	
	12:621g–630c	
	12:621c–624c	**12**:639h–640c/**18**:449a–c

	articles	article sections	other references
b. The neuromuscular junction: nerve–muscle communication		**12**:624c–625d	
i. Nature of the communication and anatomy of the junction		**12**:624c–e	
ii. The transmission process: the transfer of information from the nerve to the muscle so that muscle contraction results		**12**:624f–625d / **2**:999f–1000a	
c. Mechanical properties: experimental study of the physical aspects of muscle contraction, and tension changes; twitch and tetanus responses; length–tension relationship; isotonic and isometric contraction		**12**:625d–627c / **11**:877g–878e	
d. Energy transformations and metabolic pathways supporting energy events: energy-yielding and energy-building reactions; the glycolytic and oxidative pathways		**12**:627c–628h / **11**:1026f–1029d / **11**:1033b–1037d	**11**:1022h–1024c *passim*
e. Molecular basis of contraction		**12**:628d–630c	
i. Molecular components: myosin, actin, actomyosin		**12**:628h–629e	**15**:91e–f
ii. Molecular mechanisms of contraction: excitation–contraction coupling; the development of muscular force and the sliding-filament theory		**12**:629e–630c	
3. Cardiac muscle		**12**:630d–631g	**3**:879b–880d *passim*
a. Structure and organization: the myocardial cell; pacemakers of the heart		**12**:630d–631a	**12**:640c–d
b. Mechanical properties: the contraction–relaxation cycle; regulation of the heartbeat		**12**:631a–e	
c. Metabolic pathways: conversion of chemical energy by the myocardium		**12**:631e–g	
4. Smooth muscle		**12**:631g–633e	
a. Vertebrate smooth muscle: visceral, or single unit, muscle; multi-unit muscle		**12**:631g–632g	**12**:640e–f
b. Invertebrate smooth muscle; *e.g.*, catch muscle, conspicuous in animals with two shells; quick action muscle that operates the wings of some insects		**12**:632g–633e / **12**:640e–641a	
E. Bioluminescence: the conversion of chemical energy to light energy	BIOLUMINESCENCE **2**:1027–1032		**11**:178g–h / **11**:179c–e / **11**:179g–h
1. The significance of bioluminescence in behaviour, metabolism, and research		**2**:1028a–f	**4**:142b–d
2. The range and variety of bioluminescent organisms		**2**:1028f–1031d	
a. Marine organisms; *e.g.*, certain crustaceans, squids, deep-sea fishes		**2**:1028g–1031a	**1**:931h–932c / **5**:316c–d / **16**:190c–e
b. Land and freshwater organisms; *e.g.*, certain fungi, fireflies		**2**:1031a–d	**4**:833e
3. The biochemical events of light emission: enzymic and nonenzymic systems		**2**:1031e–1032d	

Division III. The structures and functions of organisms

[for Part Three headnote see page 130]

Division I dealt with the nature, origin, evolution, distinctive properties, and classification of living things. Division II dealt with the molecular level of biotic organization.

The outlines, and the articles and parts of articles referred to, in the nine sections of Division III deal with life at the cellular level and at the organismic level.

Section 331, concerned with the cellular basis of biological form and function, treats cell theory and cell classification, the design of cells, the functional aspects of cells in life, the cell cycle, and fertilization.

Section 332, concerned with the relation of form and function in multicellular organisms, treats the basic structure and levels of biological organization; the classification, organization, and main function of the tissues of plants and of the tissues of animals; plant organs and organ systems; and animal organs and organ systems.

Section 333, concerned with the coordination of vital processes, treats homeostasis, the maintenance of steady states in biological systems; reception and processing of sensory information; invertebrate and vertebrate endocrine systems; invertebrate and vertebrate nervous systems; and the phenomena of biological periodicity.

Section 334 treats integumentary systems, skeletal systems, and muscular systems.

Section 335 treats the basic features of nutrition, the production of food in green plants, and digestion and digestive systems.

Section 336 treats respiration and respiratory systems, circulation and circulatory systems, and elimination and excretory systems.

Section 337 treats the several forms of reproduction and their comparative adaptive significance; the origin and adaptive significance of sex and sexuality; reproductive systems in plants; and reproductive systems in animals.

Section 338 first deals with the nature, scope, types, and general systems of biological development. It goes on to the constituent processes of development—growth, morphogenesis, and differentiation. It then treats plant development and animal development, aging and decline in animals, and, finally, specialized patterns of development.

Section 339 deals with heredity. It treats the Mendelian laws; the gene–chromosome theory of heredity; the interaction of heredity and environment; heredity in the evolutionary process; and various applications of genetics.

Section 331. The cellular basis of form and function 155
332. The relation of form and function in organisms 157
333. Coordination of vital processes: regulation and integration 161
334. Covering and support 164
335. Nutrition: the procurement and processing of nutrients 167
336. Gas exchange, internal transport, and elimination 168
337. Reproduction and sex 172
338. Development: growth, differentiation, and morphogenesis 175
339. Heredity: the transmission of traits 179

Section 331. The cellular basis of form and function

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 331 deal with five main subjects: A, cell theory and classification; B, the design of cells; C, functional aspects of cells in life; D, the cell cycle; and E, fertilization.

The outline of subject A, after dealing with the historical background of cell theory, treats challenges to and revisions of the cell theory in the light of new knowledge. Dealing with the classification of cells, the outline treats comparisons between cells and viruses, and between procaryotic and eucaryotic cells; tissues as providing a functional classification of cells; the cells and tissues of animals and of higher plants; and comparisons between animal cells and plant cells.

The outline of subject B begins with the cell as a molecular system and treats the macromolecules and the small molecules in cells. It then treats the sizes, shapes, and morphological elements of cells.

The outline of subject C begins with the cell's internal environment and the cell matrix, and with the functions of the cell's surface membrane. It goes on to the interplay of nucleus and cytoplasm and to the kinds of cell movement. Finally, it treats the evolution of multicellular life—the means by which cells can combine, communicate, and contribute to the survival of societies of cells.

Subject D is the cell cycle—the doubling of a cell in size by growth, and then the division into two cells, which double in size and again divide. The outline begins with the characteristics of the growth process. It then treats the stages and products of the two kinds of nuclear division: mitosis, which distributes replicas of the parent chromosomes to the daughter cells; and meiosis, which produces daughter cells with half the number of chromosomes of the parent cell.

Subject E is fertilization—the fusion of male and female sex cells to form the primary nucleus of an embryo. The outline treats the characteristics of the mature egg; the events of fertilization; the biochemical analysis of the events of fertilization; and the structural and behavioral accessories to fertilization.

articles	article sections	other references
A. Cell theory and classification		
CELL THEORY AND CLASSIFICATION 3:1058–1063		
1. The cell theory	3:1058e–1060f	
a. Historical background; *e.g.*, the description by Schleiden and Schwann of cells as "elementary particles of organisms"	3:1058e–1059d / 2:1023f–h	

	articles	article sections	other references
b. Challenges to and revisions of the cell theory in the light of new knowledge		3:1059d–1060f	
i. The challenge of the "protoplasm" concept: protoplasm as the basic substance of living organisms but unable to account for the origin of formed structures within the cell		3:1059d–g	3:1049a–d
ii. Evolution of the cell theory: the influence of such disciplines as microbiology, molecular biology, and biochemistry on the concept of the cell as the unit of life		3:1059g–1060b	
iii. Critique of the cell theory: problems arising from the existence of syncytial life forms (*i.e.*, many nuclei sharing the same cytoplasm), from the existence of unicellular organisms having remarkable complexity, and from the inability of the cell theory to explain the development of multicellular organisms		3:1060b–f	
2. Classification of cells		3:1060f–1063e	
a. General features: comparisons between cells and viruses and between procaryotic and eucaryotic cells; tissues as providing a functional classification of cells		3:1060f–1061d / **10**:896h–897c	
b. Cells and tissues of animals		3:1061d–1062c	
i. Absorptive cells		3:1061d–e	**18**:443h–444f *passim*
ii. Secretory cells		3:1061e	**18**:447c–h *passim*
iii. Nerve cells		3:1061e–f / **12**:969a–970a / **12**:977b–978f / **12**:996e–997b	**18**:446b–d
iv. Sensory cells		3:1061f–g	**14**:359b–362a *passim* / **18**:446h–447b
v. Muscle cells		3:1061g–h / **12**:638d–e / **18**:448h–449c	
vi. Cells in supporting tissues		3:1061h–1062a	**18**:448a–g *passim*
vii. Circulating cells		3:1062a–b	**2**:1123d–1124h *passim*
viii. Reproductive cells: gametes		3:1062b–c / 3:1055f–1056b	**6**:742a–g *passim* / **7**:254g–257b *passim* / **15**:677g–h
c. Cells and tissues of higher plants: outstanding features of the plant cell; meristematic, epidermal, and other types of plant cells		3:1062d–1063c	**18**:451b–455e *passim*
d. Comparison between animal cells and plant cells		3:1063d–e / **14**:501c–e	
B. Cell design and cell organization	CELL AND CELL DIVISION 3:1043–1048	**12**:454g–455b	
1. The cell as a molecular system		3:1044b–1045b / **2**:994g–995c / **11**:876d–878e	
a. Macromolecules in cells; *e.g.*, nucleic acids, proteins, polysaccharides		3:1044b–g / **11**:877e–g	**11**:876g–h
b. Small molecules in cells; *e.g.*, lipids, nucleotides, porphyrin derivatives, water		3:1044h–1045b / **11**:877d–e	**2**:1016f–1017a / **11**:876e–g
2. Form and structure of the cell		3:1045b–1048h	
a. Sizes and shapes of cells		3:1045c–d	
b. Morphological elements: parts of cells; *e.g.*, cell membrane, extracellular membrane system, mitochondria, ribosomes, microtubules, microfilaments, nuclear envelope, chromosomes, nucleolus		3:1045d–1048c / **11**:875g–876d / **11**:878f–879c / **14**:369b–369d / **15**:124f–125h	**6**:802c–e
c. Procaryotic and eucaryotic cells [see 311.B.4.a. and 312.A.3.]			
C. Functional aspects of cells	CELL AND CELL DIVISION 3:1048–1051	**13**:725b–c	**10**:894g–h
1. The internal environment and the cell matrix: the concept of the cell as a "protoplasm"; the concept of the cell as a "bag" containing a water solution of molecules		3:1049a–d	

2. Living membranes; *e.g.*, as barriers, in transport, in the generation of electricity
3. Interplay of nucleus and cytoplasm: overall function of the nucleus in the production of messenger RNA; exchange between nucleus and cytoplasm
4. Cell movement: ciliary, flagellar, and amoeboid
5. Cells in societies: extension of the cell concept for multicellular life

D. The cell cycle: growth and division

1. Cell growth: doubling of size, genetic replication, preparation for mitosis
2. Mitosis: the separation of sister chromosomes to opposite poles of the mitotic apparatus, a spindle-shaped structure in the cytoplasm
   a. Special structures in mitosis: the centrioles that define the poles and the kinetochores (centromeres), the points at which chromosomes attach to the poles
   b. The chromosome cycle: early stages in the formation of the mitotic apparatus; engagement of the chromosomes to the mitotic apparatus and metakinesis (movement of the chromosomes); separation of chromosomes to the poles (anaphase movement); and mechanisms of chromosome movement
   c. Telophase: restoration of the daughter nuclei
   d. Cytokinesis: division of the cell body
3. Meiosis: reduction division that produces daughter cells with half the number of chromosomes of the parent cells
   a. The events and significance of meiosis
   b. Differences between meiosis and mitosis

E. Fertilization: the fusion of two different sex cells (gametes) to form the primary nucleus of an embryo (zygote nucleus)

1. Characteristics of the mature egg: the egg surface and the egg coats
2. Events of fertilization: sperm–egg association, egg activation, and formation of the zygote nucleus
3. Biochemical analysis of the events of fertilization
4. Accessories to fertilization: mechanisms that aid in the union of gametes

articles	article sections	other references
	3:1049e–1050c / **11**:879c–884g	**1**:304f–g / **11**:877g–879c *passim*
	3:1050c–f	
	11:15h–16f / **12**:621a–e / **15**:125e–126b	**12**:976d–e
	3:1050f–1051d	
CELL AND CELL DIVISION **3**:1051–1056	**15**:676f–677d	**2**:569f–570c
	3:1051e–1052d	**7**:986b–f / **8**:440g–444c *passim* / **18**:440g–441g *passim* / **19**:165f–166h *passim*
	3:1052d–1055f	**5**:626e–627c
	3:1052g–1053b	
	3:1053b–1055a	
	3:1055a–b	
	3:1055b–f	
	3:1055f–1056f	**7**:997e–998a
	3:1055f–1056b	
	3:1056b–f	
FERTILIZATION **7**:254–257	**5**:625h–626d	
	7:255d–f	**5**:625h–626c / **15**:711b–d
	7:255g–257b / **6**:743a–c	**5**:660f–661a
	7:257c–f	
	15:705f–706e / **15**:713c–714b	

Section 332. The relation of form and function in organisms

[for Part Three headnote see page 130
for Division III headnote see page 154]

Section 331 dealt with the individual cell and with the cellular basis of biological form and function. Section 332 initiates the presentation of knowledge about multicellular organisms, which is continued in the remaining sections of Division III.

The articles and parts of articles referred to in Section 332 deal with five main subjects: A, basic structure and levels of organization; B, the tissues of plants; C, the organs and organ systems of plants; D, the tissues of animals; and E, animal organs and organ systems.

The outline of subject A first treats such general features of biological form and function as the differences of energy flow in living and nonliving structures; the nonrandom character of living structure; and the significance of Newton's laws of motion, of static forces, and of simple machines to biological systems. It then deals with the biomechanical limitation of body sizes and the determination of basic body patterns. It next treats the incorporation of simple mechanisms into complex systems for the transformation of certain types of energy. Finally, it treats evolutionary changes in form and function, dealing especially with the emergence of increasingly more orderly and complex levels of biotic organization.

The outline of subject B first deals with the relatively undifferentiated tissues of nonvascular plants, such as fungi and lichens, which lack true roots, stems, leaves, and organized conducting systems. It goes on to treat well-differentiated tissues in vascular plants: first, the formative, cell-producing tissues called meristems; and then the mature tissues—dermal (protective) tissues, vascular (water- and food-conducting) tissues, and the fundamental or ground tissues composing the axis of most plants.

Subject C is the organs and organ systems of plants, such as the

shoot system and the root system. The outline first treats the development of organs in vascular plants, covering the growth and tissue organization of the stem, the leaf, and the root. It then deals with the physiology of the organs in vascular plants, and the structural adaptations of organs and organ systems to meet the needs of the whole autotrophic (self-nourishing) organism. It goes on to the varieties of shoot, root, and reproductive systems. After dealing with the analogues of stem, leaf, and root in nonvascular plants, the outline concludes with the evolution of plant organs and organ systems as disclosed in the fossil record.

The outline of subject D, after referring to anatomical and embryological classifications of animal tissues, proceeds to a functional classification. It treats tissues used for assimilation, storage, transport, and excretion; coordinating tissues, nervous and sensory tissues, and endocrine tissues; tissues for support and movement, such as those of bone and muscle; reproductive tissues; hemopoietic tissues, which produce the cellular components of blood; and the various kinds of tissue fluids, such as lymph and cerebrospinal fluid.

The outline of subject E begins with the characteristics of the several specialized organ systems relating the organism to the environment primarily; those serving cell metabolism primarily; and those serving genetic continuity primarily. It goes on to the functional interdependence, coordination, and control of the organ systems. It next deals with the embryonic origins of individual systems and their appearance during development. Finally, it treats the evolution of organ systems as disclosed in the fossil record.

articles	article sections	other references
A. Basic structure and levels of organization		
FORM AND FUNCTION, BIOLOGICAL **7**:542–547		
1. General features; *e.g.*, comparison of energy flow in living and nonliving structure, living structure as distinctly nonrandom	**7**:542d–h	
2. The significance of Newton's laws of motion, static forces, and simple machines for biological systems	**7**:542h–544c	
3. Limits on body size; *e.g.*, the problem of the surface-to-volume ratios	**7**:544d–546a / **2**:65e–g	**2**:1055c–d / **8**:443d–e / **10**:898h–899a
4. Basic body patterns and their evolution; *e.g.*, symmetry, segmentation	**5**:635b–h / **14**:381c–383d	**2**:68a–b / **4**:450b–c / **6**:181g–182d / **12**:452h–453a / **13**:725d–726a
5. The incorporation of simple mechanisms into complex systems for the transformation of certain types of energy: the need for one system to undertake the processing of the energy and another to control this processing in order to yield a suitable output	**7**:546b–e	
6. Evolutionary change in form and function	**7**:546f–547c	
a. Preadaptation: the potential for the evolution of a structure from one function to another	**7**:546f–547b / **4**:613d–f / **10**:590b–d / **11**:404g–405e / **15**:975g–976e / **16**:190a–f	**2**:68b–c / **4**:433d–g / **7**:14b–e / **7**:331h–332b / **13**:1055h–1056d / **14**:50e–g / **14**:383c–d / **14**:450c–h / **14**:1022g–1024b *passim* / **17**:499g–500a
b. Levels of orderliness and complexity: the simple viruses and the more complex single-celled organisms; the increase in cellular specialization and interdependence in multicellular organisms	**7**:547b–c / **5**:659d–660c / **13**:725b–d / **18**:442g–443b	**2**:140d–141c *passim* / **3**:1060f–1061c / **4**:770b–d
B. Tissues of plants: classification, organization, and main functions		
1. Relatively undifferentiated tissues of nonvascular plants; *e.g.*, fungi, lichens, bryophytes	**9**:665a–b / **10**:884g–886f / **12**:761c–762c	**13**:733f–g
2. Well-differentiated tissues in vascular plants		**12**:454f–g / **18**:690h–691e
TISSUES AND FLUIDS, PLANT **18**:451–455		
a. Meristematic (cell-producing) tissues: apical, lateral, and intercalary	**18**:451b–452e / **5**:664d–f	**13**:726h–727d
b. Mature tissues	**18**:452e–455e / **5**:664f–665h	**13**:727d–730g *passim*
i. Dermal (protective) tissues: the epidermis of the primary plant body; the periderm of the secondary plant body	**18**:452e–453b / **9**:665b–666b	**13**:728b–c / **13**:729d–e
ii. Vascular (conducting) tissues: the xylem, a mineral and water route; the phloem, a food route	**18**:453c–454d / **14**:501e–502e	**5**:664h–665a / **13**:727e–g
iii. Fundamental (ground) tissues: the parenchyma, a tissue of general importance in plant structure and function; the supportive collenchyma and sclerenchyma; the endodermis	**18**:454d–455e	**13**:727g–h / **13**:729e–g / **13**:730e–f
3. Cells of plant tissues [see 331.A.2.c.]		

	articles	article sections	other references
C. Organs of plants: tissue organization, functions, and types	ORGANS AND ORGAN SYSTEMS, PLANT **13**:726–734		**14**:589h–592c *passim*
1. Importance of plant organs to man; *e.g.*, for food, clothing, shelter, industrial products, drugs, decoration [see also 355.C.3.]		**13**:726c–g	
2. Development of organs in vascular plants: internal and external morphology, tissue organization, functions, types, and modifications		**13**:726g–730h / **3**:325g–326a / **10**:973b–e / **12**:774h–775d / **18**:690g–691f	
a. The stem		**13**:726h–728h / **1**:1132f–h / **5**:5a–c / **7**:240g–242a / **19**:917d–h	**1**:879b–d / **14**:500h–502e *passim*
b. The leaf		**13**:728h–730c / **1**:1133a–b / **5**:5d–g / **7**:242c–243f / **12**:960a–g / **14**:502f–503a / **14**:591d–h / **16**:254a–d	**1**:879d–e / **3**:574c–g / **8**:521h–522b / **14**:585c–d / **16**:253e–f / **16**:295a–296b *passim*
c. The root		**13**:730c–h / **5**:4f–5a / **7**:242a–b / **14**:503a–c	**16**:228b
3. Physiology of organs in vascular plants: structural adaptations of organs and organ systems as ways by which the needs of the whole organism are met		**13**:731a–h / **15**:724f–725e	**5**:617b–g / **14**:500e–504h *passim*
4. Diverse sizes and forms of organ systems in vascular plants: potential for unlimited growth		**13**:731h–733f / **13**:650h–651f / **14**:589h–590c	**18**:689b–h
a. Varieties of shoot systems: the tree, shrub, and vine		**13**:732b–733a / **5**:665b–667d / **18**:690b–f	**1**:879b–d
b. Varieties of root systems; the transition between root and shoot systems		**13**:733a–d / **5**:667d–668e	
c. Varieties of reproductive organs and organ systems	REPRODUCTIVE SYSTEMS, PLANT **15**:719–724	**13**:733d–f	**16**:480d–481d *passim*
i. Reproductive structures in nonflowering plants; *e.g.*, oogonia, archegonia, antheridia		**15**:719a–720e / **7**:243g–244h	
ii. Cones		**15**:721b–722a	**8**:522b–f
iii. Flowers		**15**:722b–724c / **1**:879e–880h / **15**:509b–e / **15**:1152d–f	**10**:973g–h / **14**:380f–381a / **14**:743g–747f *passim*
5. Organs of nonvascular plants: analogues of stem, leaf, and root		**13**:733f–h	**3**:353d–e / **8**:780d–e
6. Evolution of plant organs and organ systems into the complex, multicellular state: estimates of time of origin of the multicellular plant body; adaptive radiation of plants into suitable habitats		**13**:734a–d	**18**:691h–692a
D. Tissues of animals: classification, organization, and main functions	TISSUES AND FLUIDS, ANIMAL **18**:442–450		
1. Classification of tissues: anatomical, embryological, and functional		**18**:443b–h	**12**:454c–f
2. Tissues for assimilation, storage, transport, and excretion		**18**:443h–446b	
a. Alimentary tissues		**18**:443h–444g	**5**:782e–787h *passim* / **5**:789d–795e *passim*
b. Liver tissues		**18**:444g–445a / **5**:786f–g / **10**:1269b–1270g	**5**:795h–796b / **15**:782a–b

	articles	article sections	other references
c. Blood and lymph		**18**:445a–c	**2**:1111f–1120d *passim* / **2**:1121d–1125a *passim*
d. Kidney tissues		**18**:445c–g	**7**:46e–50d *passim* / **7**:51a–52c *passim*
e. Lung tissues		**18**:445h–446b	**15**:752f–755f *passim*
3. Tissues for coordination		**18**:446b–447h	
a. Physical coordinators: nervous and sensory tissues		**18**:446b–447b / **12**:969a–970a / **12**:996c–997e / **16**:545g–547a	**4**:176a–187b *passim* / **11**:801h–809b *passim* / **12**:977b–985d *passim* / **14**:353h–362a *passim* / **17**:40d–49d *passim*
b. Chemical coordinators: endocrine tissues		**18**:447c–h	**6**:841a–849a *passim*
4. Tissues for support and movement		**18**:448a–449c	
a. Connective tissues		**18**:448a–b / **5**:13a–16d	**1**:301h–302a
b. Cartilage		**18**:448b–c	**5**:16c–d
c. Bone		**18**:448d–g / **3**:18a–19e / **16**:827f–830a	**5**:16d–17b
d. Muscle		**18**:448h–449c / **12**:621h–624c / **12**:637g–641a	
5. Other tissues		**18**:449c–450g	
a. Reproductive tissues		**18**:449c–450c	**15**:690h–696e *passim* / **15**:702g–705f *passim* / **15**:707e–713b *passim*
b. Hemopoietic tissues		**18**:450c–e	**15**:780b–782e *passim*
c. Tissue fluids		**18**:450e–g / **2**:1114d–1115f / **3**:1172f–1174a / **10**:584b–e / **11**:212a–213c	**12**:986h–987a
6. Cells of animal tissues [see 331.A.2.b.]			
E. Comparative structure and function of the organ systems and constituent organs of animals	ORGANS AND ORGAN SYSTEMS, ANIMAL **13**:722–726		
1. Specialized organ systems		**13**:722b–723e	
a. Relating to the environment primarily		**13**:722b–h	
i. Integumentary system [see 334.A.]			
ii. Skeletal system [see 334.B.]			
iii. Muscular system [see 334.C.]			
iv. Nervous system [see 333.D.]			
v. Endocrine system [see 333.C.]			
b. Serving cell metabolism primarily		**13**:722h–723d	
i. Digestive system [see 335.C.3.]			
ii. Respiratory system [see 336.A.]			
iii. Circulatory system [see 336.C.]			
iv. Excretory system [see 336.F.]			
c. Serving genetic continuity primarily: the reproductive system		**13**:723d–e	
2. Interrelationships between organ systems		**13**:723f–724c / **6**:839d–840d	**12**:1035f–1039g *passim*
a. Functional interdependence		**13**:723f–724a	**6**:800c–g
b. Feedback mechanisms		**13**:724b–c	**6**:800h–801f

articles	article sections	other references
3. Development of organ systems: embryonic origins of individual systems from the various germ layers; the stages at which organ systems make their appearance [see also 338.E.]	**13**:724d–725b	
4. Evolution of organ systems	**13**:725b–726a	**14**:381g–h

Section 333. Coordination of vital processes: regulation and integration

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 333 deal with five main subjects: A, the maintenance of steady states in biological systems; B, information reception and processing; C, endocrine systems in animals; D, nervous systems in animals; and E, biological periodicity.

The outline of subject A begins with the nature of homeostatic systems, treating the comparison of self-regulatory devices in mechanical and biological systems, the pattern that identifies a homeostatic system, and the limits of homeostatic regulation. It goes on to treat the different homeostatic processes; their coordinated control for homeostasis in the organism as a whole and in natural biological communities; and the origin and evolution of homeostasis. The outline next deals with the individual adjustments to gradual changes in the environment—adaptive responses, collectively called responses of acclimatization, to environmental changes in temperature, illumination, humidity, salinity, and pressure. Finally, it deals with dormancy, an inactive state accompanied by a lower than normal rate of metabolism and a mechanism used by some organisms to avoid stressful environmental conditions. It treats the general adaptive value of dormancy, the environmental variables that can cause it, and the types of dormancy states and associated mechanisms in different kinds of organisms.

The outline of subject B begins with two classifications of sensory systems—one, according to the surface or internal location of the receptors; the other, according to the various types of stimuli, into photoreception, thermoreception, chemoreception, mechanoreception, and sound reception. It then treats the evolution of sensory systems, and sensory information as involving interactions between adjacent sense cells and sensory neurons.

The outline of subject C begins with the general characteristics and functions of hormonal coordination. It goes on to the structure and function of vertebrate endocrine systems and of invertebrate endocrine systems. Finally, it treats the comparative, adaptive, and evolutionary aspects of endocrine systems.

The outline of subject D begins with the comparison of chemical and nervous regulation. It then treats the cytoplasmic responsiveness to a stimulus, or irritability, common to every living cell; organelle systems, which channel responsiveness at the subcellular level within more complex protozoans; and nervous systems, which channel responsiveness at the cellular level within multicellular organisms. The treatment of invertebrate nervous systems covers theories of the evolutionary origin of the nervous system; the diffuse nervous systems found in coelenterates; and the trend, in the evolution of nervous systems, toward concentration, centralization, and cephalization of the nervous functions. The treatment of vertebrate nervous systems begins with the central nervous system, including the brain and its components, the spinal cord, the brain coverings, cavities, cerebrospinal fluid, and the neuroglia, or non-nervous tissue. It goes on to the peripheral nervous system, in which smooth muscles, heart muscle, and glandular tissues are innervated. The outline of subject D further treats the embryonic development, the evolution, and the biodynamics of the vertebrate nervous system.

Subject E is the biological clock: rhythmicity of organismic activity. The outline begins with rhythms, such as those of breathing or of heartbeat, that are without apparent external correlates. It goes on to rhythms definitely correlated with natural geophysical cycles—solar-day, lunar-tidal, monthly, annual or seasonal, and epochal rhythms. Finally, it attempts to analyze the nature and mechanisms of biological rhythms, and the factors that affect biological periodicities.

articles	article sections	other references
A. Maintenance of steady states in biological systems		
1. The nature of homeostatic systems		
a. The concept of homeostasis	**8**:1014d–1015d	
b. The comparison and regulation of self-regulatory devices in mechanical and biological systems	**8**:1014d–g	
c. The pattern that identifies a homeostatic system and the limits of homeostatic regulation	**8**:1014g–1015b	**18**:328a–d
2. Survey of homeostatic processes	**8**:1015b–d / **2**:1039d–e	**2**:570d–f / **14**:996h–998b *passim*
a. Physiological homeostasis; *e.g.*, the balance of hormones, the composition of the blood	**8**:1015e–1017a	
b. Genetical homeostasis: gene regulation and expression	**8**:1015e–g / **7**:45g–46b / **7**:429c–430b / **13**:724b–c	**1**:704f–g / **6**:800h–801f / **9**:664e–f
c. Developmental homeostasis; *e.g.*, maturation, tissue growth, regeneration	**8**:1015h–1016b / **7**:990d–991c / **11**:429d–e / **11**:1046f–1048g	
d. Ecological homeostasis; *e.g.*, predator–prey relationships	**8**:1016b–d / **5**:647h–648e / **8**:443b–e	
e. Medical homeostasis: mental health and the response to disease	**8**:1016d–f	**14**:831b–836a *passim*
	8:1016g–1017a / **5**:843d–844d	**11**:212c–f

HOMEOSTASIS
8:1014–1017

	articles	article sections	other references
3. Homeostatic control hierarchies: homeostatic subsystems that serve the whole		**8**:1017a–d	
a. In organisms; *e.g.*, circulatory, nervous, and hormonal systems		**8**:1017a–b / **6**:839d–840d / **12**:637g–638c / **12**:992e–h / **13**:723f–724a	**4**:618e–g / **12**:1005f–1006f / **12**:1026b–d / **14**:439b–e
b. In natural communities; *e.g.*, among social insects		**8**:1017b–d / **4**:1031f–1032c	
4. Origin and evolution of homeostasis		**8**:1017d–f	**7**:49c–50d *passim*
5. Individual adjustments to gradual changes in the physical environment	ACCLIMATIZATION **1**:32–35		
a. General features: acclimatization as an adaptive change that is reversible when conditions return to their former state but that is distinct from both the process of adaptation effecting evolution and homeostatic regulation		**1**:32c–e	
b. Influences of environmental conditions upon life		**1**:32e–35e	
i. Temperature		**1**:32f–33h / **15**:735f–h	**2**:1058d–g / **14**:995h–998b *passim* / **17**:500a–b
ii. Illumination		**1**:33h–34c	
iii. Other factors; *e.g.*, humidity, chemicals, changes in pressure		**1**:34c–35e / **15**:762c–763f	**14**:994b–995h *passim*
c. The biological significance of acclimatization: the exploitation of regions of great seasonal variation or of wholly new environments		**1**:35e–g	
6. Inactive states accompanied by a lower than normal rate of metabolism: dormancy	DORMANCY **5**:958–966		
a. General features: adaptive value of dormancy; environmental variables which can cause dormancy		**5**:959b–e	
b. Types of dormancy states and associated mechanisms in different organisms; *e.g.*, production of resistant structures; hibernation and aestivation; sleep, torpor, and hypnotic states		**5**:959e–966a / **16**:876g–877e / **16**:882h–883h	**6**:762f–g / **9**:137c–e
i. In bacteria and fungi		**5**:959e–g	
ii. In vascular plants		**5**:959h–960e / **16**:486c–487h	**5**:617c–d / **5**:670a–c
iii. In protozoans and invertebrates		**5**:960f–961d	**2**:139a–b / **14**:550a–b / **15**:122d–h
iv. In cold-blooded vertebrates		**5**:961e–962c	**5**:814f–g / **16**:560f–561a
v. In warm-blooded vertebrates		**5**:962d–966a / **3**:809d–e / **4**:434c–d / **12**:387b–c	**9**:623d–e / **11**:404c–d / **15**:974d–e
B. Information reception and processing: sensory reception	SENSORY RECEPTION **16**:545–547	**11**:23f–24c	
1. Classification of sensory systems		**16**:545h–546g	
a. According to location of receptors: exteroceptors, surface receptors responding to the external environment, and enteroreceptors, internal receptors responding to changes inside the body		**16**:545h–546a / **11**:802e–806c	
b. According to type of stimulus		**16**:546b–g / **4**:1012a–1013e / **9**:131b–e / **15**:734f–735e / **19**:808g–809a	**4**:434e–f / **5**:315h–316b / **7**:336a–g / **10**:899e–h / **16**:496c–e / **18**:446h–447b
i. Photoreceptors: light receptors	PHOTORECEPTION **14**:353–365	**4**:1012e–h	**7**:118a–b / **7**:336b–c / **14**:45b–c / **15**:734f–g / **16**:546b–e
ii. Thermoreceptors: temperature (level of heat energy) receptors	THERMORECEPTION **18**:328–332		
iii. Chemoreceptors: receptors of chemical stimuli	CHEMORECEPTION **4**:176–188	**4**:1012h–1013c / **15**:761h–762c	**9**:131c–e / **13**:761g–762a / **15**:735c–d

iv. Mechanoreceptors and electroreceptors: pain receptors, position and interior stretch receptors, balance and motion receptors, and touch and pressure receptors

v. Sound receptors

2. Evolution of sensory systems; *e.g.*, specialized organs, information-processing structures

3. Sensory information: interactions between adjacent sense cells and sensory neurons

C. Endocrine systems in animals

1. General features of hormonal coordination; *e.g.*, relationships between endocrine and neural regulation

2. Vertebrate endocrine systems

a. Relationships of endocrine glands to each other and to the blood; the role of endocrine glands in the manufacture and release of hormones; the chemical nature and action of hormones

b. Structure and function; *e.g.*, neurosecretory systems, thyroid gland, ultimobranchial gland, gastrointestinal endocrine system

3. Invertebrate endocrine systems; *e.g.*, insects, crustaceans, and annelid worms

4. Comparative, adaptive, and evolutionary aspects of endocrine systems; *e.g.*, the neurosecretory cell, hypothalamus-pituitary control systems

5. The human endocrine system
[see 422.F.]

D. Nervous systems in animals

1. Comparison of chemical and nervous regulation: control mechanisms located between the stimulus and the response

2. Nervous coordination

a. Intracellular coordination: general cytoplasmic responsiveness, or irritability, to a stimulus

b. Organelle systems: the channelling of responsiveness at the subcellular level within more complex protozoans

c. Nervous systems: the channelling of responsiveness at the cellular level within multicellular organisms

i. The neuron, or nerve cell

ii. The transmission of the nerve impulse and the synapse
[see 323.C.4.]

3. Invertebrate nervous systems: structure and function

a. Theories of the evolutionary origin of the nervous system

b. Diffuse nervous systems: the nerve net of hydra and simple radial systems of other cnidarians (coelenterates)

c. Centralized nervous systems

i. Complex radial systems in echinoderms

ii. Simple bilateral systems as in flatworms

iii. Moderately cephalized systems as in annelid worms and simple mollusks

iv. Complexly compartmentalized systems as in insects, spiders, and cephalopods such as squids

4. Vertebrate nervous systems: structure and function

a. The central nervous system

articles	article sections	other references
MECHANO-RECEPTION **11**:801–809	**4**:1013c–e / **13**:866c–h	**5**:1130b–1131a / **12**:1015e–g / **13**:764c–e / **15**:761b–g / **16**:189g–190a
SOUND RECEPTION **17**:39–51	**4**:1012b–e / **17**:30g–31e	**10**:899f / **13**:761d–f / **15**:734g–735c
	16:546g–547a	**18**:328a–c
	16:547a–c	
ENDOCRINE SYSTEMS **6**:839–849		
	6:839d–h / **8**:1074c–g	**6**:800c–801f / **13**:723g–h / **14**:439b–e
	6:839h–845f / **8**:1074h–1085f	
	6:839h–841a / **8**:1074a–f	**4**:912c–g
	6:841a–845f / **7**:335g	**11**:409d–e / **18**:447c–h
	6:845f–846g / **8**:1085f–1086f	**5**:316d–e / **5**:961d / **12**:981h–982a
	6:846h–849a / **8**:1074f–g / **8**:1077b–1078e / **12**:992e–h	
NERVES AND NERVOUS SYSTEMS **12**:975–992	**13**:722f–g	
	12:975f–976b	**13**:723g–724a
	12:976b–979a	
	12:976b–c	
	12:976d–e	
	12:976f–979a	**17**:692f–693a / **14**:439a–b
	12:977b–978f / **12**:969a–970a / **12**:996c–997g	**3**:1061e–f / **18**:446b–h
	12:979a–982a	
	12:979a–c	
	12:979d–g	**4**:770g–h
	12:979g–982a	**5**:315g–316a / **10**:739e–740a
	12:979h	
	12:980a–b	
	12:980b–g	**1**:934e–935a / **2**:1090g–1091a
	12:980g–982a / **9**:617d–618c	
	12:982a–992h	
	12:982d–987c	**7**:335h–336a

	articles	article sections	other references
i. The brain and its components		**12**:982d–984h / **15**:760f–761a	**11**:409d–f / **14**:1024f–h
ii. The spinal cord		**12**:984h–986f	
iii. The brain coverings (meninges), cavities, cerebrospinal fluid, and neuroglia (nonnervous tissue)		**12**:986f–987c	**18**:446d–e
b. The peripheral nervous system; *e.g.*, sensory and motor fibres, the autonomic nervous system		**12**:987c–988h / **12**:1033c–f	**14**:1024b–f
c. Embryonic development of the vertebrate nervous system from the outer cell layer (ectoderm)		**12**:988h–990a / **5**:633e–634f	
d. Evolution of the vertebrate nervous system: the primitive condition in chordates; sensory centralization; dominance of the cerebrum		**12**:990a–991f	**12**:994h–995b
e. Biodynamics of the vertebrate nervous system: intrinsic and extrinsic controls exerted on the nervous system; interaction between nervous and endocrine systems		**12**:991f–992h	
5. The human nervous system [see 422.K.]			
E. The biological clock: rhythmicity of organismic activity	PERIODICITY, BIOLOGICAL **14**:69–75	**18**:422a–c	
1. Rhythms without apparent external correlates; *e.g.*, brain waves, breathing, heartbeat		**2**:1125h–1127d	**2**:356d–f / **15**:750f–h
2. Rhythms definitely correlated with natural geophysical cycles		**14**:69e–71e / **4**:1028d–e / **12**:121d–f	
a. Solar-day rhythms; *e.g.*, wakefulness and sleep in animals, sleep movements in plants		**14**:69f–h / **16**:877f–878b	**4**:431b / **5**:961g–963e *passim* / **17**:673g–h
b. Lunar-tidal rhythms that are characteristic of most activities of tidal zone organisms		**14**:69h–70e	**4**:806d–e
c. Monthly rhythms; *e.g.*, reproductive cycles of many marine organisms, menstrual period in females of certain primates		**14**:70f–71a	**11**:908a–b
d. Annual or seasonal rhythms; *e.g.*, breeding in many animals, growth and fruiting in many plants, hibernation and aestivation in some animals		**14**:71b–c / **5**:670a–d / **7**:538c–539c	**5**:958h–966a *passim* / **11**:907h–908a / **12**:177c–184h *passim* / **14**:352b–353e *passim* / **14**:496b–d / **16**:590f–591a
e. Epochal rhythms; *e.g.*, lemming migrations, population cycles in some animals		**14**:71c–e / **15**:974e–975a	
3. The mechanism of the biological clock: attempts to analyze the nature of biological rhythms		**14**:71e–74d	
a. The notion of natural time as an inherent basis of biological rhythms		**14**:71e–72a	**18**:420a–c
b. The relation of the biological clock to external events		**14**:72a–73g / **12**:183g–184c	
i. Modifiable and persistent clock-timed rhythms		**14**:72a–73e	
ii. Fluctuating activity		**14**:73f–g	
c. The biological clock as an internal timer based on external clues		**14**:73g–74d	
4. Factors affecting biological periodicities; *e.g.*, environmental factors, hormonal and neural factors		**14**:74d–75a / **4**:722c–h / **12**:184c–h / **15**:714c–g	**1**:32e–39g *passim* / **7**:538c–539c *passim* / **16**:591a–c
5. The amplification and superimposition of individual rhythms in communities [see 352.C.2.b.]			

Section 334. Covering and support

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 334 deal with three main subjects: A, the body covering; B, the body skeleton; and C, the body musculature.

The outline of subject A begins with the major common functions and adaptive character of the coverings, or integuments, of organisms. It goes on to treat the poorly defined integuments of

lower, nonvascular plants; the structure and organization of the integuments of higher, vascular plants; and the cellular components and noncellular coatings of the invertebrate integuments. It next deals generally with the vertebrate integumentary system, the only boundary covering to attain the complexity of an organ system, providing not only protection from the environment for the tissues beneath it, but also a sensory grid for communication with it. It treats not only the character and relations of the two skin layers, the epidermis and the dermis, but the wide array of derivatives and appendages that have appeared among the various classes of vertebrates. It then covers, comparatively and descriptively, the integuments of various classes of vertebrates in the order of their position on the evolutionary scale. Finally, it treats the embryology, evolution, and biodynamics of vertebrate skin.

The outline of subject B first deals with the major functions of the body skeleton: the primary supportive function and, in some animals, its role in providing protection, facilitating movement, and aiding certain sensory functions. It goes on to the principal types of skeletal elements: so-called hard, cuticular structures, semirigid structures, connective tissue, hydrostatic structures, elastic structures, and buoyancy devices. The treatment of the invertebrate skeleton covers the skeletomusculature of a mobile coelenterate, such as a sea anemone or a jellyfish; of earthworms; of arthropods, such as insects and spiders, and of echinoderms, such as the starfish. The treatment of the vertebrate skeleton covers the variations associated with each vertebrate class and with particular problems of adaptation; the embryology of vertebrate skeletons; the vertebral column and thoracic skeleton; and the appendicular (limb) skeleton. Finally, the outline deals with joints in vertebrates and invertebrates and with the properties and development of bone.

The outline of subject C begins with the several roles played by muscle systems in animal life and with the arrangement and gross function of muscle tissues. It goes on to the characteristics of simple contractile systems and to the kinds of complex contractile tissues, varying in the rates of contraction they undergo. Finally, it treats the comparative structure and function and the evolution of invertebrate and vertebrate muscle systems and muscle system variations among classes of vertebrates.

articles	article sections	other references
A. The body covering		
INTEGUMENTARY SYSTEMS **9**:664–672	**13**:722b	**4**:914c–923g *passim*
1. General features of the body covering, of integument: comparisons among unicellular organisms, plants, and animals	**9**:664d–665a	
2. Plant integuments: organization and function	**9**:665a–666b / **18**:452e–453b	
3. Invertebrate integuments: organization and function	**9**:666b–667e	
a. Cellular components and their derivatives	**9**:666b–e / **15**:125d–e	**14**:548g–549a
b. Noncellular coatings of the integument; *e.g.*, the secretion of various types of cuticles, replacement of the body covering through molting	**9**:666e–667e / **7**:953c–f / **9**:614c–d	**5**:316e–g / **2**:68e–h / **2**:1089f–1090a
4. Vertebrate integuments: cellular components and their derivatives	**9**:667e–668g	
a. Skin layers: the relatively thin outer layer, the epidermis, and the thicker and tougher inner portion, the dermis	**9**:667e–h	
b. Skin derivatives and appendages; *e.g.*, skin glands and pigment; epidermal scales; claws, nails, and hoofs; horns and antlers; feathers and hair; dermal derivatives	**9**:667h–668g / **16**:842b–844c	**2**:76f–77g *passim* / **4**:74e–f / **7**:285a–d / **11**:406a–d
5. Skin variations among vertebrates	**9**:668h–672b	
a. In cyclostomes and fishes	**9**:668h–669f / **7**:333d–334a	
b. In amphibians and reptiles	**9**:669g–670d / **16**:286h–287a / **16**:562b–c	**4**:74e–f / **5**:288e–f / **18**:1087a–b
c. In birds	**9**:670d–671c / **2**:1055f–1056d	
d. In mammals	**9**:671c–672b / **2**:77e–g / **11**:405h–406d / **14**:85d–e	**2**:76f–g
6. Embryology and evolution of the vertebrate skin: ectodermal origin; adaptive changes during evolution	**9**:672b–e / **5**:634f–635a	
7. The biodynamics of vertebrate skin: protection from and communication with the environment	**9**:672e–g	
8. Human integument and derivatives; *e.g.*, skin, hair, nails, teeth, gums [see 422.I.9.]		
B. The body skeleton		
SKELETAL SYSTEMS **16**:818–830	**13**:722c	
1. The roles of the body skeleton: the major supportive function in all animals; in some animals, a protective function, facilitation of movement, and aid in certain sensory functions	**16**:818e–g	**12**:645h–648a *passim* / **13**:499h–500b / **14**:500f–502e *passim*

	articles	article sections	other references
2. Description and composition of the skeletal elements		**16**:818g–820e	**6**:713h–715d *passim*
a. Cuticular structures; *e.g.*, bone, crystals, cuticle, ossicles, spicules		**16**:818h–819f / **3**:18d–19e / **7**:953c–f / **18**:448d–g	**2**:1089h–1090a
b. Semirigid structures; *e.g.*, flexible cuticular structures, calcareous spicules that are not tightly packed, keratin, notochord, cartilage		**16**:819g–h / **18**:448b–c	
c. Other elements: connective tissue, the hydrostatic skeleton, elastic structures, and buoyancy devices		**16**:819h–820e	**4**:627a
3. The invertebrate skeleton: organization and function		**16**:820e–822c	
a. Skeleto-musculature of coelenterates		**16**:820e–821a	**4**:770h–771c
b. Skeleto-musculature of earthworms		**16**:821a–b	
c. Skeleto-musculature of arthropods		**16**:821c–822b	**2**:68e–h / **5**:314h–315b
d. Skeleton of echinoderms		**16**:822b–c	**6**:182d–f
4. The vertebrate skeleton: structure and function		**16**:822d–826h	
a. General features: variations associated with each vertebrate class and with adaptations for particular habits or environments		**16**:822d–823b / **2**:1056d–1057g / **11**:406f–407f / **14**:85e–86c / **14**:1022g–h	**2**:75h–76d / **15**:732c–f / **16**:564a–f
b. Embryology of vertebrate skeletons: development of the skeleton from the embryonic mesoderm		**16**:823b–g	
c. Vertebral column and thoracic skeleton		**16**:823g–824e	
d. Appendicular skeleton: pectoral girdle, pelvic girdle, and limbs		**16**:824e–826h / **2**:77a–d	
5. Joints in vertebrates and invertebrates permitting various types of movement		**16**:827a–f	**15**:732h–733b
6. Properties of bone and its development [see 422.I.2.]			
7. The human skeletal system [see 422.I.1.]			
C. The body musculature	MUSCLE SYSTEMS **12**:637–648	**13**:722d–e	
1. General features of muscle tissue: its role in movement, support, colour changes, temperature regulation, and discharge of certain glands; arrangement and gross function		**12**:637e–639e / **12**:621e–f	**3**:1061g–h / **12**:625d–e
2. Muscle contractile systems		**12**:639e–641a	
a. Simple contractile systems: simple contractile fibrils and epithelio-muscular cells		**12**:639e–f	
b. Complex contractile tissues: their occurrence in jellyfish, and in all groups of animals above coelenterates in the evolutionary scale		**12**:639f–641a / **18**:448h–449c	
i. Striated muscle: skeletal and cardiac		**12**:639h–640d / **12**:621g–624c / **12**:630d–631a	**2**:1057h–1058a
ii. Smooth muscle: as found in the viscera of vertebrates (classic smooth muscle), in certain invertebrate tissues such as the body wall of annelid worms (helical smooth muscle), and in the adductor muscle of clams (paramyosin)		**12**:640e–641a	
3. Muscle contraction: the main work of muscle tissue [see 323.D.]			
4. Invertebrate muscle systems: comparative structure and function		**12**:641e–644f	
a. Main trends in the evolution of invertebrate muscular systems		**12**:641e–643a	
b. Function and regulation of muscle action in certain invertebrate groups; *e.g.*, cnidarians (coelenterates), arthropods, mollusks		**12**:643a–644f / **12**:632g–633e	**16**:820e–822b *passim*
5. Vertebrate muscle systems: comparative structure and function		**12**:644g–648f	

articles	article sections	other references
a. Embryonic development and divisions of the muscular system: mesodermal derivation of the somatic and visceral muscles	**12**:644g–645f	**5**:635b–c
b. Evolution of the vertebrate muscular system	**12**:645g–648a / **11**:407g–h	
c. Function and regulation of muscle action; *e.g.*, striated postural muscles; visceral smooth muscle; multi-unit nonstriated muscle affecting the eye, hair, and arteries	**12**:648a–e / **12**:631g–632g / **16**:822d–823b	
d. Electric organs in certain fishes	**12**:648f	**2**:1000a–f / **13**:761f–g / **13**:764c–e
6. The human musculatory system [see 422.I.7.]		

Section 335. Nutrition: the procurement and processing of nutrients

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 335 deal with three main subjects: A, the basic features of nutrition; B, the production of food in green plants; and C, the procurement and processing of nutrients by animals.

The outline of subject A begins with the distinction in mode of nutrition, basic in the food cycle of the biosphere, between autotrophic organisms, those that can make their own organic substances from inorganic nutrients; and heterotrophic organisms, those that require a supply of organic nutrient compounds from other living organisms. After dealing with the nutritional evolution of living organisms, the outline goes on to essential nutrients—the compounds that cannot be synthesized by an organism and must be supplied in food. It treats the determination of essential inorganic and essential organic nutrients, and the comparative magnitudes of the requirements for different types of nutrients. Finally, it treats syntrophism—the nutritional interrelationships in which the immediate or end products of metabolism of one organism may provide essential nutrients for another.

Subject B is the production of food in green plants. The outline treats the components and products of photosynthesis; the evolution of photosynthesis; the factors affecting the rate of photosynthesis; the mechanisms of photosynthesis; and the process of photosynthesis, producing carbohydrates through the agency of chlorophyll.

Subject C is the procurement and processing of nutrients by animals. The outline, after again referring to the contrast between autotrophs and heterotrophs, deals with the different ways of obtaining nutrients—by absorption directly from the environment and by the ingestion of bulk food. It then goes on to the alimentary system in animals other than man. It first deals with the organization, function, and special adaptations in invertebrate digestive systems, covering vacuolar, channel-network, saccular, and tubular digestive systems. The treatment of the basic structure and functions of vertebrate digestive systems covers the oral cavity, the teeth, and the pharynx; the esophagus and the stomach; the small intestine, pancreas, and liver; and the large intestine. Finally, the outline treats the embryology, the evolutionary development, and the biodynamics of vertebrate digestive systems. The outline concludes by indicating that the human alimentary system is treated in Section 422.

articles	article sections	other references
A. The basic features of nutrition		
NUTRITION **13**:401–407	**7**:208a–b	
1. The various nutritional patterns; *e.g.*, autotrophism and heterotrophism, phototrophism and chemotrophism	**13**:401c–402d	**4**:1028e–h / **5**:781a–c / **13**:417d–418b
2. Nutritional evolution of living organisms; *e.g.*, the origin of heterotrophic organisms, the evolution of photosynthesis	**13**:402d–403a / **14**:366d–f	**10**:902h–903c
3. Methods of ingestion or penetration [see C.2., below]		
4. The essential nutrients: compounds that cannot be synthesized by an organism and must be supplied in food; the nutritional needs of organisms	**13**:403d–406h / **1**:908f–909g / **8**:129f–g / **12**:762h–764d	**1**:34h–35a / **2**:575a–b / **8**:442h–443a / **15**:126e–h
a. The determination of essential nutrient requirements	**13**:403d–404a / **2**:995d–e	
b. Essential inorganic nutrients (minerals); *e.g.*, boron, iodide, calcium, potassium	**13**:404a–h / **1**:909a–d	**13**:418d–419d / **14**:503a–b
c. Organic nutrients that are essential building blocks of various cell components; *e.g.*, certain amino acids, fatty acids, vitamins	**13**:404h–406h / **1**:908f–909a / **1**:909d–g / **19**:488a–493a	**3**:868b–d / **13**:418b–d / **13**:419d–420d / **15**:81c–d
5. Comparative magnitudes of the requirements for different types of nutrients; *e.g.*, the relatively small requirements for trace elements and vitamins	**13**:407a–d	
6. Syntrophism: nutritional interrelationships in which the immediate or end products of metabolism of one organism may provide essential nutrients for another	**13**:407d–f	**2**:1051a–c / **8**:130g–h

B. The production of food in green plants

1. General characteristics: components and products of photosynthesis; the evolution of photosynthesis
2. Factors affecting the rate of photosynthesis; *e.g.*, intensity and wavelength of light, temperature, concentration of carbon dioxide
3. Determination of the mechanism of photosynthesis
4. The process of photosynthesis: the manufacture of carbohydrates through the agency of chlorophyll
   a. The light reactions and photophosphorylation
   b. The dark reaction: the carbon reduction cycle

C. Procurement and processing of nutrients by animals

1. The contrast between autotrophs and heterotrophs
2. Ways of getting nutrients: absorption directly from the environment; ingestion of bulk food
3. The alimentary system in animals other than man
   a. Invertebrate digestive systems: organization, function, and special adaptations
      i. Vacuolar systems
      ii. Channel-network systems, as in sponges
      iii. Saccular systems, as in cnidarians (coelenterates) and flatworms
      iv. Tubular systems, as in earthworms and mollusks
   b. Vertebrate digestive systems: basic structures and functions; variations among classes of vertebrates
      i. Oral cavity, teeth, and pharynx
      ii. Esophagus and stomach
      iii. Small intestine, pancreas, and liver
      iv. The large intestine
   c. Embryology and evolutionary development of the vertebrate digestive system
   d. Biodynamics of the vertebrate digestive system: control of secretions and intestinal movements
4. The human alimentary system
   [see 422.E.]

articles	article sections	other references
PHOTOSYNTHESIS **14**:365–373	**15**:93c–e	**3**:824d–f/**13**:523h–524b
	14:366a–f	**2**:1038g–1039a/**4**:1029e–f/**10**:903b–c/**15**:415f–g
	14:367a–e	**2**:1039b–c/**15**:415a
	14:367h–369b	
	14:370d–373e	
	14:370d–371e	**14**:291e–g
	14:371e–373e	
DIGESTION AND DIGESTIVE SYSTEMS **5**:780–788	**2**:995e–g/**13**:722h–723a/**14**:549e–g	
	5:780h–781c	
	5:781c–782d/**11**:405e–g/**13**:403b–d	**7**:208c–209e *passim*/**15**:126b–e
	5:782e–788h	
	5:782e–783h	**6**:720h–721b
	5:782e/**11**:884e–g	**5**:781d–g
	5:782f/**14**:851b–f	**14**:853c–d
	5:782f–783d	**14**:549d
	5:783d–h	**2**:1090e–f/**5**:315c–d
	5:783h–787a/**7**:334b–g/**18**:443h–445a	**11**:407h–408a/**14**:86c–87a *passim*/**16**:189f–g
	5:783h–785a/**11**:406e–f	**2**:76h–77a/**3**:927e–f/**15**:732g–h/**18**:443h–444c
	5:785a–f	**2**:77h–78c/**18**:444c–e
	5:785f–786g/**18**:444e–445a	
	5:786g–787a	
	5:787b–h/**5**:639b–h	
	5:788a–h/**6**:842h–843f	

Section 336. Gas exchange, internal transport, and elimination
[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 336 deal with six main subjects: A, gas exchange and breathing; B, circulation; C, the transport system in animals; D, transport of materials in plants; E, elimination; and F, excretion.

The outline of subject A begins with the biological significance of breathing and with the varying composition and physical characteristics of water and air in the environment, which affect the range of respiratory problems faced by aquatic and terrestrial animals. It goes on to the basic types of respiratory structures, covering insect respiration by tracheae, the gill breathing of invertebrates and vertebrates, and lung breathing in higher animals. It further treats the dynamics of respiratory mechanisms; the control of respiration; and the processes of adaptation to special conditions, such as prolonged submersion in water or activity at high altitudes.

The outline of subject B begins with the biological significance of circulation and with a comparison of the circulation of blood in animals with the movement of fluids through plants. It goes on to circulation and transport patterns, covering the streaming movement of fluid cytoplasm in single cells and the major roles and modes of circulation in multicellular animals. It next deals with the fluid media involved in circulation, covering the evolu-

tionary origins of circulating fluids; plasma, the fluid part of the circulating medium; the formed elements of the circulating fluid; and lymphocytes and lymph in vertebrates.

The outline of subject C begins with invertebrate circulatory systems, covering circulation in sponges and coelenterates, circulation in acoelomates, such as flatworms, and circulation in coelomates, such as mollusks. Dealing with the vertebrate circulatory system, the outline treats the common ancestral plan, evolutionary trends, and modifications of circulatory systems among the classes of vertebrates. It further treats coronary circulation; the embryonic development of the circulatory system; and the biodynamics of vertebrate circulation.

The outline of subject D begins with general features of the two main transport systems in highly developed land plants. Then, after dealing with the structural basis of plant transport, it treats xylem transport, phloem transport, and vascular transport.

The outline of subject E first deals with the distinction between types of waste-disposal processes, the biological significance of elimination, and the distinction between metabolic and nonmetabolic wastes. It then treats specific elimination mechanisms—the alimentary canal, the respiratory system, and the kidney; and nonspecific mechanisms for the elimination of heat, toxic substances, and particulate wastes. Finally, after a comparative overview of elimination schemes at the different levels of biotic organization, the outline treats the utilization of the waste products of all living systems in the various ecological cycles.

Subject F is animal excretion—the term confined here to the elimination of the nitrogenous by-products of metabolic processes. The outline first treats the role of osmotic pressure in the excretory system; the homeostatic role of that system in regulating the water–salt balance; and the principal excretory structures. It then treats the five main types of excretory organs in the higher invertebrates, and the structure, function, and evolution of the excretory systems in the different classes of vertebrates.

articles	article sections	other references
A. Gas exchange and breathing		
RESPIRATION AND RESPIRATORY SYSTEMS **15**:751–763	**13**:723a–b	
1. The significance of breathing: the extraction of oxygen from the environment and the release of carbon dioxide	**15**:751b–h	
2. Gases in the environment: the range of respiratory problems faced by aquatic and terrestrial animals	**15**:752a–f	**6**:719h–720b
3. Basic types of respiratory structures	**15**:752f–755b / **18**:445h–446b	**13**:1057a–c
a. Respiratory organs of invertebrates: tracheae and gills	**15**:752h–754c / **9**:616d–g	**5**:315b–c
b. Respiratory organs of vertebrates: gills and lungs	**15**:754c–755f	**11**:409b–c
4. Dynamics of respiratory mechanisms	**15**:755g–760f	
a. Respiration in fishes	**15**:755g–757a / **7**:334h–335b / **16**:496f–g	**5**:814d–f
b. Respiration in amphibians and terrestrial vertebrates	**15**:757b–758f	**15**:733h–734b
c. Gas transport by the blood	**15**:758g–760e	**2**:1113a–d / **2**:1125d–e / **2**:1127g–1128b / **18**:608h–609h *passim*
5. The control of respiration: neural reflexes, muscular feedback, and chemically sensitive controls	**15**:760e–762c	
6. Adaptation to special conditions; *e.g.*, diving, high altitudes	**15**:762c–763f / **13**:761c–d / **14**:995b–h	**1**:35c–d / **3**:939e–h
7. The human respiratory system [see 422.D.]		
B. Basic features of circulation		
CIRCULATION AND CIRCULATORY SYSTEMS **4**:618–620	**13**:723b–c	
1. General features: comparison between unicellular and more complex organisms; the role of circulating fluids in homeostasis; comparison of the circulation of blood in animals with the movement of fluids through plants	**4**:618e–619a	**14**:438a–e
2. Circulation and transport patterns: general aspects common to all circulatory systems	**4**:619b–620d	
a. Circulation in single cells: streaming movements within the protoplasm	**4**:619b–c	**16**:886e–f
b. Circulation in multicellular animals	**4**:619c–620d	
i. Major roles of circulation: transport of oxygen and foodstuffs	**4**:619c–e / **15**:758g–760e	
ii. Modes of circulation: the movement of circulating fluids through vessels	**4**:619e–620d	

	articles	article sections	other references
3. The fluid media involved in circulation	BLOOD AND LYMPH **2**:1121–1125	**18**:445a–c	**2**:995h–996a / **2**:1111h–1112c / **2**:1125d–e / **4**:619g–h
a. General features; *e.g.*, evolutionary origins of circulating fluids		**2**:1121e–1122a	
b. Plasma: fluid part of the circulating medium		**2**:1122a–1123d	
i. Small molecules and the regulation of water content: the maintenance of an osmotic equilibrium		**2**:1122a–g	
ii. Proteins and their various roles: the evolution of albumins, fibrinogen, and various globulins; globulins (*e.g.*, hemoglobin) that carry specific metal ions		**2**:1122g–1123d	
c. Formed elements of the circulating fluid; *e.g.*, their physical characteristics, their functions		**2**:1123d–1124e	**3**:1062a–b
i. Red cells of vertebrates and certain worms		**2**:1123d–h	**1**:934a–b / **4**:918f–h / **15**:760c–e / **18**:609a–c
ii. White cells in vertebrates and invertebrates		**2**:1123h–1124c	
iii. The platelets of mammals and the thrombocytes of other vertebrates		**2**:1124d–e	
d. Lymphocytes and lymph in vertebrates; *e.g.*, the formation and characteristics of lymphocytes, the role of the thymus, homeostatic mechanisms		**2**:1124e–1125a / **9**:249c–252f	
C. Transport systems in animals	CIRCULATION AND CIRCULATORY SYSTEMS **4**:620–634		
1. Invertebrate circulatory systems		**4**:620d–624a	
a. Circulation in sponges and coelenterates		**4**:620d–621a / **14**:851b–f	
b. Circulation in acoelomates; *e.g.*, flatworms, nematodes, rotifers		**4**:621a–c	
c. Circulation in coelomates; *e.g.*, annelids, arthropods, mollusks		**4**:621c–624a / **9**:616a–c	**5**:315d–e
2. Vertebrate circulatory systems		**4**:624b–634d	
a. The basic vertebrate pattern		**4**:624b–626b / **2**:1125b–g / **18**:450c–e	
i. The common ancestral plan of venous system, chambered heart, and arterial system		**4**:624b–625a	
ii. Evolutionary trends: comparison of the condition of jawless and jawed vertebrates		**4**:625b–626b	
b. Modifications of circulatory systems among classes of vertebrates		**4**:626b–630d	
i. In fishes		**4**:626b–628c / **7**:335b–c	
ii. In amphibians		**4**:628c–h	
iii. In reptiles		**4**:628h–629d	**15**:733a–h
iv. In birds		**4**:629d–630b	
v. In mammals		**4**:630b–d / **11**:408h–409a	
c. Coronary circulation: the blood supply to the cardiac muscle		**4**:630d–h	
d. Embryonic development of the circulatory system: the blood system and the lymphatic system		**4**:630h–632f / **5**:636d–638a	
e. Biodynamics of vertebrate circulation: blood pressure and blood flow; electrical activity of the heart; control of the heart and circulation		**4**:632f–634d	
f. The human cardiovascular system [see 422.A.]			
D. Transport of materials in plants	PLANT INTERNAL TRANSPORT **14**:500–504		
1. General features of the two main transport systems in highly developed land plants		**14**:500h–501c	**13**:731b–h

	articles	article sections	other references
2. Structural basis of transport		**14**:501c–503c	
a. Cell-to-cell transport		**14**:501c–e	
b. The structure of xylem and phloem		**14**:501e–502e	
c. Gas exchange and transport in leaves		**14**:502f–503a	
d. Uptake of water and mineral nutrients from the soil		**14**:503a–c	
3. Xylem transport: quantitative aspects and mechanisms of sap ascent (*e.g.*, transpiration)		**14**:503c–g / **9**:107c–108d	**8**:437b–d
4. Phloem transport: quantitative aspects of and mechanisms for the transport of photosynthetic products		**14**:503h–504d	
5. Vascular transport and plant growth: the storage and circulation of nutrients; the transport of growth regulators (*e.g.*, hormones)		**14**:504d–h	
E. Elimination: the disposal of wastes	ELIMINATION **6**:718–721		
1. General features of elimination		**6**:718h–719f	
a. The distinction between types of waste-disposal processes: excretion, secretion, egestion, and elimination		**6**:718h–719b	**7**:45a–b
b. The biological significance of elimination: waste disposal in organisms as vital to their well-being and to the continuance of life		**6**:719b–d / **18**:453c–454d	
c. Types of wastes: metabolic wastes produced by the chemical processes of living cells; nonmetabolic wastes, which are merely passed through the digestive tract of an organism without actually entering into its life processes		**6**:719d–f	
2. Methods of waste disposal		**6**:719g–720e	
a. Specific elimination mechanisms: the alimentary canal, the respiratory system, and the kidney		**6**:719g–720c	
b. Nonspecific mechanisms for the elimination of heat, toxic substances, and particulate wastes		**6**:720d–e	
3. Comparative overview of elimination schemes: the nonspecialized elimination mechanisms of protists and plants; the egestion of undigestible matter and excretion of metabolic wastes in animals		**6**:720e–721c	**5**:782d–783f *passim*
4. Waste disposal: the utilization of the waste products of all living systems by the various ecological cycles		**6**:721c–e	
F. Patterns of animal excretion	EXCRETION AND EXCRETORY SYSTEMS **7**:44–50	**13**:723c–d	
1. The meaning of excretion; the products of excretion		**7**:45a–e	
2. Excretory mechanisms		**7**:45e–46d	
a. Osmotic pressure: the behaviour of molecules in solution		**7**:45e–g / **11**:879c–g	
b. Regulation of the water–salt balance: maintenance of the internal chemical environment		**7**:45g–46b / **16**:496e–f	
c. Principal excretory structures; *e.g.*, the kidney in mammals, gills in fishes		**7**:46b–d	**2**:1113f–g / **5**:1044c–f / **6**:719g–720e *passim*
3. Invertebrate excretory systems		**7**:46e–48c	
a. The contractile vacuoles of protozoans		**7**:47a–b	
b. The nephridia of annelids, nemertines, flatworms, and rotifers		**7**:47b–d	**1**:934b–c / **2**:141c–d
c. The renal glands of mollusks		**7**:47d–f	
d. The coxal glands of aquatic arthropods		**7**:47f–h	**5**:315f
e. The malpighian tubules of insects		**7**:47h–48c	
4. Vertebrate excretory systems		**7**:48c–50d / **18**:445c–g	
a. Structure and function		**7**:48d–49g / **5**:635h–636c	**18**:445d–g
i. In mammals		**7**:48d–49b	**7**:50f–54f *passim* / **11**:408b–c
ii. In birds and reptiles		**7**:49c–e	**15**:734b–d

articles	article sections	other references
iii. In amphibians and fishes	**7**:49e–g/ **7**:335c–f	
b. The evolution of the vertebrate excretory system	**7**:49g–50d	**18**:445c–d
c. The human excretory system [see 422.H.]		

Section 337. Reproduction and sex

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 337 deal with four main subjects: A, the forms of reproduction and their comparative adaptive significance; B, the nature and role of sex; C, the reproductive system in plants; and D, the reproductive system in animals.

The outline of subject A, after distinguishing the levels of reproduction, first treats the replication of virus molecules at the expense of host molecules, and reproduction in single-celled organisms. Dealing with multicellular organisms, it treats vegetative, or asexual, reproduction; sexual reproduction; and variations of gametic reproduction, such as parthenogenesis. Finally, it treats the evolutionary significance of the different modes of reproduction.

The outline of subject B first deals with the distinctions between sex, sexuality, and reproduction. It then treats certain nuclear exchanges, or recombinations, in viruses and bacteria that are sexlike in character; the adaptive and evolutionary significance of sex; and the superiority of the sexual mode of reproduction in producing and controlling the variations on which natural selection comes to bear. Dealing with the origin of sex and sexuality, the outline covers the evidence for the early evolution of sex cells; the development of specialized reproductive tissues and of associated structures for delivering functional sex cells at the appropriate time and place; the process of mating; and the elaboration of courtship behaviour that facilitates mating between potential partners. It next deals with the forms and functions of secondary sex differentiation and with seasonal or periodic sexual cycles. Finally, dealing with the determination of the sex of individuals, the outline treats the decisive determination of the sex, in most species of animals, by means of chromosomal distribution at the time of fertilization; abnormal chromosome effects; the effects of parthenogenetic development; and the environmental and hormonal influences on sex determination.

The outline of subject C begins with the different effects in plants of asexual systems and sexual systems. It goes on to treat the sex organs of bryophytes (liverworts and mosses); the complex variations of sex organs in tracheophytes, in which the union of sex cells results in individuals or tissues called sporophytes; and variations in reproductive cycles. Finally, it treats the physiology of reproduction and the influence of internal and environmental factors on the maturation of sporophytes and gametophytes.

Subject D is the reproductive system in multicellular animals, exclusive of man. The outline begins with general points about the evolution of animal reproductive systems and about the synchronization between the total behaviour of animals and their reproductive activity. Dealing with the reproductive systems of invertebrates, the outline treats the characteristics of gonads (sex organs) at the several levels of invertebrate life; the mechanisms that aid in the union of gametes (male or female reproductive cells); the specializations associated with parthenogenesis; and provisions for the developing embryo. The treatment of the reproductive systems of vertebrates covers the gonads, structures associated with them, and their products; adaptations for internal fertilization; the role of gonads in hormonal cycles; and the provisions for the developing embryo.

articles	article sections	other references
A. The forms of reproduction and their comparative adaptive significance		
1. Levels of reproduction		
a. Molecular replication and reproduction	**15**:676d–678f	
	15:676d–f/ **3**:1051e–1052d/ **7**:985h–986f	
b. Cell reproduction: binary and multiple fission	**15**:676f–677d/ **3**:1052d–1055f	**2**:570b–c/**15**:122h–123e
c. Reproduction of organisms [see A.2., below]		
d. Reproduction of living forms in relation to time	**15**:677h–678f	
i. Life cycles of plants	**15**:678b–d/ **1**:876h–877d/ **5**:3b–4a/ **5**:659a–d/ **7**:237f–h/ **12**:759d–760b/ **15**:137c–e/ **17**:500h–501b	**15**:717f–h
ii. Life cycles of animals	**15**:678d–f	**5**:639h–642g *passim*/ **15**:122d–h/**16**:187d–g/ **16**:586h–587e
2. Reproduction of organisms	**15**:677d–h/ **5**:625d–g/ **15**:716d–717h	
a. Viruses: replication of virus molecules at the expense of host molecules (*e.g.*, transduction)	**19**:165c–167b	**19**:167b–168e *passim*
b. Single-celled organisms; *e.g.*, bacteria, protozoans		**2**:570b–d/**15**:122h–124c/ **15**:677d–e

	articles	article sections	other references
i. Asexual reproduction: simple division [see A.1.b., above]			
ii. Sexual reproduction; *e.g.*, conjugation, syngamy, autogamy			7:984d–985d / **15**:123f–124c/ **16**:587e–g
c. Multicellular organisms; *e.g.*, certain algae, fungi, the higher plants and animals		**12**:758f–759d / **15**:716d–717h / **16**:585d–586a	**15**:576e–g / **15**:677e–h / **15**:702b–d / **16**:884h–887g *passim*
i. Vegetative, or asexual, reproduction; *e.g.*, by budding, formation of spores, fragmentation		**1**:489g–490d / **12**:758f–h / **15**:716d–717c	**1**:578c–e / **8**:1106c–1107g *passim* / **14**:849h–850b / **16**:585d–f
ii. Sexual reproduction: by means of gametes, or sex cells		**1**:490d–e / **3**:1055f–1056b / **15**:717c–h	**1**:704a–b / **7**:240a–e / **12**:758h–759b / **15**:702g–h / **15**:707e–g / **16**:585f–586a
iii. Variations of gametic reproduction; *e.g.*, parthenogenesis, apomixis		**15**:706e–707b / **15**:724c–f / **16**:592b–d	**2**:214b–c / **7**:245d–g
3. Natural selection and reproduction: the evolution of reproduction and variation control		**15**:678f–679c / **5**:625d–g / **5**:659a–d / **7**:18d–g	**16**:586b–589c *passim*
B. The nature and role of sex: definitions and distinctions	SEX AND SEXUALITY **16**:585–592		
1. The distinctions between sex, sexuality, and reproduction		**16**:585d–586a	**15**:702b–d
2. Transduction and transformation as sexlike recombination in viruses and bacteria		**7**:984b–985h	
3. The adaptive significance of sex: establishment of genetic diversity		**16**:586b–587e / **15**:679f–g	**5**:625f–g
a. Reproduction and evolution: the need to produce perfect working copies of the parent organism and yet introduce novelties		**16**:586e–h / **14**:744c–745b	**10**:897f–h / **15**:1151c–d
b. Life cycles adapted to environmental change: the exploitation of reproduction to meet widely fluctuating environmental conditions, such as seasonal changes		**16**:586h–587e	**9**:622d–623a
4. The origin of sex and sexuality		**16**:587e–590a	
a. Individual mating cells among single-celled organisms as evidence of the early evolution of the differentiation of sex cells		**16**:587e–588a	**15**:677g–h
b. Differentiation of the sexes: the development of specialized reproductive tissues and of associated structures in order to deliver functional sex cells at the appropriate time and place		**16**:588b–e / **14**:1024h–1025c / **15**:690c–g	
c. Mating: a necessary adjunct to fertilization when eggs must be fertilized at or before the time they are shed		**16**:588f–589c /	**15**:705f–706e *passim* / **15**:713c–714b *passim*
d. Courtship: elaboration of sexual behaviour that facilitates mating between potential partners		**16**:589c–590a / **15**:681b–g	**15**:727h–728c / **8**:445d–446c *passim* / **17**:451g–452b
5. Sex patterns		**16**:590a–591c / **14**:84h–85b / **16**:940g–941e	
a. Distinctions: separate sexes and double-sexed individuals; cross-fertilization and self-fertilization		**16**:590a–d	
b. Secondary sexual differences, as in structure		**16**:590d–f	**13**:760c–e / **14**:48a–d
c. Seasonal or periodic sexual cycles; *e.g.*, the role of hormonal controls		**16**:590f–591c / **14**:1017a–d	**4**:430c–d / **11**:403a–b / **14**:353b–c
6. Determination of the sex of individuals: the question of how the development of one sex is suppressed in a potentially double-sexed organism		**16**:591c–592h	
a. The sex chromosomes: determination by means of chromosomal distribution at the time of fertilization of the egg		**16**:591f–h	**7**:998a–c
b. Abnormal chromosome effects; *e.g.*, superfemales, gynandromorphs		**16**:592a–b	**2**:1075g–h / **2**:1076b–d / **15**:697h–698e *passim*
c. The effect of parthenogenetic development		**16**:592b–d	
d. Environmental and hormonal influences		**16**:592e–h	

	articles	article sections	other references
C. The reproductive system in plants: its organization and function	REPRODUCTIVE SYSTEMS, PLANT **15**:716–725		
1. General features: asexual systems that create new plants identical to the parent plant; sexual systems that create new plants different from either of the two parents		**15**:716d–717h	
2. The sex organs of bryophytes, in which the sexual phase (gametophyte) is dominant; *e.g.*, antheridia, archegonia		**15**:718a–719a	
a. In liverworts and hornworts		**15**:718a–d	**8**:779g–780c
b. In mosses		**15**:718e–719a	**3**:353d–354a *passim*
3. The complex variations of sex organs in tracheophytes, in which the union of sex cells results in individuals or tissues called sporophytes		**15**:719a–724c	**5**:660d–661a *passim*
a. In spore plants; *e.g.*, lycopsids, ferns		**15**:719a–720e / **7**:239c–240e / **7**:243g–244h	
b. In seed plants; *e.g.*, direct production of plants by cells other than the usual ones (apomixis)		**15**:720f–724c	**16**:480d–481d *passim*
i. Cones		**15**:721b–722a	**8**:521b–e / **8**:522b–g
ii. Flowers		**15**:722b–724c / **1**:879e–880h	**14**:380f–381a / **14**:743g–747f *passim*
4. Variations in reproductive cycles: apogamy and apospory (apparent secondary loss of capacity for sexual reproduction)		**15**:724c–f	
5. The physiology of reproduction: the influence of internal and environmental factors on the maturation of sporophytes and gametophytes as manifested by their ability to produce spores and gametes		**15**:724f–725e	
D. The reproductive system in animals: its organization and function	REPRODUCTIVE SYSTEMS, ANIMAL **15**:702–715	**13**:723d–e / **18**:449c–450c	
1. General features: evolutionary trends in the complexity of reproductive systems; the direct relationship between behaviour and the functional state of the gonads		**15**:702b–g	**3**:1062b–c
2. Reproductive systems of invertebrates		**15**:702g–707e	
a. Gonads, associated structures, and products in monoecious (both sexes in the same individual) and dioecious (sexes separate) types		**15**:702g–705f	
i. In the lower invertebrates; *e.g.*, sponges, coelenterates, flatworms, aschelminths		**15**:702h–703g	**14**:546h–547b
ii. In annelid worms and mollusks		**15**:703g–704d	**1**:928g–929f / **2**:1085h–1086d / **3**:1151e–g / **7**:950h–951e
iii. In arthropods		**15**:704d–705d / **9**:616g–617d	**10**:826d
iv. In echinoderms and protochordates		**15**:705d–f	**6**:183f–g
b. Mechanisms that aid in the union of gametes		**15**:705f–706e	
c. Specializations associated with parthenogenesis (development of an organism from an unfertilized egg)		**15**:706e–707b	
d. Provisions for the developing embryo: nutrients; protection from the environment [see 338.E.2.b.]			
3. Reproductive systems of vertebrates		**15**:707e–715g / **11**:541h–542c	
a. Gonads, associated structures, and products		**15**:707e–713c / **6**:845b–f	
i. General features: the intimate association of the reproductive system and the excretory system; development of the gonads and their ducts		**15**:707e–708c / **5**:638a–639a	**7**:49g–50c
ii. Male systems: testes, ducts, and accessory glands		**15**:708c–710a	**11**:408c–d / **18**:449d–g
iii. Female systems: ovaries, reproductive tracts, and accessory glands		**15**:710a–713c	**11**:408d–g / **18**:449h–450c
b. Adaptations for internal fertilization; *e.g.*, the cloaca, intromittent (copulatory) organs, accessory structures (*e.g.*, claspers)		**15**:713c–714b	**15**:734d–e / **16**:589b–c

articles	article sections	other references
	15:714c–g	

c. Role of gonads in hormone cycles: influence of neurosecretions and certain pituitary gland hormones on the gonads; effects of the gonadal hormones

d. Provision for the developing embryo: nutrients, oxygen, a site for the discharge of metabolic wastes, and protection from the environment
[see 338.E.2.b.]

e. The human reproductive system: male and female
[see 422.G.2.]

Section 338. Development: growth, differentiation, and morphogenesis

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 338 deal with seven main subjects. The first three concern development generally: A, the nature and scope of development; B, the constituent processes of development and their control; and C, development and evolution. The next two subjects involve more detailed treatment of D, plant development, and E, animal development. Subject F is aging and decline in animals. Subject G is specialized patterns of development.

The outline of subject A begins with the definition of development as the series of progressive, nonrepetitive changes that occur during the life history of an organism—a definition that distinguishes development from the essentially repetitive metabolic maintenance processes on the one hand, and from the sequence of many life histories that constitute evolutionary changes on the other. The outline goes on to the scope of development, conceived as encompassing all the processes concerned with carrying out the genetic instructions encoded in DNA (deoxyribonucleic acid). It next deals with the main types of development and with the general systems of development—the development of single-celled organisms, the closed system of animals, the open system of plants, and asexual and sexual development. Finally, it treats chemical, environmental, and nutritional factors that influence development.

The outline of subject B first deals with three constituent processes of development: growth, an increase in cell numbers or in cell size; morphogenesis, the processes by which parts of a developing system come to have a definite shape or to occupy particular relative positions; and differentiation, the processes that yield functionally specialized tissues and place them in different regions. The outline then treats the mechanisms that control and integrate the three developmental processes.

Subject C is development and evolution. The outline treats the length and timing of the reproductive phase and the recapitulation of ancestral stages; the adaptability and canalization resulting in the development of relatively invariant organisms; and genetic assimilation, the Darwinian interpretation of the inheritance of acquired characteristics.

The outline of subject D, plant development, begins generally with types of life cycles and with the alternation of generations as independent phases of the life cycle. It goes on to the preparatory events—the formation of sex cells, pollination, and fertilization. It then deals with the early development, from fertilized egg (zygote) to seedling, treating embryo formation, the independent dormant stages, and the germination of the seeds and fruits of higher plants. The treatment of the later development covers the continuation of organ formation and the development of the shoot and root systems and their derivatives. Finally, the outline treats the coordination of shoot and root development; the determination of mature form and the attainment of reproductive capacity; the seasonal adaptations of plants; and plant senescence and death.

The outline of subject E, animal development, first treats the preparatory events; embryo formation and embryonic adaptations for the maintenance of the developing embryo; and the primary and secondary organ rudiments. The outline next deals with the development of mature organs and organ systems, treating them by reference to their source in the outermost, the middle, and the innermost primary germinal layers. It concludes with the postembryonic development that brings the newborn to mature functional and reproductive capacity.

Subject F is aging and decline in animals. The outline begins with the natural history of aging, treating the relation of it to reproduction, species differences in longevity and aging, and the inheritance of longevity. It then deals with senescence in mammals, covering changes in body composition, metabolism, activity, and structural tissues; tissue cell loss and replacement; the limited growth potency of dividing cells; and changes in tissue and cell morphology. It next treats the aging of genetic information systems, of immunological systems, and of neural and endocrine systems. It next deals with external environmental agents that affect aging, and with internal metabolic causes of aging. The outline further deals with the life-span in human beings, subhuman animals, and plants. At the end an article is referred to that treats death.

Subject G involves the results of special physiological and embryological studies that supplement knowledge of the general course of development. The outline covers the modes, processes, and range of biological regenerative capabilities; healing processes and scar tissue formation; aberrant development—plant and animal malformations; twinning and multiple births; cell and tissue cultures; and the development of transplanted tissues and organs.

articles	article sections	other references
DEVELOPMENT, BIOLOGICAL **5**:643–646		
	5:643a–d	
	5:643e–644a	
	5:644b–645f	**5**:640b–642d *passim*

A. The nature and scope of biological development

1. The concept of development: the distinction of biological development from the changes involved in the maintenance of the body (metabolism) and from evolutionary changes
2. The scope of development: development as encompassing all the processes concerned with carrying out the genetic instructions contained in deoxyribonucleic acid (DNA)
3. Types of development: quantitative and qualitative, progressive and regressive, single-phase and multiphase, structural and functional, and normal and abnormal

	articles	article sections	other references
4. General systems of development		**5**:645f–646d	
a. Development of single-celled organisms; *e.g.*, cell division		**5**:645f–g	**15**:122h–124e
b. Open and closed systems of development: continued embryonic capability of certain plant cell types and lack of such capability in animals		**5**:645h–646a / **5**:664d–f	
c. Blastogenesis versus embryogenesis: the remodelling of part of a parental body into a new organism versus involvement of egg or sperm		**5**:646b–d / **5**:625d–g	**15**:577d–578d *passim* / **16**:586h–587b
5. Factors influencing development; *e.g.*, genetic constitution, growth substances, environmental factors, nutritional factors		**8**:1079c–e / **16**:586b–e	**2**:1073a–1074e *passim* / **7**:997b–e / **8**:130b–131a *passim* / **8**:810g–h / **8**:1075b–e / **8**:1083c–1087h *passim* / **11**:378h–380h *passim* / **13**:401c–e / **13**:404a–406h *passim*
B. The constituent processes of development and their control	DEVELOPMENT, BIOLOGICAL **5**:646–649		
1. Growth	GROWTH **8**:440–444	**5**:646d–f / **12**:762c–h	
a. The nature of growth; *e.g.*, growth as an increase in cell numbers or as an increase in cell size; the relation between growth and development		**8**:440g–441a / **6**:745g–746a / **13**:731h–732b	**15**:729d–e
b. Types of growth: in cells, in plants, and in animals		**8**:441a–442c	
c. Environmental and internal factors that regulate growth; *e.g.*, temperature, pressure, light, hormones		**8**:442d–443e / **8**:1086g–1087h / **14**:367a–e / **14**:995h–996e	**5**:5g–6b / **8**:1075b–e / **13**:403f–407f *passim* / **14**:994d–g
d. Dynamics of growth: the growth curve and the measurement of growth; the study of growth		**8**:443f–444c / **3**:1051e–f / **5**:652a–g	
2. Morphogenesis: processes involving the action of physical forces by which parts of a developing system come to have a definite shape or to occupy particular relative positions in space		**5**:646f–647f	
3. Differentiation: differentiation in time involving the production of the characteristic features of adult tissues (histogenesis); differentiation in space involving an initially similar mass of tissue becoming separated into different regions (regionalization)		**5**:647f–h / **6**:746a–d	**10**:897e–f
4. Control and integration of development		**5**:647h–649c	
a. Phenomenological aspects: regulation in terms of some appropriate time path		**5**:647h–648e / **8**:1016b–d	
b. Analytical aspects: development as an expression of the controlled activities of genes		**5**:648f–649c / **7**:987g–991c / **8**:808c–h	
C. Development and evolution	DEVELOPMENT, BIOLOGICAL **5**:649–650		
1. Effect on life histories: length and timing of the reproductive phase and recapitulation of ancestral stages		**5**:649d–650a / **1**:299h–300g	**3**:805b / **5**:545a–b / **5**:642d–f / **5**:965b–f / **8**:813c–e
2. Adaptability and canalization resulting in the development of relatively invariant organisms		**5**:650a–c	
3. Genetic assimilation: the Darwinian interpretation of the inheritance of acquired characteristics		**5**:650d–f	**7**:12d–g
D. Development of plants	DEVELOPMENT, PLANT **5**:658–671		**5**:644f–h / **12**:455d–e
1. General features: types of life cycles; alternation of generations as independent phases of the life cycle		**5**:659a–660c	**15**:678b–d
2. Preparatory events		**5**:660d–661a / **1**:876h–878g / **15**:717c–h	

	articles	article sections	other references
a. Formation of sex cells		**1**:879e–880h / **3**:1055f–1056f / **16**:585g–586a	**15**:717c–e
b. Pollination	POLLINATION **14**:743–747	**2**:214a–c / **3**:704h–705f / **8**:3d–g / **11**:397b–d / **12**:218b–g / **13**:652c–655a / **14**:587g–588b / **15**:509h–510c / **18**:1090h–1091d	**2**:794a–b / **3**:324f–g / **4**:927c / **12**:774b–e / **13**:429d–f / **14**:497e–g / **14**:1048c–e / **15**:723c–e / **16**:181c–e
c. Fertilization		**1**:877d–878g	**7**:254f–h / **15**:721c–d / **15**:721f–g / **15**:723c–h
3. Early development: from fertilized egg (zygote) to seedling		**5**:661a–664b / **7**:240e–g	
a. Embryo formation: cleavage of the zygote; origin of the primary organs; nutritional dependence of the embryo		**5**:661a–663d	**13**:523h–524b
b. Independent dormant stages and germination of the seeds and fruits of higher plants	SEED AND FRUIT **16**:480–487	**5**:960b–e / **6**:1029g–h / **14**:591c–d	
i. General features of seeds and fruits: formation, development, and classification		**16**:480d–481g / **5**:4b–c	**1**:878g–879b / **7**:764h–765h
ii. Form and function; *e.g.*, seed size, shape of dispersal units, polymorphism of seeds and fruits		**16**:481h–484a	**7**:129a–c
iii. Dispersal of seeds and fruits by animals, by wind, by water, or by self-dispersal		**16**:484b–486c / **2**:214c–d / **3**:706a–b / **3**:804c–805a / **5**:175g–176a / **8**:2e–3c / **14**:659g–h / **15**:510d–e	**16**:415b–c
iv. Seed germination and resumption of growth by the embryo: the role of the seed coat, after-ripening, environmental factors, and internal chemical effects		**5**:663e–664b / **16**:486c–487h / **10**:915f–g	**3**:805a–d / **10**:620f–g
4. Later development: the sporophyte plant body		**5**:664c–668e / **13**:726g–730h	**1**:876h–877d / **7**:240g–243f *passim*
a. Continuation of organ formation: the continuous elaboration by meristematic (cell-producing) regions; the determination of the forms of tissues and organs		**5**:664c–665a / **18**:451a–452e	**13**:726g–727e
b. The shoot system and its derivatives: the shoot tip, the production of leaves, branching of the shoot, and vascular development		**5**:665b–667d / **13**:726h–730c / **13**:732b–733a	**18**:453d–h
c. The root system and its derivatives: the root tip; branching of the root		**5**:667d–668e / **13**:730c–h / **13**:733a–d	
5. Correlations in plant development		**5**:668f–671c	
a. Coordination of shoot and root development: control by hormones and nutrients		**5**:668f–669a / **8**:1086g–1087h	**17**:672f–673f *passim*
b. Determination of mature form: juvenility, maturity, and the attainment of reproductive capacity		**5**:669a–670a	**14**:352c–e
c. Seasonal adaptations		**5**:670a–d / **7**:538c–539c / **10**:915d–f / **14**:659h–660a	**1**:32g–33a / **5**:959a–960e *passim* / **13**:729h–730a
d. Senescence and death		**5**:670d–671c	**10**:914e–915f *passim*
E. Development of animals	DEVELOPMENT, ANIMAL **5**:625–642		**5**:645h–646d
1. Preparatory events: the egg and its activation by normal fertilization or by parthenogenesis		**5**:625h–626d / **6**:742a–743c	**7**:254f–257f *passim* / **11**:403a–b / **15**:678d–h / **16**:585d–587e *passim*
2. Early development		**5**:626e–631c	**1**:930c–d / **12**:455c
a. Embryo formation: cell proliferation and the formation of a three-layered embryo, or gastrula		**5**:626e–629c	**1**:929f–g / **10**:897e–f

	articles	article sections	other references
i. Cleavage, a series of consecutive cell divisions that ends with the formation of a blastula (hollow ball-like structure)		**5**:626e–627d / **6**:743d–744b	
ii. Gastrulation: transformation by various mechanisms of the blastula to form the three germinal layers (ectoderm, mesoderm, and endoderm)		**5**:627d–629c / **6**:745d–f	**5**:648a–c
b. Embryonic adaptations for the maintenance of the developing embryo		**5**:629g–631c	
i. In animals other than mammals; *e.g.*, shell, yolk stores, membranous sacs		**5**:629g–630e / **15**:707b–e	**7**:950h–951h *passim* / **15**:714g–715f / **16**:588f–589a
ii. In mammals; *e.g.*, placenta		**5**:630e–631c / **14**:1025c–e	**2**:78e–g / **6**:744c–h *passim* / **11**:403c–f / **11**:541h–542b / **15**:715f–g
3. Organ formation		**5**:631d–633e / **13**:724d–725b	
a. Primary organ rudiments: the narrowing of prospective potencies of embryonic tissues		**5**:631d–633b	
b. Organogenesis and histogenesis: formation of the secondary rudiments of various organs and their component tissues		**5**:633b–e	**6**:746b–d
4. Ectodermal derivatives: the nervous system (brain, spinal cord, and major sense organs); the epidermis and its outgrowths (hairs, feathers, and skin glands)		**5**:633e–635a / **6**:749g–751f / **12**:988h–990a	**5**:1131g–1132e *passim* / **9**:672c / **14**:361h–362a
5. Mesodermal derivatives: the body muscles and axial skeleton; the appendages (tail and limbs); excretory organs; circulatory organs; reproductive organs		**5**:635b–639a / **4**:630h–631h / **6**:751f–753c / **16**:823b–g	**15**:707e–708c *passim* / **7**:49g–50a
6. Endodermal derivatives: the alimentary canal; the pharynx and its outgrowths; the liver, pancreas, and lungs		**5**:639b–h / **5**:787b–d / **6**:753c–g	**15**:766e–f
7. Postembryonic development: transformation of the newborn into the adult		**5**:639h–642f	**2**:1086g–1087a / **5**:644e–h / **6**:179d–180b / **10**:911d–e
a. The larval phase and metamorphosis: the larva as a form differing substantially from the adult, and the process of transformation into an adult		**5**:640b–642b / **2**:67f–68a / **4**:830a–831b / **13**:743f–744g	**1**:898b–899c / **1**:929h–930c / **1**:1005c–e / **2**:138e–g / **4**:768g–769e / **5**:312g–313e / **7**:950f–h / **9**:130g–131a / **9**:611g–612c / **10**:821f–822a / **18**:1085g–1086f
b. Direct development: gradual and direct transformation of the embryo through a juvenile period		**5**:642b–d	**1**:1006f–1007e / **14**:1017f–1018d / **18**:450f–g
c. Attainment of mature functional and reproductive capacity as marking the pinnacle of development and morphogenesis and, for many animals, signalling the end of life		**5**:642d–f / **5**:526h–527a	**10**:822a–c / **14**:1018e–f
d. Human postnatal development [see 422.G.1.b.ii.]			
F. Aging and decline in animals [for aging in man, see 421.C.4.]	AGING **1**:299–304		**5**:643a–650f *passim*
1. Natural history of aging		**1**:299h–301f	
a. Reproduction and aging: the influence of population dynamics on the evolution of reproductive and bodily senescence		**1**:299h–300g / **5**:642d–f	**5**:649d–f
b. Longevity and aging: species differences in longevity and aging; the inheritance of longevity		**1**:300h–301f / **10**:914e–915d	
2. Senescence in mammals		**1**:301f–303b	
a. Changes in body composition, metabolism, and activity		**1**:301f–h	
b. Changes in structural tissues		**1**:301h–302b	
c. Tissue cell loss and replacement: comparison between renewal and nonrenewal tissues		**1**:302b–g	
d. Mammalian cell cultures: the limited growth potency of dividing cells		**1**:302g–303a	**18**:441h–442b

e. Changes in tissue and cell morphology; *e.g.*, atrophy of tissues

3. Aging as a loss of information: theories explaining the aging mechanism
   a. Aging of genetic information systems
   b. Aging of the immunological systems; *e.g.*, age-related autoimmune disease
   c. Aging of neural and endocrine systems; *e.g.*, decrease in hormone responsiveness
4. Causes of aging
   a. External environmental agents; *e.g.*, ionizing radiations, temperature
   b. Internal environment: consequences of metabolism
5. The duration of life
   a. General background; *e.g.*, the significance of individual existence, having a definite beginning and end
   b. Life-span in human beings: studies on longevity; actual versus possible life-span
   c. Life-span in subhuman animals: maximum and average longevity; environmental influences; patterns of survival
   d. Life-span in plants: the problem of defining age
6. The ultimate effect of aging: death

G. Specialized patterns of development
1. Regeneration
   a. The modes and significance of regeneration
   b. The regeneration process
   c. The range of regenerative capability
      i. In protists and plants
      ii. In invertebrates
      iii. In vertebrates
2. The healing processes and scar tissue formation
3. Aberrant development
   a. Animal malformations
   b. Plant malformations
4. Twinning: multiple births
5. Development in vitro: cell and tissue cultures
6. Development of transplanted tissues and organs
   [see 423.C.2.k.]

articles	article sections	other references
	1:303a–b	**2**:351h–352g *passim*
	1:303b–304a / **1**:305b–f	
	1:303b–f / **1**:305b–c	
	1:303f–g	
	1:303h–304a	
	1:304a–g	**10**:913c–f
	1:304a–f	
	1:304f–g	**17**:452g–h
LIFE-SPAN **10**:911–915		
	10:911c–f / **14**:830a–831b	**5**:645h–646a
	10:911f–913a	**1**:306b–c
	10:913b–914e / **1**:300h–301f / **15**:973b–e	**1**:930d–f / **4**:430h–431a / **13**:744f–g / **15**:729e–g
	10:914e–915g	**5**:6c–d / **13**:728c–d / **14**:502c–e
DEATH **5**:526–529		**5**:649d–f / **5**:670d–671c *passim*
REGENERATION, BIOLOGICAL **15**:576–580		
	15:576d–577d	**8**:441h–442b
	15:577d–578d	
	15:578d–580e / **12**:997f–g	**1**:302e–g / **5**:646c–d / **12**:978e–f
	15:578e–h	
	15:578h–579h / **14**:547d–f / **14**:850b–d	**1**:930f–931a
	15:579h–580c	**5**:846a–c
	16:827f–828a / **19**:1020a–e	**3**:27h–28d / **5**:846a–d / **9**:562h–563c
MALFORMATION, BIOLOGICAL **11**:378–380		**2**:1073a–1076e *passim* / **5**:645d–f / **8**:441g–h
	11:379a–380b / **6**:749c–f	
	11:380b–h	
	2:1148c–d / **6**:748f–749a	
TISSUE CULTURE **18**:438–442	**1**:302g–303a / **3**:1050g–1051d / **8**:444a–c	**19**:169g–h

Section 339. Heredity: the transmission of traits

[for Part Three headnote see page 130
for Division III headnote see page 154]

The articles and parts of articles referred to in Section 339 deal with seven main subjects: A, basic features of heredity; B, Mendel's experiments and their significance; C, the physical and chemical bases of heredity; D, the combined action of heredity and environment in producing an organism; E, changing heredity; F, heredity and evolution; and G, heredity and applied science.

The outline of subject A deals with early speculations on the nature of heredity; the biological bases of heredity; and the distinction between genotype and phenotype.

The outline of subject B begins with the discovery and universality of Mendel's laws of inheritance. It then treats apparent exceptions to Mendelian inheritance, such as those posed by the discovery of polygenic inheritance and of inheritance of characters from the cytoplasm of the germ cell.

The outline of subject C begins with the concept and the physical reality of the gene, and with the proofs of the gene–chromosome theory of heredity. It goes on to recent functional and structural analyses in genetics, touching upon the nature of the genetic material, the way information is encoded in the genes, and the mechanisms that translate this information into the developmental processes of an organism.

The outline of subject D treats theories of preformation and epigenesis; the genetic causes of diseases and defects; and the genetic and environmental components of heritability.

Subject E involves the need for occasional deviations (mutations) from the precision of the copying mechanism of the hereditary material.

A. Basic features of heredity

1. Early speculations on the nature of heredity; *e.g.*, views on the relative contributions of the female and male parents, the blood theory of heredity
2. The biological bases of heredity; *e.g.*, origin of the sex cells (gametes)
3. The distinction between genotype and phenotype: the interaction of heredity and environment in the development of organisms; the noninheritance of acquired characteristics

B. Mendel's experiments and their significance

1. The deduction of the rules governing inerhitance by following the changes of one easily visible trait at a time; the distinction between dominant and recessive traits; the mechanism and ratio of gene transmission as stated in Mendel's laws
2. Universality of Mendel's laws: their application to the inheritance of many kinds of characters in most organisms; the lack of clear-cut dominance or recessiveness in many of the traits of organisms
3. Apparent exceptions to Mendelian inheritance
   a. Polygenic inheritance: quantitative inheritance depending upon the cumulative action of many genes, each of which produces a small effect
   b. Cytoplasmic inheritance: the transmission of a trait by a component of the cytoplasm of the cell
   c. Sex-linked inheritance: traits affected by genes carried on the sex chromosomes
   d. Reduced viability of certain mutant individuals: lethal and sublethal effects

C. The physical and chemical bases of heredity

1. The gene–chromosome theory of heredity and its development
   a. Early views on the transmission of heredity
   b. The relation of genes to chromosomes
      i. Chromosomes as carriers of heredity
      ii. The parallel between the behaviour of chromosomes and genes during maturation of the sex cells: segregation of genes as a consequence of segregation of chromosomes

Subject F is heredity and evolution. The outline begins with the basic concepts of population genetics: of a Mendelian population as one in which matings among individuals can occur; of a gene pool as the sum of the genes carried by individual members of the population; and of gene frequency as a measure of genetic equilibrium. It then treats the interaction of the genetic processes in Mendelian populations with natural selection and Darwinian fitness; the biological consequences of the several varieties of natural selection; the genetics of race and species differences; and the origin of new species.

The outline of subject G begins with legal applications of genetics, as in disputed paternity cases, and with the genetic counselling sought by prospective parents. It goes on to the effects of outbreeding on the vigour, viability, and fertility of the offspring, and to different theories concerning the ways by which hereditary variability is maintained in populations of sexually reproducing species. Finally, it treats genetic improvements of selected organisms, such as domestic animals.

articles	article sections	other references
HEREDITY **8**:801–802		
	8:801c–g	**2**:1024e–g
	3:1055f–1056b/ **16**:586b–e	**7**:996h–998c *passim*/ **16**:585h–586a
	8:801g–802f	**2**:576c–d/**5**:650d–f/ **10**:899c–e/**12**:754g–755a
HEREDITY **8**:802–805	**7**:998c–1001d	**8**:1147a–1151e *passim*/ **11**:899a–c/ **14**:774c–777b *passim*
	8:802g–804b/ **8**:1150d–1151e	**2**:1024h–1025c/ **7**:998d–1000f
	8:804b–f/ **4**:911h–912c	**2**:1073d–f
	8:804f–805c/ **7**:996a–b	
	8:804f–805b/ **14**:497c–e	**1**:904e–905b
	8:805b–c/ **7**:987f–g	
	8:807c–808a	**7**:1000f–1001b
	7:1001b–d	**2**:1073f–g/**12**:756a–b/ **15**:387a–c/**19**:168g–169a
GENE **7**:981–991	**8**:805d–808h	
	7:981d–984a	
	7:981d–982f	
	7:982g–984a/ **8**:805d–806a	
	8:805d–g	**3**:1048a–c/**7**:996d–997a/ **10**:895b–d
	7:982g–983c	**8**:805g–806a

	articles	article sections	other references
iii. The linear order of genes and genetic maps		**7**:983c–984a / **2**:1147b–g / **19**:169a–e	
c. Proof of the gene–chromosome theory; *e.g.*, linkage of traits, genetic sex determination, development of gynandromorphs		**8**:806b–808a / **2**:1076b–e / **16**:591c–592d	**7**:998a–c / **7**:1000f–1001b
2. The nature of the gene		**7**:984a–987g	
a. Functional analysis: clarification of genetic mechanisms		**7**:984b–985h	
i. Recombinational ability in bacteria: gene transfer		**7**:984b–985d	
ii. Information transferral: nucleic acids as the carriers of genetic information		**7**:985d–h / **8**:808b–c / **15**:676e–f	
b. Structural analysis		**7**:985h–987g	
i. Molecular structure: the Watson–Crick model, which permits an explanation of the mechanism for precise replication of deoxyribonucleic acid (DNA)		**7**:986a–f / **15**:676d–e	**3**:1051f–1052b
ii. Changes in chromosomes and their significance: the role of bacteriophage (bacterial virus) studies involving mutation, transduction, and complementation		**7**:986g–987f / **12**:754c–755a / **19**:167g–168c	**2**:576d–f
iii. Extranuclear genetic material in higher organisms		**7**:987f–g	
3. Genes and development		**7**:987g–991c / **5**:648f–649c / **8**:808c–h / **8**:1015h–1016a	**1**:303b–e
a. Gene action		**7**:987g–988e / **11**:1044h–1046e	
i. The one gene–one enzyme hypothesis		**7**:987g–h / **3**:1050c–e	**8**:808d–g
ii. The determination of protein structure and synthesis		**7**:987h–988e	**5**:649a–c / **11**:1045h–1046e
b. The genetic code		**7**:988f–990c / **10**:902b–f	**10**:895e–f / **10**:895h–896a
c. The regulation of genes: the operon system and repressor mechanisms		**7**:990d–991c	
D. The combined action of heredity and environment in producing an organism	HEREDITY **8**:808–810	**6**:1025c–f	
1. Theories of preformation and epigenesis: the role of environmental influences on development		**8**:808h–809c	
2. Heredity in health and disease: genetic causes of diseases and defects		**8**:809d–h / **1**:301c–f / **1**:904e–h / **3**:765d–f / **5**:851c–d	**2**:1073a–1074b *passim*
3. The genetic and environmental components of heritability: the nature–nurture problem		**8**:809h–810h / **7**:1002c–1003h / **8**:1146e–h	**8**:1148b–1149h
E. Changing heredity: the need for occasional deviations (mutations) from the precision of the copying mechanism of the hereditary material	HEREDITY **8**:811	**7**:1004e–1005g / **11**:428c–h / **12**:756a–c / **15**:379h–381c	
F. Heredity and evolution	HEREDITY **8**:811–816		**11**:428h–430a *passim*
1. A Mendelian population as one in which matings among individuals can occur: a gene pool as the sum of the genes carried by individual members of the population; gene frequency as a measure of genetic equilibrium		**8**:811e–812c / **7**:1007h–1009e	**5**:32d–g *passim*
2. Natural selection and Darwinian fitness, or adaptive value, of one or more genotypes		**8**:812c–813e	
3. Varieties of natural selection and their operation		**8**:813e–815c	**7**:14g–15g
4. Genetics of race and species differences: the origin of new species		**8**:815c–816e / **7**:17c–g	**17**:452c–e
G. Heredity and applied science	HEREDITY **8**:816–819		

	articles	article sections	other references
1. Medicolegal applications and genetic counselling [see also 425.D.3.b.]		**8**:816f–817b	
2. Outbreeding and inbreeding: the evidence that the progenies of matings of closely related parents tend to be less vigorous than the offspring of unrelated parents		**8**:817b–e/ **14**:744c–f	**1**:906a–h
3. Genetic load and hybrid vigour: the maintenance of hereditary variability		**8**:817f–818b/ **14**:498h–500c	**7**:1009c–e
4. Genetic improvements of selected organisms			
a. In domestic animals and cultivated plants; *e.g.*, pets, livestock, crops		**8**:818b–819e/ **5**:941e–h **8**:818b–e/ **1**:341a–343e/ **1**:903e–904b/ **1**:907d–h/ **3**:999a–c/ **5**:934f–935b/ **14**:496e–497b	
b. In organisms of experimental interest that elucidate hereditary principles; *e.g.*, *Drosophila*, *Neurospora*, bacteriophage		**19**:168e–169e	**7**:982g–991c *passim*/ **15**:124d–e
c. In man [see 414.A.3. and 355.B.3.]			

Division IV. Behavioral responses of organisms

[for Part Three headnote see page 130]

Several of the sections in Division III dealt with the structure and internal functioning of organisms. The outlines, and the articles and parts of articles referred to, in the three sections of Division IV deal with the external actions and reactions of living things in relation to changes in their environment.

Section 341 first deals with patterns of stereotyped responses in plants and animals—unlearned behavioral reactions of organisms to some environmental stimulus. It goes on to the diversity, the classification, and the components of animal behaviour. It then treats hormonal and nervous control of behaviour.

Section 342 deals with the development and range of behavioral capacities. It first treats basic behavioral activities of individuals, such as food procurement, locomotion, and aggressive behaviour. It goes on to the types of animal learning and the behavioral and physiological aspects of animal learning. It then deals with the behaviour of animals in groups, treating animal communication, the kinds of animal societies, and the dynamics of animal social behaviour.

Section 343 deals with the evolution of behaviour. It treats evidence for the genetic determination of behaviour; phyletic patterns in the evolution of learning; and the evolutionary origins and evolutionary consequences of behaviour patterns.

Section 341. Nature and patterns of behavioral responses 182
342. Development and range of behavioral capacities: individual and group behaviour 184
343. Evolution of behaviour 189

Section 341. Nature and patterns of behavioral responses

[for Part Three headnote see page 130]

The articles and parts of articles referred to in Section 341 deal with three main subjects: A, patterns of stereotyped response; B, diverse conceptions of behaviour; and C, hormonal and nervous control of behaviour.

The outline of subject A begins with plant movements, covering tropic movements, nastic movements, nutation, and other autonomous movements. Going on to animal movements, the outline treats reflex and reflexlike activities, such as kineses, which are undirected velocity changes caused by changes of intensity in the stimulus; taxes, which are oriented locomotory reactions to various kinds of stimuli, such as moisture, heat, or light; and the characteristics and varieties of instinctive behaviour. The outline ends with photoperiodism, responses of organisms to relative length of light and dark periods, exemplified in plants by flowering, fruit-set, and abscission, and in animals by bird migration.

The outline of subject B begins with the diversity of animal behaviour and with several ways of classifying it. It then deals with the components of animal behaviour—various kinds of

stimuli initiating selective responses, and kinds of internal drives and motivations that initiate, control, and redirect behavioral changes.

The outline of subject C first deals generally with the interaction of the endocrine and nervous systems in the control of behaviour.

A. Patterns of stereotyped response: unlearned behavioral reactions of organisms to some environmental stimulus

1. Plant movements
   a. Tropic movements: curvature of growing parts of plants classified according to spatial orientation (*e.g.*, orthotropism, plagiotropism,) or to type of stimulus (*e.g.*, phototropism, geotropism)
   b. Nastic movements: movements whose direction is limited by the structure of the responding organ
   c. Nutation: rhythmic or periodic movements exhibited by shoot apexes during growth
   d. Other autonomous movements: turgor movements, hydration movements, circadian rhythm, movements in insectivorous plants
2. Animal movements
   a. Reflex and reflex-like activities; *e.g.*, kineses, or velocity changes of an entire animal based on intensity of the stimulus
   b. Taxes: oriented locomotory reactions in response to a stimulation
   c. Fixed action patterns and instinct
      i. Characteristics of instinctive behaviour: heritability, complexity of pattern, adaptive function, and stability under external change
      ii. Varieties of instinctive behaviour: reflex activity, fixed action patterns, and modifiable action patterns
      iii. Modification of instinctive behaviour by experience
3. Photoperiodism: responses of organisms to relative length of light and dark periods
   a. In plants: flowering, fruit-set and abscission, or the dropping of plant parts
   b. In animals: bird migration, reproduction

B. Diverse conceptions of animal behaviour

1. The variety of animal behaviour: the relation between animal behaviour and human behaviour; behaviour as an aid in taxonomy; contrast between simple behaviour, as in taxis or kinesis, and complex behaviour, such as nest building
2. Classification of behaviour
   a. Ways of classifying behaviour: by the immediate causation, by the similarity of evolutionary history, or by the similarity of function
   b. The influence of genetics and experience: classification according to the nature of the changes occurring during evolution or ontogeny; innate versus learned behaviour
3. Components of behaviour
   a. Fixed action patterns: behaviour that is independent of environmental stimuli for its form, although such stimuli may be responsible for its elicitation

It treats hormonal influences on such animal activities as migration, territoriality, or sexual behaviour. It then treats the nervous system in relation to behaviour—its role in receiving information, processing it in the brain and spinal cord, and initiating the appropriate response.

articles	article sections	other references
STEREOTYPED RESPONSE **17**:671–676		**12**:975f–h
	17:672d–674g	
	17:672f–673f	**5**:664a–b
	17:673f–h	
	17:673h–674b	
	17:674b–g	**12**:960b–e
	17:674h–676b / **11**:23g–24a	**2**:804d–e / **12**:975f–977b *passim*
	17:674h–675b	**9**:628h–629b / **12**:976g–h / **12**:1004a–f / **12**:1009b–d / **12**:1010f–g / **14**:438f–h
	17:675b–676a	**3**:115c–d / **4**:177h–178b / **11**:23h–24a
INSTINCT **9**:628–630	**17**:676b / **6**:760b–d	**7**:210h–211a / **12**:564e–f
	9:628c–g / **2**:809e–810c	
	9:628g–630e	**5**:361a–g
	2:810e–811h / **2**:812c–g / **16**:945a–d	**4**:1018c–e
PHOTOPERIODISM **14**:352–353		
	14:352c–g / **5**:669e–671b / **16**:487c–f	
	14:352g–353e	**12**:183g–184b / **15**:680b–d
BEHAVIOUR, ANIMAL **2**:804–814		
	2:804a–e	**12**:975g–976b
	2:804f–805c	
	2:804f–805a	
	2:805a–c	**14**:776b–c
	2:805d–809d	
	2:805d–g	**9**:629b–e

	articles	article sections	other references
b. Key stimuli: pertinent stimuli that will initiate a selective response		**2**:805g–806h	
c. Drive and motivation: internal changes that initiate behavioral changes		**2**:807a–c / **1**:297f–298a	**6**:760f–761e *passim* / **10**:737g–738a / **12**:559c–561a *passim*
d. "Supernormal" stimuli: enhanced stimulation which is even more effective than normal in triggering particular behaviours		**2**:807c–g	
e. Movement and control systems		**2**:807g–808b / **8**:1014h–1015b / **11**:24a–c	**9**:628g–630e *passim* / **12**:557h–558a
f. Behavioral chains: series of responses dependent upon appropriate stimuli		**2**:808b–d	**9**:628h–629b
g. Simultaneous stimulation: conflict between drives activated simultaneously		**2**:808d–h	
h. Redirection and displacement: redirection of behaviour to another object when the original behaviour is prevented; resolution of a conflict situation in which a seemingly irrelevant activity is performed		**2**:808h–809b	
i. Transitional activity: resolution of a conflict situation in which the environmental stimulus becomes unavailable during the course of response		**2**:809b–d	
4. Evolution and development of behaviour [see also 343]		**2**:809d–812g	
C. Hormonal and nervous control of behaviour	BEHAVIOUR, ANIMAL **2**:812–814		
1. Interaction of endocrine and nervous systems		**2**:812g–813c / **8**:1074c–f	**9**:629a–e / **12**:992g–h
2. Hormonal influences on behaviour; *e.g.*, by sex hormones		**2**:813d–814a / **1**:298a–b	**2**:542g–h / **12**:183g–184b / **15**:680c–e
3. The nervous system and behaviour: the role of the nervous system in receiving information, processing it in the brain and spinal cord, and initiating the appropriate response		**2**:814a–g / **12**:975f–977b / **15**:159c–160a	**2**:356b–d / **6**:763d–766f *passim* / **12**:982d–986f *passim* / **15**:161c–h
a. The integrative capabilities and hierarchical organization of the nervous system		**12**:991f–992a	**15**:159g–160a
b. Relation of the complexity of the nervous system to behaviour		**10**:740a–g	**7**:91b–d / **11**:409e–f / **12**:976h–977b / **12**:990d–991f *passim*

Section 342. Development and range of behavioral capacities: individual and group behaviour

[for Part Three headnote see page 130
for Division IV headnote see page 182]

The articles and parts of articles referred to in Section 342 deal with three main subjects: A, basic behavioral activities of individuals; B, higher behavioral characteristics of individuals; and C, the behaviour of animals in groups.

The outline of subject A treats food getting, locomotion, avoidance behaviour, aggressive behaviour, behaviour related to habitat, and behaviour related to reproduction.

The outline of subject B begins with the types of learning, the periods of sensitization during which organisms can perceive and change their behaviour as a result of their perceptions. It first treats habituation; and then, dealing with associative learning, it treats classical conditioning, trial-and-error learning, latent learning, insight learning, imitation, tool use and construction, perceptual learning, and imprinting. The outline then treats stimulus–response and cognitive mechanisms and the neurophysiological mechanisms involved in animal memory and learning.

The outline of subject C begins with distinctions between groups of social animals and groups of nonsocial ones, and with the signs of sociality. Dealing with biocommunication as a common feature of social behaviour, the outline covers the role of information, the functions and processes of animal communication, and the development and evolution of communication. The treatment of the range of social behaviour covers parental societies; societies with sexual bonds; nonfamilial social bonds, arising from spacing or swarming; and certain interspecific associations, such as symbiotic associations. Finally, the outline treats the advantages and disadvantages of animal social behaviour; the factors in its development; and the evolution of sociality.

	articles	article sections	other references
A. Basic behavioral activities of individuals			
1. Food getting	FEEDING BEHAVIOUR **7**:207–212		

	articles	article sections	other references
a. Nutritional requirements of higher organisms		7:208a–b	13:401c–407f *passim*
b. Types of food procurement: structural mechanisms for dealing with different forms of food; selective feeders versus filter feeders		7:208c–209e / 2:1055b–c / 6:180c–e / 7:949b–950f / 11:406e–f / 12:326e–g / 19:808c–f	2:1090b–d / 3:98e–f / 3:1148g / 5:314e–f / 5:782e–785a *passim* / 5:822c–d / 7:334b–c / 13:759f–g / 14:49d–g
c. Regulation of food intake: the regulation of feeding to metabolic rate and the physiological mechanisms of feeding motivation		7:209e–210g / 7:546 b–e / 13:423f–424c	
d. Selection of food items and food specificity: learned versus innate processes		7:210g–211e / 4:176f–g / 16:553c–f	4:1028g–h
i. In vertebrates		7:210h–211d / 11:405e–g / 14:1020f–1021d / 15:730h–731a	2:74d–75b / 4:432h–433c
ii. In invertebrates		7:211e	
e. Hunting behaviour of predatory animals		1:1069a–1070a / 16:564g–565e	3:928b–c / 3:936c–e / 5:287f / 16:494g–495e *passim* / 16:943h–944b
f. Specialized aspects of feeding behaviour		7:211f–212a / 14:1021b–f / 15:973e–g	
i. Relation of feeding to other functions		7:211f–g / 12:184f–h	5:911g–912b / 12:183h–184c
ii. Food-directed activities in social situations		7:211h–212a	9:129b–c / 15:688a–b
2. Locomotion	LOCOMOTION 11:15–24	11:404g–405e / 15:731a–732b	1:1004a–b
a. General considerations		11:15b–h	
i. Physical restraints to movement		11:15c–f	7:544h–545c / 14:995b–f
ii. Axial and appendicular locomotion		11:15g–h / 16:822d–823b	1:931a–b
b. Aquatic locomotion: bottom walking, bottom creeping, and swimming		11:15h–18g	
i. In micro-organisms		11:15h–16f / 15:125h–126b	
ii. In invertebrates		11:16f–17f / 3:1150h–1151d / 6:180f–181a / 12:326g–327a	4:770e–g / 5:544e–f / 7:952h–953a
iii. In vertebrates		11:17g–18g / 7:331h–332c / 19:807b–f	1:943c–d / 13:760h–761b / 15:731g–732a
c. Fossorial locomotion: burrowing and boring		11:18g–19f	1:931a–c / 2:1087b–e / 2:1088b / 9:624d–e / 15:972a–d / 16:1014g
d. Terrestrial locomotion		11:19f–21g	15:731a–e
i. Walking and running		11:19f–20e	2:66h–67a / 2:74b–d / 14:1020a–b
ii. Saltation (hopping)		11:20e–21a	15:972e–f
iii. Crawling		11:21a–g / 16:562c–h	
e. Arboreal and aerial locomotion: climbing, leaping, brachiating, and flying		11:21g–23f / 4:39a–b / 7:147b–f	1:942g–943a / 2:67a–c / 2:270f–h / 2:1055d–e / 4:431c–e / 9:615c–d / 14:1018g–1019h / 15:16a–d / 15:731e–g / 15:732a–b / 15:971g–972a / 16:286d–h
f. Directional control		11:23f–24c	4:432c–h
3. Avoidance behaviour: behaviour induced by aversive stimuli; patterns of active and passive avoidance	AVOIDANCE BEHAVIOUR 2:541–543		
a. Factors that elicit and regulate avoidance behaviour; *e.g.*, specific stimuli, hormones		2:541h–542h	1:296h–297a
b. Patterns of avoidance behaviour and their functions; *e.g.*, fleeing and escape, freezing, armour, warning behaviour		2:542h–543h / 12:215d–g / 14:823c–824e	4:924c–e / 4:1014d–h / 13:746g–h / 15:730f–h / 16:944f–945a

	articles	article sections	other references
4. Aggressive behaviour: attack and defensive threats	AGGRESSIVE BEHAVIOUR **1**:295–299		**2**:73b–c /**4**:37b–d /**13**:759b–c / **15**:18a–b /**15**:729h–730f / **19**:806a–e
a. Causation: stimulus, physiological effects, and threat displays		**1**:296e–298d / **19**:544b–e	**4**:927e–f /**4**:1014h–1015c / **12**:875c–876a /**14**:449f–g
b. Evolution in invertebrates: functional modifications		**1**:298d–299e	
5. Behaviour related to habitat			
a. Habitat selection		**5**:911e–912c	**4**:431e–432a /**15**:973h–974c / **16**:944d–e
b. Migratory behaviour		**12**:177c–182e / **14**:836a–d	**1**:942b–e /**4**:432a–b / **10**:741c–d
c. Homing and local navigation		**12**:182e–183g / **12**:902c–e	**4**:432c–h /**9**:129d–h / **10**:741d–743e /**17**:50e–g / **17**:51d–f
6. Behaviour related to reproduction	REPRODUCTIVE BEHAVIOUR **15**:679–689		**15**:702d–g
a. General features: the dominance of sexual reproduction; natural selection and reproductive behaviour; environmental and hormonal influences on reproductive behaviour		**15**:679f–680e / **16**:590f–591c	
b. Modes of sexual attraction: clues by which organisms advertise their readiness to engage in reproductive activity; courtship		**15**:680e–683c / **16**:589c–590a / **16**:940g–941e	**1**:296f–g /**4**:926f–927b / **4**:927d–h /**4**:1013e–1017b *passim*
c. Postfertilization behaviour: protective adaptations; parental or group care of eggs and young		**15**:681g–683c / **16**:936h–940f	**2**:1054g–1055a /**12**:217f–g
d. Reproductive behaviour in invertebrates		**15**:683c–686g	
i. In the lower invertebrates; *e.g.*, sponges, cnidarians (coelenterates), segmented worms, mollusks		**15**:683c–684f	**1**:928g–929f /**3**:1151f–h / **4**:769d–f /**7**:950h–951h
ii. In arthropods		**15**:684g–686g / **2**:792b–d	**1**:1062a–d /**1**:1067e–1068e / **2**:66d–g /**5**:543h–544c / **9**:612c–d /**10**:822f–g / **13**:745a–b /**16**:401f–h
e. Reproductive behaviour in vertebrates		**15**:686g–689a	
i. In fishes and amphibians		**15**:686g–687e / **7**:332c–f / **16**:495e–g	**1**:1004d–1007e *passim* / **13**:758g–759b /**14**:48d–49a / **18**:1085e–f
ii. In reptiles		**15**:687e–g / **5**:288a–b / **15**:727h–729d / **16**:561c–g	**4**:72e–h /**16**:285b–f
iii. In birds		**15**:687g–688e / **4**:612f–613c / **7**:147f–148c / **7**:855c–856c / **8**:445d–446g / **13**:1053d–1054c / **14**:448f–449h / **15**:139f–h	**1**:941a–e /**2**:1054c–1055a / **4**:35d–39a *passim* / **4**:612d–e /**4**:934c–935d / **5**:360a–361d /**14**:596d–g / **17**:498f–499d /**17**:735e–g
iv. In mammals		**15**:688e–689a / **14**:1017a–g / **15**:975a–f	**2**:72c–73h /**3**:928d–h / **3**:929h–930a /**3**:936e–f / **3**:937h–938d /**4**:430c–f / **12**:385c–g /**14**:84d–g / **19**:806f–h
f. Evolution of reproductive behaviour [see 343.C.2.b.]			
B. Higher behavioral characteristics of individuals			
1. Types of learning: periods of sensitization during which organisms can perceive and change their behaviour as a result of their perceptions	LEARNING, ANIMAL **10**:731–746	**2**:810e–811h / **10**:755a–e	
a. Habituation: the relatively persistent waning of a response as a result of repeated or continuous stimulation that is not associated with any kind of reward or reinforcement		**10**:731g–732b	**2**:356d–357g *passim* / **2**:810e–f
b. Associative learning		**10**:732c–736h	**10**:756c–759f *passim*
i. Classical conditioning: the process by which an animal acquires the capacity to respond to a given stimulus with the same reflex action that can be elicited by another stimulus		**10**:732c–g / **12**:219c–e	**2**:542f–g /**2**:810f–811a / **12**:1036f–1037a

	articles	article sections	other references
ii. Trial-and-error learning, or operant conditioning; the process of selecting from initial, unlearned behaviour those responses that are effective for obtaining a reinforcement (*i.e.*, a reward)		**10**:732h–733g/ **18**:598g–h	**12**:214d–e/**12**:559g–h/ **12**:1036h–1037a
iii. Latent learning: the association of stimuli in absence of any reward		**10**:733g–h	**2**:811b–d
iv. Insight learning: the sudden production of a new adaptive response that is not arrived at by trial-and-error behaviour		**10**:733h–734c	**2**:811d–e
v. Imitation: social facilitation, local enhancement, and true imitation		**10**:734c–g	**16**:944b–c
vi. Tool use and construction: the nature of true tool using and the ability to make tools		**10**:734g–735b/ **8**:1026g–1027c	
vii. Perceptual learning: the way in which stimuli are perceived as a result of continued or repeated exposure to them; discrimination of brightness and of form		**10**:735c–g/ **10**:747c–748d	**14**:38f–44b *passim*/ **17**:378d–381f *passim*
viii. Imprinting: the process by which an animal may develop a preference for any moving object during a very early and brief sensitive period		**10**:735g–736h	**2**:811e–h/**10**:759c–d
2. Behavioral and physiological aspects of learning: effects of limitations in sensory and perceptual mechanisms	LEARNING, ANIMAL **10**:736–739		
a. Stimulus–response and cognitive mechanisms: comparison of classical and operant conditioning; role of reinforcement in motivating learning; the ability to form concepts		**10**:737d–738c/ **4**:1064c–e/ **10**:758b–g	**10**:757c–d
b. Neurophysiological mechanisms: memory and learning; problems in explaining neurophysiological learning mechanisms		**10**:738d–739d/ **15**:161h–163b/ **18**:600a–f	**1**:307b–c/**10**:758g–759a
3. Evolution of learning ability and intelligence [see 343.B.]			
C. The behaviour of animals in groups	SOCIAL BEHAVIOUR, ANIMAL **16**:933–945		
1. Distinctions between groups of social animals and groups of nonsocial ones		**16**:933e–936c/ **2**:1044h–1045c/ **16**:561a–b	
a. The significance of the distribution, or grouping, of an animal within its needed habitat		**16**:933e–934a	**5**:908g–909c
b. The importance of the constancy of the distance an animal maintains from its neighbours		**16**:941e–942a/ **14**:837b–g	**1**:296f–g
c. Signs of sociality: lack of dominance hierarchy, occurrence of division of labour, and altruistic behaviour		**16**:934b–936c/ **9**:129b–c/ **9**:1052d–1053d/ **14**:836h–837b	**4**:1015c–g
2. Biocommunication as a common feature of social behaviour	COMMUNICATION, ANIMAL **4**:1010–1019		
a. The role of information: an exchange during interactions among individuals as they cope with the social circumstance of their environment		**4**:1010g–1011b	**4**:1005a–c/**16**:935b–c
b. The functions of communication; *e.g.*, identification, establishment of social order, coordination of group activity		**4**:1011b–1012a/ **1**:299c–e	
c. The process of animal communication		**4**:1012a–1018a/ **17**:477a–b	
i. Modes of information transfer: sound, vision, chemicals, and electrical energy		**4**:1012a–1013e/ **4**:176h–177b/ **15**:680e–681a/ **16**:555b–d/ **17**:41c–42d/ **17**:477h–478a	**1**:1004d–g/**4**:182c–183b/ **4**:186g–187a/**4**:833d–e/ **13**:747f–g/**14**:146b–c/ **13**:761d–762a
ii. The role of displays: the display repertoire, and the information content of displays		**4**:1013e–1016f/ **9**:129d–h/ **17**:734g–735d/ **19**:807f–h	**1**:940g–941e/**2**:1054c–e/ **13**:1054c–d/**14**:83e–f/ **15**:727h–728c/ **15**:729h–730d/**16**:285b–e

	articles	article sections	other references
iii. The interpretation of information: the study of meanings of information to animals		**4**:1016f–1017b	
iv. Sources of information: modified displays, functional activities and behaviour, and historical information		**4**:1017b–1018a / **1**:298c–d	**15**:681c–g
d. The development and evolution of communication; *e.g.*, the development of song in young birds; evolutionary precursors of displays		**4**:1018a–1019g / **15**:689b–d	**10**:734e–g / **10**:746a–d
e. Human communication [see 441 and 442]			
3. The range of social behaviour among social and nonsocial animals		**16**:936d–943e	
a. Parental societies, in which parent and offspring stay together for some period of time		**16**:936h–940f	
i. Formation of aggregations, or colonies, among simple organisms such as bacteria, protozoans, sponges, and cnidarians (coelenterates)		**16**:937a–938a / **3**:355a–356a	**6**:181e–f
ii. Arthropods as the lowest animal group in which extended associations occur between parents and offspring; *e.g.*, advanced societies of ants, bees, and wasps with various types of care for the young and with division of labour determined by such factors as polymorphism and age		**16**:938b–939d / **2**:791g–792e / **9**:128b–129c / **9**:613b–d / **9**:1050f–1051e	**1**:1068b–e / **7**:211h–212a
iii. The variety of parental societies among vertebrates and their predecessors; *e.g.*, care of young by males among fishes; bands and troops among mammals		**16**:939d–940f / **15**:2f	**1**:1006c–e / **2**:1054g–1055a / **11**:403h–404a / **13**:759a–b / **14**:84f–g
b. Societies with sexual bonds: the role of behavioral patterns in bringing together males and females and their sex cells at the right time		**16**:940g–941e / **15**:681b–g	
i. Individual courtship as a way to get male and female of the same species together as efficiently as possible		**16**:940g–941a / **16**:589c–590a	**4**:1015c–g
ii. Group courtship as a way to synchronize breeding and to perpetuate the genetic superiority of the most dominant males		**16**:941a–e / **15**:689e–g	
c. Nonfamilial social bonds: social behaviour in associations not necessarily related by parental or sexual bonds		**16**:941e–942h	**3**:928b–c / **5**:911g–h
i. Spacing: the distinctions between aggregations of colonies and interactions between unrelated and unmated individuals requiring personal space or territory		**16**:941e–942a	
ii. Swarming: communal mating displays of arthropods, especially fireflies, and vertebrates such as birds; hordes of migratory locusts; flock formation in birds; herds and packs of mammals; troops among primates		**16**:942a–h / **4**:765h–766e / **10**:478d–f / **11**:403h–404a	**2**:72b–d / **10**:745g–746a / **14**:83g–h / **15**:688c–e / **19**:806a–b
d. Interspecific associations: symbiosis; complex asocial associations among animals such as flies, other insects, and birds around army ants or driver ants; mixed flocks of mammals and birds		**16**:942h–943e / **14**:838e–f	**2**:1049c–1051f *passim*
4. Dynamics of social behaviour		**16**:943e–945f	
a. A comparison of the disadvantages and the advantages accompanying social behaviour		**16**:943e–945a	
i. Disadvantages: utilization of energy and interference with activities necessary for life (*e.g.*, eating); increase in susceptibility to disease and predation and in chances for conflict		**16**:943e–g	
ii. Advantages: combining of desirable genes that might not otherwise get together, care and teaching of young, selection of habitat and shelter, avoidance of small hazards such as excessive cold, removal by grooming of parasites, and protection against predators		**16**:943g–945a	
b. Factors in the development of social behaviour: instinct and learning		**16**:945a–d / **4**:1018b–e / **10**:735g–736h	**9**:628g–629e / **10**:744c–746a / **14**:84f–g
c. The evolution of sociality: social behaviour as an adaptive advantage [see 343.C.2.d.]			

Section 343. Evolution of behaviour

[for Part Three headnote see page 130
for Division IV headnote see page 182]

The articles and parts of articles referred to in Section 343 deal with three main subjects: A, evidence of the genetic determination of behaviour; B, the influence of experience on behaviour; and C, evolutionary origins and evolutionary consequences of behaviour patterns.

The outline of subject A treats the evidence of genetic determination of behaviour afforded by selection in domestic animals and by behaviour in hybrids.

The outline of subject B first deals with learning in invertebrates and the evolution of neural structures. It then treats general features of learning in vertebrates, and a comparison of the higher animal groups in terms of the exceptional features of their learning ability.

The outline of subject C first deals with the evolutionary origins of communication, as exemplified in display behaviour, mimicry, displacement activities, or ritualization. It then treats aggressive, reproductive, migratory, and social behaviour as factors of greater or lesser influence in evolution.

	articles	article sections	other references
A. Evidence of the genetic determination of behaviour		**2**:809d–810c	**2**:804b–c/**9**:628c–d/ **10**:899c–e/**16**:945a–c/ **17**:671g–672b
1. Selection in domestic animals		**2**:809e–g/ **5**:935a–b	**5**:931h–932c
2. Behaviour in hybrids		**2**:809g–810c	
B. The influence of experience on behaviour: phyletic patterns in the evolution of learning		**2**:810e–811h/ **10**:739d–746e	
1. Learning in invertebrates: evolution of neural structures; organizational patterns by neural elements		**10**:739d–740d	
2. Learning in vertebrates		**10**:740d–746e	
a. General features: the nature of intelligence; learning to learn		**8**:1090a–c/ **10**:740d–h/ **18**:599a–c	**5**:931f–g
b. Comparison of the higher animal groups in terms of the exceptional features of their learning ability		**10**:740h–746e/ **18**:599d–e	
i. Fishes		**10**:740h–741g	
ii. Birds		**10**:741g–744c	**4**:1018c–e
iii. Mammals		**2**:811h–812c/ **10**:744c–746e	**8**:1152e–1153g *passim*/ **11**:409e–f/**11**:420f–g/ **19**:806c–d
C. Evolutionary origins and evolutionary consequences of behaviour patterns			
1. Evolutionary origins of communication; *e.g.*, display behaviour, mimicry, displacement activities, ritualization		**4**:1018f–1019g/ **5**:930h–931e	**4**:1013f–1014a/**15**:679h–680a
2. Behaviour as a factor in evolution			
a. Aggressive behaviour		**1**:298d–299e	
b. Reproductive behaviour		**15**:689a–g	
c. Migratory behaviour		**12**:184c–h	
d. Social behaviour		**16**:945d–f	**5**:929h–930a/**9**:128c–f

Division V. The biosphere: the world of living things

[for Part Three headnote see page 130]

Division I of Part Three dealt with the nature, origin, evolution, distinctive properties, and classification of living things. Divisions II, III, and IV dealt with life at the molecular, cellular, organismal, and behavioral levels.

The outlines, and the articles and parts of articles referred to, in the five sections of Division V deal with the world of living things taken as a single system of biotic and environmental interactions and interdependencies.

Section 351 begins with the levels of organization within the biosphere and with the energy flow and the cycling of matter in the biosphere. It then deals with the interactions of the biotic and the abiotic components of an ecosystem—a collection of integrated biological communities taken together with the nonliving factors in their environments.

Section 351. Basic features of the biosphere 190
352. The community: a collection of interacting populations 192
353. Hazards of life in the biosphere: disruptions and death 195
354. Patterns of life in the biosphere 196
355. Man's place in the biosphere 200

Section 352 begins with the properties of biological populations, groups of interacting individuals of the same species; and of biological communities, which contain interacting populations of two or more species. It next treats the positive and negative intraspecific and interspecific biotic reactions in populations and communities. It then treats the structure, functioning, growth, and classification of biological communities.

Section 353 first deals with the ecology of disease and then treats the diseases of plants and the diseases of animals.

Section 354 treats terrestrial and aquatic biocycles; factors that affect the distribution of organisms; and the regional differentiation in faunal and floral distribution.

Though what is specific to human life is the subject of Part Four, the last section of Part Three, Section 355, deals with man's place in the biosphere. It treats the qualities that set man apart in the biosphere; the influence of the human species on the modification of the environment; plant and animal domestication and breeding; and the conservation of natural resources.

Section 351. Basic features of the biosphere

[for Part Three headnote see page 130
for Division V headnote see 189]

The articles and parts of articles referred to in Section 351 deal with two main subjects: A, the biosphere; and B, the ecosystem, the most inclusive unit in the biosphere. Less inclusive units, populations and communities, are dealt with in Section 352.

The outline of subject A begins with the preconditions of the biosphere—the physical and chemical facts about the Earth and the solar system that facilitate life in both the aquatic and terrestrial realms. It then sets forth the levels of organization within the biosphere: populations, made up of interacting and interdependent individual organisms of the same species; communities, composed of two or more interacting and interdependent populations; and ecosystems, more or less self-contained units of interaction between several communities and their environments. The outline next deals with the patterns of energy transformations and transfers in the biosphere. Finally, it treats the cyclic flow of the chemical materials needed for life, covering the carbon and oxygen cycles, the nitrogen cycle, the sulfur cycle, the water cycle, and the sedimentary cycles of essential minerals.

The outline of B begins with a historical review of the ecosystem concept. It goes on to the biotic components of the ecosystem—producer, consumer, and decomposer organisms linked in great food chains. It next treats the limiting effects and the influence in ecosystems of eleven abiotic components, such as pressure and temperature, water, or fire; the influence of organisms on the atmosphere, hydrosphere, and lithosphere; and the variable subregional microclimates. The outline next deals with productivity in ecosystems as a function of the rates in which energy is fixed, transformed, transferred, and reused. Finally, it treats the features of the ecosystem as disclosed by the use of models, and the stages in the development of ecosystems.

articles	article sections	other references
BIOSPHERE **2**:1037–1044		
	2:1037h–1038a	
	2:1038b–f	
A. The extent of the biosphere		
1. Preconditions of the biosphere: the Earth as an ideal medium for life	**2**:1038f–1039g	**4**:1029e–1030g *passim* / **6**:282d–g
2. The levels of organization within the biosphere		
a. The biocycle: a collection of biotic realms [see 354]	**2**:1038f–1039a / **10**:894c–f	
b. The ecosystem: a collection of integrated communities and their environment [see B., below]	**2**:1039a–c / **14**:367e–h	**3**:824a–g *passim* / **4**:1031g–h
c. The community: a collection of interacting populations of two or more species [see 352.C.]	**2**:1039d–e	**4**:727g–728c
d. The population: a collection of interacting individuals of the same species [see 352.A.]		
3. Energy flow in the biosphere		
a. Energy and organization: life as an organized system capable of creating more order from less order		
b. Efficiency of utilization of solar energy: the notion of the biosphere as an open system with respect to energy exchange with outer space		
c. Energy balance of organisms: plants, warm-blooded animals, and cold-blooded animals		

	articles	article sections	other references
4. Cycling of matter in the biosphere		**2**:1039g–1042h / **16**:1014h–1018a	
a. The general pattern of chemical cycles in nature		**2**:1039g–1040b / **4**:1030h–1031b	**2**:572a–c / **6**:283d–g / **10**:346b–d
b. The carbon and oxygen cycles		**2**:1040b–f	
c. The nitrogen cycle		**2**:1040f–1041d / **16**:1015g–1016a	**13**:125a–b
d. The sulfur cycle		**2**:1041d–g / **7**:737b–d / **16**:1016b	
e. The water cycle		**2**:1041h–1042e / **8**:435c–h / **12**:118c–g	**9**:102e–116c *passim*
f. The sedimentary cycles of essential minerals		**2**:1042e–h	**6**:713d–715h *passim*
5. The concept of the noosphere: man's place in the biosphere [see 355.B.]			
B. The ecosystem: a collection of integrated communities and their environment	ECOSYSTEM **6**:281–285		
1. Definition of an ecosystem and historical review of the ecosystem concept		**6**:281b–282a	
2. The components of the ecosystem		**6**:282a–d	
a. Biotic components		**18**:147c–148c	
i. Producers: chiefly green plants that manufacture food from simple substances and light energy		**14**:365h–366f	**3**:824a–b
ii. Consumers: animals that ingest other organisms or particulate organic matter		**2**:1045f–1046g	
iii. Decomposers: chiefly micro-organisms that break down complex compounds with release of products that are recycled by plants or that affect other biotic components		**7**:537g–538a / **16**:1014d–1018a	
b. Abiotic components: limiting factors and their influence on the biotic environment		**1**:32e–35e / **4**:727g–728h / **5**:881d–882b / **8**:442d–443a / **14**:367a–d	**1**:492g–493d / **5**:4d–e / **15**:121d–122a
i. Pressure and temperature: range and variation	PRESSURE AND TEMPERATURE, BIOLOGICAL EFFECTS OF **14**:994–998	**1**:32f–33h / **1**:35b–e	**1**:358g–359a / **5**:881d–e / **7**:749e–g / **8**:442d–f / **10**:612h–613d / **10**:898b–d / **12**:120g–121b / **18**:734g–735a
ii. Radiation: quality, intensity, and duration	RADIATION, BIOLOGICAL EFFECTS OF **15**:378–391	**15**:414g–416a	**1**:304a–c / **10**:898f–g / **12**:755b–f / **15**:400e–401c / **15**:417a–420g *passim*
iii. Illumination		**1**:33h–34c / **10**:612g–h / **11**:487c–f	**1**:493b–d / **8**:442f–h
iv. Water: availability and quality		**1**:34c–f	**4**:805f–806e *passim* / **5**:615a–619c *passim* / **8**:280e–f
v. Interaction of temperature and moisture as a special limiting factor in terrestrial environments		**9**:2f–5c	**5**:881e–g / **10**:339c–340a / **16**:487a–c
vi. Gases		**15**:752a–f	**17**:841a–d
vii. Biogenic salts: macronutrients and micronutrients		**10**:613d–e / **13**:404a–h	**1**:34h–35a / **1**:350d–f
viii. Water and wind currents		**10**:613f–614b	**1**:360a–b / **1**:492g–493a
ix. Soil characteristics		**8**:281d–h / **16**:1025d–1028b	**5**:881g–882b / **7**:536c / **10**:341a–c
x. Salinity		**17**:841d–f	**1**:34f–h / **6**:974f–h
xi. Fire as an ecological limiting factor		**8**:280g–281c	**16**:418f–419b *passim* / **16**:420e–f
c. Conditioning of the abiotic environment by living organisms: the influence of organisms on the atmosphere, the hydrosphere, and the lithosphere		**7**:536e–538a / **8**:437a–e / **9**:109d–110a / **16**:1014h–1018a / **16**:1020c–d	**2**:1042c–e / **16**:1023c–e

	articles	article sections	other references
d. Micro-environments: the local horizontal and vertical differences in limiting factors	MICROCLIMATES **12**:114–121	**4**:722h–723d / **8**:281c–d	**1**:358g–360c *passim* / **7**:536e–537f *passim* / **10**:342f–343b
3. Energy flow and nutrient cycling: processes that determine the nature and productivity of the ecosystem		**6**:282d–283g / **4**:1029e–1031b / **7**:541f–542b / **8**:285e–286b / **10**:345f–346d / **13**:500g–501c / **15**:891d–g / **17**:842a–b	**14**:657f–g / **17**:518c–g
a. Productivity as dependent upon the continuous inflow of solar energy [see A.3., above]			
b. Productivity as dependent upon the reuse of continuously cycling matter within the biosphere [see A.4., above]			
c. Attempts to increase productivity and channel available energy into usable food form [see 355.C., 731.H., and 425.G.]			
4. Features of the ecosystem made evident by the use of the formal or mathematical models of systems ecology		**6**:283g–284f	
5. Ecosystem development: comparison in energy flow between the early successional growth stage and the mature stages; relevance to land-use planning		**6**:284g–285a	
6. Types of ecosystems [see 354]			

Section 352. The community: a collection of interacting populations

[for Part Three headnote see page 130
for Division V headnote see page 189]

Section 351 dealt generally with the hierarchical structure of the biosphere. The articles and parts of articles referred to in Section 352 deal in more detail with the components of the biosphere. They treat three main subjects: A, biological populations, made up of interacting and interdependent individual organisms of the same species; B, biotic interactions, the dynamic processes in the large ecological units of populations and communities; and C, biological communities, composed of two or more interacting and interdependent populations.

The outline of subject A begins with the factors that determine the distribution in biological populations of age, sex, and genetic difference, and with the reproductive and death rates that determine population densities. It goes on to the types of population growth, and to the causes and extent of fluctuations in relatively stable populations. Finally, it treats the four main types of movements—migration, emigration, dispersion, and dispersal.

Subject B is the biotic interactions that constitute the principal stabilizing, connective linkages among the various species contained in a biological community. The outline first deals with negative, or competitive, and positive, or cooperative, interactions of individuals within a species. It goes on to the range and types of interactions among members of different species, classified mainly by their effect of enhancing or reducing survival or reproduction in the species involved. The treatment of negative interactions covers such things as herbivory, predation, parasitism, and types of competition between two species utilizing a common, limited resource (such as food, space, or moisture). The treatment of positive interactions covers commensalism, an interaction in which one species benefits, without harming the other, with respect to such things as the attainment of nutrients, space or support, shelter or protection, and transport; and mutualism, associations of two different species bringing benefit or gain to both. Finally, the outline deals with the population effects of interactions, covering the effects on the numbers and thus on the state of rareness or commonness of different species, and the effects on the qualities of individuals in the populations and thus on evolutionary developments.

Subject C is the biological community, which consists of all of the organisms that live together in a given environment and, in various ways, affect one another. Dealing with the structure of communities, the outline treats the process of stratification and zonation that distribute the organisms of a community vertically and horizontally; the phenomena of periodicity correlating community activities with diurnal, lunar, seasonal, and annual changes; the interactions of species in communities competing for food sources, light, soil, space, and other resources; the position and function of a species in the community in relation to other species, or the niche of a species; and the special characteristics of ecotones—the marginal, intergrading areas between adjoining major communities, exemplified by the seashore ecotone. The outline goes on to community functioning, the energy flow in a community through the trophic levels of the food chain: producers (synthesizing plants), consumers (ingesting animals), and reducers or decomposers (bacteria and fungi). The outline next deals with the stages in the development of communities, terminating in the relatively stable communities called climax communities. It goes on to the grouping of communities into larger systems called landscapes, which consist of a pattern of ecosystems related to one another. The outline concludes with the various criteria used by ecologists to classify communities.

	articles	article sections	other references
A. Properties of the species population	POPULATION, BIOLOGICAL **14**:824–838		
1. The study of populations [see 10/34.B.6.]			
2. The measurable characteristics of biological populations		**14**:826b–831b	**11**:404f–g

	articles	article sections	other references
a. Age, sex, and genetic differences and their distribution		**14**:826b–827b / **8**:811e–816e	**15**:689f–g / **16**:586h–587d / **16**:590h–591a
b. Numbers and density: the effects of natality and mortality, the reproductive rate and death rate		**14**:827b–831b / **14**:814h–815d	**2**:75e–h / **3**:927h–928b / **4**:764g–h / **14**:144c–146b *passim*
3. Growth of populations: growth form and carrying capacity		**14**:831b–f / **2**:569f–570f / **5**:914a–d / **8**:443f–444a / **10**:913h–914e	
4. Fluctuations in stable populations: variations in population size		**14**:831g–836a / **2**:1046c–g / **14**:71b–e	**14**:496b–d / **15**:890g–891a
5. Movements: processes of distribution		**14**:836a–g / **4**:612b–c / **15**:974e–975a	**5**:908f–909h *passim*
a. Migration: periodic departure from and return to an area	MIGRATION, ANIMAL **12**:177–184	**14**:836a–d	
i. Survey of migrations in animals		**12**:177e–182e / **4**:764h–765d	**1**:942b–e / **4**:432a–b / **7**:374f–h / **8**:446h–447b / **11**:404d–e / **10**:822h–823a / **19**:806h–807b
ii. Mechanisms of migration time and directional control		**12**:182e–184c	**10**:741c–743e / **16**:188g–189a
iii. Evolution and significance of migrations		**12**:184c–h / **14**:568g–569b	
b. Emigration: one-way movement out of an area in direct response to food shortage or overcrowding		**14**:836d–f / **15**:974e–975a	
c. Dispersion: the spacing out of organisms, especially for breeding		**14**:836f–g / **16**:941e–942a	
d. Dispersal: the movement of young animals or plant seeds from their birthplace to where they settle down		**14**:836g / **5**:911e–913d / **16**:484b–486c	
e. The influence of topographical, climatic, and biological barriers		**4**:727g–728h / **5**:909c–h / **14**:568g–569b	**5**:910f–911d
6. Interactions of populations: changes as a result of interspecific and intraspecific interactions in the population [see B., below]			
7. Factors affecting the structure of human populations [see 525.A.]			
B. Biotic interactions	BIOTIC INTERACTIONS **2**:1044–1052	**14**:836h–838f	
1. Intraspecific interactions: positive and negative interactions of individuals within a species		**2**:1044h–1045c / **14**:836h–837g / **16**:943e–945a	**1**:295h–299e *passim*
2. Interspecific interactions: interactions among members of different species		**2**:1045c-1051f / **4**:1028e–1029a / **16**:942h–943e	**15**:122a–c
a. The range of interspecies associations		**2**:1045c–f / **8**:127h–128c	
b. Negative interactions, in which one or both populations are harmed		**2**:1045f–1049c	
i. Consumption: herbivory, the consumption of plants by animals; predation, the consumption of animals by other animals		**2**:1045f–1046g	**4**:1028e–h
ii. Parasitic interactions: classical endoparasitism and ectoparasitism in which the host is usually not killed; parasitoidism among insects in which the host is consumed; brood parasitism in which one species lays its eggs in the nest of another species		**2**:1046h–1047g / **5**:838b–840g / **12**:217d–218b / **14**:660a–c / **16**:227f–h	**1**:931f–g / **5**:360b–361c / **10**:823b–c / **12**:216b–d / **12**:220d–f / **14**:374c–f / **14**:547h–548e / **16**:808f–g
iii. Amensalism and antagonism, associations in which neither species is benefitted and one or both are harmed: competition for a common, limited resource; antibiosis, involving the secretion of a chemical substance; mutual antagonism		**2**:1047g–1049c	**1**:986a–b / **5**:909f–h / **14**:606e–f

	articles	article sections	other references
c. Positive interactions, in which one or both populations are benefitted		**2**:1049c–1051e / **13**:407d–f	**4**:770a–b
i. Commensalism, an association in which one species benefits without harming the other: nutritional commensalism and physical commensalism		**2**:1049c–1050a / **13**:1054f–1055c	**1**:931e–f / **9**:533g–534a / **12**:960g–h
ii. Mutualism, an association of two different species that results in mutual benefit or gain: facultative mutualism (protocooperation), and obligative mutualism (interdependency)		**2**:1050a–1051e / **10**:883h–884f / **14**:745b–746e / **14**:746h–747e	**3**:325c–f / **7**:129d–g / **9**:1053e–f / **12**:760f–761a / **13**:650g–h / **14**:49g–50a / **18**:1091d–e
d. Neutralistic interactions, in which two or more species persistently appear together with neither benefit nor harm accruing to any		**2**:1051f	**16**:943c–e
3. Interactions between populations of different species and the ecological, evolutionary, and biogeographical aspects of interaction on the population level		**2**:1051g–1052g / **14**:837g–838f	**12**:213h–214c / **14**:775d–776c / **19**:726h–727e *passim*
C. Organization at the community level	COMMUNITY, BIOLOGICAL **4**:1027–1035		
1. Definitions of the biological community		**4**:1027d–f / **8**:1017b–c	
2. Community structure		**4**:1027g–1029e	
a. Vertical and horizontal patterns: the influence of variations in environmental conditions on the stratification and zonation of organisms		**4**:1028a–d / **7**:536e–537f / **10**:342e–343b	**8**:282h–283a / **10**:344c–h / **14**:1021f–h
b. Time relations: periodicity and population changes in the community		**4**:1028d–e / **7**:538c–539c / **14**:71c–e	**8**:283a–b
c. Interactions in the community: *e.g.*, heterotrophic nutrition, predation, symbiosis		**4**:1028e–1029a	**2**:1045c–1052g *passim*
d. Niches and species diversity		**4**:1029b–e	**2**:1005b–e / **7**:11f–h / **10**:342d–f / **18**:147c–g
e. Ecotones and the "edge effect": overlapping communities and their abundance and variety of life		**7**:540f–541f	**2**:1048e–f
3. Community function: energy flow		**4**:1029e–1031b	
a. Productivity of organic matter: transfer of energy through the trophic levels of the food chain		**4**:1029e–1030d / **2**:1045f–1046c / **7**:541f–542b	**10**:345b–d
b. Decomposition of organic matter		**4**:1030d–g / **7**:537g–538a	
c. Nutrient circulation		**4**:1030g–1031b	**2**:1039h–1040b
4. Community succession: growth toward a stable, mature condition		**4**:1031c–1032c / **7**:539c–541f / **8**:284a–d	**6**:284g–285a
a. Developmental communities: communities that replace one another in sequence so that each stage paves the way for the next		**4**:1031d–f	**19**:845h–846b
b. Stable communities: the climax of community succession, characterized by a condition of relative constancy in an open system		**4**:1031f–1032c	
5. Communities in space		**4**:1032c–1033h / **5**:908f–910b	**18**:144a–g *passim*
a. Landscape patterns: the habitats of a landscape as forming a pattern of environmental gradients		**4**:1032c–g	**7**:534h–536d *passim*
b. Climax interpretation: monoclimax theory, polyclimax theory, and climax pattern hypothesis		**4**:1032g–1033a	
c. Community gradients: coenclines		**4**:1033a–h	
6. Community classification and its bases		**4**:1034c–1035g	
a. The association as the unit of classification		**4**:1034d–f	
b. The biome or formation as the unit of classification		**4**:1034g–1035g	
c. Other bases for classification: *e.g.*, ecological succession, habitat, community metabolism		**4**:1034c–d / **4**:1031c–g	
7. Community structure in past ages: biogeographical succession [see 242.B. and 243]			

Section 353. Hazards of life in the biosphere: disruptions and death

[for Part Three headnote see page 130
for Division V headnote see page 189]

The articles and parts of articles referred to in Section 353 deal with three main subjects: A, the ecology of disease; B, hazards to plants; and C, hazards to animals.

The outline of subject A begins with general conceptions of disease and of death. It goes on to the metabolic defects and environmental hazards involved in noncommunicable disease. The treatment of contagious disease covers the multifactorial concept of it; diseases endemic in particular regions; diseases that occur in sporadic epidemics; and the processes that yield immunity, defense against biotic invasion.

The outline of subject B begins with the nature and economic importance of plant diseases. It goes on to the causes and stages of disease development and spread and to the variable factors affecting diagnosis of plant diseases. It next treats various kinds of noninfectious-disease-causing agents and various kinds of infectious-disease-causing agents. Finally, it deals with the principles of disease control—the disinfection of plants and seeds; eradication of an established disease agent through crop rotation and other methods; protection of the host; host resistance and selection; and therapy.

Subject C is hazards to animals other than man. (Human disease is treated in sections 423 and 424 of Part Four.) The outline begins with the historical development of veterinary medicine, the economic consequences of animal diseases, and the development of modern epidemiology as the medical aspect of ecology. It goes on to the methods for the detection, diagnosis, and treatment of animal disease. The treatment of particular animal diseases and disorders covers those that arise from bacterial infection or insect infestation; those that arise from interspecies competition and predation; and various kinds of noninfectious diseases and disorders. Finally, the outline deals with the methods of disease prevention, control, and eradication.

	articles	article sections	other references
A. The ecology of disease	DISEASE **5**:837–841		
1. Disease as a departure from the "normal" state, or a disruption of homeostasis; death as the irreparable disruption of life processes		**5**:837d–f / **5**:526h–528b / **8**:1016g–1017a	**5**:842f–843a / **5**:846f–847g *passim*
2. The nature of noncommunicable disease: metabolic defects and environmental hazards		**5**:837f–838b	
3. The nature of communicable, or contagious, disease		**5**:838b–840g	
a. The multifactorial concept of contagious disease		**5**:838b–839b	
i. Host–parasite relationships: the various degrees of dependence of the parasite on the host		**5**:838b–e	**5**:855b–c / **9**:532c–d
ii. Parasite specificity and host resistance		**5**:838f–839f / **2**:575g–576a / **19**:169h–170f	**2**:1046h–1047b / **5**:855d–856f
iii. Life in an experimentally controlled environment with regard to contaminants	GERMFREE LIFE **8**:127–131		
b. Endemic disease and epidemic disease		**5**:839b–840e	
i. Apparent and inapparent infection: the concept of the "carrier" state and of endemic disease; interactions with commensal and pathogenic organisms		**5**:839b–e / **19**:170g–171b	**9**:533g–534g *passim*
ii. Inheritance of resistance: genetic control of resistance or susceptibility		**5**:839e–g	
iii. Epidemic disease and the factors that contribute to spread of disease		**5**:839g–840e / **5**:881a–d / **9**:533d–g	**9**:535f–540a *passim*
c. Immunity: defense against biotic invasion	IMMUNITY **9**:247–258	**5**:840e–g / **2**:1124e–1125a / **5**:845e–846a / **9**:534g–535f	**19**:170c–d
4. Control of disease: prevention and treatment		**5**:840h–841e / **19**:171b–e	**9**:544g–548a *passim*
B. Hazards to plants	DISEASES OF PLANTS **5**:880–895		
1. Plant diseases: general features		**5**:880c–883g	
a. Nature and importance of plant diseases: extent of damage; important epidemics		**5**:880c–g	
b. Disease development and spread: pathogenesis and saprogenesis, vital and nonvital association of the pathogen with the host tissue; epiphytotics or epidemics; environmental factors affecting disease development; conditions of disease development		**5**:880h–882c	
c. Diagnosis of plant diseases: variable factors affecting diagnosis; signs and symptoms of specific diseases		**5**:882c–883g	**1**:350f–351a
2. Classification and control of plant diseases		**5**:883g–895f	
a. Noninfectious disease-causing agents		**5**:885d–886f	

i. Adverse environment; *e.g.*, drought, frost, nutritional deficiencies

ii. Toxic chemicals; *e.g.*, herbicides, insecticides, pollutants

iii. Physical injury: *e.g.*, high winds, fire, insect and animal feeding

b. Infectious disease-causing agents

i. Infection; *e.g.*, by viruses, mycoplasmas, bacteria, fungi

ii. Infestation; *e.g.*, by nematodes, parasitic seed plants, insects

c. Principles of plant disease control: exclusion and avoidance; the disinfection of plants and seeds; eradication of an established disease agent through crop rotation and other methods; protection of the host; host resistance and selection; therapy

C. Hazards to animals

1. General features of animal diseases: historical background, importance, and the role of ecology

2. Detection and diagnosis: the reactions of tissue to disease; methods of examination; tests as diagnostic aids

3. Survey of animal diseases and disorders

a. Infectious and noninfectious diseases

i. Infectious diseases and interspecies competition: infection, infestation, and predation by other organisms

ii. Noninfectious diseases and disorders; *e.g.*, nutritional deficiencies, hereditary conditions, congenital deformity, trauma

b. Zoonoses: human diseases acquired from or transmitted to any other vertebrate animal

c. Disease prevention, control, and eradication: prevention through quarantine, mass immunizations, and other methods; control programs such as the testing and slaughter of infected animals

4. Human diseases
[see 423 and 424]

articles	article sections	other references
	5:886a–c	**1**:358g–360c *passim*
	5:886d–f / **1**:360d–361b	
	5:886f / **2**:1045f–1046c	**8**:280g–281c / **16**:420e–f
	5:886g–894b	
	5:886g–892c / **16**:294g–295a / **16**:889c–d	**12**:763d–f
	5:892c–894b / **9**:610c–f	
	5:894b–895f / **1**:354c–e	
DISEASES OF ANIMALS **5**:863–879		
	5:864b–865h / **10**:823a–c	
	5:865h–874f	
	5:874f–879g	**5**:965g–h
	5:874f–875f / **8**:1090e–f / **15**:120f–121b	**10**:1284h–1285a
	2:794b–h / **2**:1046c–1047f / **5**:934a–e / **9**:610g–611b / **14**:546d–f	**5**:838b–840g *passim* / **6**:998h–999a / **9**:532c–d / **10**:1281d–g / **10**:1282d–e
	1:301f–303b / **5**:837f–838b / **11**:379a–380b / **14**:607h–616h / **19**:488g–489c / **19**:1018e–1019b	**13**:403f–406h *passim*
	5:875g–877d / **9**:531h–532a / **9**:537c–539e / **9**:552g–553a / **14**:151h–152b	**9**:530e–f / **9**:551c–d / **9**:554f–558c *passim* / **15**:770g–771a
	5:877d–879g	

Section 354. Patterns of life in the biosphere
[for Part Three headnote see page 130
for Division V headnote see page 189]

The articles and parts of articles referred to in Section 354 deal with four main subjects: A, the terrestrial biocycle; B, the aquatic biocycles; C, the distribution of living things; and D, biogeographical regions and their inhabitants.

The outline of subject A first treats the land environment as a medium for life; the contrasts between terrestrial and aquatic ecosystems; and limiting factors to living on land. It goes on to descriptions of the major terrestrial communities of the Earth, called biomes, which, though they include animals, are identified from characteristic vegetation forms. It next deals with the major terrestrial life forms, classified first by habitat as soil organisms, rooted plants, animals and plants attached to the major rooted plants, and animals that move freely above the ground; and classified next by their niche or operating role in an ecosystem as producers, consumers, and decomposers, or reducers. Finally, it deals with productivity in terrestrial ecosystems—the processes by which plants and animals convert nutrients into their own kind of body substance.

The outline of subject B first deals with water as a medium for life, with the limiting factors to life in water, and with the major marine and inland divisions of the aquatic environment. Dealing with the ocean as a biological environment, the outline covers the

processes of zonation that distribute aquatic organisms vertically and horizontally; the major aquatic life forms, such as the benthos, the plankton, and the nekton; the modes of adaptation to marine conditions; and the productivity of marine communities, as judged by biological oxygen consumption or by nutrient concentration. The treatment of inland communities covers lacustrine, or standing-water, communities and riverine, or flowing-water, communities. Finally, the outline deals with boundary ecosystems, covering estuaries—the marine–freshwater border ecotones—and life along seacoasts, called the neritic habitat.

The outline of subject C first deals with broad distribution patterns and with the processes that bring about patterns within local ranges as well as large-scale patterns of distribution—regional and global. It goes on to the distinction between active, self-initiated dispersal of organisms and such passive dispersals as plant seeds carried by wind or animals, or surface organisms carried by oceanic currents; and to the dispersal abilities and environmental factors that lead to the effective colonization of new areas. Finally, it deals with hypotheses in biogeography concerning the centres of evolutionary origin of species and the environmental, geological, and human influences on their subsequent spread.

The article referred to on subject D treats the biogeographical world maps that set forth regional differentiations in faunal and floral distribution. It also describes the various biogeographical regions of the Earth, which are based on average patterns of distribution of present plant and animal species.

	articles	article sections	other references
A. The terrestrial biocycle: life on land	TERRESTRIAL ECOSYSTEM **18**:144–149		
1. The land environment		**18**:144b–146f	
a. Land as a medium for life and the comparison of the terrestrial and aquatic ecosystems		**18**:144b–g	
b. Limiting factors to living on land		**18**:144g–145c	**3**:573g–h/**7**:952d–f/**14**:500f–g/**15**:736b–e
c. Major terrestrial biomes		**18**:145c–146f/**16**:1025d–1028b	
i. The tundra: Arctic and alpine	TUNDRA **18**:733–736		**4**:727c–d/**14**:655g–657e *passim*/**16**:1025h–1026b
ii. The coniferous forest: moist-temperate and taiga	FORESTS **7**:534–542	**16**:1026c	**2**:1003b–c/**5**:1f–h/**7**:528g–h/**8**:520e–f/**13**:190d–h/**18**:145d–g
iii. The middle-latitude forest: deciduous and evergreen	FORESTS **7**:534–542		**13**:190h–191h/**16**:1014h–1018a *passim*/**18**:145g–h
iv. The tropical rain forest: equatorial and subtropical	JUNGLES AND RAIN FORESTS **10**:336–346	**7**:540c–541b/**16**:1027a–c	**1**:193h–194c/**1**:650g–651h *passim*/**4**:725a–c/**7**:529d–e/**7**:534h–539c *passim*/**14**:1021f–1022a/**17**:86d–87c
v. The grassland and savanna	GRASSLANDS **8**:280–286	**14**:589d–h/**16**:1026d–f	**1**:194c–g/**4**:727a–c/**7**:540f–h/**13**:192b–d/**16**:101b–h/**18**:146b–c
vi. The scrublands: chaparral, macchie, mellee, and ecotones	SCRUBLANDS **16**:418–420	**16**:1026f–g	**7**:540f–541c
vii. The desert: cold deserts and tropical deserts	DESERTS **5**:615–619	**16**:1026g–1027a	**1**:1055a–h/**4**:725f–h/**5**:540a–c/**8**:220g–h/**8**:434a–435b/**8**:437a–b/**13**:204a–c/**16**:149e–h/**19**:846b–d
d. Specialized biomes			
i. Polar biomes: Arctic and Antarctic	POLAR BIOMES **14**:655–657	**2**:1006c–d	**1**:956c–958f/**1**:1115h–1118f/**2**:1002d–1003a/**4**:727d–g
ii. Subterranean biomes		**4**:431e–432a	**3**:1022a–b/**12**:120d–e
2. Major life forms		**18**:146f–148c/**4**:1027h–1028a/**10**:343c–345b	
a. Growth habits and indicator organisms		**18**:146f–h	
b. Classification by habitat		**18**:146h–147c	
i. Soil organisms	SOIL ORGANISM **16**:1014–1018	**7**:537g–538a	**2**:67d–e/**2**:572a–c/**7**:952f–h/**8**:283h–284a
ii. Trees and other rooted plants	TREE **18**:687–692		**1**:876f–g/**7**:528d–529e *passim*/**8**:521f–h/**13**:732d–g
iii. Epiphytes and periphytes: animals and plants that cling to or are attached to the major rooted plants		**16**:227f–228b	**3**:325c–f/**10**:343f–g/**13**:650g–651c/**13**:651h–652b
iv. Permeants: animals that move freely above the ground [see 342.A.2.]			
c. Classification by niche: producers, consumers, and decomposers		**18**:147c–148c	

	articles	article sections	other references
3. Productivity in terrestrial ecosystems: net primary production, secondary production, and man-influenced ecosystems		**18**:148c–149g / **5**:619c–e / **7**:541f–542b / **8**:285e–286f / **10**:345f–346d / **18**:735f–736a	**14**:147e–g / **14**:657f–g
B. The aquatic biocycles: life in fresh and marine water	AQUATIC ECOSYSTEM **1**:1029–1035		
1. The aquatic environment		**1**:1029b–1030e	
a. Water as a medium for life: physical properties of water		**1**:1029b–g	
b. Limiting factors to living in water: biotic effects of light intensity, salinity, and other factors of the aquatic environment		**1**:1029g–1030b / **1**:492g–493e / **10**:612f–614b / **14**:994h–995a	**15**:888d–g
c. Major divisions of the aquatic environment: marine and inland		**1**:1030b–e	
2. The ocean and its communities: communities of the open sea	OCEANS AND SEAS **13**:497–501	**1**:1030f–1032b	
a. The sea as a biological environment: the relative constancy of abiotic factors; the antiquity of the marine environment; relation of chemical composition of organisms to that of seawater; habitat zonation (benthic and pelagic divisions and their subdivisions)		**1**:1030f–1031d / **13**:497c–498b	
b. Character of oceanic populations: in lighted open water, in dark open water, and on the deep sea floor		**1**:1031d–1032b / **13**:498c–h / **2**:1028g–1031a	**2**:302g–303a
i. Benthos: organisms on the bottom		**1**:1031d–f	**5**:958h–966a *passim*
ii. Plankton: organisms floating in water	PLANKTON **14**:494–496	**1**:1031f–1032a / **14**:167h–168g	
iii. Nekton: organisms swimming in water		**1**:1032a–b / **3**:1151h–1152e / **7**:330g–331c	**19**:805b–g
c. Adaptations to marine conditions: structural, functional, and ecological		**13**:498h–500f	**3**:939b–h / **14**:994c–995h *passim*
d. Productivity of marine communities as judged by biological oxygen consumption or by nutrient concentration		**13**:500g–501c	
3. Inland waters and their communities: freshwater communities		**1**:1032c–1033h	**5**:616f–g / **7**:952c–d
a. Lacustrine, or standing water, communities		**1**:1032c–1033b	
i. In lakes and ponds	LAKES AND LAKE SYSTEMS **10**:612–616		
ii. In swamps, marshes, and bogs	SWAMPS, MARSHES, AND BOGS **17**:840–842		
b. Riverine, or flowing water, communities		**1**:1033c–h	
i. In rivers and streams	RIVERS AND RIVER SYSTEMS **15**:888–891		
ii. In springs	SPRINGS AND WELLS **17**:516–519		
4. Boundary ecosystems: between waters or between water and land		**1**:1033h–1034e	
a. Estuarine communities: communities in brackish water	ESTUARIES **6**:973–976	**1**:1033h–1034b	
b. Neritic communities: life along seacoasts	COASTAL FEATURES **4**:802–807	**1**:1034b–e	
i. Coasts as habitats: the supralittoral zone, the midlittoral zone, and the infralittoral fringe		**4**:802h–804d	
ii. Character of coastal populations: the communities of rocky shores, of sandy and muddy shores, and of specialized habitats		**4**:804d–805e / **10**:593d–g	**1**:491d–h / **5**:162b–167f *passim* / **6**:974c–975b *passim* / **7**:541d–f

	articles	article sections	other references
iii. Adaptations to coastal living: physical and behavioral adaptations		**4**:805f–806e	
iv. Associations between different neritic species: commensal, parasitic, and symbiotic associations		**4**:806e–h	
v. Productivity of coastal communities		**4**:806h–807c	
5. Productivity in aquatic ecosystems: the problem of determining productivity; comparisons of productivity		**1**:1034e–1035d / **4**:806h–807c / **6**:974h–975d / **10**:615g–616d / **13**:500g–501c / **14**:495g–496d / **15**:891d–g	**17**:842a–b
C. The distribution of living things	DISTRIBUTION OF ORGANISMS **5**:908–916		
1. Patterns and processes of distribution		**5**:908f–911d	
a. Local distribution: spatial and temporal arrangements; the effects of environmental influences and of interactions with other organisms		**5**:908f–909h / **4**:1028a–d / **16**:941e–942h	**16**:933g–934a
b. Large-scale distribution: shape and extent of spread; factors limiting spread		**5**:909h–911d / **2**:1001a–c / **4**:727g–728h / **18**:688d–e	**2**:75c–e
2. The nature of dispersal		**5**:911e–913d / **16**:484b–486c	**14**:836a–g *passim*
a. Active dispersal; *e.g.*, the search for a place to breed, animal irruptions		**5**:911f–912c / **16**:485h–486c	
b. Passive dispersal: transport by wind, water, and other organisms		**5**:912c–913d / **16**:484b–485h	**4**:642g–643a
3. Colonization of new areas		**5**:913d–914d	
a. Effects of dispersal abilities and barriers		**5**:913e–914a / **10**:882g–883a	**2**:1053c / **7**:239a–b / **12**:961b–d
b. Effects of the new environment		**5**:914a–d / **2**:1045f–1048f	
4. Changes in distribution with time		**5**:914d–916b	**2**:1002d–1006d *passim* / **5**:603a–d / **7**:16e–g / **7**:331b–c
a. Centres of evolutionary origin		**5**:914e–h	
b. The spread of organisms: environmental, geological, and human influences		**5**:914h–916b / **5**:938f–h	**3**:927h–928a / **5**:678h–679a / **5**:938h–940h *passim* / **11**:402a–b / **14**:564g–565c / **18**:734d–f
D. Biogeographic regions and their inhabitants: regional floras and faunas	BIOGEOGRAPHIC REGIONS **2**:1001–1006		
1. General features: the notion of regional boundaries versus that of overlapping and interdigitating regional floras and faunas; floral and faunal systems of classification; concepts of faunal elements and faunal types		**2**:1001b–1002d	**5**:910a–911d *passim*
2. Description of the biogeographical regions: average patterns of distribution of present plant and animal species		**2**:1002d–1006d	
a. The Megagaean realm		**2**:1002d–1005a	
i. Holarctic region: the nontropical parts of Eurasia, northern Africa, and North America		**2**:1002d–1003f	**2**:167c–e / **2**:170b–f / **6**:1047c–1050a / **13**:190d–191h
ii. Ethiopian region: Africa south of the Sahara, southwestern Arabia, and Madagascar		**2**:1003g–1004d	**1**:196c–197c
iii. Oriental region: tropical southern and southeastern Asia		**2**:1004d–1005a / **2**:170f–171d	**2**:167h–169d
b. The Notogaean realm: Australia, New Guinea, New Zealand, and tropical Pacific islands		**2**:1005a–f	**2**:393c–395g / **13**:827e–h
c. The Neogaean realm: Central and South America		**2**:1005f–1006c	**17**:85h–90h
d. The Antarctic realm: Antarctica and most of the sub-Antarctic islands		**2**:1006c–d	**1**:956c–959e

Section 355. Man's place in the biosphere

[for Part Three headnote see page 130
for Division V headnote see page 189]

Though what is specific to human life, health, and behaviour is separately dealt with in Part Four, on human life, this last section of Part Three deals with man's place in the biosphere. The articles and parts of articles referred to in Section 355 deal with four main subjects: A, the qualities that set man apart in the biosphere; B, the role of man in the biosphere; C, the utilization of organisms by man; and D, the conservation of natural resources.

The outline of subject A treats the structural, physiological, and behavioral characteristics that give man, despite his many dependencies on the biosphere, unique versatility for action in it.

The outline of subject B begins with the influence of man on the modification of the environment—in different types of mobile societies, in transitional sedentary societies, and in contemporary urbanized society. It goes on to the influence of the environment on the modification of the human species. It then treats man's attempts to correct heritable defects and to change genetic endowment.

Subject C is man's utilization of other living things in the biosphere. The outline begins with the domestication of plants and animals in accordance with the interests of man. It goes on to plant selection and breeding, plant growing, and the control of natural factors in support of cultivated plants. It next deals with the nutrient, industrial, medical, educational, scientific, and aesthetic uses of plants. The outline goes on to treat the cultivation of animals and the major uses of animals—as food, in industrial processes, for medicines, as labourers, in various sports, in education and research, and as pets. The outline closes with the maintenance of public and private collections of live and preserved animals and plants, articles being referred to that treat zoological gardens and aviaries, aquariums, and botanical gardens and arboretums.

Subject D is the conservation of natural resources. The outline begins with the nature and scope of conservation management. Dealing with concepts operative in conservation management, it treats the central concept of the total environment as a natural resource; the concept of rational use and sustained yield; multiple use and restoration; and issues arising from short-term versus long-term views. After dealing with the history of conservation, it goes on to the types of natural resources, using the principle of cycling time as the distinction between renewable and nonrenewable resources. It then treats resources considered to be renewable but with widely different cycling times; resources consumed by use; and resources with exhaustible sources of supply but reusable after recycling. The treatment of the management of nonliving resources covers soil ecosystem resources, water resources, air resources, and fuel and mineral resources. The treatment of the management of living resources covers wildlife management, fisheries management, multiple-use management, and agricultural management. The outline next deals with the arrangements for the management of resources that are international in character. Finally, dealing with problems created by mismanagement of resources, it treats environmental pollution, including noise pollution; soil depletion and erosion; alterations of patterns of evaporation, distribution, and availability of water; and the introduction into biological communities of foreign plants and animals that create pest problems and epidemics. It concludes by treating trends in resource conservation.

	articles	article sections	other references
A. The qualities that set man apart in the biosphere			
1. Structural characteristics and physical capabilities providing man with a versatility unparalleled in the biosphere		**7**:20a–g / **11**:419h–420e	**10**:649f–h / **16**:815h–816e / **16**:818b–d
2. Physiological characteristics underlying man's unique behaviour			
a. Lack of a definite breeding season		**11**:907h–908b	**14**:1017c–d / **15**:161d–h / **15**:689h–690c
b. Long life-span with slow development and lengthy dependency to maturity		**10**:911f–913a	**1**:981a–c
3. Behavioral capacity as the basis of man's unique culture			
a. Communication through propositional speech		**4**:1008b–1009a	**1**:979h–980c
b. Intellect and conceptualization		**8**:1151g–1153c / **10**:652h–653e	**8**:1146c–1151e *passim*
B. The role of man in the biosphere	BIOSPHERE **2**:1042–1044		**6**:281b–285a *passim*
1. The influence of the human species on the modification of the environment		**5**:936h–937h	
a. In types of mobile societies: hunters and collectors as transient and minor influences on the biosphere			**3**:1119b–1120e *passim* / **8**:1159c–f / **14**:429h–430c
b. In transitional sedentary societies: horticulturalists, pastoralists, and peasants as moderate influences on local areas in the biosphere		**1**:847e–h	**1**:195f–196c / **2**:1042h–1043c / **8**:1161d–e / **14**:430c–e / **17**:221d–e
c. In contemporary urbanized society: developers of complex social organizations that draw heavily upon nature and greatly influence the total biosphere		**2**:1043c–1044e / **7**:890b–891g / **9**:537e–540a	**14**:430e–g / **18**:22b–24e *passim*
i. Man as an exploiter and disrupter of nature, working toward depletion and ruin of the environment		**2**:1042h–1043e / **5**:886d–f / **18**:149e–g / **18**:1051h–1053e	**14**:430g–433g *passim* / **14**:750a–e / **19**:726f–h
ii. Man as a manager and conservator of nature, working toward the continuing usefulness of the environment		**2**:1043f–1044e	**14**:751c–756h *passim*

	articles	article sections	other references
2. The influence of the environment on the modification of the human species		**8**:1155b–c / **11**:428h–430g / **14**:841b–f	**4**:728h–729c / **7**:10g–16a *passim* / **8**:1017d–f / **15**:349 f–h
3. Man's attempts to change genetic endowments through deliberate selective measures; *e.g.*, genetic counselling, birth control, artificial insemination	EUGENICS **6**:1023–1026	**7**:22g–23a / **7**:1005g–1007h / **8**:818f–819e	**7**:858g–859f *passim* / **8**:816g–817b
C. The utilization of organisms by man			
1. Domestication of plants and animals: distribution and development	DOMESTICATION, PLANT AND ANIMAL **5**:936–941	**5**:929d–930d / **14**:149b–e	**2**:71b–c
a. Early selective influences		**5**:929h–930d / **5**:936h–937h / **8**:1088b–d	
b. Selected domesticated organisms: zones of origin and distribution		**5**:929d–g / **5**:937h–940h	**1**:325a–326b / **14**:658a–b
c. Evolutionary developments		**5**:940h–941h	
2. The cultivation of plants			
a. Plant selection and breeding	PLANT BREEDING **14**:496–500		**1**:341d–g
i. Plant breeding goals and the evaluation of plants		**14**:496g–497e / **8**:1111d–e	
ii. Methods of plant breeding		**14**:497e–500d / **14**:744c–745b	
b. Plant growing			
i. Commercial plant production: large-scale plantings		**1**:339a–340b / **3**:1160c–h / **7**:529f–531b / **8**:1111e–1113e / **8**:1119g–1121d / **11**:396c–397a / **19**:46h–47e	**1**:347g–366f *passim* / **7**:273c–283e *passim*
ii. Noncommercial plant production: plantings primarily for aesthetic, recreational, or home use		**7**:903b–905c	
c. Control of natural factors in support of cultivated plants			
i. Regulation of water and nutrients		**1**:350c–352e / **8**:1110a–g / **12**:118h–119e	**1**:340d–341a / **8**:1121g–1122b / **9**:899g–904c *passim* / **19**:49b–d / **19**:50d–e
ii. Control of disease		**1**:354c–e / **5**:894b–895f / **7**:532a–e / **8**:1110h–1111c	**19**:50g–51a
iii. Control of pests		**1**:344f–345h / **1**:353e–354c / **7**:532a–e / **8**:1110h–1111c / **9**:611b–d / **14**:139a–148e	**8**:1122b–e
iv. Control of weeds		**1**:354e–h / **8**:1110h–1111c / **19**:722d–723b	**19**:50f–g
v. Control of environmental factors: temperature, frost, and light		**1**:357h–360c / **8**:1107g–1108g / **19**:47f–48d	**8**:1121d–g
3. The uses of plants			
a. For food and flavouring		**1**:489a–c / **3**:1171a–1172a / **3**:803h–804d / **5**:901g–902g / **16**:294e–g / **17**:503d–508a	**3**:69d–f / **3**:823h–824d / **6**:174d–h / **6**:954f–h / **7**:498c–f / **7**:751e–761d *passim* / **9**:890f–891a / **11**:396e–f / **13**:533b–e / **14**:467h–468c / **14**:585d–586a / **16**:102g–103b / **16**:414f–g / **18**:16e–g / **18**:1090d–e / **19**:43a–46g *passim*

	articles	article sections	other references
b. For industrial products		**7**:260e–263h / **13**:967d–969g / **15**:1145c–1146a / **15**:1174a–1175b / **16**:240f–241a / **16**:293h–294e / **18**:187f–188b / **19**:921d–925a	**1**:89d–e / **1**:487h–489f *passim* / **3**:69g–70c / **7**:271f–283e *passim* / **7**:1018a–c / **8**:1f–h / **13**:523b–d / **13**:532f–g / **14**:167h–168g / **16**:103b–f / **18**:1089f–1090c / **18**:1090e–h / **19**:916c–e
c. For medical products		**1**:986a–b / **16**:293b–h	**1**:489e–f / **1**:595b–605d *passim* / **3**:70c–e / **3**:704f–g / **7**:1017h–1018a / **8**:1h–2a / **16**:414g–h
d. For education and scientific research		**8**:1113f–h	
e. For aesthetics and shelter			
i. Garden plants	GARDENING **7**:901–907	**2**:213b–214a / **7**:413d–414f / **8**:978c–e	**5**:175f–g / **6**:954h–955a / **7**:1018c–d / **8**:2b–e / **8**:1111h–1113a *passim* / **9**:890e–f / **16**:291c–293b / **16**:414c–e
ii. Houseplants	HOUSEPLANT **8**:1119–1122		
iii. Trees		**18**:688f–690a	**3**:1037g–h / **8**:1113a–c
4. The cultivation of animals			
a. Selection and breeding	ANIMAL BREEDING **1**:903–908	**1**:342f–343e / **5**:425e–g / **5**:934f–936a / **8**:1097g–1098b	
b. Animal raising			
i. Commercial animal production		**5**:425d–426g / **7**:349g–h / **7**:812f–815a	**2**:791e–f / **7**:176e–f / **7**:283f–288h *passim* / **10**:1279a–1287e *passim*
ii. Noncommercial animal raising: animals kept as pets in the home		**5**:932b–934e / **8**:979b–c	**14**:149b–150f *passim*
c. Control of natural factors in support of domestic animals; *e.g.*, nutrition, disease, predators and pests		**1**:908e–909g / **5**:877d–879g / **8**:1089h–1090a / **8**:1090e–f	**10**:1281b–1287e *passim* / **13**:404a–406h *passim* / **14**:139a–148e *passim*
5. Major uses of animals			
a. For food; *e.g.*, livestock, poultry, seafood		**5**:425d–435c / **7**:854e–855a / **11**:748f–750g / **13**:501f–502a	**2**:1053d–e / **2**:1085d–f / **5**:311g–312e / **7**:345c–349b *passim* / **7**:351f–g / **14**:46h–47f / **16**:493c–f
b. For industrial products, hides, and medicine		**1**:986a–b / **7**:811d–815a / **10**:759g–760e	**1**:89b–c / **2**:1085f–g / **3**:929b–939a *passim* / **7**:286d–288h *passim* / **16**:493f–g / **19**:812g–813d
c. For labour *with special attention to*		**5**:970a–972e	
i. Horses	HORSE **8**:1088–1092	**5**:971a–c	**14**:87b–e
ii. Other beasts of burden; *e.g.*, camels, llamas, elephants, oxen		**5**:970c–971a / **5**:971c–h	**15**:2a–b
d. For sport		**7**:152g–153b / **9**:52e–53b	**7**:367d–376d *passim* / **15**:835d–839h *passim*
e. For education and research		**1**:1026f–1027b / **5**:865b–d / **7**:374e–h / **8**:127e–128e / **14**:150a–b / **15**:121b–c	**1**:996f–g / **10**:617b–c
f. For pets	PET **14**:149–152		
i. Cats	CAT **3**:996–1000		
ii. Dogs	DOG **5**:929–936		**5**:971c–d / **9**:52a–e
iii. Other types of pets; *e.g.*, birds, tropical fish		**14**:150e–151f / **14**:47e–f / **15**:138h–139c	**13**:1052e–f

	articles	article sections	other references
6. The maintenance of public and private collections of live and preserved animals and plants			
a. Museums of natural history		**12**:655g–656b	
b. Zoological gardens and aviaries	ZOOLOGICAL GARDEN **19**:1160–1163		**4**:638a–b
c. Institutional and private aquariums	AQUARIUM **1**:1026–1028		
d. Botanical gardens and arboretums	BOTANICAL GARDEN **3**:63–65	**7**:884c–885c	
D. The conservation of natural resources	CONSERVATION OF NATURAL RESOURCES **5**:39–62		
1. The nature and scope of conservation management: definitions and interrelationships		**5**:39b–d	
2. Concepts operative in conservation management		**5**:39g–42a	
a. The central concept—the total environment as a natural resource		**5**:39g–40e	
i. The unchanging nature of primary needs		**5**:39g–40a	
ii. The increase in secondary needs and natural resource requirements through agricultural development, urbanization, industrialization, and technological growth		**5**:40a–e	
b. Rational use and sustained yield: the need to preserve the quality of the environment while using its resources		**5**:40e–g / **7**:527g–528d	
c. Multiple use and restoration: the consideration of all values of a resource in the context of a specific use; the regeneration of depleted resources		**5**:40g–h	
d. Conflicting values, attitudes, and issues: short-term versus long-term views		**5**:40h–42a / **4**:521a–g	
3. The history of conservation		**5**:42a–44a	
a. Early evidence of conservation management by pre-industrial man		**5**:42a–e / **9**:899g–900f	**7**:526c–e
b. The influence of the Industrial Revolution; the rise of the 19th-century conservation movement		**5**:42e–43b	
c. Developments in the 20th century		**5**:43b–44a	**14**:750d–756h *passim*
4. Types of natural resources		**5**:44a–46g	
a. Knowledge of the character of natural resources as basic to sound ecological management		**5**:44a–e / **2**:1037h–1042h / **6**:199c–g / **14**:825b–h	
i. Practices applicable to nonrenewable resources: beneficiation, maximization, substitution, allocation, and recycling		**5**:44a–c / **14**:754f–h	
ii. Problems of classification: the principle of cycling time as the basic distinction between renewable and nonrenewable resources		**5**:44c–e	
b. Resources that are considered renewable but with widely different cycling times		**5**:44f–45f / **17**:836c–h	
i. Plants and animals and the communities they occupy		**5**:44f–45b / **1**:487a–b / **7**:527g–528d / **7**:534h–538b / **8**:285a–286f / **10**:345b–346d / **17**:840h–842b	**1**:1031d–1034e *passim*
ii. Soil ecosystems		**5**:45b–c	
iii. Solar energy, air, and water		**5**:45c–f / **6**:857e–858b / **19**:643f–645f	
c. Resources that are considered nonrenewable		**5**:45g–46f	

	articles	article sections	other references
i. Resources consumed in use; *e.g.*, coal, petroleum, natural gas, and radioactive materials		**5**:45g–46b / **4**:793a–c / **6**:857a–e / **12**:858g–860b	**14**:165f–166d
ii. Resources that have exhaustible sources of supply but that can be reused after recycling; *e.g.*, minerals		**5**:46b–f / **13**:661g–663a	
5. Management of natural resources		**5**:46g–62b / **2**:1043f–1044d	
a. Managing nonliving resources		**5**:46g–51c	
i. Soil ecosystem resources: the management of soil, water, and vegetative cover for the protection of plants and animals useful to man		**5**:46g–48e / **9**:902f–903e / **19**:48h–49e	**2**:572a–c
ii. Water resource practices: the maintenance of present water supplies; the development of the oceans as sources of freshwater		**5**:48e–49c / **6**:975d–g / **7**:532e–533a / **19**:646b–648e	**10**:601f–h / **17**:836e–f
iii. Air resource management: the maintenance of clear, unpolluted air		**5**:49c–50c / **2**:328h–329f	
iv. Fuel and mineral resource practices: conserving exhaustible fuel and mineral resources; repairing environmental damage caused by extraction techniques		**5**:50c–51c / **12**:256e–g	**4**:777h–779a *passim* / **13**:662g–663a / **14**:431a–c
b. Managing living resources		**5**:51c–56c	
i. Wildlife management: the maintenance of habitats that support desired wildlife populations for recreational, commercial, or scientific purposes		**5**:51d–53g / **7**:533b–g / **9**:48h–50b / **19**:1161h–1162g	**1**:197g–198b / **7**:149b–d / **7**:854f–855a
ii. Fisheries management: practices that maximize sustained yield of fish and other seafood populations		**5**:53g–54e	**1**:1035a–b
iii. Multiple-use management: practices involved in the conservation of wild lands; *e.g.*, recreation, wildlife habitats, timber production, livestock grazing		**5**:54e–55h / **7**:527a–g	**1**:197c–198c
iv. Agricultural management: practices involved in intensive land use; *e.g.*, the use of fertilizers, pesticides, and insecticides		**5**:55h–56c / **1**:360d–362f / **19**:723h–726h	**5**:895a–c
c. The management of resources that are international in character		**5**:56d–58d	
i. Establishment of Antarctica as a strict nature reserve for scientific research		**5**:56g–h	
ii. Management of whales, fur seals, and migratory birds		**5**:56h–57d	**19**:813d–h
iii. Control of international waters: territorial limits and marine resources		**5**:57e–g	
iv. International trade in animals and plants: efforts to preserve endangered species		**5**:57g–58d	**9**:49d–g / **11**:538a–c / **16**:560a–c / **19**:1161f–h
d. Problems created by mismanagement of natural resources		**5**:58e–60a / **2**:1042h–1043e	
i. Environmental pollution: accumulation of wastes in water, air, and land; noise pollution		**5**:49c–50c / **5**:58g–60a / **1**:361b–362f / **5**:886d–f / **6**:721c–e / **6**:976b–e / **14**:750e–756h / **15**:769h–770b	**1**:345d–e / **1**:1031c–d / **2**:570f–571f / **6**:199e–g / **10**:601c–f / **11**:110a–b / **14**:143b–e / **14**:433b–d / **19**:647g–648a
ii. Soil depletion and erosion		**5**:47b–48d / **10**:341a–h	**1**:361e–g / **6**:63b–c / **14**:429h–433g *passim* / **16**:420f–h
iii. Hydrological disruption: alteration of patterns of evaporation, distribution, and availability of water		**5**:48g–49c / **10**:610g–611e	**10**:601a–d / **14**:432c–g
iv. Community instability and disruption: introduction of foreign plants and animals that create pest problems and generate epidemics		**14**:144c–146b	**5**:915h–916b / **8**:447h–448a / **14**:82a–83e *passim* / **14**:825c–g / **14**:834g–836a *passim*
e. Trends in the conservation of natural resources		**5**:60a–62b	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AGGASIZ, LOUIS **1**:289
ARISTOTLE **1**:1162
BAER, KARL ERNST VON **2**:581
BROWN, ROBERT **3**:331
BUFFON, GEORGES-LOUIS LECLERC, COMTE DE **3**:451
CUVIER, GEORGES, BARON **5**:389
DARWIN, CHARLES **5**:492
DOBZHANSKY, THEODOSIUS **5**:925
DRIESCH, HANS ADOLF EDUARD **5**:1040
ELTON, CHARLES **6**:734
GALTON, SIR FRANCIS **7**:858
GALVANI, LUIGI **7**:859
GESNER, CONRAD **8**:131
HAECKEL, ERNST **8**:541
HARVEY, WILLIAM **8**:660
HIPPOCRATES **8**:940
HOOKER FAMILY **8**:1066
HUXLEY FAMILY **9**:71
LAMARCK, JEAN-BAPTISTE DE MONET, CHEVALIER DE **10**:616
LEEUWENHOEK, ANTONIE VAN **10**:772
LINNAEUS **10**:1013
LORENZ, KONRAD **11**:106
LYSENKO, TROFIM DENISOVICH **11**:218
MALPIGHI, MARCELLO **11**:388
MENDEL, GREGOR JOHANN **11**:898
MORGAN, THOMAS HUNT **12**:440
MULLER, HERMANN JOSEPH **12**:614
MÜLLER, JOHANNES PETER **12**:615
OPARIN, ALEKSANDR IVANOVICH **13**:577
OWEN, SIR RICHARD **13**:800
PAVLOV, IVAN PETROVICH **13**:1095
PLINY THE ELDER **14**:572
RAY, JOHN **15**:535
ROMER, ALFRED SHERWOOD **15**:1133
SIMPSON, GEORGE GAYLORD **16**:778
SPALLANZANI, LAZZARO **17**:444
SPENCER, HERBERT **17**:492
WALLACE, ALFRED RUSSEL **19**:530
WEISMANN, AUGUST **19**:735

Introduction to Part Four:

The cosmic orphan

by Loren Eiseley

When I was a young lad of that indefinite but important age when one begins to ask, Who am I? Why am I here? What is the nature of my kind? What is growing up? What is the world? How long shall I live in it? Where shall I go? I found myself walking with a small companion over a high railroad trestle that spanned a stream, a country bridge, and a road. One could look fearfully down, between the ties, at the shallows and ripples in the shining water some 50 feet below. One was also doing a forbidden thing, against which our parents constantly warned. One must not be caught on the black bridge by a train. Something terrible might happen, a thing called death.

From the abutment of the bridge we gazed down upon the water and saw among the pebbles the shape of an animal we knew only from picture books—a turtle, a very large, dark mahogany-coloured turtle. We scrambled down the embankment to observe him more closely. From the little bridge a few feet above the stream, I saw that the turtle, whose beautiful markings shone in the afternoon sun, was not alive and that his flippers waved aimlessly in the rushing water. The reason for his death was plain. Not too long before we had come upon the trestle, someone engaged in idle practice with a repeating rifle had stitched a row of bullet holes across the turtle's carapace and sauntered on.

My father had once explained to me that it took a long time to make a big turtle, years really, in the sunlight and the water and the mud. I turned the ancient creature over and fingered the etched shell with its forlorn flippers flopping grotesquely. The question rose up unbidden. Why did the man have to kill something living that could never be replaced? I laid the turtle down in the water and gave it a little shove. It entered the current and began to drift away. "Let's go home," I said to my companion. From that moment I think I began to grow up.

"Papa," I said in the evening by the oil lamp in our kitchen. "Tell me how men got here." Papa paused. Like many fathers of that time, he was worn from long hours, he was not highly educated, but he had a beautiful resonant voice and he had been born on a frontier homestead. He knew the ritual way the Plains Indians opened a story.

"Son," he said, taking the pattern of another people for our own, "once there was a poor orphan." He said it in such a way that I sat down at his feet. Once there was a poor orphan with no one to teach him either his way, or his manners. Sometimes animals helped him, sometimes supernatural beings. But above all, one thing was evident. Unlike other occupants of Earth he had to be helped. He did not know his place, he had to find it. Sometimes he was arrogant and had to learn humility, sometimes he was a coward and had to be taught bravery. Sometimes he did not understand his Mother Earth and suffered for it. The old ones who starved and sought visions on hilltops had known these things. They were all gone now and the magic had departed with them. The orphan was alone; he had to learn by himself; it was a hard school.

My father tousled my head; he gently touched my heart. "You will learn in time there is much pain here," he said. "Men will give it to you, time will give it to you, and you must learn to bear it all, not bear it alone, but be better for the wisdom that may come to you if you watch and listen and learn. Do not forget the turtle, nor the ways of men. They are all orphans and they go astray; they do wrong things. Try to see better."

"Yes, papa," I said, and that was how I believe I came to study men, not the men of written history but the ancestors beyond, beyond all writing, beyond time as we know it, beyond human form as it is known today. Papa was right when he told me men were orphans, eternal seekers. They had little in the way of instinct to instruct them, they had come a strange far road in the universe, passed more than one black, threatening bridge. There were even more to pass and each one became more dangerous as our knowledge grew. Because man was truly an orphan and confined to no single way of life, he was, in essence, a prison breaker. But in ignorance his very knowledge sometimes led from one terrible prison to another. Was the final problem then, to escape himself, or, if not that, to reconcile his devastating intellect with his heart? All of the knowledge set down in great books directly or indirectly affects this problem. It is the problem of every man, for even the indifferent man is making, unknown to himself, his own callous judgment.

Long ago, however, in one of the Dead Sea Scrolls hidden in the Judaean Desert, an unknown scribe had written: "None there be, can rehearse the whole tale." That phrase, too, contains the warning that man is an orphan of uncertain beginnings and an indefinite ending. All that the archaeological and anthropological sciences can do is to place a somewhat flawed crystal before man and say: This is the way you came, these are your present dangers; somewhere, seen dimly beyond, lies your destiny. God help you, you are a cosmic orphan, a symbol-shifting magician, mostly immature and inattentive to your own dangers. Read, think, study, but do not expect this to save you without humility of heart. This the old ones knew long ago in the great deserts under the stars. This they sought to learn and pass on. It is the only hope of men.

What have we observed that might be buried as the Dead Sea Scrolls were buried for 2,000 years, and be broken out of a jar for human benefit, brief words that might be encompassed on a copper scroll or a ragged sheet of vellum? Only these thoughts, I think, we might reasonably set down as true, now and hereafter. For a long time, for many, many centuries, Western man believed in what we might call the existent world of nature; form as form was seen as constant in both animal and human guise. He believed in the instantaneous creation of his world by the Deity; he believed its duration to be very short, a stage upon which the short drama of a human fall from divine estate and a redemption was in progress.

Worldly time was a small parenthesis in eternity. Man lived with that belief, his cosmos small and man-centred. Then, beginning about 350 years ago, thoughts unventured upon since the time of the Greek philosophers began to enter the human consciousness. They may be summed up in Francis Bacon's dictum: "This is the foundation of all. We are not to imagine or suppose, but to *discover,* what nature does or may be made to do."

When in following years scientific experiment and observa-

tion became current, a vast change began to pass over Western thought. Man's conception of himself and his world began to alter beyond recall. " 'Tis all in pieces, all coherence gone," exclaimed the poet John Donne, Bacon's contemporary. The existing world was crumbling at the edges. It was cracking apart like an ill-nailed raft in a torrent—a torrent of incredible time. It was, in effect, a new nature comprising a past embedded in the present and a future yet to be.

First, Bacon discerned a *mundus alter,* another separate world that could be drawn out of nature by human intervention—the world that surrounds and troubles us today. Then, by degrees, time depths of tremendous magnitude began, in the late 18th century, to replace the Christian calendar. Space, from a surrounding candelabrum of stars, began to widen to infinity. The Earth was recognized as a mere speck drifting in the wake of a minor star, itself rotating around an immense galaxy composed of innumerable suns. Beyond and beyond, into billions of light years, other galaxies glowed through clouds of wandering gas and interstellar dust. Finally, and perhaps the most shocking blow of all, the natural world of the moment proved to be an illusion, a phantom of man's short lifetime. Organic novelty lay revealed in the strata of the Earth. Man had not always been here. He had been preceded, in the 4,000,000,000 years of the planet's history, by floating mollusks, strange fern forests, huge dinosaurs, flying lizards, giant mammals whose bones lay under the dropped boulders of vanished continental ice sheets.

The Orphan cried out in protest, as the cold of naked space entered his bones, "Who am I?" And once more science answered. "You are a changeling." "You are linked by a genetic chain to all the vertebrates. The thing that is you bears the still aching wounds of evolution in body and in brain. Your hands are made-over fins, your lungs come from a creature gasping in a swamp, your femur has been twisted upright. Your foot is a reworked climbing pad. You are a rag doll resewn from the skins of extinct animals. Long ago, 2,000,000 years perhaps, you were smaller, your brain was not so large. We are not confident that you could speak. Seventy million years before that you were an even smaller climbing creature known as a tupaiid. You were the size of a rat. You ate insects. Now you fly to the Moon."

"This is a fairy tale," protested the Orphan. "I am here, I will look in the mirror."

"Of course it is a fairy tale," said the scientists, "but so is the world and so is life. That is what makes it true. Life is indefinite departure. That is why we are all orphans. That is why you must find your own way. Life is not stable. Everything alive is slipping through cracks and crevices in time, changing as it goes. Other creatures, however, have instincts that provide for them, holes in which to hide. They cannot ask questions. A fox is a fox, a wolf is a wolf, even if this, too, is illusion. You have learned to ask questions. That is why you are an orphan. *You are the only creature in the universe who knows what it has been.* Now you must go on asking questions while all the time you are changing. You will ask what you are to become. The world will no longer satisfy you. You must find your way, your own true self."

"But how can I?" wept the Orphan, hiding his head. "This is magic. I do not know what I am. I have been too many things."

"You have indeed," said all the scientists together. "Your body and your nerves have been dragged about and twisted in the long effort of your ancestors to stay alive, but now, small orphan that you are, you must know a secret, a secret magic that nature has given to you. No other creature on the planet possesses it. You use language. You are a symbol-shifter. All this is hidden in your brain and transmitted from one generation to another. You are a time-binder, in your head the symbols that mean things in the world outside can fly about untrammelled. You can combine them differently into a new world of thought or you can also hold them tenaciously throughout a lifetime and pass them on to others."

Thus out of words, a puff of air, really, is made all that is uniquely human, all that is new from one human generation to another. But remember what was said of the wounds of evolution. The brain, parts of it at least, is very old, the parts laid down in sequence like geological strata. Buried deep beneath the brain with which we reason are ancient defense centres quick to anger, quick to aggression, quick to violence, over which the neocortex, the new brain, strives to exert control. Thus there are times when the Orphan is a divided being striving against himself. Evil men know this. Sometimes they can play upon it for their own political advantage. Men crowded together, subjected to the same stimuli, are quick to respond to emotion that in the quiet of their own homes they might analyze more cautiously.

Scientists have found that the very symbols which crowd our brains may possess their own dangers. It is convenient for the thinker to classify an idea with a word. This can sometimes lead to a process called hypostatization or reification. Take the word "Man," for example. There are times when it is useful to categorize the creature briefly, his history, his embracing characteristics. From this, if we are not careful of our meanings, it becomes easy to speak of all men as though they were one person. In reality men have been seeking this unreal man for thousands of years. They have found him bathed in blood, they have found him in the hermit's cell, he has been glimpsed among innumerable messiahs, or in meditation under the sacred bô tree; he has been found in the physician's study or lit by the satanic fires of the first atomic explosion.

In reality he has never been found at all. The reason is very simple: men have been seeking Man capitalized, an imaginary creature constructed out of disparate parts in the laboratory of the human imagination. Some men may thus perceive him and see him as either totally beneficent or wholly evil. They would be wrong. They are wrong so long as they have vitalized this creation and call it Man. There is no Man; there are only men: good, evil, inconceivable mixtures marred by their genetic makeup, scarred or improved by their societal surroundings. So long as they live they are *men,* multitudinous and unspent potential for action. Men are great objects of study, but the moment we say "Man" we are in danger of wandering into a swamp of abstraction.

Surveying our fossil history perhaps we are not even justified as yet in calling ourselves true men. The word carries subtle implications that extend beyond us into the time stream. If a remote half-human ancestor, barely able to speak, had had a word for his kind, as very likely he did, and just supposing it had been "man," would we approve the usage, the shape-freezing quality of it, now? I think not. Perhaps no true orphan would wish to call himself anything but a traveller. Man in a cosmic timeless sense may not be here.

The point is particularly apparent in the light of a recent and portentous discovery. In 1953 James D. Watson and Francis H.C. Crick discovered the structure of the chemical alphabet out of which all that lives is constituted. It was a strange spiral ladder within the cell, far more organized and complicated than 19th-century biologists had imagined; the tiny building blocks constantly reshuffled in every mating had both an amazing stability and paradoxically, over long time periods, a power to alter the living structure of a species beyond recall. The thing called man had once been a tree shrew on a forest branch; now it manipulates abstract symbols in its brain from which skyscrapers rise, bridges span the horizon, disease is conquered, the Moon is visited.

Molecular biologists have begun to consider whether the marvellous living alphabet which lies at the root of evolution can be manipulated for human benefit. Varieties of domesticated plants and animals have been improved. Now at last man has begun to eye his own possible road into the future. By delicate excisions and intrusions could the mysterious alphabet we carry in our bodies be made to hasten our advancement into the future? Already our urban concentrations, with all their aberrations and faults, are future-oriented. Why not ourselves? Is it in our power to perpetuate great minds *ad infinitum?* But who is to judge? Who is to select this future man? There is the problem. Which of us poor orphans by the roadside, even those peering learnedly through the electron microscope, can be confident of the way into the future? Could the fish unaided by nature have found the road to the reptile, the reptile to the mammal, the mammal to man? And how was man endowed with speech? *Could* men choose their way? Suddenly before us towers the blackest, most formidable bridge of our experience. Across what chasm does it run?

Biologists tell us that in the fullness of time over ninety percent of the world's past species have perished. The mammalian ones in particular are not noted for longevity. If the scalpel, the excising laser ray in the laboratory, were placed in the hands of some one man, some one poor orphan, what would he do? If assured, would he reproduce himself alone? If cruel, would he by indirection succeed in abolishing the living world? If doubtful of the road, would he reproduce the doubt? "Nothing is more shameful than assertion without knowledge," a great Roman, Cicero, once pronounced as though he had foreseen this final bridge of human pride—the pride of a god without foresight.

After the disasters of the second World War when the dream of perpetual progress died from men's minds, an orphan of this violent century wrote a poem about the great extinctions revealed in the rocks of the planet. It concludes as follows:

I am not sure I love
the cruelties found in our blood
from some lost evil tree in our beginnings.
May the powers forgive and seal us deep
when we lie down,
May harmless dormice creep and red leaves fall
over the prisons where we wreaked our will.
Dachau, Auschwitz, those places everywhere.
If I could pray, I would pray long for this.

One may conclude that the poet was a man of doubt. He did not regret man; he was confident that leaves, rabbits, and songbirds would continue life, as, long ago, a tree shrew had happily forgotten the ruling reptiles. The poet was an orphan in shabby circumstances pausing by the roadside to pray, for he did pray despite his denial; God forgive us all. He was a man in doubt upon the way. He was the eternal orphan of my father's story. Let us then, as similar orphans who have come this long way through time, be willing to assume the risks of the uncompleted journey. We must know, as that forlorn band of men in Judaea knew when they buried the jar, that man's road is to be sought beyond himself. *No man there is who can tell the whole tale.* After the small passage of 2,000 years who would deny this truth?

Part Four. Human life

The outlines, and the articles and parts of articles referred to, in the five divisions and twenty-one sections of Part Four treat stages in the development of human life on Earth; human health and diseases; human behaviour and experience; communication and language; and aspects of man's daily life.

Several points should be noted about the relations of Part Four to preceding and subsequent parts.

The fundamental physical and chemical properties of matter were dealt with in Part One. The treatment of the Earth in Part Two encompassed those properties of the Earth that are supportive of human life. Much fundamental biological knowledge concerning human life was involved in the treatment—in Part Three, Life on Earth—of what is common to all animal life; the last section of Part Three dealt with man's place in the biosphere.

Knowledge of the biomedical and psychological aspects of human life is not wholly separable from, and is germane to, the subjects covered in Parts Five through Ten, which treat human society, the fine arts, technology, religion, the history of peoples and civilizations, and man as logician, mathematician, scientist, historian, and philosopher.

The biological, medical, and psychological sciences have been themselves the object of historical and analytical studies concerned with their nature, methods, and interrelations. These studies are set forth in Sections 10/34, 10/35, and 10/36 of Part Ten. The instrumentation involved in these sciences is dealt with in Section 723 of Part Seven.

The articles referred to in the four sections of Division I treat the taxonomy of the primates and the Quaternary Hominidae; the evolution of man; human heredity; and the races of man.

The articles referred to in the five sections of Division II treat the general conception of human health; the structures and functions of the healthy human body; the manifestation, recognition, and treatment of human disease; the diseases and disorders of the human body; and the practice and profession of medicine.

The articles referred to in the eight sections of Division III set forth discoveries and theories in the psychological sciences concerning human capacities, human behaviour, and human experience.

The articles referred to in the two sections of Division IV deal with the methods and forms of communication; with the sciences of human language and speech; and with the characteristics of the principal languages of world history.

The articles referred to in the two sections of Division V treat first the organization of human work and the provision of the daily necessities of food and drink, clothing, and shelter; and then deal with leisure and play—with man's exercises, games, hobbies, and avocations.

Division I. Stages in the development of human life on Earth 209
II. Human health and diseases 217
III. Human behaviour and experience 241
IV. Communication and language 263
V. Aspects of man's daily life 273

Division I. Stages in the development of human life on Earth

The outlines, and the articles and parts of articles referred to, in the four sections of Division I present studies in historical comparative anatomy that place *Homo sapiens* within a general taxonomy; the theory of the biological evolution of man; and studies, in genetics and physical anthropology, of human heredity and the races of man.

The articles referred to in Section 411 treat the distinguishing characteristics of the order of primates; and then, within that order, the distinguishing characteristics of the family Hominidae, which includes the species *Homo sapiens* and its extinct precursors.

Section 411. The order of primates and the emergence of Hominidae 210
412. Quaternary Hominidae 211
413. The evolution of man 213
414. Human heredity: the races of man 215

Section 412 deals with the evolution of Hominidae during the Early, Middle, and Late Quaternary periods on the evolutionary time scale, extending from around 1,000,000 years ago to around 10,000 years ago. Articles referred to treat *Homo erectus; Homo sapiens;* Neanderthal man; prehistoric Africans; prehistoric Asians; and Cro-Magnon man.

Section 413, dealing with the evolution of man, first treats man's evolutionary relationships to living primates and to fossil primates. It goes on to the discovery, range, and limitations of the hominid fossil record. It next deals with the role of genetics in the evolutionary process, and with conflicting hypotheses concerning the phylogeny of Hominidae. Finally, it treats estimates of the antiquity of man and of the chronology of hominid evolution.

The articles referred to in Section 414 treat heredity in man; survey the nature and origin of human races; and provide a geographical taxonomy of the living races.

Section 411. The order of primates and the emergence of Hominidae

[for Part Four headnote see page 209
for Division I headnote see page 209]

The articles and parts of articles referred to in Section 411 deal with two main subjects: A, the mammal order of primates generally; and B, the distinguishing characteristics of the family Hominidae, which includes man and extinct manlike creatures.

The outline of subject A deals first with the distinguishing characteristics of the primates such as their variation in size, adaptive diversity, and distribution and abundance. It goes on to treat the characteristics of primate natural history and the morphological and functional features of primates. Finally, it treats the evolutionary history of the primates as revealed in the primate fossil record, and the classification of the recent primates into the suborder of prosimians, or lower primates (lemurs, lorises, and tarsiers) and the suborder of anthropoids, or higher primates (monkeys, apes, and hominids).

The outline of subject B deals first with the anatomical, physiological, and biochemical characteristics that distinguish the Hominidae from other primates. It goes on to inferred behavioral characteristics of the hominids, such as their toolmaking capabilities, their use of language, and their social organization. It next deals with the contrasting adaptive patterns of Hominidae and Pongidae (anthropoid apes). Finally, it treats the ecological aspects of hominid origins and the morphological and inferred behavioral characteristics of hominids in the basal Quaternary Period, as well as the controversies concerning their classification.

A. The primates

1. Historical background of primate studies
2. Distinguishing characteristics of the primates: size range and adaptive diversity; distribution and abundance
3. The natural history of primate life: reproduction and the life cycle; growth and longevity; locomotion; ecology and diet
4. Form and function: distinguishing features of the primates and their differences from other mammals
   a. Vertebral column and posture
   b. Hands and feet: manipulative capabilities
   c. Dentition, snout, muzzle, and nose
   d. Brain, nervous system, and sensory perception
   e. Reproductive system
5. Evolution and paleontology
   a. Renewed interest in primate origins
   b. Primate fossil record
6. Classification of the primates: the two main groups or suborders, the prosimians (principally lemurs, lorises, and tarsiers) and the anthropoids (monkeys, apes, and man)

B. The distinguishing characteristics of the Hominidae: their differentiation from other primates

1. Morphological characteristics

articles	article sections	other references
PRIMATES **14**:1014–1030		
	14:1015a–1016b	
	14:1016c–g	
	14:1016h–1022a	**11**:403a–b/**16**:596a–f
	14:1022b–1025e/ **16**:838g–844c	**10**:744c–746d
	14:1022g–h	**16**:812f–818d *passim*
	14:1022h–1023c	**11**:420b–c
	14:1023c–1024b	
	14:1024b–h/ **12**:1033c–f	**4**:1064d–e/**12**:982a–991f *passim*/**16**:595f–h
	14:1024h–1025e	**15**:690h–696e *passim*
	14:1025e–1027h	
	14:1025e–h	
	14:1025h–1027h/ **11**:421a–h	
	14:1027h–1030e	**8**:1023a–b
HOMINIDAE **8**:1023–1029	**7**:20a–21f/ **11**:419a–h	**8**:1030b–d/**14**:985b–c/ **14**:1030b
	8:1023g–1026e/ **1**:286d–287h/ **8**:1032b–1033c/ **11**:419a–420g	**2**:438b–h/**5**:289h–290d/ **12**:911f–912e *passim*

	articles	article sections	other references
a. Body structure		**8**:1023g–1026b / **6**:751f–h	**5**:653c–654g *passim* / **12**:636d–637d *passim* / **16**:812f–818d *passim*
i. Orthograde posture		**8**:1023h	**16**:815h–816e
ii. Bipedal locomotion: running and walking		**8**:1024a–g / **16**:818a–d	**8**:1045e–g / **14**:1020a–d
iii. Forelimb structure and manipulation		**8**:1024g–h / **16**:817e–818d	**8**:1045g–1046b
iv. Facial structure		**8**:1024h–1025h / **16**:815e–h	
v. Dentition and diet		**8**:1025h–1026b / **14**:1023c–f / **18**:55g–56h	**8**:1045d–e
b. Brain and nervous system		**8**:1026b–c / **12**:994h–996c	**6**:750c–751f *passim* / **12**:982a–991f *passim*
c. Biomolecular characteristics		**8**:1026c–e / **2**:1112c–h / **2**:1144b–1149b	
2. Inferred behavioral characteristics [see also 431]		**8**:1026e–1028a / **1**:287h–289c / **8**:1033d–1034e	**2**:438h–439e
a. Toolmaking capabilities		**8**:1026g–1027c	
b. Language and related symbolic behaviour		**8**:1027c–h / **6**:874e–875d / **10**:649e–650c / **10**:652h–653e / **10**:657f–g	**4**:1008b–d / **4**:1009a / **4**:1064b–c / **17**:477f–g
c. Social organization		**8**:1027h–1028a / **10**:478d–f	**14**:986d–e
3. Contrasting adaptations of Hominidae and Pongidae		**8**:1028a–h	
4. Ecological aspects of hominid origins: controversy about the transition from hominoid to early hominid to human		**8**:1028h–1029g / **8**:1034f–1035h	7:20a–c / **11**:421f–h
5. Hominidae of the basal Quaternary: from 3,000,000 to 1,000,000 years ago			
a. Hominid origins in the Tertiary Period: *Ramapithecus* and *Kenyapithecus*		**11**:421h–422c	**8**:1023a–1029g *passim* / **14**:1027b–c
b. The genus *Australopithecus* and its species: *robustus* and *africanus*	AUSTRALOPITHECUS **2**:436–440	**11**:422c–423f	7:20b–c / **8**:1030b–c
i. Morphological characteristics: brain size, dentition, and posture		**2**:438b–h / **8**:1023g–1026e	**8**:1026e–1028c *passim* / **8**:1032f–1033c / **11**:422c–g
ii. Inferred behavioral characteristics: tool use, hunting, and diet		**2**:438h–439e	
iii. Relative geologic age and distribution		**2**:439e–440a	**11**:422h–423b
iv. Controversies concerning classification		**2**:440a–g	**11**:423b–f
6. Later Quaternary hominids (the genus *Homo*) [see also 412]		**11**:423f–425b	

Section 412. Quaternary Hominidae

[for Part Four headnote see page 209
for Division I headnote see page 209]

The articles and parts of articles referred to in Section 412 continue the evolutionary history, carried through the basal Quaternary Period in Section 411, of the family called Hominidae, which includes *Homo sapiens* and his extinct precursors. They treat the evolution of hominids during later epochs of the Quaternary Period: A, during the Early Quaternary; B, during the Middle Quaternary; and C, during the Late Quaternary.

Subject A is Hominidae of the Early Quaternary Period, from 1,000,000 to 400,000 years ago. The outline deals primarily with *Homo erectus*, formerly called *Pithecanthropus* (ape-man). It treats first the history of the discoveries of fossil remains and the geographical distribution, the antiquity, and the distinguishing morphological characteristics of *Homo erectus*. It then deals with such inferred behavioral characteristics as the sites occupied by *Homo erectus*, and his fire using, toolmaking, and food collecting capabilities. Finally, it treats recent controversies concerning the evolutionary relationships between *Homo erectus* and *Homo sapiens*.

Subject B is Hominidae of the Middle Quaternary, from 400,000 to 100,000 years ago. The outline first treats the interpretations, from European and African fossil remains, of the morphological characteristics, especially skull and jaw structure and dentition, of the earliest populations of *Homo sapiens*. It then deals with inferred behavioral characteristics, such as the kinds of sites occupied and toolmaking capabilities.

Subject C is Hominidae of the Late Quaternary, from 100,000 to 10,000 years ago. The outline first deals with human populations from 100,000 to 35,000 years ago, treating the Neanderthal

peoples of Europe and the Mediterranean regions; the prehistoric populations of sub-Saharan Africa; and the prehistoric populations of Asia. The outline goes on to human populations of from 35,000 to 10,000 years ago. It deals primarily with the Cro-Magnon populations of Europe, covering the age and distribution of their remains, as well as their morphological characteristics, their phylogenetic affinities with other European populations, and their culture. Finally, it treats morphological and cultural evidence regarding Asia and the people of the Western Hemisphere.

A. Hominidae of the Early Quaternary: from 1,000,000 to 400,000 years ago
   1. *Homo erectus* (*Pithecanthropus*)
      a. Distribution of *Homo erectus*: discoveries in Asia, Africa, and Europe
      b. Age of *Homo erectus*
      c. Morphological characteristics
      d. Inferred behavioral characteristics
         i. Nature of occupation places: discovery sites
         ii. Evidence of the use of fire
         iii. Toolmaking capabilities: East Asian chopper-tool industries; African Acheulean industrial complex
         iv. Food-collecting techniques
         v. Evidence of ritual
      e. Recent controversies concerning the relationship between *Homo erectus* and *Homo sapiens*
   2. *Homo sapiens*
      [see B.1., below]

B. Hominidae of the Middle Quaternary: from 400,000 to 100,000 years ago
   1. Morphological characteristics of early populations of *Homo sapiens*
      a. Definition of *Homo sapiens*: the distinguishing characteristics of the species
      b. Fossil remains of *Homo sapiens*: skull structure; jaw structure and dentition; postcranial skeleton
      c. The problem of Neanderthal man: morphological diversity among the Neanderthal fossils
      d. *Homo sapiens* fossil remains from Europe: Vertesszőllős man; Swanscombe man; Steinheim man; Fontéchevade man
      e. *Homo sapiens* fossil remains from Africa: Omo man
   2. Behavioral characteristics of early populations of *Homo sapiens*: cultural remains preserved in the fossil record
      a. Occupation places, hunting techniques, and evidence of the use of fire at sites in Europe and Africa
      b. Toolmaking capabilities: stone tools associated with *Homo sapiens*
         i. Acheulean industrial complex: hand-ax cultures
         ii. Clactonian industry: flake tool cultures
   3. Methods for dating *Homo sapiens* sites and the fossils associated with these sites

C. Hominidae of the Late Quaternary: from 100,000 to 10,000 years ago
   1. Human populations from 100,000 to 35,000 years ago
      a. Neanderthal peoples of Europe and the Mediterranean regions
         i. Fossil remains of the ancestors of Neanderthal man: Neanderthals of the third interglacial period
         ii. Neanderthals of the fourth glacial period: habitations, use of fire, diet, stone technology, burial practices, and distribution of skeletal remains

articles	article sections	other references
HOMO ERECTUS **8**:1030–1035	**11**:423f–425b	
	8:1030g–1031g	**2**:198f–g/**2**:439h–440a
	8:1031g–1032b	
	8:1032b–1033c	**8**:1044g–1045e
	8:1033d–1034e	
	8:1033d–e	
	8:1033e–f	
	8:1033g–1034a	
	8:1034a–c	
	8:1034c–e	
	8:1034f–1035h/ **8**:1046g–1047b/ **8**:1047d–g	**2**:440e–f/**11**:427g–h
HOMO SAPIENS **8**:1043–1052	**11**:425b–426f	
	8:1043g–1044f/ **11**:425f–426b	
	8:1044f–1046c	**11**:427d–f
	8:1046c–g/ **11**:426f–427d/ **12**:911a–912e	
	8:1046g–1048a	**11**:426b–e
	8:1048a–f/ **1**:286h–287b	**11**:426e–f
	8:1048f–1051b/ **17**:119b–g	**2**:203g–204e *passim*/ **8**:1026e–1028a *passim*
	8:1048g–1050e	
	8:1050e–1051b	
	8:1050f–1051a	**2**:203g–h/**8**:608f–h
	8:1051a–b	**2**:203h–204b
	8:1051c–1052c/ **11**:425b–e	
NEANDERTHAL MAN **12**:910–912	**8**:1046c–e/ **11**:426f–427d	
	12:910h–911b/ **11**:426f–h	
	12:911b–912b	**8**:608h–609b/**11**:426h–427c

	articles	article sections	other references
iii. Morphological characteristics and population variation: supposed causes of morphological distinctiveness		**12**:912d–e	
iv. Phylogenetic affinities with later populations: Neanderthal man and Cro-Magnon man; Asian and African peoples; non-Mousterian contemporaneous populations		**12**:912e–h / **2**:204f–205a	**13**:145h–146b
b. Populations of sub-Saharan Africa	AFRICANS, PREHISTORIC **1**:286–289	**17**:274f–276a	**11**:421h–425b *passim* / **13**:145g–146d
i. Ages and distribution of fossil remains		**1**:286b–d / **12**:912g–h	**1**:281h–282a
ii. Morphological characteristics and population variation		**1**:286d–287h	**8**:1048a–c
iii. Inferred behavioral characteristics: nature of occupation places and cultural adjustments		**1**:287h–289c	**1**:282a–c
iv. Phylogenetic affinities with later African populations		**1**:289d–f	
c. Populations of Asia	ASIANS, PREHISTORIC **2**:200–205	**4**:297g–301e	**11**:421h–425b *passim*
i. Ages and distribution of fossil remains; areas of human occupation; remains of Neanderthal man and of *Homo sapiens sapiens*		**2**:200g–202e	
ii. Neanderthal morphology in western and eastern Asia; Asian *Homo sapiens* fossils		**2**:202e–203f	**2**:198f–g
iii. Life-styles of prehistoric man in Asia, including stone tool cultures, the uses of fire and shelter, and cultural data		**2**:203g–204e / **2**:198h–199d	
iv. Phylogenetic affinities with later Asian populations		**2**:204f–205a	
2. Human populations from 35,000 to 10,000 years ago			
a. The Cro-Magnon populations of Europe	CRO-MAGNON MAN **5**:289–291		**14**:985c–988a *passim*
i. Ages and distribution		**5**:289f–g	
ii. Morphological characteristics and population variation: analysis of Cro-Magnon fossils; variant Cro-Magnon types		**5**:289g–290e	
iii. The place of Cro-Magnon man in human evolution: phylogenetic affinities with other European populations		**5**:290e–f	**12**:912e–g *passim*
iv. The culture of Cro-Magnon man: toolmaking, dwellings, and hunting techniques		**5**:290g–291c / **17**:702h–706d	**8**:609c–g
b. Asia and the peopling of the Western Hemisphere		**13**:213e–215a	**14**:847c–f
i. Morphological evidence			**13**:213e–f
ii. Cultural evidence		**13**:213h–215a	

Section 413. The evolution of man

[for Part Four headnote see page 209
for Division I headnote see page 209]

The articles and parts of articles referred to in Section 413 deal with four main subjects: A, man's evolutionary relationships; B, the fossil record of the Hominidae; C, the evolutionary process in man; and D, estimates of the antiquity of man and of the chronology of hominid evolution.

The outline of subject A deals with man's evolutionary relationships to living primates and to fossil primates.

The outline of subject B first deals with the discovery and recognition of *Ramapithecus*, of *Australopithecus*, of *Homo erectus*, and of Neanderthal peoples. It then treats the extent and range of the hominid fossil record.

The outline of subject C treats the role of genetics in the evolutionary process and conflicting hypotheses concerning the phylogeny of Hominidae.

The outline of subject D begins with estimates of the antiquity of man based on myth, folklore, and interpretations of religious beliefs. It then deals with estimates based on data drawn from the history of the Earth and the evolution of life, treating the relative chronologies established from stratigraphy, and the efforts at absolute age dating of fossils by estimates of the relative quantities of radioactive and ordinary carbon in fossil remains.

	articles	article sections	other references
A. Man's evolutionary relationships	MAN, EVOLUTION OF **11**:418–421	**7**:20a–21g	**7**:1009e–1010a / **8**:1023a–1029g *passim*

	articles	article sections	other references
1. To living primates		**11**:419a–420g / **14**:1014g–1016b	
2. To fossil primates		**11**:420g–421h	**14**:1026g–1027f
B. The fossil record of the Hominidae and its limitations	MAN, EVOLUTION OF **11**:421–428		**14**:839a–c
1. The discovery and recognition of the hominid fossil record		**11**:421h–425b / **5**:290e–f	**7**:1009e–g
a. The discovery and recognition of *Ramapithecus*		**11**:421h–422c	**8**:1023e–g
b. The discovery and recognition of *Australopithecus*		**11**:422c–423f / **2**:436g–440a	
c. The discovery and recognition of *Homo erectus*		**11**:423f–425b / **8**:1030a–1034e	
d. The discovery and recognition of Neanderthal peoples		**11**:426f–427d / **2**:201b–h / **8**:1046c–g / **12**:910f–912b	
2. The extent and range of the hominid fossil record		**11**:425b–428a / **14**:839f–841a	**7**:1009e–g
a. Problems of preservation in the fossil record: geological and other factors		**11**:425b–e	
b. Representation of skeletal parts in the fossil record: the antiquity of *Homo sapiens*		**11**:425f–426b / **8**:1044f–1048f	**5**:289g–290d
c. The evidence for past hominid populations: early *Homo sapiens* remains in Europe and Africa		**11**:426b–427f / **3**:1072d–1073h	**7**:1009g–1010a
d. The principal gaps in the fossil record: lack of fossil evidence; theoretical gaps		**11**:427f–428a / **2**:437e–438a	
C. The evolutionary process of man	MAN, EVOLUTION OF **11**:428–430		
1. The role of genetics		**11**:428c–430a	**14**:839c–f
a. Mutation and natural selection		**11**:428c–429b	
b. Adaptation and genetic change: homeostatic change; blood types, abnormal hemoglobins, and disease; random genetic drift		**11**:429b–430a	
2. Man's continuing evolution: conflicting hypotheses concerning the phylogeny of Hominidae		**11**:430b–g / **2**:440a–g / **8**:1028h–1029g / **8**:1034f–1035h / **14**:840c–g / **15**:352f–353a / **15**:354h–355f	
a. Phyletic evolution: cumulative changes in the population gene pool leading to separation into new species		**11**:430b–e	
b. Phenetic evolution: changes in response to environmental stimuli producing subspecies, races, or varieties		**11**:430e–g	**8**:1029c–g
D. Estimates of the antiquity of man and of the chronology of hominid evolution	MAN, EVOLUTION OF **11**:425–426		
1. Estimates based on myth, folklore, and interpretations of religious beliefs		**18**:411a–413b	**12**:799c–h
a. Origin myths		**4**:301h–302a / **5**:239g–241e / **8**:928g–929c / **11**:1009d–1011h	**9**:870e–871b / **11**:445f–446e / **12**:918g–919a / **14**:1044a–e
b. Religious calendars		**4**:302f–g / **11**:1005c–e / **12**:800c–e	**4**:581c–582e *passim* / **11**:721f–h / **14**:1044e–g
2. Estimates based on data drawn from the history of the Earth and the evolution of life		**7**:572f–h / **8**:1031g–1032b / **8**:1051c–1052c	**2**:439e–h
a. Relative chronologies from stratigraphy		**17**:119d–g	**1**:1081g–1082b / **14**:738h–739a
b. Radiometric (chronometric) criteria for age assessment relative to the evolution of Hominidae		**15**:456c–d	**1**:1082b–d

Section 414. Human heredity: the races of man

[for Part Four headnote see page 209
for Division I headnote see page 209]

The articles and parts of articles referred to in Section 414 deal with three main subjects: A, heredity in man; B, the nature and origin of human races; and C, race populations and their types.

Subject A is the special features of human heredity, heredity having been treated generally in Section 339 of Part Three. The outline begins with the biological basis of human heredity, covering single-factor inheritance and the inheritance of blood types. It goes on to the inheritance of behaviour traits in man, stressing the difficulty of assessing the contributions of heredity and environment. It then treats the applications of human genetics, specific behavioral traits such as intelligence and temperament, and the effects of consanguinity.

Subject B is the nature and origin of human races—subgroups within the human species, *Homo sapiens*. The outline deals first with various classifications of race: with geographical races, very large genetically different human groupings that often correspond with the major continents or great island chains; with local races, which are breeding populations within geographical areas; and with the still smaller subgroups called microraces. As aspects of racial diversity, it deals with genetic adaptations to environment and with deeply entrenched cultural differences. After dealing with old and new hallmarks of race, it treats modern measures of race—single gene traits, metabolic factors, and diseases and congenital defects. The outline next deals with the many causes that lead, through changes in gene pools, to the ongoing evolution of races—the decline and disappearance of some races and the appearance of new races. The outline concludes with problems in the study of racial traits and human genetics.

The outline of subject C, race populations and their types, first deals with the emergence of various human populations as the evolutionary result of biological and cultural selection, and with the prehistoric basis of human races. It then presents a geographical taxonomy of the living races, covering the peoples of Europe, Africa, Austronesia, Asia, India, and the Western Hemisphere.

articles	article sections	other references
A. Heredity in man		
1. The biological basis of human heredity: genetic reproduction		
a. Single-factor inheritance; *e.g.*, dominant gene traits, recessive traits, sex-linked inheritance, lethal genes	**7**:996h–1002c **7**:998c–1001d/ **6**:1024g–1025c/ **8**:1147a–e	**14**:839c–f **2**:1073a–1076e *passim*/ **5**:32d–f
b. Inheritance of blood types: various blood types, Rh gene complex, abnormal hemoglobins and blood clotting, and serum proteins	**7**:1001d–1002c/ **2**:1147b–1148d/ **14**:841f–h/ **15**:352a–f/ **15**:353b–354c	
2. Inheritance of behavioral traits in man: the difficulty of assessing the contributions of heredity and environment	**7**:1002c–1005g/ **6**:1025c–e/ **8**:1146c–h/ **15**:350c–351c/ **15**:355f–h	**8**:809d–810h *passim*/ **16**:954b–c/**16**:955a–c
a. Fraternal and identical twins and the inferences that can be made from twin studies	**7**:1002c–1003h	**8**:810g–h/**8**:1147e–1149h *passim*
b. Genetic explanations for abnormalities: chromosome variations; mutation [see also 413.C.1.a.]	**7**:1004a–1005g/ **11**:428c–h	**15**:353d–e/**15**:353h–354g/ **16**:595b–c
3. Applications of human genetics; *e.g.*, genetic counselling, eugenics, the study of populations	**7**:1005g–1010a/ **8**:818f–819e	**5**:31h–32d/**11**:428h–429h *passim*/**14**:839a–c/ **15**:352c–353a/ **15**:354h–355f
4. Specific behavioral traits affected by inheritance; *e.g.*, intelligence, temperament, artistic or athletic ability, neurotic or eccentric behaviour	**6**:1025c–e/ **9**:672h–673d	**8**:1148a–1149h/**9**:674a–e/ **14**:114f–h/**14**:117g–118b/ **15**:175d–e
5. Consanguinity and its effects	CONSANGUINITY **5**:31–32	**2**:1073d–e
B. The nature and origin of human races: subgroups within a species	RACES OF MANKIND **15**:348–356	**7**:1009g–1010a
1. Various classifications of race	**15**:348e–349f/ **15**:360b–d	**8**:1023c–e/**12**:261h–262b/ **14**:839a–b
a. Geographical races: races formed by the geographical isolation of the breeding population	**15**:348g–349b/ **1**:237f–238a	**9**:365d–368a *passim*/ **14**:839f–841a *passim*
b. Local races: special breeding populations within large geographical races	**15**:349b–d	
c. Microraces and smaller groups: localized populations stemming from marriages restricted by cultural preferences	**15**:349d–f	
2. Aspects of racial diversity	**15**:349f–351c/ **8**:815c–816c	**8**:1149h–1150c/ **15**:363b–364g *passim*
a. Genetic adaptations to environment: climatic adaptations; immunity	**15**:349f–h/ **1**:1128g–h/ **5**:839e–g/ **14**:841b–f	**4**:728h–729d/**5**:365d–g/ **7**:1008h–1009c/ **15**:745g–746d/**16**:841f–h

	articles	article sections	other references
b. Deeply entrenched cultural differences; *e.g.*, language, patterns of thinking, gestures, emotional expression		**15**:350c–351c	**9**:677a–d
3. Hallmarks of race		**15**:351c–352c	
a. Old hallmarks; *e.g.*, colour, hair form, body measurements, features such as eyes and nose		**15**:351c–352a	**16**:841f–h
b. New hallmarks; *e.g.*, blood traits, amino acids, enzymes		**15**:352a–c	
4. Modern measures of race		**15**:353a–354g / **14**:841f–842a	
a. Single gene traits		**15**:353b–354c / **7**:998c–1001d	
i. Blood groups and subtypes	BLOOD GROUPS **2**:1144–1149	**15**:353e–h / **14**:841f–h	**2**:1116b–c / **7**:15g–h / **7**:1001d–g / **8**:815e
ii. Abnormal hemoglobins and associated disorders: sickle-cell anemia, thalassemia, and various enzyme deficiencies		**15**:353d–e / **15**:353h–354c / **2**:1138d–1139b	**2**:1146d–g / **7**:15a–c / **7**:1001g–1002c / **11**:429f–h / **11**:1050c–e / **11**:1051g–1053c *passim*
b. Metabolic factors; *e.g.*, BAIB (β-amino-isobutyric acid) excretion, lactase deficiencies		**15**:354d–e	**11**:1049a–1060h *passim*
c. Other diseases and congenital defects		**15**:354e–g / **2**:1076b–e / **9**:258d–g	
5. Ongoing evolution of races: changes in gene frequency as a result of chance, natural selection, geography, political and social attitudes and norms, advancing technology		**15**:354h–355f / **14**:847h–848c	**7**:1007h–1010a *passim* / **8**:811e–816c *passim* / **11**:428h–429h *passim*
6. Race and society: race, intelligence, and behaviour; the problem of racism [see 522.B.]			
7. Problems in the study of racial traits and human genetics: the limitations of statistical methods; the difficulty in assessing cultural capacities of populations		**15**:350c–351c / **15**:352c–353a / **15**:355f–h / **5**:32d–g / **6**:1025e–1026g	**7**:1002c–1003h *passim* / **7**:1006h–1007c / **9**:676f–677f / **14**:839a–c
C. Race populations and their types [see also 512.C. and 522.A.]	POPULATIONS, HUMAN **14**:839–848	**15**:348e–349f / **15**:360a–d	
1. The emergence of various human populations as the evolutionary result of biological and cultural selection		**14**:839a–f	
2. Prehistoric basis of human races: primary breeding grounds, major divisions of mankind, and prehistoric racial movements		**14**:839f–841a / **1**:289d–f / **12**:910h–912h	**1**:286d–287h *passim* / **7**:1009e–g / **11**:427g–428a
3. A geographical taxonomy of the living races: the five original geographic races and their offshoots		**14**:841b–847h	
a. Caucasoids		**14**:842b–843b	**1**:1128c–f
i. The Europeans		**14**:842b–f / **6**:1124e–g	
ii. The western Asians		**14**:842f–h	
iii. North African Caucasoids		**14**:842h–843b	
b. Congoids and Capoids: African peoples		**14**:843b–844b	
i. Congoids: the Pygmies		**14**:843b–e	
ii. Congoids: the Negroes		**14**:843e–h	
iii. Capoids: the Bushmen and Hottentots		**14**:843h–844b	**10**:448g–449a
c. Australoids and Oceanic peoples		**14**:844b–845c	
i. Australoids: Tasmanians and Australian Aboriginals		**14**:844b–e	
ii. Australoids: the Papuans		**14**:844e–f	
iii. Australoids: the Negritos		**14**:844f–h	
iv. Melanesians, Micronesians, and Polynesians		**14**:844h–845c / **13**:468d–469b	**11**:864h–865b
d. Peoples of East Asia		**14**:845c–846c	
i. Northern Mongoloids		**14**:845c–g	**1**:1127g–1128c
ii. Southern Mongoloids		**14**:845g–846a	
iii. The Ainu		**14**:846b–c	

	articles	article sections	other references
e. Peoples of the Indian subcontinent		**14**:846c–847b	
i. The aborigines		**14**:846c–e	
ii. The Dravidians		**14**:846e–f	
iii. The Munda peoples and the Newars		**14**:846f–g	
iv. The Aryans		**14**:846g–847b	
f. Peoples of the Western Hemisphere: North, Central, and South American Indians		**14**:847c–h	
4. Present distribution of human populations		**14**:847h–848c	

Division II. Human health and diseases

[for Part Four headnote see page 209]

The outlines, and the articles and parts of articles referred to, in the five sections of Division II treat the general conception of human health; the structures and functions of the healthy human body; the manifestation, recognition, and treatment of human disease; the various diseases and disorders of the human body; and the practice of medicine.

The articles referred to in Section 421 treat the concept of human health; special mechanisms for the maintenance of health during stress; routine factors affecting standard values in human health; and problems associated with the cessation of life.

The articles referred to in Section 422 deal with the structures and the functions of the several organ systems, the proper coordination and regulation of which constitute the health of the human body. The articles referred to separately treat the cardiovascular system; the lymphatic system; the reticuloendothelial system; the respiratory system; the digestive system; the endocrine system; the reproductive system; the excretory system; the supportive-protective system; body cavities and membranes; the nervous system; and the composition and properties of body fluids and tissues.

The articles referred to in Section 423 first treat the general characteristics, causes, and classifications of human disease. They then treat the concepts, principles, and methods of the medical art, in the two stages of diagnosis and therapy.

The articles referred to in Section 424 encompass detailed studies of the diseases of the human body. They treat the symptoms, diagnosis, and treatment of diseases that affect the body as a whole, and of diseases that affect each of the organ systems dealt with in their healthy state in Section 422.

The articles referred to in Section 425 deal with issues relating to the professionalization of the practice of medicine—not only those internal to the profession but also those arising from the educational, economic, social, political, and legal dimensions of institutionalized medicine.

Section 421. Human health 217
422. The structures and functions of the human body 220
423. Human disease: its manifestations, recognition, and treatment 227
424. Diseases and disorders of the human body 230
425. The practice of medicine and the care of health 238

Section 421. Human health

[for Part Four headnote see page 209]

The articles and parts of articles referred to in Section 421 deal with four main subjects: A, the concept of human health; B, special mechanisms for the maintenance of health during stress; C, routine factors affecting standard values in human health; and D, problems associated with the cessation of life.

The article referred to in subject A deals with problems about the definition of human health and with issues about the ranges of normality in health.

The outline of subject B begins with the maintenance of the internal environment and the adaptation of cells to severe stress. It goes on to such bodily defenses against disease as the responses of inflammation and the immunological responses, and to the mechanisms of blood clotting to prevent hemorrhage.

The outline of subject C treats human nutrition and diet; exercise and physical conditioning; the state of sleep and its effects; and the process of aging.

The outline of subject D begins by treating various aspects of dying and death. It then covers the disposal of the dead.

	articles	article sections	other references
A. Definitions and ranges of normality in human health	HEALTH, HUMAN **8**:687–689	**5**:846f–g	**5**:841h–842f
B. Special mechanisms for the maintenance of human health during stress		**5**:843a–846g	**2**:1112h–1114c *passim*
1. The maintenance of the internal environment and the adaptation of cells to severe stress		**5**:843d–844g / **12**:1035f–1036b	**12**:1005f–1006f
2. Bodily defense against disease		**5**:844g–846g / **15**:782f–h	
a. Maintenance of integrity of skin and mucosal linings [see 422.I.9.]			
b. Phagocytic cells of the body: cells with the capacity to engulf particulate material [see 422.A.3., B., and C.]			
c. The response to biological insult	INFLAMMATION **9**:559–564	**5**:845c–e / **5**:871b–c **9**:559g–563c	**2**:1139g–1140a / **5**:15f–g
i. Simple acute inflammation; *e.g.*, burns, mechanical injury, frostbite, allergy, bacterial or viral infection		**9**:563c–g / **10**:259e–f	**5**:19e–23d *passim* / **15**:782g
ii. Chronic inflammation; *e.g.*, tuberculosis, leprosy, rheumatoid arthritis	IMMUNITY **9**:247–258	**5**:845e–846a / **9**:534g–535f	
d. The immune response		**9**:248b–249e / **18**:631c–f	**2**:1113h–1114c / **3**:770h–771a / **19**:170c–d
i. General features of immunological mechanisms: nonspecific and specific immunity; evolution of the immunological responses		**9**:249f–251b / **11**:210b–e	**6**:815g–h / **11**:213d–f
ii. The cellular basis of immunological responses: role of lymphocytes as the source of immunoglobulins synthesized in response to antigenic stimulus		**9**:251c–253d / **15**:97g–98g	
iii. Immunoglobulins (antibodies): substances that combat invading organisms or foreign proteins		**9**:253d–255a	
iv. Antigens: foreign substances such as toxins that evoke an immunological response if introduced into the body		**9**:255a–256b / **2**:1143h–1144b	
v. Interaction of antigens and antibodies: general and protective effects; activation of complement in blood		**9**:256b–258g / **1**:303f–g / **5**:854c–855a / **18**:631f–632b	**2**:1119c–g
vi. Manifestations of immunological reactions; *e.g.*, hypersensitivity, auto-immunity, immunosuppression			
3. The prevention of hemorrhage	BLEEDING AND BLOOD CLOTTING **2**:1107–1111	**2**:1142b–1143c / **15**:91g–h	**2**:1119h–1120c
4. Healing: the processes of regeneration and organization in the repair of tissues [see 338.G.2.]			
5. The alarm reaction: preparation through the effects of certain hormones for either flight or resistance [see 422.F.2.e.i.]			
C. Routine factors affecting standard values in human health			
1. Nutrition and diet: the determination of daily nutrient requirements and allowances for man under various conditions	NUTRITION AND DIET, HUMAN **13**:417–427		**2**:1117b–c
a. Functions of food: the supply of energy, general building and maintenance, and the supply of essential nutrients for normal growth and good health		**13**:417d–420d / **3**:22f–23d / **3**:1158d–1159a	**3**:824b–d / **5**:856a–b / **13**:401c–f / **13**:408a–e / **19**:488a–493c *passim*
b. Classes of food; *e.g.*, cereals and cereal products; vegetables and fruits; meat, fish, and eggs; beverages		**13**:420d–422a / **3**:1159a–1160b / **5**:427b–436a / **7**:345d–346f / **11**:746d–f	**13**:530h–531d / **15**:92d–93e *passim* / **19**:44c–d
c. Recommended intakes of nutrients to meet standards of physiological and metabolic requirements		**13**:422a–423f / **14**:975d–976d / **19**:488g–h / **19**:492c–g	**3**:22g–h
d. Feeding behaviour: hunger, satiety, and the physiological regulation of body weight		**13**:423f–424c / **16**:553c–f	**7**:190d–f / **13**:413h–414d / **13**:416f–h / **14**:975d–f

	articles	article sections	other references
e. Therapeutic diets: restorative diets designed to restore losses resulting from wasting disease; restrictive diets designed to remove previous excess or to reduce the load on the functional capacity of an organ or on tissue damaged by, or susceptible to, disease		**13**:424c–425d / **18**:279h–280d	**3**:524f–g / **13**:416h–417a / **13**:524f–h
f. Government and group efforts to prevent malnutrition [see 425.G.3.]			
2. The effects of exercise and the results of training	EXERCISE AND PHYSICAL CONDITIONING **7**:68–72		
a. Relevant terms: exercise, fatigue, physical fitness, physical conditioning, health, and skill		**7**:68d–69b	**5**:841h–842f / **7**:189a–193a *passim*
b. The modern need for exercise and the problem of physical inactivity and obesity		**7**:69c–g	**13**:414d–f / **13**:423a–c
c. Physiological responses to exercise and the effects of physical conditioning		**7**:69h–71c	**2**:1127h–1128b / **5**:392a–b / **5**:844d–f / **18**:542g–h
d. Development of movement behaviour		**7**:71c–f	**5**:654b–g / **8**:1138d–1139f *passim*
e. Exercise needs: maintenance of health, avoidance of exercise injuries, and assessment of exercise adequacy		**7**:71g–72h	**1**:309e–f
3. The state of sleep and its effects	SLEEP **16**:876–883		
a. The nature of sleep: criteria for and problems in defining sleep		**16**:876h–877e	**6**:762g–763a
b. Developmental patterns of sleep and wakefulness: age-related changes in sleep		**16**:877f–878b	**14**:74e–h
c. Psychophysiological variations in sleep; *e.g.*, REM, NREM, light and deep sleep, dreaming		**16**:878c–880a	**5**:1012c–1014c *passim* / **9**:244h–245g *passim*
d. Effects of general and selective sleep deprivation		**16**:880b–881c / **9**:245h–246b	
e. Pathology of sleep: disturbances related to or accentuated during sleep		**16**:881c–882e / **18**:357h–358c	**5**:1013f–1014b
f. Drugs and sleep		**16**:882e–g / **5**:1057b–d	**16**:456e–457b
g. Theories of sleep		**16**:882h–883h	
4. The process of aging	AGING, HUMAN **1**:305–310		
a. Theories of aging; *e.g.*, genetic determination of life-span; the gradual accumulation of mutated cells that do not perform normally; the accumulation within cells of waste products that interfere with function		**1**:305b–f / **1**:303b–304a	**1**:304a–g *passim* / **15**:386g–387a
b. Psychological, social, and economic aspects of aging; *e.g.*, impairment in short-term memory; the tendency to become more cautious and rigid in behaviour; the need for housing, recreational facilities, and medical care for the increasing number of elderly in the population [see 432.C.8. and 522.C.2.]			
c. Effects of aging on the body systems; *e.g.*, reduction of performance by the heart, slight loss of neurons in the brain, gradual loss of elasticity by the skin		**1**:306d–309g / **1**:301f–303b / **5**:862b–g / **11**:909d–e / **13**:547h–548d	**2**:352d–g / **7**:71g–72b / **11**:907b–g *passim* / **12**:1049h–1050b
d. Aging as a normal part of the life-span and as a result of the complex interplay of physiological, psychological, and social factors		**1**:309g–310a / **13**:546a–b	**13**:551h–552c
D. The cessation of life			
1. Dying and death	DEATH **5**:526–529		
a. The concept of death: the significance of biological death and of human death		**5**:526h–527c / **5**:538b–g / **6**:735h–736b	**5**:533a–534c *passim*
b. The biomedical aspects of death: death of cells and tissues; death of the entire organism		**5**:527d–528b	
c. The prospect of death: stages in the acceptance of oncoming death; the fear of death		**5**:528b–529b	**5**:538c–d / **13**:550b–c
d. The determination of death: medical and legal aspects		**5**:529c–g	

2. Disposal of the dead

articles	article sections	other references
EMBALMING, BURIAL, AND CREMATION 6:735–741	11:581h–583b/ 13:1051g–1052a	1:835h–836a
	6:736c–737e/ 5:535d–f	
	6:737e–741f/ 5:535f–537c/ 14:985c–g	7:201d–e

a. Embalming: history and practices

b. Burial practices: modes of burial, cemeteries, cremation, and burial societies

Section 422. The structures and functions of the human body
[for Part Four headnote see page 209
for Division II headnote see page 217]

The articles and parts of articles referred to in Section 422 deal with the physiological basis of human health. They treat the structures and functions of the several organ systems, which, when well coordinated and regulated, constitute the welfare or health of the human body and help to ensure its reproduction.

In dealing with each of the organ systems, the articles referred to treat the structures and functions of the component parts of the system and the contribution of the system as a whole to the body's performance of vital functions. They treat the following 12 subjects: A, the cardiovascular system; B, the lymphatic system; C, the reticuloendothelial system, a network of specialized cells capable of engulfing foreign bodies; D, the respiratory system; E, the digestive system; F, the endocrine system; G, the reproductive system; H, the excretory system; I, the supportive-protective system; J, body cavities and membranes; K, the nervous system; and L, the composition and properties of body fluids and tissues, which refers to material in Section 332.

In addition to the general articles dealing with each of these subjects, more specialized articles are referred to that deal with some of the subtopics. Articles referred to in subject A of the outline treat human blood, blood groups, and blood circulation; in D, the regulation, control, and dynamics of breathing; in E, human teeth and gums, the liver, and the digestion and absorption of food; in F, menstruation, pregnancy, parturition, lactation, menopause, and hormones; in G, human embryology, postnatal development, and the mammary glands; in H, the processes of human excretion; in I, the human skeletal system, the composition and properties of bone, connective tissue, the joints, the bursae, the sinuses, the muscle system, and skin; in K, the composition and properties of cerebrospinal fluid, eye and vision, ear and hearing, and the structures and functions of other sensory receptors.

A. The structures and functions of the cardiovascular system

articles	article sections	other references
CARDIOVASCULAR SYSTEM, HUMAN 3:875–885		2:1125d–f/3:886a–b
	3:875h–881b	2:1125g–1127d *passim*
	3:875h–876g	
	3:876g–878a/ 5:636d–638a	6:752c–e
	3:878a–879b/ 12:630d–g	
	3:881b–885f/ 2:1109e–f	2:1128f–1133d *passim*
	3:881c–h	
	3:881h–885f	7:52c–g/10:1269e–f/ 12:1008a–b/15:766c–d
	3:881h–883f	10:258h
	3:883f–885b	
	3:885b–d	2:1130f–1131f *passim*/ 11:212c–f
	3:885d–f/ 6:751h–752e	

1. The heart: a muscular pump functioning to propel the blood into and through vessels
   a. General description: shape and location; the pericardium, or enclosing sac; the four chambers of the heart; external grooves
   b. The mesodermal origin of the heart in the embryo and its development, including comparisons to the hearts of lower animals
   c. Structure and function of parts of the heart: characteristics of the atrioventricular and semilunar valves, the heart wall, and the coronary arteries
   d. Dynamics of the heart: heartbeat and cardiac output [see A.4.a., below]
2. The blood vessels: a closed system of tubes functioning to transport blood to all parts of the body and back to the heart
   a. Structure: the walls of the arteries and veins; the transition from artery to capillary and from capillary to vein; the venous valves
   b. The various vessel systems
      i. Arteries: the pulmonary circuit; the aorta and its principal branches; the pulse
      ii. Veins: the superior vena cava and its tributaries from the upper body; the inferior vena cava and its tributaries from the lower body; the portal system; the venous pulmonary system
      iii. Capillaries: characteristics including their structure and function
      iv. Fetal circulation

	articles	article sections	other references
c. Techniques of evaluating the heart and vascular system [see 423.B.]			
3. Human blood	BLOOD, HUMAN **2**:1111–1121		**2**:1121d–1124e *passim*/ **2**:1133g–1143c *passim*/ **15**:781g–782a
a. Properties and functions		**2**:1112c–1114c/ **2**:1107a–e/ **15**:749f–750f/ **18**:282c–e	**5**:845a–b/**9**:247d–249b *passim*/**14**:974f–h
b. Components of blood and their examination in the laboratory		**2**:1114d–1121c/ **15**:91g–92d	**5**:693b–c
i. Plasma		**2**:1114d–1115f/ **7**:429c–h	**2**:1120g–1121c/**7**:1002b–c
ii. Red blood cells (erythrocytes)		**2**:1115g–1117g	**2**:1120d–g/**15**:94g–95b/ **18**:609a–c
iii. White blood cells (leukocytes)		**2**:1117g–1119g	**9**:559h–563g *passim*
iv. Platelets (thrombocytes)		**2**:1119h–1120d/ **2**:1107e–1109e	
c. Blood groups: types of blood determined on the basis of their possessing or lacking certain antigens	BLOOD GROUPS **2**:1143–1149	**9**:254f–h/ **14**:841f–h	**2**:1116b–c/**7**:1001d–g/ **14**:776e–g/**15**:352a–b/ **15**:353e–h
4. The circulation of the blood flow, blood pressure, and hemodynamics	BLOOD CIRCULATION, HUMAN **2**:1125–1133		**6**:816d–817c/**12**:1006e–f/ **12**:1038b–d
a. The central pump		**2**:1125g–1128f/ **12**:630d–631e	
i. Rhythmicity of the heart		**2**:1125h–1126f/ **3**:879b–880d/ **12**:630g–631a	
ii. The cardiac cycle		**2**:1126f–1127d/ **12**:631a–c	
iii. Cardiac output		**2**:1127d–1128f/ **3**:880d–881b/ **12**:631c–e	**14**:972f–973a
b. The systemic circulation		**2**:1128f–1132d	**7**:36b–37b/**12**:1007b–f/ **14**:973a–c
c. The pulmonary circulation		**2**:1132d–1133d/ **3**:881h–882b/ **15**:766c–e	
B. The structures and functions of the lymphatic system	LYMPHATIC SYSTEM, HUMAN **11**:210–213	**2**:1133e–f	**16**:839e–f
1. The lymphocytes		**11**:210b–e/ **9**:249f–251b	
2. The lymphatic vessels, lymph nodes, and other aggregates of lymphoid tissue		**11**:210e–212a/ **6**:815f–h/ **15**:781f–g	
3. The lymph: composition, formation, pressure, and flow		**11**:212a–213c	
4. Functions of the lymphatic system: return of protein and tissue fluid to the blood; removal of bacteria and foreign particles		**11**:213c–f	**9**:247d–258g *passim*
C. The structures and functions of the reticuloendothelial system of cells and its associated organs and tissues	RETICULO-ENDOTHELIAL SYSTEM, HUMAN **15**:780–783		**2**:1117a–g/**18**:450d–e
1. General structure of reticuloendothelial tissues and cells		**15**:780e–g	
2. The spleen		**15**:780g–781f/ **18**:450c–e	
3. The lymph nodes [see B.2., above]			
4. The bone marrow		**15**:781g–782a	**2**:1117a–e/**6**:817d–e
5. The liver		**15**:782a–c/ **10**:1268f–1269g/ **10**:1270a–c	
6. The roles of the reticuloendothelial system and their determination		**15**:782c–783c	**2**:1118g–1119b

	articles	article sections	other references
D. The structures and functions of the respiratory system	RESPIRATORY SYSTEM, HUMAN **15**:764–766	**6**:753f–g	**15**:767h–768c
1. The upper portion of the respiratory tract: nasal cavity, pharynx, larynx, and trachea		**15**:764c–765d / **5**:791h–792c / **17**:478h–480e	**14**:275f–276b / **16**:553g–555d *passim* / **17**:480e–483e *passim*
2. The lungs and bronchi		**15**:765d–766h / **15**:745c–d	**2**:1132d–1133d *passim*
3. The regulation, control, and dynamics of breathing	RESPIRATION, HUMAN **15**:747–751		**15**:768f–769e *passim*
a. Mechanics of breathing and speech		**15**:748a–h / **15**:758d–f / **17**:478d–h	
b. Composition of lung air and arterial blood and the diffusion of gases between them		**15**:748h–749g	
c. Oxygen and carbon dioxide transport by the blood		**15**:749h–750f	**2**:1113a–d / **15**:758g–760e *passim*
d. Regulation of ventilation by the nervous system		**15**:750f–751a	**12**:1006c–e / **12**:1038d–f / **15**:760e–762c *passim*
E. The structures and functions of the digestive system	DIGESTIVE SYSTEM, HUMAN **5**:789–796	**6**:753d–e	**5**:783h–787a *passim*
1. Location, structure, innervation, and blood supply of the components of the digestive tract			
a. Mouth and related structures		**5**:789d–791h	**6**:750a–b / **14**:276a–c
i. Lips, cheeks, and palate		**5**:789d–h	
ii. Teeth and gums	TEETH AND GUMS, HUMAN **18**:55–57	**5**:789h–790d	**8**:1045d–e / **13**:413f–g
iii. Tongue		**5**:790d–791b	**16**:551h–553f *passim*
iv. Salivary glands		**5**:791b–h	
b. Pharynx and esophagus		**5**:791h–792g	
c. Stomach		**5**:792g–793e	**18**:444c–e
d. The small intestine and the small bowel mucosa		**5**:793e–794e	**18**:444e–f
e. Large intestine, rectum, and anus		**5**:794e–795e	
f. Associated glands and structures		**5**:795e–796d	
i. Pancreas		**5**:795e–h	**6**:811g–812b
ii. Liver, gallbladder, and bile ducts	LIVER, HUMAN **10**:1268–1270	**5**:795h–796d / **15**:782a–c / **18**:444g–445a	**14**:973g–974a
2. The digestion and absorption of food: mechanics and movements of the gastrointestinal tract; chemical functions of secretion and absorption	DIGESTION, HUMAN **5**:771–780	**1**:438b–h / **5**:788a–h / **6**:814f–815f	**2**:1113d–f / **8**:1084g–1085a / **12**:632c–f / **12**:1038g–1039a
a. Digestion in the mouth, pharynx, and esophagus		**5**:771h–773d / **5**:788a–b	
b. Digestion in the stomach		**5**:773d–775g / **5**:788b–e	**6**:843c–d
c. Digestion in the small intestine		**5**:775h–779c / **5**:788d–f / **6**:842h–843f	
d. Digestion in the large intestine and elimination		**5**:779d–780g	
F. The structures and functions of the endocrine system	ENDOCRINE SYSTEM, HUMAN **6**:799–817		**8**:1015e–f / **14**:974h–975b
1. The nature of the human endocrine system and its hormones: known and suspected endocrine glands and tissues; regulation of endocrine secretions by neural and feedback control; hormone action through the mechanism of the genetic code and the generation of cyclic AMP (adenosine-3,5-monophosphate)		**6**:799h–802e / **17**:683d–h	
2. The glands and tissues comprising the system: their functions, structure, location, and development; the nature, action, metabolism, and regulation of their secretions	HORMONE **8**:1074–1085	**6**:802e–817g / **5**:657a–g	

	articles	article sections	other references
a. The testes		**6**:802e–803c / **8**:1084e–g	**15**:692a–d
b. The ovaries and placenta		**6**:803d–805a / **8**:1083d–1084e / **14**:1025c–e / **17**:684c–e	**14**:969e–971h / **15**:695g–696e / **17**:682a–b
c. Female sex-oriented processes under endocrine control			
i. The menstrual cycle	MENSTRUATION **11**:907–910	**6**:803e–h	**6**:804c–f / **14**:70h–71a / **15**:694h–695e
ii. Gestation: the initiation and the progress of pregnancy	PREGNANCY **14**:968–983	**6**:804f–h / **6**:743a–749a	**5**:651c–h / **8**:1083g–1084c / **15**:695h–696e
iii. Parturition, or labour: the process of bringing forth a child from the uterus, or womb	PARTURITION, HUMAN **13**:1036–1041		**12**:843f–g
iv. The secretion of milk	LACTATION, HUMAN **10**:582–584	**11**:416d–g	
v. The termination of menstrual life	MENOPAUSE **11**:907	**11**:909d–e / **15**:177a–c	
d. The thyroid		**6**:805a–806c / **8**:1078f–1079g / **6**:842b–d	
e. The adrenal glands		**6**:806d–809a / **8**:1081b–1083c / **17**:682c–d	**6**:843h–845b *passim*
i. Chromaffin tissue of the medulla		**6**:808d–809a / **8**:1081b–1082a	
ii. Adrenocortical tissue of the cortex		**6**:806g–808d / **8**:1082b–1083c / **17**:684f	**7**:43c–d
f. The pituitary		**6**:809a–810g / **8**:1074h–1078e / **5**:657b	**5**:657e–f / **12**:1005f–g / **15**:97b–f
i. Anterior pituitary		**6**:809b–810c / **8**:1075b–1077b	
ii. Posterior pituitary		**6**:810d–g / **8**:1077e–1078e	
g. Hypothalamus		**6**:810g–811f / **8**:1077e–1078e	**5**:657f–g
h. Pancreatic islets		**6**:811g–813h / **8**:1080c–1081b / **6**:843f–g	
i. Parathyroid glands		**6**:813h–814f / **8**:1079g–1080b / **3**:20h–21d / **6**:842g–h	
j. Gastrointestinal mucosa		**6**:814f–815f / **8**:1084g–1085b / **5**:774h–775b / **6**:842h–843f	
k. Thymus, pineal body, kidneys, and other possible endocrine organs or hormones		**6**:815f–817g / **8**:1085b–e	**6**:841d–g / **7**:43d–f
G. The structures and functions of the reproductive system			
1. The reproduction and development of the human body			
a. The process of human reproduction: events preparatory to development	EMBRYOLOGY, HUMAN **6**:742–743	**14**:968c–e	**15**:690a–c
i. The formation and liberation of the male and female gametes		**6**:742a–743a / **3**:1055f–1056b	**11**:908e–g / **14**:968c–d
ii. Fertilization: union of the sperm with the oocyte and the formation of an activated zygote		**6**:743a–c	**7**:255g–257b *passim* / **14**:968d–e
b. The development of the human body			
i. Prenatal development: cell proliferation, the growth of daughter cells, the differentiation of organs and their tissues, and the integration of the body and its parts into a coordinate, functioning mechanism before birth	EMBRYOLOGY, HUMAN **6**:743–753	**3**:855d–f / **3**:876g–878a / **5**:651c–652a / **5**:1131g–1132e / **8**:1137g–1138a / **14**:969d–e	**4**:630h–631h *passim* / **5**:626e–639h *passim* / **12**:994h–995f / **12**:996a–c / **14**:970e–971h / **15**:690c–e / **16**:595b–c / **16**:596a–b

	articles	article sections	other references
ii. Postnatal development: the physical growth of a child from birth to maturity	DEVELOPMENT, HUMAN **5**:650–658	**4**:219c–h / **4**:227a–h / **5**:642b–d / **8**:1138c–e / **11**:909c–d / **18**:55g–56b	**8**:1145a–b / **12**:995f–996a / **15**:690e–g / **16**:595d–e / **19**:1091b–f
2. The reproductive system	REPRODUCTIVE SYSTEM, HUMAN **15**:689–696		**15**:696f–h
a. The sexes: male and female		**15**:690c–g / **6**:752g–753b	**5**:654h–656b / **7**:54b–e / **16**:588b–e *passim*
b. The male system		**15**:690h–693c	**15**:708c–710a *passim*
i. The penis		**15**:690h–691e	
ii. The scrotum		**15**:691e–692a	
iii. The testes		**15**:692a–e / **6**:802e–803c	
iv. The sperm canal: the epididymus, ductus deferens, and ejaculatory duct		**15**:692e–g	
v. The glands: the prostate, seminal vesicles, and bulbo-urethral glands		**15**:692g–693c	
c. The female system		**15**:693d–696e / **14**:969e–972f	**15**:710a–713c *passim*
i. The external genitalia: the labia and clitoris		**15**:693d–h	
ii. The vagina		**15**:693h–694c	
iii. The uterus		**15**:694c–695e	**6**:803g–h / **14**:969h–971h
iv. The uterine tubes		**15**:695e–g	
v. The ovaries		**15**:695g–696e / **6**:803d–804c	**14**:969e–g
vi. The mammary glands	MAMMARY GLANDS, HUMAN **11**:416–417	**10**:582g–583a	**14**:972e–f / **18**:450f–g
H. The structures and functions of the excretory system	EXCRETORY SYSTEM, HUMAN **7**:50–54	**6**:752e–g / **7**:54h–55b	
1. The kidneys		**7**:50g–52h	**7**:35d–36a / **18**:445e–g
2. The ureters		**7**:52h–53b	
3. The urinary bladder		**7**:53c–54a	
4. The urethra		**7**:54b–f	
5. The excretory process: the mechanism and regulation of urine production and micturition	EXCRETION, HUMAN **7**:35–44		**7**:48f–49b
a. Vascular considerations		**7**:36b–37b	**2**:1113f–g
b. The formation of urine: glomerular filtration and tubule function		**7**:37b–39f	
c. Tests of renal function		**7**:39f–40f	
d. The composition and properties of the urine		**7**:40f–41h	**5**:693c–d
e. Urine collection and emission: the bladder and its function; micturition		**7**:41h–43b	
f. Hormones and the kidney		**7**:43c–f	**12**:1005g–h
g. Biological considerations; *e.g.*, pregnancy, acid–base balance, regulation of body fluid		**7**:43f–44h	**5**:561d–e / **14**:974a–f
I. The structures and functions of the supportive-protective system			
1. The structure and functions of the skeletal system	SKELETAL SYSTEM, HUMAN **16**:812–818	**8**:1044f–1046c	**6**:751f–g / **7**:91g–h / **12**:998a–b
2. The composition and properties of bone	BONE **3**:18–23	**3**:23g–24c / **5**:16d–17b / **15**:781g–782a / **16**:827f–830a / **18**:448d–g	
a. The structure of bone		**3**:18d–19b / **16**:828b–e	**3**:23g–h

	articles	article sections	other references
b. The metabolism, growth, and functioning of bone tissue		**3**:19c–23d / **16**:828e–830a	**3**:23h–24c / **13**:412h–413b
3. The structure and functions of connective tissues	CONNECTIVE TISSUE, HUMAN **5**:13–17		
a. Components of connective tissue: cells, extracellular fibres, and amorphous matrix		**5**:13c–15g	**15**:90d–91a
b. Types of connective tissue		**5**:15h–17b / **18**:448a–c	**10**:253b–256d *passim* / **10**:257h–259b *passim*
4. The structure and functions of the joints	JOINT **10**:252–259	**16**:827a–f	
a. Synarthroses: fibrous, cartilaginous, and fibrocartilaginous joints		**10**:253b–254d	
b. Diarthroses: synovial joints		**10**:254e–257h	
c. Joint ligaments		**10**:257h–258e	
d. Nerve supply, blood supply, metabolism, and nutrition of the joint		**10**:258f–259b	**12**:1023b–1024e *passim*
5. The structure and functions of the bursae	BURSA **3**:525		**10**:254e–256d *passim*
6. The structure and functions of the sinuses	SINUS **16**:806–807		
7. The structure and functions of the muscular system	MUSCLE SYSTEM, HUMAN **12**:636–637	7:93c–e	7:92c–g / **12**:637f–h / **12**:638f–639a / **12**:644g–648e *passim*
8. The structure and properties of muscle		**12**:621e–632g / **18**:448h–449c	
a. Striated, skeletal, or voluntary muscle		**12**:621g–628h	**5**:790h–791b / **12**:639h–640c / **16**:550f–551d *passim*
b. Nonstriated, smooth, or involuntary muscle		**12**:631g–632g	**5**:793c–d / **12**:640e–f / **12**:1025f–g
c. Cardiac muscle		**12**:630d–631g	**3**:878f–879a / **12**:640c–d / **12**:1025d–e
d. The contraction of muscle fibres [see 323.D.]			
9. The structure and functions of the integument and derivatives	SKIN, HUMAN **16**:838–844	**9**:672e–g	
a. The skin as a whole: general characteristics, nerve supply, and blood supply		**16**:838g–839f / **5**:844h–845a	**16**:844f–g
b. Particular aspects of the skin		**16**:839f–844d / **6**:749g–750a	**4**:920d–921a / **15**:351c–d
i. The surface of the skin		**16**:839f–h	
ii. The epidermis and the underlying dermis		**16**:839h–842a	**9**:667e–f / **16**:846b–849c *passim*
iii. The pilary system: hair		**16**:842b–f	**9**:671c–672b *passim* / **16**:849c–e
iv. The glands of the skin: sebaceous glands and sweat glands		**16**:842f–843g	
v. Nails		**16**:843g–844c	
J. The body cavities and their membranes	BODY CAVITIES AND MEMBRANES, HUMAN **2**:1178–1180	**6**:753b–c	
1. The thoracic cavity		**2**:1178e–1179c	**3**:876a–c
2. The abdominal cavity		**2**:1179c–1180c	
K. The structure and functions of the nervous system	NERVOUS SYSTEM, HUMAN **12**:994–1040	**15**:159c–161a	**12**:982a–992h *passim*
1. Fundamental considerations		**12**:994h–997g	
a. Origin and development: the ectodermal origin of the nervous system and its embryological development; phylogenetic comparisons		**12**:994h–996c / **12**:1032f–1033f / **5**:633e–634f / **6**:750c–751f / **12**:988h–991f / **14**:1024b–h	

	articles	article sections	other references
b. Characteristic structures: neurons, peripheral nerves, and cells of the central nervous system		**12**:996c–997e / **12**:969a–970a / **12**:977b–978f	**18**:446b–h
c. Nerve degeneration and regeneration		**12**:997f–g	**1**:307b–c
2. The central nervous system: the brain and spinal cord		**12**:997h–1016g / **12**:982d–987c	
a. The brain: the membranes covering the brain and the ventricles situated in the substance of the brain; structure and function of the medulla oblongata, cerebral cortex, and other specific parts of the brain; the brainstem and its special roles; nutrition of the brain and cerebral circulation; weight of the brain		**12**:998d–1008c / **12**:982d–984h / **17**:484h–485f	**2**:356b–358b *passim* / **5**:1127g–1128e / **6**:761e–766f *passim*
b. The spinal cord: its structure and function; the interaction of reflex arcs at a common path as influenced by intensity of stimulation, fatigue and freshness, spinal induction, and functional species		**12**:1008d–1016g / **12**:984h–986f	
c. The composition and properties of the cerebrospinal fluid	CEREBROSPINAL FLUID **3**:1172–1174		**12**:986h–987a / **12**:998h–999h *passim*
3. The peripheral nervous system: cranial nerves, spinal nerves, and that part of the autonomic system that is outside the brain and spinal cord		**12**:1016h–1024e / **10**:258f–g / **12**:987c–988d	
a. Cranial nerves (12 pairs): olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear, glossopharyngeal, vagus, accessory, and hypoglossal nerves		**12**:1017e–1021f	**5**:1124d–f / **5**:1127e–f / **7**:98g–h
b. Spinal nerves (31 pairs): cervical, thoracic, lumbar, sacral, and coccygeal nerves		**12**:1021g–1024e	
4. The autonomic nervous system: the sympathetic and parasympathetic systems		**12**:1024f–1040d / **12**:988d–h	
a. General organization and function: the two-nerve-cell pathways; cardiac muscle, smooth muscle, and glands as the supplied effectors; viscera and visceral activity; the main divisions, sympathetic systems and parasympathetic system		**12**:1024g–1027g / **6**:758g–759e	
b. Levels of structural organization: the autonomic nervous system as a series of levels from the two-nerve-cell pathway up to the cerebral hemispheres in which the higher the level, the more widespread and general are its functions; the ganglia and the preganglionic and postganglionic fibres		**12**:1027g–1032f	
c. Early development and comparative features [see K.1.a., above]			
d. Autonomic transmission: the transmission of the nerve impulse; acetylcholine and noradrenaline as excitory transmitters; experimental studies using drugs [see 323.C.4.]			
e. General and integrative functions of the autonomic nervous system levels: the specific motor effects upon various organs as important components of more complex mechanisms of homeostasis; control of visceral functions (*e.g.*, blood pressure, respiration) by the cerebral hemispheres, diencephalon, brainstem, and cerebellum; sympathetic and parasympathetic outflow illustrated by local autonomic reflexes such as salivation and emptying of the bladder		**12**:1035e–1039g / **5**:791g–h / **15**:750f–751a	**2**:1129g–1130f *passim* / **7**:42c–d
5. The structures and function of the eye and the process of vision	EYE AND VISION, HUMAN **7**:91–116		**7**:117a–125c *passim*
a. Basic anatomy and physiology of the visual apparatus		**7**:91g–97c	**6**:751c–d
i. Structures auxiliary to the eye and their functions: the orbit, or socket, enclosing the eye; the protecting eyelid; the glandular apparatus; the extraocular muscles governing eye movements		**7**:91g–93e / **12**:1018e–h	
ii. The eye and its internal organization: general description of the eyeball; the three coats of the eye that enclose the optically clear aqueous humour, lens, and vitreous body		**7**:93f–97c	**12**:1018d–e / **14**:354c–355e *passim* / **14**:361a–e
b. The visual process		**7**:97d–116g	**12**:1004a–b

i. The work of the auxiliary structures, optical lens system, and retina
[see 433.C.2.a. and b.]

ii. The transduction process and the perceptual processes
[see 433.C.2.c. and d.]

6. The structures and functions of the ear and the process of audition

a. Structure

i. External and middle ear: the auricle, which projects from the side of the head, and the external auditory canal; the tympanic membrane; the cavity of the middle ear, including the eustachian tube and the auditory ossicles

ii. Inner ear: the complicated system of fluid-filled passages and cavities, deep in the rock-hard petrous portion of the temporal bone

b. Function

i. The process of audition: transmission of sound waves; the cochlear nerve and the central auditory pathways; hearing tests (audiometry)
[see 433.C.3.]

ii. Vestibular function: the equilibrium sense primarily concerned with controlling the position of the head and the posture of the body
[K.7.b.iii., below]

7. The structures and functions of other sensory receptors

a. Basic features of the human senses and interdisciplinary approaches to the study of sensing

b. Specific sensory systems: the structure and nature of the receptors; acuity and sensory adaptation; the role played by sensory reception in survival

i. Cutaneous (skin) senses: touch, heat, cold, and pain

ii. Kinesthetic (motion) sense: the role of kinesthetic feedback of muscle and tendon receptors in movement control and in orientation

iii. Vestibular sense (equilibrium): acceleration, rotation, orientation, and balance

iv. Taste (gustatory) sense: sour, salt, sweet, and bitter

v. Smell (olfactory) sense: perception of odorous molecules in the air

L. The composition and properties of body fluids and tissues
[see 332.D.]

articles	article sections	other references
EAR AND HEARING, HUMAN **5**:1120–1131	**5**:1131g–1133e	**17**:39c–40a *passim*
	5:1120e–1125b / **17**:48g–49e	**5**:1132e–1133c / **6**:751e–f
	5:1120h–1121h	**5**:1132e–g
	5:1121h–1125b / **12**:555e–f	**5**:1132g–1133c
	5:1125c–1131b / **12**:1019h–1020c	**12**:1004c–d / **15**:160c–f / **17**:19d–f
SENSORY RECEPTION, HUMAN **16**:547–555	**16**:547c–548g / **14**:39e–h	**4**:176a–b / **12**:1009d–1010a / **16**:545h–546b
	16:548g–555d	**4**:183d–185b *passim* / **17**:379f–380h *passim*
	16:548g–550e / **18**:328d–329a	**9**:242h–243a / **11**:801h–803a *passim* / **12**:1015e–g / **13**:866c–h *passim* / **18**:331b–332e *passim*
	16:550f–551d / **11**:805b–h	**16**:544d–f
	16:551d–h / **5**:1130b–1131b / **12**:555e–556a	**5**:1123c–g / **5**:1132g–1133a / **11**:808d–f / **12**:1019h–1020b / **14**:46c–e
	16:551h–553f / **4**:187c–e	**8**:1147e–f
	16:553g–555d / **4**:187f–188c / **12**:1018c	

Section 423. Human disease: its manifestations, recognition, and treatment

[for Part Four headnote see page 209
for Division II headnote see page 217]

The articles and parts of articles referred to in Section 423 deal with three main subjects: A, the characteristics, causes, and classifications of human disease; B, the detection and diagnosis of disease; and C, the treatment of disease. Accounts of diseases and disorders of the body as a whole, of organs and tissues, and of the various organ systems are set forth in the articles referred to in Section 424.

The outline of subject A first deals with problems concerning the definition and relation of health, physical fitness, illness, and disease. After treating the major bodily mechanisms involved in the maintenance of health, the outline goes on to the general or most common signs and symptoms of disease, conceived of as the failure of homeostatic and defensive controls. It next deals with the major categories of diseases based on their presumed etiology. Finally, it treats various classifications of diseases: topographical, by bodily region or system; anatomical, by organ or

tissue; physiological, by function or effect; pathological, by the nature of the disease process; etiological, by the nature of the origin or cause; juristic, by the speed of advent of death; epidemiological; and statistical.

The outline of subject B begins with general considerations about the nature, methods, and stages of medical diagnosis; its relation to prognosis and therapy; its growth with the development of the medical sciences; and its relation to different conceptions of disease. The outline next treats the different stages and methods of the diagnostic process: the elaboration of the patient's individual medical history; the different aspects of the physical examination—visual inspection, tactile palpation, percussive strikings, and auscultation; the many laboratory tests made possible by advances in physiological chemistry and biochemistry; multiphasic health screening, which tests for several disorders simultaneously for early detection of diseases; the uses of radiology for views of internal structures and processes; and the uses of surgical methods to obtain materials for pathological reports. The outline goes on to the importance, components, and uses of the record of a patient's medical history, to the sources of error in diagnosis, and to the procedures of autopsy.

Subject C is the treatment of disease. The outline begins with the general factors considered in the formulation of therapeutic regimens for different kinds of patients. It then covers the major therapeutic techniques, differing mainly in the types of therapeutic actions taken and the types of medication used.

	articles	article sections	other references
A.	Characteristics, causes, and classifications of human disease		
1.	Problems about the defining of and the relations among health, physical fitness, illness, and disease	DISEASE, HUMAN **5**:841–863	
2.	Mechanisms for the maintenance of health: homeostasis, the maintenance of a constant internal environment; adaptations to stress situations; defenses against microbiotic invasions; repair and regeneration of damaged tissue or cells; clotting of blood to prevent excessive bleeding		**5**:841h–843a / **7**:69a–b	**5**:837d–e / **8**:687d–689d *passim*
3.	Common signs and symptoms of disease conceived as the failure of homeostatic and defensive controls: abnormal temperature, pulse, and respiratory rates; increased number of circulating phagocytic white cells; high or low blood pressure; fluid and electrolytic imbalances; abnormal levels of blood sugar, blood urea, nitrogen, and serum protein		**5**:843a–846g / **8**:1016g–1017a	**5**:684g–685a
4.	Categories of diseases based on presumed etiology: diseases originating from genetic constitution; congenital malformations; chemical and physical injuries; hyperreactivity of the immune system; microbiotic invasions; abnormal cell growth; hypersecretion or hyposecretion of hormones; nutritional excess or deficiency; psychogenic disorders; senescence		**5**:846h–847g / **3**:900c–f / **2**:1139g–1140b	**3**:891b–e / **12**:1037b–d
5.	Classifications of disease and their importance: topographical, by bodily region or system; anatomical, by organ or tissue; physiological, by function or effect; pathological, by the nature of the disease process; etiological (causal); juristic, by speed of advent of death; epidemiological; statistical		**5**:847g–862g / **5**:874f–875f	**5**:837e–838e *passim*
			5:862g–863g	
B.	The detection and diagnosis of disease	DIAGNOSIS **5**:684–695		**4**:218c–f
1.	The nature, methods, and stages of medical diagnosis: the continuum of diagnosis–prognosis–treatment; progress in diagnostic arts with progress in medical sciences; concepts of disease affecting diagnosis		**5**:684a–685a	
2.	Direct evidence from the patient		**5**:685b–692h	
a.	The medical history: the individual patient's delivery of his medical autobiography and the physician's skilled hearing or reading of it; the conjoint analysis of present pain or other symptoms, their location, extensions, and other features; the review of various body systems for specialty problems		**5**:685b–688d	**11**:841h–842b / **11**:886d–888c *passim* / **14**:968f–g / **15**:767b–g
b.	The physical examination: the physician's skilled visual inspection of the patient, unaided or aided by instruments; palpation; percussion; auscultations; miscellaneous special investigations		**5**:688d–692h / **3**:885f–h / **7**:123a–b / **12**:1041d–1043f	**3**:880h–881b / **5**:847a–g / **15**:769c–d
3.	Routine laboratory examinations and other tests		**5**:692h–695a / **3**:768h–769a / **3**:1174b–d / **5**:1128f–1130b / **10**:264f–h	**12**:1043a–e
a.	Laboratory diagnosis: routine laboratory tests of the many constituents and properties of blood, urine, and feces; special tests of gastric juice, cerebrospinal fluid, and of the functioning of a number of organs		**5**:692h–693f / **2**:1120d–1121c / **7**:39f–40f / **10**:1271c–f	**5**:873c–874f *passim* / **6**:821b–h / **6**:823d–f / **14**:968g–969a

	articles	article sections	other references
b. Multiphasic health screening: testing for several disorders simultaneously on a wide variety and large number of people to detect diseases early and prevent their progress; issues about the automation of multiphasic health testing and about the medical use of computer technology		**5**:693f–694d	**17**:818a–c
c. The use of X-rays, radioactive isotopes, and ultrasound waves in diagnosis: advances in the techniques for producing immediate and detailed views of internal structures and processes		**5**:694d–695a / **15**:461c–464g	
4. Other important aids to diagnosis		**5**:695b–f	
a. Surgical diagnosis: the obtaining of materials by surgical methods for pathological reports; the role of simple and complex biopsies in diagnosis		**5**:695b–c / **3**:885f–h	**17**:819b–d
b. The medical record: the components and uses of the record of a patient's medical history and of various medical dealings with him		**5**:695d–f	
c. The post-mortem examination: the autopsy	AUTOPSY **2**:536–538		
5. Difficulties and sources of error in medical diagnosis		**5**:695f–h / **5**:685b–e / **14**:969b–c	**5**:686d–g / **14**:977c–e
C. The treatment of disease	THERAPEUTICS **18**:278–286	**5**:841c–e	
1. Aspects of medical treatment: factors for consideration in the formulation of a therapeutic regimen		**18**:279f–282a	
a. The activity status of the patient: benefits and disadvantages of rest in the treatment of various disorders		**18**:279f–h / **16**:883f–h	
b. The diet and fluid intake of the patient; *e.g.*, essentials for an adequate diet, special therapeutic diets, foods causing allergic reactions		**18**:279h–280d / **13**:416h–417a / **13**:424c–425d	**3**:524f–g / **13**:417b–423f *passim*
c. Symptomatic and supportive measures: the relief of unpleasant symptoms and the maintenance of the patient's general condition and morale		**18**:280d–h / **13**:867c–e	**5**:1049b–c
d. Specific therapeutic measures [see C.2., below]			
e. Modification of regimens to suit the patient; *e.g.*, the influence of the patient's age; the consideration of the associated social consequences and hardships		**18**:281c–282a	**4**:218f–219a / **8**:1117c–e
2. Major therapeutic techniques		**18**:280h–281b / **18**:282a–286h	**1**:447c–448g *passim* / **15**:141h–148g *passim*
a. Surgical treatment		**18**:282a–c / **3**:895h–897g / **13**:1038e–1039e	**3**:29e–30b *passim* / **3**:769b–e / **15**:144e–145b / **17**:816a–823f *passim*
b. Biological therapy		**18**:282c–f	
c. Pharmacodynamic therapy		**18**:282f–285b / **5**:1044g–1047b / **15**:142g–143g / **17**:686d–688b	**5**:1049d–e / **5**:1054b–f / **14**:191h–192a
d. Chemotherapy		**18**:285b–g / **5**:1047b–g	**1**:986a–h *passim* / **3**:769g–770a / **4**:188g–192f *passim* / **15**:771g–772a
e. Substitution therapy		**18**:285g–286a	**2**:1146a–d / **15**:144c–e / **16**:701d–f / **16**:701h–702a
f. Radiation therapy		**18**:286b–e / **15**:464g–466e	**3**:769e–g / **15**:418h–419a
g. Physical therapy		**18**:286e–f	
h. Occupational therapy		**18**:286g–h	
i. Shock therapy		**16**:701d–702d	**3**:523b–e / **11**:838h–839a
j. Burn treatment		**3**:522h–525a	
k. Organ and tissue transplants; *e.g.*, types of transplants; immunological and surgical problems; complementary procedures such as dialysis and use of the heart-lung machine	TRANSPLANTS, ORGAN AND TISSUE **18**:627–632	**1**:610e–611b / **3**:895a–g / **7**:59e–h / **9**:258a–d	**2**:1144e–f / **3**:29h–30b / **3**:897d–g / **5**:854h–855a / **7**:94f–g / **11**:840f–h / **15**:386d–f
l. Psychological therapy [see 438.D.4.]			

Section 424. Diseases and disorders of the human body

[for Part Four headnote see page 209
for Division II headnote see page 217]

The articles referred to in Section 423 dealt generally with the conceptions of disease and with the medical arts of diagnosis and therapy. The articles and parts of articles referred to in Section 424 set forth detailed accounts of diseases. They deal with 13 main subjects: A, the symptoms, diagnosis, and treatment of diseases not confined or related to specific organ systems, or of diseases of the body as a whole; B, the symptoms, diagnosis, and treatment of diseases affecting any organ or tissue of the body; and C through M, the symptoms, diagnosis, and treatment of diseases that affect the organ systems, the structures and functions of which are treated in the articles referred to in Section 422.

The outline of subject A covers the following subjects: the several kinds and causes of physiological shock; disorders of metabolism caused by nutritional deficiencies, by endocrine diseases, by diseases of the liver and kidney, and by genetic factors; disorders related to nutritional deficiencies and excesses; fluid and electrolyte disorders; infectious diseases; childhood diseases; disorders and injuries caused by physical agents, such as injuries from electrical shock, those from exposure to extremes of temperature or to harmful radiation, and compression and decompression injuries; disorders from dehydration; poisons and poisoning; and allergy and anaphylactic shock.

The outline of subject B deals with the causes, methods of spread, and types of tumours, both malignant and benign; with hyperplasia; and with several kinds of atrophy, or wasting away of tissue.

The remainder of the outline of Section 424 covers the symptoms, diagnosis, and treatment of diseases and disorders of: C, the cardiovascular system and circulation; D, the lymphatic system; E, the respiratory system; F, the digestive system; G, the endocrine system; H, the birth process and genetic inheritance; I, the reproductive system; J, the mammary glands; K, the excretory system; L, the various parts of the supportive-protective system—bones, connective tissue, joints, muscles, and skin; and M, the nervous system, including diseases of the peripheral, autonomic, and central nervous systems, diseases of the eye and ear and other sensory receptors, and headache.

A. The symptoms, diagnosis, and treatment of diseases not confined or related to specific organ systems, or of diseases of the body as a whole

1. Physiological shock

a. Types of shock and their recognition

i. Shock owing to inadequate blood volume; *e.g.*, hemorrhage, burns, dehydration

ii. Shock owing to inadequate cardiac output; *e.g.*, cardiogenic shock, pulmonary embolus, cardiac tamponade

iii. Shock owing to increased circulatory capacity; *e.g.*, infection, drugs, endocrine causes

iv. Refractory and irreversible shock

v. Identification of the causes of shock

b. Management, prognosis, and salient features of shock

2. Metabolic diseases and disorders

a. Metabolic disturbances caused by nutritional deficiencies or by liver, kidney, and endocrine diseases

b. Inborn errors of metabolism

i. General features

ii. Disturbances in amino acid metabolism

iii. Disturbances in carbohydrate metabolism

iv. Disturbances in lipid metabolism

v. Disturbances in mucopolysaccharide metabolism

vi. Disturbances in purine and pyrimidine metabolism

vii. Miscellaneous disturbances

3. Nutritional diseases: disorders related to nutritional deficiencies and excesses

a. Caused by deficiencies

b. Caused by overconsumption

articles	article sections	other references
SHOCK, PHYSIOLOGICAL **16**:699–702	**17**:816h–817h	
	16:699d–701d	
	16:699d–f	**3**:521a–d/**5**:561c–e
	16:699f–h	**3**:894b–h *passim*
	16:700a–e/ **1**:608c–e	
	16:700e–701a	
	16:701b–d	
	16:701d–702d	**3**:523b–e
METABOLISM, DISEASES OF **11**:1049–1060	**3**:24e–26a	
	11:1049a–f/ **13**:409d–412a	
	11:1049f–1060h/ **12**:1044f–1045e	**5**:850b–d/**8**:1147b–e/ **13**:415a–c
	11:1049f–1051e	
	11:1051e–1056g/ **5**:18g–h	
	11:1056g–1058a/ **12**:1045c–e	**12**:634h–635b
	11:1058a–1059b/ **12**:1044h–1045c	
	11:1059b–c/ **5**:19c–d	
	11:1059d–1060a	
	11:1060b–h	
NUTRITIONAL DISEASES AND DISORDERS **13**:408–417	**5**:860e–861a/ **11**:1049a–d	**5**:856a–b
	13:408g–413h/ **2**:1135e–1136c/ **4**:223g–224a/ **5**:860f–861a/ **7**:503b–f/ **19**:488h–489c	**2**:1136h–1137c/**3**:24h–25b
	13:413h–414h/ **5**:860e	**19**:491g–h

	articles	article sections	other references
c. Caused by other disease mechanisms		**13**:415a–f	**5**:769a–f/**5**:770a–c/**7**:56a–c/**7**:56f–58a *passim*/**11**:1049f–1060h *passim*
d. Caused by habitual dietary pattern		**13**:415g–417a	**13**:423f–425d *passim*/**18**:285h–286a
4. Diseases and disorders of fluid and electrolyte balance	FLUID AND ELECTROLYTE DISORDERS **7**:429–433	**7**:55c–56c	**7**:44a–h
a. The depletion of water and salts in the body		**7**:430b–431b	**5**:560b–561f *passim*
b. The abnormal accumulation of water and salts in the body		**7**:431b–432e	**3**:894b–895a *passim*
c. Disturbances in acid–base balance and mineral metabolism		**7**:432f–433f	
5. Infectious or contagious diseases: the impairment of health by living invaders of the body	INFECTIOUS DISEASES **9**:532–559	**5**:855b–858c/**19**:169h–171h	
a. General features		**9**:533a–548a/**2**:575g–576b	**5**:838b–841e *passim*
i. Types of infective agents: size, structure, and modes of survival		**9**:533a–g/**1**:987c–e	**2**:568c–569e *passim*/**5**:838c–e/**5**:855b–h/**15**:120c–121c *passim*/**19**:163c–168e *passim*
ii. Man as a host: interactions with commensal and pathogenic organisms, and the operation of immunity		**9**:533g–535f/**19**:170a–f	**5**:838f–839g *passim*/**5**:840e–f/**5**:855h–856f
iii. The effects of man's activities and surroundings on the spread of disease		**9**:535f–540a/**9**:530e–g/**9**:531h–532a/**9**:610g–611b	**5**:839h–840e/**5**:875g–879g *passim*/**7**:948e–949a/**14**:546d–f/**15**:970h–971a
iv. Routes and modes of infection; *e.g.*, respiratory route, gastrointestinal route, the skin		**9**:540b–544g/**4**:222e–223c/**12**:1052e–1054a/**15**:699g–700f	**3**:26e–h/**5**:796g–797a/**12**:635h–636a
v. Prevention: immunization programs, isolation, disinfection, and disinfestation		**9**:544g–548a/**19**:171b–e	**1**:995d–998e *passim*/**5**:840h–841c/**11**:833g–835b *passim*
b. Individual systemic diseases according to their portal of entry		**9**:548a–559a/**5**:856g–858c	
i. Diseases of the respiratory tract; *e.g.*, influenza, smallpox, tuberculosis, leprosy		**9**:548a–553a/**4**:191g–192d/**15**:770c–772c	**4**:222g–223b/**5**:857g–858a/**12**:1052f–1053a
ii. Diseases of the gastrointestinal tract; *e.g.*, typhoid, botulism, poliomyelitis, trichinosis		**9**:553b–555h/**10**:1272b–1273a/**10**:1274b–g	**4**:189e–h/**5**:857e–g/**12**:1053e–f/**12**:1056b–c
iii. Diseases of the skin and mucous membranes; *e.g.*, anthrax, tetanus, rabies, malaria		**9**:555h–559a/**4**:189h–190e/**5**:857c–d	
6. Childhood diseases	CHILDHOOD DISEASES **4**:217–227		**2**:1073a–1076e *passim*
a. Diagnosis and general considerations of treatment and prevention		**4**:218c–219b	**15**:207b–e
b. Disease-affecting differences between children and adults: anatomical and physiological		**4**:219b–h	**5**:650g–658e *passim*
c. Diseases peculiar to the newborn infant; *e.g.*, transplacental infections, diseases associated with prematurity, idiopathic respiratory distress syndrome, erythroblastosis fetalis		**4**:219h–222e/**15**:776d–f	**2**:1146e–g/**2**:1073a–1076e *passim*
d. Diseases associated with later infancy and childhood; *e.g.*, infantile diarrhea, chicken pox, mumps, rickets, tonsillitis		**4**:222e–227a/**6**:837e	**5**:797f–g/**6**:822f–g/**9**:549c–e
e. Diseases and disturbances associated with adolescence; *e.g.*, psychological disturbances, adolescent goitre, acne		**4**:227a–h	**5**:656d–e/**15**:698e–h
7. Disorders and injuries caused by physical agents			
a. Injury from electrical shock	SHOCK, ELECTRICAL **16**:698–699		**5**:853c–d/**15**:745d–g *passim*
b. Injury from exposure to extremes of temperature		**9**:530b–c	

	articles	article sections	other references
i. Heat	BURNS **3**:519–525		**5**:853b–c
ii. Cold	FROSTBITE **7**:750–751		**5**:852h–853a / **5**:1133e–f
c. Injury from exposure to harmful radiation	RADIATION INJURY **15**:417–420	**1**:144c–e / **9**:530c–e	**5**:853g–854c / **15**:415h–416c / **15**:459a–461b *passim*
i. Ultraviolet and other non-ionizing radiation		**15**:417a–g	**15**:389c–391b *passim*
ii. Ionizing radiation		**15**:417g–420g / **3**:26c–e / **3**:764g–765a / **15**:383b–389c	**1**:304a–c / **7**:1005c–g / **12**:756a–b / **15**:415b–f / **15**:416a–c
d. Injury from blast, concussion, decompression, and other pressure effects	COMPRESSION AND DECOMPRESSION INJURIES **4**:1043–1045	**15**:745g–746e	**1**:35b–d / **1**:143d–e / **5**:853d–g / **14**:995g–h / **15**:747a–d
e. Motion sickness	MOTION SICKNESS **12**:555–556		**1**:143f–144c *passim*
f. Closed and open wounds	WOUND **19**:1018–1020	**3**:27a–28g / **7**:59d–e / **12**:1054e–1055d / **17**:819f–820a	**4**:1043f–1044e *passim* / **9**:556c–557c *passim*
8. Dehydration and associated disorders	DEHYDRATION **5**:560–561	**7**:430a–g	**2**:1114d–f / **13**:408g–409a
9. Poisoning	POISONS AND POISONING **14**:617–622	**5**:851d–852g	**14**:606g–h
a. The field of toxicology [see 10/35.B.2.g.]			
b. Classifications of toxicity: levels of effect and types of poisons		**14**:618h–619g / **9**:528h–529h / **12**:1055h–1056e	**9**:553g–554f *passim* / **14**:607h–616h *passim* / **16**:553e–f
c. Acute and chronic poisoning		**14**:619g–621a / **1**:867g / **5**:1043b–d / **9**:530g–531f	**1**:718c–d / **5**:692a–b / **16**:457c–f
d. The fate of poisons in the body and mechanisms of action		**14**:621b–622c / **10**:1270f–g	**5**:1043d–1044g *passim* / **15**:746g–h
e. Attainment of safety against poisoning: the role of the toxicologist		**14**:622c–g	**9**:528f–g
10. Allergenic diseases and anaphylactic shock	ALLERGY AND ANAPHYLACTIC SHOCK **1**:608–611	**9**:256e–257e	**8**:944h–945f *passim* / **16**:847c–g
a. Immediate allergies; *e.g.*, anaphylactic shock, hay fever, allergic asthma		**1**:608c–609a / **15**:772d–773d	**4**:224c–d / **5**:854e–f / **9**:256e–g / **16**:847c–d
b. Delayed allergy; *e.g.*, contact dermatitis, allergic reaction to infection, autoimmune diseases		**1**:609a–f / **5**:17g–18a / **9**:256h–257e	**5**:854f–h / **7**:58a–b / **16**:847d–f
c. Allergenic reactions of blood		**1**:609f–610b	**2**:1137h–1138d / **2**:1146e–g
d. Drug allergies		**1**:610b–d	
e. Organ and tissue rejection reaction		**1**:610e–611b	**5**:854h–855a / **18**:631c–632b *passim*
f. Recent therapeutic advances		**1**:611c–g	
B. The symptoms, diagnosis, and treatment of diseases affecting any organ or tissue of the body			
1. Tumours: uncontrolled growth of abnormal cells		**3**:28g–29a / **6**:835c–e / **7**:58f–59b / **12**:1050g–1051b / **15**:700h–701g / **19**:171f–h	**5**:797d–e / **5**:798d–e / **5**:801h–802a / **6**:819h–820a / **8**:441g–h / **11**:417a–e
a. Malignant tumours	CANCER **3**:763–771	**5**:858d–859g / **15**:777a–f / **15**:783c–e	**11**:214f–215c / **11**:417b–e / **14**:983f–h / **15**:700h–701g *passim*

	articles	article sections	other references
i. Causes; *e.g.*, chemicals, radiation, viruses, genetic factors		**3**:763g–765f / **15**:388e–389a / **15**:420b–d / **18**:286b–e	**16**:847g–h
ii. Methods of spread: by direct extension, the infiltration of surrounding tissue; by metastasis, the transfer of cancers to other areas of the body		**3**:765g–766e	**11**:215g–216a / **15**:466a–d
iii. Types of cancer; *e.g.*, carcinomas and sarcomas; cancers of the lung, colon, or stomach		**3**:766e–768g / **6**:825b–d / **10**:127a–b	**2**:1140d–1142b *passim* / **5**:799d–800b / **7**:58g–h
iv. Prevention and treatment of cancer; *e.g.*, early detection of the disease; the use of surgery, radiation, and chemotherapy		**3**:768g–770a / **4**:192e–f / **5**:1047g–1048a / **6**:825d–f	
v. Research; *e.g.*, cancer drugs, role of viruses, investigation of the immune response		**3**:770b–771c / **1**:303f–g / **11**:836b–d / **18**:467c–f	
b. Benign tumours		**12**:1047d	**3**:763d–e / **7**:59a–b / **12**:1050g–1051b *passim* / **15**:701e–f
2. Hyperplasia: abnormal increase in the number of normal cells, as in skin calluses or goitres		**5**:858d–f	
3. Atrophy: a normal or abnormal decrease in size of a cell, organ, tissue, or body part	ATROPHY **2**:351–353	**15**:177h–178c	**1**:306d–309g *passim* / **5**:871a–b / **7**:121b–g
C. The symptoms, diagnosis, and treatment of diseases of the cardiovascular system and of circulatory disorders	CARDIOVASCULAR SYSTEM DISEASES AND DISORDERS **3**:886–900	**1**:306d–h / **18**:283d–g	**2**:1075c–e / **5**:687b–c
1. Of the heart and the great vessels		**3**:886f–897g / **4**:226a–b / **14**:978e–h / **18**:283d–g	**5**:690d–691b
a. Congenital heart disease		**3**:886f–888a / **3**:895h–896d	
b. Acquired heart disease		**3**:888a–895a / **3**:896d–897g / **7**:123b–c	**13**:415h–416b / **13**:524f–h
c. Surgical treatment of the heart		**3**:895a–897g / **18**:630c–f	**17**:823d–f
2. Of the blood vessels		**3**:897h–900c	**16**:849b–c
a. Diseases of the arteries		**3**:897h–899f	**5**:862c–e
b. Diseases of the veins		**3**:899f–900a	
c. Diseases of the capillaries		**3**:900b–c	
3. Of blood circulation		**3**:900c–f / **7**:58e–f / **15**:776f–777a	**12**:1007d–1008a / **12**:1051b–1052a *passim* / **15**:463b–d / **16**:699b–702d *passim*
4. Of the blood and blood-forming tissues	BLOOD DISEASES **2**:1133–1143	**1**:609f–610b / **2**:1109h–1111c / **4**:225c–g	
a. Diseases related to red blood cells (erythrocytes)		**2**:1134d–1139e / **9**:557c–558a / **10**:1270h–1271b	**2**:1146e–g / **5**:687f–g / **7**:1001g–1002a / **13**:413c–d / **15**:353h–354c
b. Diseases related to white blood bells (leukocytes)		**2**:1139f–1142b	**3**:768e–g
c. Diseases related to platelets (thrombocytes)		**2**:1142b–1143c	**7**:1002a–b
D. The symptoms, diagnosis, and treatment of diseases of the lymphatic system	LYMPHATIC SYSTEM DISEASES **11**:213–216	**2**:1140d–1142b / **9**:258d–g / **11**:212g–213c	
1. Disorders of lymphatic vessels and their drainage		**11**:214a–e	
2. Disorders of lymphoid tissue		**11**:214e–216a / **15**:783c–e	**5**:797f–g
3. Significance of enlargement of accessible lymph nodes		**11**:216a–d	

E. The symptoms, diagnosis, and treatment of diseases of the respiratory system and of breathing disorders

1. General considerations
   a. Signs and symptoms of respiratory disease
   b. Morphological classification of respiratory disease
   c. The effect of respiratory disease on pulmonary function
   d. Relationship of respiratory disease to air pollution
2. Infectious diseases of the respiratory system
   a. Diseases caused by viruses, and similar organisms; *e.g.*, the common cold, influenza
   b. Bacterial diseases; *e.g.*, bacterial pneumonia, pulmonary tuberculosis
3. Allergic lung diseases; *e.g.*, asthma, hay fever, farmer's lung
4. Bronchopulmonary diseases
   a. Bronchitis
   b. Generalized nonobstructive lung disease
   c. Pulmonary response to chemical and physical irritants
   d. Congenital and developmental abnormalities
   e. Other causes; *e.g.*, circulatory disorders, lung cancer
5. Diseases of the nonpulmonary structures
   a. Diseases of the pleura
   b. Diseases of the mediastinum and diaphragm
6. Disorders in the dynamics of respiration
   a. Basic disorders of respiration: asphyxiation, altitude sickness, anemia, and carbon monoxide poisoning
   b. Special situations affecting respiration: swimming and diving; abnormalities of respiratory rhythm; space exploration

F. The symptoms, diagnosis, and treatment of diseases of the digestive system and of digestive disorders

1. Of the mouth, pharynx, and associated structures; *e.g.*, mouth lesions, nutritional deficiencies, tonsillitis
2. Of the esophagus; *e.g.*, inflammation strictures, esophagogastric junction disturbances
3. Of the stomach and duodenum; *e.g.*, peptic ulceration, gastric cancer
4. Of the small intestine and appendix; *e.g.*, intestinal obstruction, appendicitis
5. Of the large intestine; *e.g.*, diverticulitis, dysentery, hemorrhoids
6. Of the digestive glands; *e.g.*, cirrhosis of the liver, gallstones, pancreatitis
7. Disorders in the digestion and absorption of foods; *e.g.*, heartburn, nausea, diarrhea

G. The symptoms, diagnosis, and treatment of diseases of the endocrine system and of endocrine disorders

1. Of the pituitary
   a. The anterior pituitary; *e.g.*, acromegaly

articles	article sections	other references
RESPIRATORY SYSTEM DISEASES **15**:767–778	**1**:308h–309b / **4**:224a–e / **18**:283h–284a	**5**:689h–690d
	15:767a–770b	
	15:767b–h	**15**:463a–b
	15:767h–768f	
	15:768f–769h	
	15: 769h–770b	
	15:770c–772c	**4**:224a–c / **9**:543c–e / **14**:979g–980b
	15:770c–771b / **9**:552f–553a	**9**:548b–549a
	15:771b–772c	**1**:609b–d / **5**:857g–858a / **9**:550d–f / **9**:550h–551e
	15:772d–773d / **1**:608e–g	**4**:224c–d
	15:773d–777f / **18**:630g–631a	
	15:773d–775a	
	15:775a–e	
	15:775e–776d / **9**:530g–531a	**9**:529b–h
	15:776d–f	
	15:776f–777f	**3**:767d–e
	15:777f–778b	
	15:777f–h	
	15:777h–778b	
RESPIRATION, DISORDERS OF **15**:745–747	**9**:531a–c	**9**:529c–d
	15:745d–746h / **15**:769f–h	**2**:1116d–h / **2**:1134d–1135a *passim*
	15:746h–747f / **1**:142h–143f	**4**:1043c–d / **4**:1045a–f
DIGESTIVE SYSTEM DISEASES **5**:796–804	**4**:223c–g / **14**:980b–c / **18**:284a–d	**2**:1075a–c / **3**:767f–768a
	5:796f–797h	**17**:490h–492a *passim*
	5:797h–799a	
	5:799a–800c	
	5:800c–h	
	5:800h–802d	**9**:553e–g
	5:802d–804a / **10**:1270h–1274h / **18**:630f–g	**9**:555b–d / **9**:555g–h / **11**:1049e–f
DIGESTION, DISORDERS OF **5**:768–771		**12**:1004d–f / **14**:973d–g
ENDOCRINE SYSTEM DISEASES AND DISORDERS **6**:818–839	**4**:224e–g / **5**:859g–860d / **12**:1043g–1044d / **14**:979a–e / **18**:284f–h	**5**:658a–b / **12**:634f–h
	3:818d–820d	**12**:1043g–h / **12**:1005h–1006a
	6:818d–820a	**15**:698e–f

	articles	article sections	other references
b. The posterior pituitary; *e.g.*, diabetes insipidus		**6**:820b–d	
2. Of the thyroid; *e.g.*, hyperthyroidism, myxedema, goitre		**6**:820e–826g	**13**:413d–e/**15**:698f–h
3. Of the parathyroids; *e.g.*, hyperthyroidism, hypothyroidism		**6**:826h–828d	
4. Of the adrenals		**6**:828d–832g	**14**:979d–e
a. Adrenal cortex; *e.g.*, Cushing's syndrome, Addison's disease		**6**:828d–832c	
b. Adrenal medulla; *e.g.*, pheochromocytomas		**6**:832c–g	
5. Of the gonads and placenta; *e.g.*, premature development, disorders of the testes and the ovaries, tumours		**6**:832g–836b	**1**:308d–f/**15**:698e–699e *passim*
6. Female sex-oriented process under endocrine control			
a. Menstrual disorders; *e.g.*, amenorrhea (absence of menstruation), dysmenorrhea (painful menstruation)		**11**:909f–910f/**15**:699c–e	
b. Abnormal changes in pregnancy		**14**:976d–983h	
i. Ectopic pregnancy		**14**:976d–977f	
ii. Abortion or miscarriage		**14**:977f–978e	**2**:1069b
iii. Effects of systemic diseases on pregnancy and of pregnancy on systemic diseases		**14**:978e–980f/**6**:749b–c	**5**:851a–b
iv. Diseases of pregnancy; *e.g.*, acute toxemia, diseases of the placenta, abnormalities of the amniotic fluid, abnormal growths		**14**:980f–983h	
7. Of the pancreas: diabetes mellitus		**6**:836c–838e/**7**:123d–e	**1**:308c–d/**6**:812h–813a/**11**:835c–e/**12**:1044a–c/**14**:979a–b
8. Of other endocrine glands: pineal gland; thymus		**6**:838e–839b	
H. Diseases and disorders present at the time of birth	BIRTH DEFECTS AND CONGENITAL DISORDERS **2**:1073–1076	**5**:848a–851d	**4**:219h–222e *passim*
1. The occurrence of birth defects, congenital disorders, and premature birth		**2**:1073b–1074e/**4**:220a–221a/**5**:850e–851b/**6**:1024g–1025c/**8**:1138a–b/**11**:378h–380b/**15**:420d–g	**7**:1005g–1007h *passim*
a. Causes of abnormalities: past and present views		**2**:1073b–1074b/**3**:765d–f/**5**:848g–849a/**6**:749b–g/**9**:544d–g/**14**:982h–983c	**5**:1056d–e/**5**:850g–851b/**8**:809d–h/**15**:385d–h/**15**:387a–c
b. The incidence of various types of defects		**2**:1074b–e/**15**:354e–g	**5**:850e–f/**6**:745h–746a/**7**:1004h–1005b/**15**:353d–e/**15**:353h–354c
2. Defects of the different body systems		**2**:1074e–1076b/**11**:1049f–1060h	**8**:1147b–e
a. Of the supportive-protective systems		**2**:1074e–f/**3**:29a–e/**5**:18a–19e/**10**:262g–263d	**12**:635d–g/**16**:845d–e
b. Of the nervous system and sense organs		**2**:1074g–1075a/**12**:1044f–1045h/**12**:1052c–e	**5**:1134e–f/**5**:1136d–f/**7**:120d–e/**7**:124b–c
c. Of the cardiovascular system and blood		**2**:1075c–e/**2**:1138d–1139b/**3**:886f–888a	**2**:1109h–1111b *passim*/**2**:1137d–h/**7**:1001g–1002b
d. Of other systems; *e.g.*, reproductive, respiratory		**2**:1075a–c/**2**:1075e–1076b/**9**:258e–g/**15**:697a–698e/**15**:776d–f	**17**:491d–492a
3. Conditions arising from chromosomal defects; *e.g.*, Turner's syndrome, Klinefelter's syndrome, Down's syndrome (mongolism)		**2**:1076b–e/**5**:849a–850b/**6**:833h–834d/**7**:1004a–e	**8**:1148h–1149a/**15**:698c–e

I. The symptoms, diagnosis, and treatment of diseases of the reproductive system

1. Genetic and congenital abnormalities
2. Functional genital disorders
3. Infections; *e.g.*, syphilis, puerperal infection, prostatitis
4. Structural changes of unknown causes: tumours and injuries

J. The symptoms, diagnosis, and treatment of diseases of the mammary glands

K. The symptoms, diagnosis, and treatment of diseases of the excretory system and of disorders of urine production

1. Functional aspects: disorders of urine production and micturition
2. Of the kidneys and tubules
3. Of the urinary tract: ureters, bladder, and urethra

L. The symptoms, diagnosis, and treatment of diseases of the supportive-protective system

1. Of the skeletal system and of bone
   a. Abnormal stress on bone; *e.g.*, nerve injury, space flight
   b. Metabolic bone disease
   c. Deficient blood supply to bone; osteonecrosis
   d. Ionizing radiation injury to bone
   e. Infectious disease of bone: osteomyelitis
   f. Fractures
   g. Bone tumour
   h. Congenital bone diseases
   i. Surgical treatment of the locomotor system
2. Of connective tissue: bone and periosteum, cartilage, tendon, and ligament
   a. Classification, general characteristics, and theories of causation
   b. Heritable disorders of connective tissue
   c. Acquired connective tissue diseases
3. Of the joints
   a. Inflammatory joint diseases: infectious arthritis, rheumatoid arthritis, collagen diseases, and miscellaneous arthritides
   b. Noninflammatory joint diseases: acquired diseases, congenital and hereditary abnormalities, and secondary joint diseases
4. Of the bursae
5. Of the sinuses and the body cavities and their membranes
6. Of muscle

articles	article sections	other references
REPRODUCTIVE SYSTEM DISEASES **15**:696–701		**16**:592f–h
	15:697a–698e / **6**:833c–834g	**2**:1075g–h / **2**:1076b–d
	15:698e–699b / **6**:832g–833c	**6**:834h–835a / **11**:910e–f
	15:699g–700f	**3**:891f–g / **9**:543e–g / **12**:1053g–1054a
	15:700f–701g / **6**:835c–e / **13**:1039e–1040f	**3**:768c–d
	6:835e–836b / **11**:416g–417e	
EXCRETORY SYSTEM DISEASES **7**:54–60	**4**:226c–f / **14**:979e–g / **18**:284d–e	**2**:1075e–f / **3**:768a–b
	7:55c–56f	**4**:226e–f / **7**:41d–h
	7:56f–59h / **1**:309b–c / **18**:629e–630c	**3**:25d–f / **4**:226d–e / **7**:430b–433f *passim*
	7:59h–60e	**4**:226c / **7**:42h–43b
BONE DISEASES AND INJURIES **3**:23–30		**2**:1074e–f / **15**:462g–h
	3:24c–e	**2**:352h–353b
	3:24e–26a	**5**:1135f–1136c / **13**:410b–e
	3:26a–c	
	3:26c–e	**15**:388h–389a
	3:26e–27a	**19**:1019b–1020a *passim*
	3:27a–28g	**4**:1043e–1044f *passim* / **19**:1019a–b
	3:28g–29a	
	3:29a–e	
	3:29e–30b	**17**:821g–822a
CONNECTIVE TISSUE DISEASES **5**:17–23		
	5:17d–18a	
	5:18a–19e	
	5:19e–23d	**16**:848g–h
JOINT DISEASES AND INJURIES **10**:259–265		**5**:17c–23d *passim*
	10:259e–261f / **11**:1059f–h	**5**:862e–f
	10:261f–264h	
	3:525f–526c	
	3:892g–h / **15**:777f–778b / **16**:807e–f	**2**:1178h–1179c / **2**:1179g–1180c
MUSCLE DISEASES **12**:633–636		

	articles	article sections	other references
a. Common indications of diseased muscle tissue		**12**:634a–e / **2**:352g–353c	
b. Types of muscle disease; *e.g.*, Cushing's syndrome, muscular dystrophy, muscle rupture		**12**:634e–636c / **12**:1056e–1057f	**9**:555e–f
7. Of the skin	SKIN DISEASES **16**:844–850	**18**:628d–f	**5**:688b–c / **14**:975b–c
a. Skin lesions; *e.g.*, blisters, ulcers, sunburn		**16**:845a–846a / **9**:543h–544d	**13**:411c–e / **15**:417c–f
b. The epidermis; *e.g.*, dandruff, impetigo, eczema, parasites		**16**:846b–848c / **1**:608h–609b / **4**:225g–226a / **9**:558g–559a	**3**:767b–d
c. The dermis; *e.g.*, chronic granulomatous inflammation, hair loss, prickly heat		**16**:848d–850a / **2**:353e–f	**5**:18d–19b *passim* / **5**:20b–21c *passim* / **9**:551g–552a / **9**:555h–556b
M. The symptoms, diagnosis, and treatment of diseases of the nervous system	NERVOUS SYSTEM DISEASES **12**:1041–1057	**4**:224h–225c / **14**:980d–f / **18**:282g–283d	**5**:687h–688a / **17**:692e–695b *passim*
1. The neurological examination [see 423.B.]			
2. Neurological manifestations secondary to other diseases, neurochemical disorders, and development defects		**12**:1043f–1045h / **2**:353c–e	**2**:1074g–h
3. Disorders of the peripheral nerves		**12**:1045h–1046h	
4. Disorders of the spinal cord and autonomic nervous system		**12**:1046h–1047h / **12**:1039h–1040d	**18**:283b–d
5. Disorders of the central nervous system		**12**:1047h–1052e	**1**:307b–c / **1**:439b–441b *passim* / **11**:888a–c / **17**:489c–490d
6. Other disorders of the general nervous system		**12**:1052e–1057f	
a. Infections		**12**:1052e–1054a	**9**:554h–555b / **9**:557a–c
b. Demyelinating disorders		**12**:1054a–e	
c. Craniocerebral trauma		**12**:1054e–1055d	**11**:887a–c
d. Epilepsy		**12**:1055d–h	
e. Toxins		**12**:1055h–1056e	**9**:531d–f / **9**:549h–550c / **9**:554c–f / **9**:556c–f
f. Neuromuscular disorders		**12**:1056e–1057f	
7. Disorders of the eye and vision	EYE DISEASES AND VISUAL DISORDERS **7**:117–125		**1**:307e–f / **17**:822d–f
a. The outer eye and auxiliary structures; *e.g.*, sties, squints, conjunctivitis		**7**:117b–119f / **6**:825g–826a	**9**:542h–543c
b. The inner eye; *e.g.*, cataracts, detached retina, glaucoma		**7**:119g–122e	
c. Ocular injuries; *e.g.*, foreign bodies, radiation		**7**:122e–123a	**15**:417f–g
d. Manifestations of systemic disease; *e.g.*, arteriosclerosis, diabetes, thyroid disease		**7**:123a–f	**12**:1048d–e
e. Visual disorders, corrective devices, and blindness		**7**:123g–125c / **7**:100d–e	**7**:107c–e
8. Disorders of the ear and hearing	EAR DISEASES AND HEARING DISORDERS **5**:1133–1138		
a. The outer ear: diseases that afflict skin, cartilage, and the glands and hair follicles in the outer ear canal		**5**:1133e–1134f	
b. The middle ear: subject to the same allergic reactions and infections that afflict the nasal passages		**5**:1134f–1136c	**4**:1044h–1045a
c. The inner ear: diseases that may affect the vestibular nerve, bringing on vertigo, or the auditory nerve, with loss of hearing, or both		**5**:1136c–1137c	**12**:1049a–b
d. Causes, rehabilitation, and implications of deafness or impaired hearing		**5**:1137d–1138f	**9**:531g–h / **17**:490e–g
9. Disorders of other sensory receptors; *e.g.*, olfactory, gustatory		**12**:1042h–1043a / **12**:1046d–h	**16**:549f–h
10. Headache: intracranial, extracranial, and migraine	HEADACHE **8**:684–685		

Section 425. The practice of medicine and the care of health

[for Part Four headnote see page 209
for Division II headnote see page 217]

The articles and parts of articles referred to in Section 425 deal with ten main subjects and cover issues that arise from the professionalization of the practice of medicine and from the educational, economic, social, legal, and political dimensions of institutionalized medicine.

Subject A is the educational requirements for the practice of medicine.

Subject B is the fields of specialized medical practice, research, and related disciplines, which are treated in articles referred to in Section 10/35 of Part Ten.

Subject C is the practice of medicine and surgery. The outline first deals with the kinds of professional practice, differentiated by the places and the sponsors of practice, and with the maintenance of professional standards, involving medical ethics, licensing requirements, legal arrangements regarding malpractice, and the custodial role of professional medical organizations.

Subject D is public health services. The outline first deals with the general history of public health and with recent developments in the worldwide and national organization of public health services. It then treats special fields and concerns of public health research and specialization, covering family planning and birth control; eugenics and genetic counselling; and other fields such as environmental health and epidemiology.

Subject E is the characteristics and the organization of hospital facilities and services.

In dealing with public preventive medicine, the outline of Section 425 goes on to cover these subjects: F, the control of air, water, and soil pollution, treated in articles referred to in Section 737; G, the prevention of malnutrition, involving considerations of the world food supply and the world population, and determinations of daily nutrient requirements for man under various conditions; and H, the prevention and control of infection, involving such things as vaccination and immunization, quarantines, antiseptic precautions, and the prevention and control of epidemics.

Subject I is industrial and social medicine. The outline deals first with the aims and functions of occupational health services, the kinds of exposure to disease involved in various occupations, and some representative occupational diseases. It next covers health and safety laws. Here it deals first with the history of health and safety laws through the reforms of the 19th century in regulation of working conditions and child labour, and with more recent legal developments affecting industrial medicine, such as tort liability in industrial accidents and workmen's compensation insurance. It deals next with public welfare in the 20th century, covering unemployment compensation, public assistance, social security, and compulsory national health insurance. Finally, it deals with modern health and safety legislation, treating food and drug laws, industrial safety regulations, and international public health and safety programs.

Subject J is the economics of health and disease. The outline covers the cost and the financing of medical care, and comparisons of private and public health care expenditures in various countries.

	articles	article sections	other references
A. Educational requirements for the practice of medicine	MEDICAL EDUCATION **11**:809–812		**17**:820h–821b
1. Historical background of medical education: various aspects of the educational pattern established in the first half of the 20th century		**11**:809d–811g/ **11**:828a–829d	**11**:813c–e/**11**:830e–f/ **13**:755d–f
2. The situation in various countries since 1960; *e.g.*, China, Africa, India, United States		**11**:811g–812f	
B. Fields of specialized medical research; the related disciplines of osteopathy, dentistry, and nursing [see 10/35.C.]			
C. The practice of medicine	MEDICINE AND SURGERY, PRACTICE OF **11**:841–852		
1. The kinds of medical practice: in Britain, the United States, and other countries		**11**:841g–849f	
a. General practice and first-contact care: the general practitioner versus the specialist; clinic and health centre practice		**11**:841g–844f	
b. Hospital and specialist practice; *e.g.*, general surgery, pediatrics, anesthetics, pathology, teaching practice		**11**:844f–846d	**8**:1115d–1116c *passim*
c. Industrial medicine: health hazards of industry and the prevention of industrial diseases	INDUSTRIAL MEDICINE **9**:528–532	**11**:846d–847a	
d. Governmental practice		**11**:847a–848f	
i. Public health service: the environmental causes of ill health and their prevention		**11**:847a–g	
ii. Military practice: the medical services of armies, navies, and air forces		**11**:847g–848f	**8**:1116d–f
iii. Space medicine		**1**:146d–147d	
e. Research		**11**:848f–849f/ **1**:611c–g/ **3**:770b–771c/ **8**:127e–h/ **18**:631c–632b	**14**:204b–d

	articles	article sections	other references
2. Maintenance of professional standards		**11**:849g–852c / **11**:814h–815d	
a. The ethical basis of medical practice; *e.g.*, the Hippocratic oath, problems relating to euthanasia and abortion		**11**:849g–850b	**11**:814a–b / **11**:827c–e
b. Licensure requirements for practice: the wide variation among countries		**11**:850b–851b	**11**:811a–b / **11**:814h–815a
c. Legal restrictions on practice; *e.g.*, on procedures performed on minors, on the issuance of death certificates, on the use of certain drugs, on abortion and sterilization operations		**11**:851b–h / **11**:815b–d	**2**:1068h–1069f *passim* / **11**:813e–814h *passim* / **18**:631a–b
d. Professional organizations and the maintenance of standards		**11**:851h–852c	**11**:815a–b
D. Public health services and administration	PUBLIC HEALTH SERVICES **15**:202–209		**8**:697e–700d *passim*
1. General history of public health		**15**:202f–204f / **8**:690f–691b	**4**:517a–h *passim*
2. The recent situation of public health		**15**:204f–209g / **16**:931f–932a	**8**:690b–f / **8**:692e–693g *passim* / **11**:847c–g / **13**:397d–e / **16**:927d–e
a. Organizational and administrative patterns of international organizations, advanced nations, and developing nations		**15**:204f–208g / **13**:400c–h	**16**:930f–h
b. Recent progress in public health		**15**:208g–209g	
3. Public health fields of research and specialization		**3**:522h–523a	**11**:911c–912f *passim*
a. Family planning and birth control	BIRTH CONTROL **2**:1065–1070		**16**:926f–g
i. Family planning and its origins		**2**:1065d–1067c	**6**:1025g–1026d / **14**:821f–822a
ii. Methods of birth control		**2**:1067c–1070a	**17**:686h–687c
b. Eugenics and genetic counselling	EUGENICS **6**:1023–1026	**7**:1005g–1007h / **8**:818f–819e	**8**:816h–817e / **8**:1146c–1151e *passim*
c. Other fields; *e.g.*, environmental health, epidemiology		**5**:839g–840e / **5**:865e–h / **13**:425d–427c / **18**:280h–281b	**3**:770e–f / **5**:863d–g
E. Hospital services and facilities	HOSPITAL **8**:1114–1117		
1. History of hospitals: care of the sick as a fundamental need of community life		**8**:1114d–h	
2. The modern hospital; *e.g.*, general hospitals, specialized health and medical care facilities, regional planning		**8**:1114h–1117e	**11**:852b–c / **13**:396h–397c
F. Environmental sanitation and health: the control of air, water, and soil pollution [see 737.C.1.]			
G. Efforts directed toward the prevention of malnutrition: the recognition and attempted solution of problems relating to nutrient requirements, world food supply, and world population	FOOD SUPPLY OF THE WORLD **7**:498–504	**13**:425d–427c	
1. The major problems of food supplies: the production and utilization of foods		**7**:499e–502f / **1**:337g–346h	**3**:1158c–1160b *passim* / **10**:1279b–g / **13**:426a–e
2. Prospects: the implications of population growth, the sources of food supply, and the recommended intakes of nutrients for normal growth and the maintenance of good health		**7**:502g–503f / **13**:411f–412e / **13**:416c–h / **14**:823b–h	**13**:408c–f / **13**:418b–d
3. International and local government efforts to prevent malnutrition; *e.g.*, food, technical, and financial international aid; statistical surveys of nutritional status; food rationing; welfare foods		**7**:503g–504b / **13**:425d–426a	**13**:426e–427c
H. The prevention and control of infection		**5**:840h–841c / **8**:129a–f / **9**:544g–548a	**4**:219a–b / **5**:877d–879g *passim* / **19**:1019e–1020a

1. Vaccination and immunization
2. The quarantine and isolation of infected victims
3. Destruction of infectious agent or carrier; *e.g.*, aseptic and antiseptic precautions, control of disease carriers, disinfection
4. The use of therapeutic agents and prophylactic medication
5. The prevention and control of epidemics

I. Industrial and social medicine

1. Industrial and occupational medicine; *e.g.*, industrial physicians, nurses, first aid rooms; commercial aviation medicine
   a. Aims and functions of occupational health services
   b. Specific occupational exposures; *e.g.*, chemicals, mechanical factors, radiation
   c. Some representative occupational diseases; *e.g.*, asbestosis, lead poisoning, anthrax
2. Health and safety laws: the regulation of working hours; restrictions on female and child labour; the elimination of health, safety, and fire hazards; the control of foods and drugs
   a. The development of health and safety laws to 1800: the correlation between religious and hygienic objectives; early governmental control of health standards
   b. Reforms in the 19th century: systems of social insurance; regulations of working conditions; rudimentary child labour laws; proposals for national public health schemes
   c. The legal evolution of industrial medicine: tort liability in industrial accidents; workmen's compensation insurance
   d. Public welfare in the 20th century: unemployment compensation, public assistance, social security, and compulsory national health (illness and disability) insurance
   e. Modern health and safety legislation
      i. Legal prohibitions on the adulteration of foods, drugs, and cosmetics
      ii. Industrial safety regulations: inspection of hazardous or high-risk industrial, mining, and construction sites; fire prevention control; traffic regulation
      iii. International programs regulating public health and safety: child and women's labour laws; the transportation and use of radioactive materials; air pollution control

J. The economics of health and disease

1. The cost of medical care
   a. Problems of financing health services: the right to receive public medical care; the history of national health services
   b. The assessment of medical care costs: costs of physicians' services (fee-for-service, salary, capitation, and case payment methods) and the costs of hospital care

articles	article sections	other references
	9:544g–546c	**9**:549g–h / **11**:833g–835b *passim*
QUARANTINE AND ISOLATION **15**:326–327	**9**:546c–g	**8**:694g–695f *passim*
	2:572g–573c / **9**:546g–548a	**1**:995d–998e *passim* / **15**:970h–971a / **18**:57c–e *passim*
	1:986a–987e / **4**:189e–192e	
	5:865e–h	**9**:549f / **15**:770e–f
INDUSTRIAL MEDICINE **9**:528–532		**8**:696g–697e *passim*
	9:528d–g / **11**:846d–847a	**14**:622d–g
	9:528h–530g	**5**:1136g–1137a / **9**:537c–538a
	9:530g–532a / **15**:775e–776b	**9**:555h–556b
HEALTH AND SAFETY LAWS **8**:693–700	**5**:1052a–b	**2**:1069c–f / **11**:911g–912c / **18**:467d–f
	8:694c–695g / **15**:202f–203b	**4**:517a–e
	8:695g–696g / **3**:274c–h / **15**:203b–204d	**3**:267b–e / **6**:236d–e / **11**:846d–e / **16**:925a–d
	8:696g–697e / **9**:649b–h / **10**:572d–h / **11**:846d–847a / **19**:752h–753h	**16**:137e–138b / **18**:524g–525a / **18**:528c–d
	8:697e–698d / **15**:204d–208g	**16**:925d–e / **19**:743h–754e *passim*
	8:698d–700d	**1**:449e–g
	8:698d–g / **5**:199b–h / **7**:489b–g	**5**:101c–e
	8:698h–699c / **7**:314a–315c / **11**:846d–847a / **18**:572e–573g / **18**:1082b–1084a	**12**:251g–h
	8:699c–700d / **15**:204f–205b	**5**:49c–h / **5**:58e–61c *passim* / **5**:189b–c
HEALTH AND DISEASE, ECONOMICS OF **8**:689–693		
	8:689g–692a	
	8:690b–691b / **8**:1114h–1115d / **19**:749c–750e	
	8:691b–692a / **19**:750e–751a	**11**:842c–844f *passim*

	articles	article sections	other references
2. The financing of medical care: government aid or compulsory social insurance; voluntary private profit-making and nonprofit (friendly societies, trade unions, or mutual benefit unions) insurance programs; direct payment by the recipient of medical care		**8**:692a–e / **9**:652b–653d	**8**:1115b–d
3. Comparisons of private and public health care expenditures in various countries		**8**:692e–693g	**11**:842c–846d *passim*

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BERNARD, CLAUDE **2**:859
COHN, FERDINAND JULIUS **4**:820
EHRLICH, PAUL **6**:509
GALEN **7**:849
GALVANI, LUIGI **7**:859
JENNER, EDWARD **10**:132
KOCH, ROBERT **10**:497
LISTER, JOSEPH **10**:1033
MALPIGHI, MARCELLO **11**:388
MAYO FAMILY **11**:723
NIGHTINGALE, FLORENCE **13**:99
OSLER, SIR WILLIAM **13**:754
PARACELSUS **13**:982
REED, WALTER **15**:546
RUSH, BENJAMIN **16**:31
SEMMELWEIS, IGNAZ PHILIPP **16**:529
VESALIUS, ANDREAS **19**:94
VIRCHOW, RUDOLF **19**:150

Division III. Human behaviour and experience

[for Part Four headnote see page 209]

The articles and parts of articles referred to in the eight sections of Division III set forth the discoveries and theories in the psychological sciences concerning human capacities, human behaviour, and human experience.

Section 431 treats diverse conceptions of man and of his place in the order of nature and examines the conceptual framework for the analysis of human behaviour and conscious experience.

Section 432 deals with the antecedent conditions and developmental processes affecting a person's behaviour and conscious experience. It treats the genetic factors and the environmental antecedents that affect behaviour and experience, and the general characteristics of human behaviour at the different stages of human development.

The articles referred to in Section 433 deal with the capacities by which man receives, organizes, and interprets information about his current environment that influences his behaviour. They treat the following subjects: attention; sensation; perception; the perception of time, of space, and of movement; perceptual illusions and hallucinations; and parapsychological phenomena.

Section 434 is concerned with current internal states that affect behaviour and conscious experience. It treats the determinants and manifestations of activation level; motivational states; emotional states; and transient states affecting behaviour and experience, such as sleep, dreams, hypnosis, fatigue, and intoxication.

Section 435 is concerned with persisting capacities that integrate human behaviour and conscious experience. The articles referred to treat the nature and assessment of human abilities; sensorimotor abilities; intellectual abilities; and the distribution of intelligence.

Section 436 is concerned with the development of a person's potentials by learning and thinking. The articles referred to treat diverse general theories of learning; deal separately with psychomotor, perceptual, and conceptual learning; and then treat memory and forgetting and the theories about and the types of the higher thought processes.

Section 437 is concerned with the persisting inclinations that guide and organize human behaviour and conscious experience. The articles referred to treat personal propen-

Section 431. General theories of human nature and behaviour 242
432. Antecedent conditions and developmental processes affecting a person's behaviour and conscious experience 243
433. Influence of the current environment on a person's behaviour and conscious experience: attention, sensation, and perception 246
434. Current internal states affecting a person's behaviour and conscious experience 251
435. Persisting capacities that integrate human behaviour and conscious experience 254
436. Development of a person's potentials: learning and thinking 256
437. Persisting inclinations that guide and organize human behaviour and conscious experience 259
438. Personality and the self: integration and disintegration of the person as a whole 261

sities and idiosyncrasies involved in personal styles; the nature, functions, and development of attitudes; and changes of attitude as brought about by persuasion.

The articles referred to in Section 438 set forth those parts of psychology, psychopathology, and psychotherapy that consider the functioning, the integration, and the disintegration of the person as a whole. The articles treat diverse definitions and theories of personality and the self; theories of personality adjustment and maladjustment; and the diagnosis and kinds of psychiatric treatment of psychoses and psychoneuroses.

Section 431. General theories of human nature and behaviour

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 431 deal with two main subjects. Subject A is the diverse conceptions of man and of his place in the order of nature. Subject B is the conceptual framework for the analysis of human behaviour and conscious experience. Detailed psychological studies of human behaviour are set forth in the articles referred to in the remaining sections of Division III.

The outline of subject A first treats religious conceptions of man and philosophical conceptions of man that emphasize an essential distinctness of man from all other beings in the order of nature. It goes on to conceptions of man as homogeneous and continuous with the rest of nature, according to which his allegedly distinctive capacities are explicable by evolutionary theory. The outline next deals with controversies about the adequacy of neurological explanations of man's behavioral performances and conscious experience. Finally, it treats problems raised, with regard to general conceptions of human nature, by current parapsychological research and by comparisons made of men with automata in cybernetics and information theory.

The outline of subject B covers these topics: stimulus and response, and the distinction between conditioned and unconditioned responses; the distinction between innate and acquired factors in behaviour; the distinction between observed elements of behaviour and inferred inclinations, powers, or capacities; and the distinction of the cognitive, conative, and affective dimensions of behaviour and experience.

articles	article sections	other references
A. Diverse conceptions of man		
1. Religious conceptions of man [see Part Eight]		
2. Conceptions of man as radically distinct from the rest of nature [see also 10/51.B.5.]	**1**:977c–g / **4**:486h–487a / **4**:557d–558b / **4**:958f–h / **4**:1097e–1098f / **15**:665a–c	**6**:932h–933d / **7**:21d–f / **11**:612b–613h *passim* / **15**:158h–159b / **17**:1035b–d
3. Conceptions of man as homogeneous and continuous with the rest of nature	**8**:1023a–g	**11**:554b–d
a. Behavioral capacities and performances that man has in common with other primates and higher mammals [see also 342 and 343]	**1**:977h–979a / **2**:541f–542h / **4**:1010g–1011b / **10**:478d–f / **10**:755a–e / **11**:419a–420g / **11**:801h–802e / **19**:544b–e	**1**:32c–d / **8**:1014c–1015d *passim*
b. Behavioral capacities and performances held to be distinctive of man; *e.g.*, toolmaking, propositional language, cumulative transmission of culture	**8**:1026e–1028a / **8**:1151g–1153g / **10**:654f–655d / **17**:477c–g / **18**:21d–e	**4**:1008b–d / **4**:1009a / **8**:1048f–1051b *passim* / **10**:477f–g / **10**:642f–g / **10**:734g–735b / **15**:863f–865b *passim* / **16**:904h–905g
c. The explanation of allegedly distinctive human traits in accordance with the principle of phylogenetic continuity: the evolutionary development of man [see also 343 and 413]	**1**:979b–e / **7**:20d–g / **11**:428b–430g / **12**:636e–637d	**4**:1009a / **8**:1023a–e / **8**:1043g–1048f *passim*
4. The relation of the human brain to human behaviour and experience	**10**:755h–756c / **11**:611g–613h	
a. The hypothesis that an adequate neurological explanation can be given of man's behavioral performances and conscious experience [see also 10/53.A.2.d.]	**10**:649e–650c / **11**:613h–614f / **12**:560c–561a / **12**:994h–997g	**2**:1033b–f / **11**:886d–f / **16**:882h–883h *passim* / **18**:422b–c
b. The hypothesis that neurological factors and processes cannot adequately account for man's behavioral performances and conscious experience [see also 10/51.B.1.c.v.]	**12**:22d–23c / **12**:233a–c / **15**:648a–d	**11**:886f–g

	articles	article sections	other references
c. Diverse philosophical theories of the so-called mind–brain relation [see 10/51.B.4.c.ii.]			
5. Emergent problems in the consideration of man			
a. The data and hypotheses of parapsychology [see also 433.I.]		**5**:916c–f / **5**:1011c–e / **15**:62a–63a	**4**:548g–549b / **13**:1002a–1004g *passim*
b. The comparison of men with automata: human and machine intelligence [see also 10/23.D. and E.3.]		**4**:1064e–f / **8**:1168c–f / **9**:679e–f / **12**:224g–225d	**2**:1033h–1034c / **4**:1047c–1050f *passim* / **11**:614b–c / **12**:20a–b / **12**:226b–e / **16**:548f–g
B. The conceptual framework for the analysis of human behaviour and conscious experience			
1. Stimulus and response		**10**:899c–h	**15**:149f–g
a. Conditioned and unconditioned responses: the process of conditioning; reinforcement and inhibition [see also 342.B. and 436]		**10**:749f–751d / **13**:1100g–1101a / **18**:421g–422a	**10**:732c–738c *passim* / **10**:754f–759f *passim* / **12**:559g–h / **12**:1036f–1037a / **15**:161h–162b
b. The necessity of positing mediating factors or processes		**2**:361f–362c / **6**:760f–g / **10**:751d–752h / **10**:755h–756c / **12**:1035f–1040d	**12**:559h–560b / **13**:1100h–1101a / **18**:352d–e / **18**:354f–g
2. The distinction between innate and acquired factors in behaviour [see also 414]		**8**:1146e–h / **10**:649e–650c / **17**:478a–c	**8**:1148a–1150d *passim* / **15**:149e–g / **15**:528a / **17**:671g–672b / **18**:422b–c
a. The modifiability of behaviour		**2**:361g–362c / **10**:754f–755e	**15**:142g–148g *passim*
b. The process of learning [see also 436]		**10**:657f–658g	**10**:754f–759f *passim*
3. The distinction between observed elements of behaviour and inferred dispositional tendencies: actions and powers, habits, inclinations, or capacities		**2**:360c–e / **10**:755h–756c / **14**:114e–115b	**7**:189c–e
4. The cognitive, conative, and affective dimensions of behaviour and experience [see also 433]		**2**:360g–361a	
a. The cognitive dimension: sensation and perception; memory and imagination; concept formation, ideation, and reasoning		**2**:361c / **4**:1010a–d / **4**:1062b–e / **8**:1138f–1139g / **8**:1140e–1142d / **9**:677h–678c / **11**:891b–d / **14**:39e–44b / **16**:547c–548a / **18**:355a–358g / **18**:421d–e	**12**:231f–g / **12**:563d–564c / **15**:149g–h / **18**:352b–354e *passim*
b. The conative dimension: desires, needs, cravings, drives; motivation and purpose; the voluntary and the involuntary [see also 434.B.]		**2**:361d–e / **8**:1142d–1144e / **12**:562a–564c	**8**:1139g–1140c / **12**:232a–d / **15**:149c–e
c. The affective dimension: the pleasant and unpleasant; the emotions; the sentiments [see also 434.C.]		**2**:361e–f / **6**:757b–758e	**8**:1139g–1140c / **12**:231h–232a

Section 432. Antecedent conditions and developmental processes affecting a person's behaviour and conscious experience

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 432 deal with three main subjects. Subject A is genetic endowment as mediating behaviour and experience. Subject B is environmental antecedents that affect a person's present behaviour. Subject C encompasses the general characteristics of human behaviour at different stages of human development.

The outline of subject A first treats the nature–nurture controversy about the relative weights of genetic and environmental factors in their effects on human behaviour. It next deals with genetically mediated individual differences in both bodily and psychological characteristics, and with controversies about whether human groups in relative cultural, economic, or geo-

graphic isolation differ genetically. Finally, it deals with basic innate tendencies, such as reflexes and instincts.

The outline of subject B, environmental antecedents that affect present behaviour, treats ecological factors, cultural conditioning, and early personal socialization experiences.

Subject C is the development of human behaviour. The outline deals with the broad phases of human development and with issues about "sensitive periods" in development. It next treats contrasting conceptions of development, which differ in holding the child to be active or passive, in conceiving development as continuous or as segmented into stages, and as being goal-oriented or open-ended. It goes on to differences between the psychoanalytic and the social learning theories of personality and to differing theories of intellectual development. The treatment of the specific stages in human development covers prenatal growth and development; the effects of the birth experience; and physical and psychological developments during infancy, early childhood and childhood, adolescence, maturity, and old age.

	articles	article sections	other references
A. Genetic endowment as mediating behaviour and experience [see also 342]	HUMAN BEHAVIOUR, INNATE FACTORS IN **8**:1146–1151	**7**:996h–1005g	
1. The relative weights of genetic and environmental factors: the nature–nurture controversy		**8**:1146e–h / **2**:1073b–1074b / **5**:650d–f / **7**:1002c–1003h / **9**:678f–679b / **10**:649e–650c / **15**:350c–351c / **15**:355f–h	**7**:999b–c / **8**:801h–802d / **8**:809b–810h *passim* / **16**:954b–c / **19**:908e–h
2. Physiological mechanisms in heredity [see 414]			
3. Genetically mediated individual differences		**8**:1147a–1149h / **2**:1074e–1076e / **6**:1024g–1025e	**5**:266h–267a / **7**:998c–1001d *passim*
a. Bodily characteristics		**8**:1147a–e / **2**:1146g–1148d / **11**:428c–430a / **12**:1044f–1045h / **16**:595a–f	**2**:1116b–c / **8**:1015h–1016a
b. Psychological characteristics		**8**:1147e–1149h	
i. Sensory functions		**8**:1147e–1148c / **16**:595f–h	
ii. Intelligence		**8**:1148d–1149a / **9**:672h–673d	**9**:678f–679a / **17**:490b–c
iii. Attitudes and beliefs		**8**:1149b / **2**:361f–g	
iv. Personality		**8**:1149b–g / **15**:163c–e	**14**:114h–115b
4. Genetically mediated group differences		**8**:1149h–1150d / **9**:676c–677f / **15**:353a–354g / **16**:953h–955c	**2**:1116g–h / **7**:1001d–1002c / **7**:1009g–1010a / **9**:679a–b / **14**:114h–115c
5. Basic innate tendencies of the person *with special attention to*		**6**:1025e–1026d / **15**:161a–h	**15**:528a / **17**:381d–f / **17**:671g–672b
a. Reflexes		**8**:1138d–e / **12**:1010f–1016g	**12**:1004a–f / **17**:478b–c
b. Instincts [see also 341.A.2.]			**9**:628b–630e *passim* / **12**:556h–565c *passim* / **14**:116d–e
B. Environmental antecedents that affect a person's present behaviour			
1. Ecological factors		**5**:267c–e / **11**:428h–429e / **15**:769h–770b	**14**:751a–b
2. Cultural conditioning		**5**:267e–269b / **7**:161a–162c / **8**:1153c–1154e / **14**:44e–f / **16**:596g–597f	**1**:972d–e / **10**:479c–483a *passim* / **14**:992c–d / **16**:954b–c
3. Personal socialization experiences		**5**:269d–270a / **14**:116f–117d	**4**:242f–246c *passim* / **4**:1010a–d / **7**:160e–f / **9**:673c–d / **16**:961h–962d / **19**:908f–h

	articles	article sections	other references
C. The development of human behaviour	HUMAN BEHAVIOUR, DEVELOPMENT OF **8**:1136–1146		**4**:217h–227h *passim*
1. General aspects of human development		**8**:1136a–1137f / **4**:217h–219b / **7**:996h–998c / **10**:748h–749c	**7**:20d–f
a. Developmental sequences and "sensitive periods" in human development		**8**:1136a–c / **4**:1063e–1064a / **5**:650h–651c / **7**:71c–f / **19**:1090g–1091a	**4**:218d–f / **13**:1098b–f
b. Contrasting conceptions of development: development as active or passive; as continuous or segmented into stages; as goal-oriented or open-ended		**8**:1136c–g	**16**:954c–f
c. Theories of human development: differences between psychoanalytic and social learning theories of personality development; theories of intellectual development from global undifferentiated ability to increasing articulation, differentiation, and integration		**8**:1136g–1137g / **9**:679b–e / **13**:1099g–1101g / **14**:116a–117d / **14**:992a–c	**18**:423f–g
2. Prenatal growth and development		**8**:1137g–1138a / **4**:219h–220d / **5**:651c–652a / **6**:743a–748f / **6**:823g–824d / **15**:385d–h	**2**:1073a–1076e *passim* / **2**:1146d–g / **5**:1131g–1132e *passim* / **6**:831d–832a / **12**:995b–f / **13**:415a–c / **16**:595b–c / **16**:596a–b
3. Birth: effects of the birth experience on the person's subsequent history		**8**:1138a–b / **4**:220d–221a	
4. Infancy: the first 18 months		**8**:1138c–1140c	**7**:20h–21a
a. Physical growth		**8**:1138c–d	**12**:995f–996a / **13**:410b–e
b. Endowment at birth		**8**:1138d–e / **4**:221a–222e	
c. Events of the first year: sensory, motor, cognitive, motivational, and emotional development		**8**:1138f–1140c	
5. Early childhood and childhood: one to 12 years		**8**:1140c–1145a	**7**:21a–d
a. Physical growth		**4**:222e–227a / **5**:652h–654a / **6**:837e / **13**:411f–412e	**6**:822f–833c *passim* / **7**:71c–e / **13**:418b–c / **15**:207b–d / **16**:595d–e
b. Cognitive processes; *e.g.*, thinking, perception, attention, language learning, memory, problem-solving		**8**:1140h–1142d / **10**:649e–650c / **13**:1101a–g	**4**:1063f–g / **8**:1148d–e / **14**:992b–d / **17**:488a–489c *passim* / **18**:423f–g
c. Motivational, emotional, and moral development		**8**:1142d–1144e	
d. Influence of the family		**8**:1144e–1145a / **5**:268d–h / **5**:273e–h	
6. Adolescence: puberty to adulthood		**8**:1145a–h	
a. Physical growth		**8**:1145a–b / **4**:227a–h / **5**:654b–657a / **11**:909c–d	**6**:832a–833h *passim* / **19**:1091b–f
b. Motivational, emotional, and moral development: changes in interests, values, and self-concept during adolescence		**8**:1145c–d / **19**:1091h–1092h	**16**:596c–d
c. Influence of the peer group		**8**:1145d–h / **5**:272h–273d / **6**:414c–d	
7. Young adulthood and maturity		**5**:268h–269b / **6**:413b–414d	**19**:912h–913g *passim* / **19**:1092d–h
a. Determinants and effects of educational experiences		**2**:11f–h / **6**:413f–414a	**19**:913g–915a *passim*
b. Determinants and effects of career and occupational choices and of success and satisfaction in one's vocation and with one's work			

	articles	article sections	other references
c. Factors involved in marital choice and marital happiness; divorce		**7**:158c–159f/ **7**:162d–165a/ **10**:479c–481f/ **16**:597c–598h/ **19**:915a–f	**7**:160a–c
d. Determinants and effects of parenthood		**10**:482c–g	**7**:160d–h
e. Age trends in ability		**1**:305f–h/ **9**:679b–d	
8. Old age and death [see also 338.F. and 421.C.4.]		**1**:299h–304g/ **13**:547h–550f	
a. Physical, intellectual, and emotional changes in the later years		**1**:303b–304a/ **1**:305a–306d/ **2**:353e–f/ **6**:825b–d/ **6**:837c–d/ **11**:909d–e/ **13**:547h–550f/ **15**:177a–c	**2**:352d–g/**4**:1063g–1064a/ **15**:177g–178a/**16**:596e–f
b. Special problems in the later years; *e.g.*, retirement, health, loss of spouse and friends		**9**:501h–502h/ **12**:1049h–1050c	**7**:160h–161a/ **9**:503f–505c *passim*/ **13**:547g–h/**13**:548h–549b
c. Attitudes toward death		**5**:528b–529b/ **5**:538b–g/ **6**:735h–736b	**13**:550b–c

Section 433. Influence of the current environment on a person's behaviour and conscious experience: attention, sensation, and perception

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 433 deal with nine main subjects, which fall into four groups. Subject A is environmental conditions influencing behaviour. The next three subjects are: B, attention to the environment; C, sensation; and D, perception. The following three subjects are E, the perception of time; F, the perception of space; and G, the perception of movement. The last two subjects are H, perceptual illusions and hallucinations; and I, parapsychological phenomena.

The outline of subject A first treats the effects on human behaviour and conscious experience of gross physical conditions, of various kinds of stimulus deprivation, and of dietary deprivations. The effects of social conditions are dealt with in Sections 521 and 522 of Part Five.

The outline of subject B first treats problems about the definition of attention, the development of theories of attention, and the classification of attentive phenomena. It then deals with the determinants and physiological mechanisms of attention and analysis of attentive phenomena in terms of information theory.

Subject C is sensation, the reception of information about the environment. The outline first covers general theories about the nature of human sensation, classifications of the senses, and features common to all sense organs. It then separately treats vision; audition; cutaneous (skin) senses, with special attention to the phenomena and the theories of pain; the kinesthetic (motion) sense; vestibular (equilibrium) senses; the sense of taste; and the sense of smell.

Subject D is perception—the process of translating sensory stimulation into organized experience. The outline treats questions about the nature and causal factors of perception; the principles of perceptual organization; and differences in perceptual functioning among individuals, among classes of individuals, and within individuals.

The outline of subject E, the perception of time, treats adaptations to successive events and to periodic change; the perception of sequence and of duration; and the various factors that affect time perception.

The outline of subject F treats the nature of space perception generally; the different kinds of cues for the perception of depth and distance; the interrelation of the senses in space perception; and the social and interpersonal aspects of space perception.

The outline of subject G treats the primary visual cues for perceiving self-motion and the motion of objects, and the auditory, kinesthetic, and vestibular cues for the perception of movement.

The outline of subject H treats the types of illusory experience, such as stimulus-distortion and tactual illusions, and the types of hallucination, such as hypnotic states and sensory defects.

The outline of subject I first deals with the two types of parapsychological phenomena—extrasensory perception, such as telepathy, clairvoyance, precognition, and prophecy; and psychokinetic phenomena, involving the moving of objects by willing or by "poltergeists." It then treats problems raised by various theories of parapsychological phenomena.

	articles	article sections	other references
A. Environmental conditions			
1. Physical conditions			
a. Gross physical conditions; *e.g.*, effects of temperature, humidity, and altitude; effects of variability of climate; general stressfulness of the physical environment		**1**:35b–e/ **1**:142h–144g/ **4**:728h–729h/ **5**:837f–839e/ **5**:843a–d/ **7**:190c–191e/ **10**:752f–h/ **10**:916d–917b/ **15**:349f–h/ **15**:745g–746e/ **15**:769h–770b	**5**:852h–854c/**15**:160a–c

	articles	article sections	other references
b. Stimulus deprivation: the effects of sensory deprivation on intellectual functioning and sensory acuity		**1**:144e–g / **16**:880b–881c	**12**:560f–g / **14**:40g–41e
c. Effects of dietary deprivation; *e.g.*, malnutrition, vitamin deficiencies, bone defects [see also 421.C.1.]		**3**:22f–23d / **5**:860e–861a / **11**:1049a–d / **13**:408a–413h / **19**:488h–489c	**2**:352b–c / **13**:417b–427c *passim*
d. Specific physical energies; *e.g.*, the effects of light, sound, gravity, motion, radiation [see also C., below]		**1**:143f–144c / **5**:1137d–1138a / **9**:530c–e / **12**:555c–556c / **14**:353g–354b / **15**:390a–391b / **17**:33h–34b	**14**:46d–e
2. Social conditions [see 521 and 522]			
B. Attention to the environment: awareness of internal and external events [see 341]	ATTENTION **2**:354–359		
1. The problem of defining attention		**2**:354a–d / **9**:244f–h	**12**:228c–h
2. The development of theories of attention: the influence of stimulus-response and behaviourist studies		**2**:354d–h / **14**:123b–f	**12**:563d–g
3. Classification of attentive phenomena: the influence of adaptive processes on modes and degrees of attention		**2**:354h–355f	
4. Determinants of attention: temperament, health, social suggestion, novelty, interests, and unconscious influences		**2**:355f–356a	**15**:41h–42d *passim* / **18**:422c–423c *passim*
5. Physiological mechanisms of attention		**2**:356b–358b / **9**:244c–245b / **12**:976b–979a / **15**:159c–161a	**6**:758e–760b *passim* / **6**:761e–766f *passim* / **8**:1147e–1148a
a. Bioelectric effects: processes and systems of the cerebral cortex that mediate attention		**2**:356b–357h	**12**:997h–1016g *passim* / **18**:422h–423a
b. Biochemical effects: chemical processes in the nervous system that mediate attention		**2**:357h–358b / **12**:1033f–1040d	
6. Analysis of attentive phenomena in terms of information theory		**2**:358b–359a	
C. Sensation: the reception of information about the environment	SENSORY RECEPTION, HUMAN **16**:547–555		**12**:982d–988h *passim* / **12**:1004a–1005a / **12**:1009d–1010a / **12**:1010g–h
1. The senses in general			
a. Theories about the nature of sensation in man		**16**:548a–g / **6**:758e–759e / **9**:244c–245b / **15**:152b–155a / **15**:155h–157g / **15**:160a–161a	**10**:756c–e / **17**:378d–h
b. Classifications of the human senses: by their bodily location (exteroceptors, interoceptors); by type of stimuli to which they respond (photoreceptors, thermoreceptors, chemoreceptors, mechanoreceptors, nocireceptors, proprioreceptors)		**16**:547c–f / **12**:988c–d / **14**:359b–d / **16**:545h–546g / **18**:328d–329a	**4**:176a–b
c. Features common to all sense organs		**16**:547e–548a / **15**:160a–161a / **16**:547a–c	**8**:1147e–1148c / **11**:736c–e / **18**:422c–423c *passim*
d. The physiology of the human senses [see 422.K.]			
e. Disturbances of the senses [see 424.M.]			
2. Vision	EYE AND VISION, HUMAN **7**:97–116		**7**:117b–125a *passim* / **12**:1018d–1019g *passim* / **14**:354c–355e / **15**:160g–161a / **17**:378h–379e
a. Processes preliminary to vision: the work of the protective mechanisms, the motor apparatus, and the optical lens system		**7**:97d–101e	

	articles	article sections	other references
b. The work of the retina		**7**:101f–110a	
i. Optical principles involved in the formation of the retinal image: threshold stimulus; chromatic threshold; adaptation to light and dark		**7**:101f–102e	**8**:1147h–1148a / **14**:360h–365f *passim*
ii. Processes leading to the conversion of the retinal image to a set of messages in the brain: synaptic organization; stimulus-response variations; inhibition; flicker; visual acuity		**7**:102f–105d / **9**:241d–242f	**8**:1138g–h / **14**:45g–h
iii. Electrophysiology of the retina: the mechanisms of the central nervous system as they apply to vision; the discrimination of colour and form; the photochemical process		**7**:105d–110a	
c. The transduction process: the conversion of the retinal image into a set of messages in the brain		**7**:110b–111h	**17**:379d–e
i. Elements and processes of the visual pathway		**7**:110b–111e	
ii. Integration of the retinal halves producing binocular vision		**7**:111e–h	
d. Perceptual processes of vision		**7**:112a–116a	**17**:379b–e
i. Projection of the retina into space: perceiving the relative positions of objects		**7**:112a–f / **14**:45b–46a	
ii. Visual estimates: directions of lines and comparison of lengths		**7**:112f–113b	
iii. The function of monocular cues in producing the three-dimensional character of vision		**7**:113b–115e	**17**:379g–380d
iv. The phenomena of retinal rivalry: competition of the retinal fields for attention; ocular dominance		**7**:115e–116a	
e. Responses of the cerebral cortex to visual stimuli		**7**:116b–g	
3. Audition	EAR AND HEARING, HUMAN **5**:1125–1131	**1**:56b–57d / **17**:19b–f / **17**:48g–49d	**5**:1132e–1133e *passim* / **9**:241b–d / **12**:1020b–c / **15**:160c–f
a. The mechanisms of the external, middle, and inner ear: functions and processes involved in the transmission of sound and its conversion into neural messages		**5**:1125c–1127e / **5**:1120c–e	
i. Transmission to the inner ear: the funnelling of sound waves by the external and middle ear; direct bone conduction of mechanical vibrations		**5**:1125c–1126g	
ii. The transduction processes of the inner ear: the role of the cochlea in analyzing complex sounds into their component frequencies; the conversion of mechanical vibrations into nerve impulses		**5**:1126g–1127e	
b. The work of the auditory nerve and the auditory pathways of the central nervous system: encoding, processing, and discrimination of pitch, loudness, localization, and duration of sound		**5**:1127e–1128e / **17**:30g–31e / **17**:35c–39a	
c. The measurement of auditory phenomena: diagnosis and correction of hearing disorders		**5**:1128f–1130b	
d. The function of the semicircular canals in maintaining equilibrium: the vestibular systems [see C.6., below]			
4. Cutaneous senses: the punctate nature and discriminatory capacity of skin to respond to pressure, pain, heat, and cold		**16**:548g–550e / **11**:802e–803a	**9**:242h–243a
a. The variety of nerve terminals exhibiting a broad range of sensitivity to different stimuli		**16**:548g–549e	**13**:865f–866h *passim*
b. Localization of skin sensations: the nature of dermatomes		**16**:549e–h	
c. The concept of adequate stimulation and paradoxical cold: adaptation to pressure and thermal situations; itch, tickle, and vibration		**16**:549h–550e	**9**:9d–e
d. The sensory experience of pain: its cause and function; external signs and qualities; theories of pain; modes of treatment	PAIN, THEORIES OF **13**:865–867	**16**:550c–d / **8**:684g–685b / **12**:1046d–h	**5**:685f–686d / **5**:1045d–g / **10**:758d–e / **12**:1015d–1016a
5. Kinesthesis: the function and types of sensory structures and the role of kinesthetic feedback in movement control and orientation		**16**:550f–551d / **10**:751e–h / **11**:805b–h	**16**:544d–g / **17**:379f–g

	articles	article sections	other references
6. Vestibular senses: the role of the vestibular receptors and the semicircular canals of the inner ear in maintaining equilibrium		**16**:551d–h / **5**:1130b–1131b / **12**:555e–f	**5**:1132g–1133a / **11**:806c–809b *passim* / **12**:1019h–1020b / **14**:46c–e
7. The taste sense: the form and location of taste buds; the neural pathways; types of taste receptors; factors affecting taste		**16**:551h–553f / **4**:187c–e	**8**:1147e–f
8. The olfactory sense: the form, location, and nerve supply of olfactory receptors; olfactory qualities; odour-inducing factors; factors affecting odour sensitivity; effects on behaviour		**16**:553g–555d / **4**:187f–188c / **12**:1018c	
D. Perception: the process of translating sensory stimulation into organized experience	PERCEPTION **14**:38–44		**15**:160g–161a / **17**:380d–h
1. Contemporary theories and new concerns: the influence of Gestalt and behaviourist theories		**14**:38f–39e / **10**:755e–756c	**10**:747c–748g *passim*
2. Central problems of continuing concern		**14**:39e–42a / **6**:766g–767b / **12**:21f–22d / **12**:224e–229c	**6**:927b–943h *passim*
a. The distinction between sensing and perceiving: the question of the nature of a percept		**14**:39e–h	**1**:803b–806b *passim* / **6**:769a–g
b. Temporal relations: the question of time length in the development of percepts		**14**:39h–40f / **18**:421g–423c	
c. Perceptual organization: the question of perception as a product of learned behaviour versus the view of perception as physiologically inherent in brain functioning		**14**:40g–42a / **10**:746h–747c / **15**:148d–g / **15**:161h–162h	**13**:1100e–f / **15**:528a
3. Principles of perceptual organization		**14**:42a–44b / **9**:243a–e / **10**:747c–748d	
a. The Gestalt principle of *Prägnanz*, or good form, and the laws of grouping under it: closure, good continuation, similarity, proximity, and common fate; the significance of the phi phenomenon		**14**:42a–43a	
b. Context effects: the influence of surrounding stimuli and of previously experienced stimuli on the observer		**14**:43a–g / **10**:748e–g	
c. Perceptual constancy: the tendency of objects to appear stable in size, shape, brightness, or colour despite changing conditions of stimulation		**14**:43h–44b / **10**:747g–748d	**17**:380h–381a
4. Differences in perceptual functioning among individuals, among classes of individuals, and within individuals		**14**:44b–h / **2**:355f–356a	
a. External determinants: age, sex, and culture		**14**:44b–f	
b. Internal determinants: expectancies, needs, values, motives, and conflicts		**14**:44f–h / **2**:361a–f / **12**:563d–564c	**14**:123c–e / **15**:42a–e
E. The perception of time	TIME PERCEPTION **18**:421–424	**14**:39h–40f / **18**:410d–411a / **18**:420a–g	
1. Sequential activities related to time perception		**18**:421g–422c / **14**:39h–40f	
a. Adaptation to successive events: conditioning		**18**:421g–422a	
b. Adaptation to periodic change: rhythmic activity		**18**:422a–c / **14**:70f–74d	**16**:877f–878a
2. Perception of sequence and duration		**18**:422c–423c	
a. The psychological present: a perceptual unity		**18**:422c–e	
b. Perception of sequence: minimum and maximum intervals		**18**:422e–h	
c. Perception of duration: empty and full intervals		**18**:422h–423c / **14**:71e–72a	
3. Factors affecting time perception; *e.g.*, type of activity, level of motivation, personality traits, drugs, sensory deprivation, hypnosis		**18**:423d–424a / **14**:71e–72a / **14**:74d–75a	

F. The perception of space

1. The nature of space perception: man's orientation to his environment
2. Perception of depth and distance: gross tactual-kinesthetic, eye muscle, visual, and auditory cues
3. Interrelations among the senses
   a. Perceptual constancies: "corrections to conform to reality"
   b. Path recognition: navigation in space
4. Social and interpersonal aspects of space perception: territorial behaviour, reason in perception, and nativistic and empiricistic considerations

G. The perception of movement

1. Visual cues for perceiving self-motion and motion of objects
   a. The role of eye movements: saccadic and pursuit movements
   b. Special visual phenomena in motion perception; *e.g.*, relative movement, movement aftereffect, flicker-fusion frequency, stroboscopic effect, movement in depth
2. Nonvisual cues: auditory, kinesthetic, and vestibular cues

H. Perceptual illusions and hallucinations

1. Types of illusory experience
   a. Stimulus-distortion illusions
   b. Perceiver-distortion illusions
   c. Successive contrast illusions: the influence of a "fading trace" on subsequent perceptions
   d. Tactual illusions
   e. Anchor effect: perceptual thresholds and colour, weight, olfactory, and loudness illusions
   f. Intersensory effects: synesthesia; intersensory rivalry and facilitation
   g. Illusions of psychiatric significance
2. Hallucinations
   a. Neurological factors in hallucinations
   b. Types of hallucinatory experience
      i. Direct brain stimulation
      ii. Hallucinations associated with sleep and dreaming
      iii. Excessive excitation, sensory deprivation, and loss of sleep
      iv. Hypnotic states
      v. Sensory defects
      vi. Psychological factors: various "mental sets" conducive to hallucination
      vii. Chemical factors: effects of taking drugs

articles	article sections	other references
SPACE PERCEPTION **17**:378–381		
	17:378a–379e	**9**:242e–f
	17:379f–380d / **7**:112a–116a	**10**:747h–748c / **14**:41c–d
	17:380d–381d	
	17:380h–381a / **14**:43h–44b	
	17:381b–d / **7**:112a–113b	
	17:381d–f / **14**:44b–h	
PERCEPTION OF MOVEMENT **14**:45–46		**14**:42g–43a
	14:45b–46a	**17**:381b–d
	14:45c–e / **7**:98c–100b	**5**:1130g–1131b
	14:45f–46a	**7**:100b–116a *passim* / **14**:41f–42a / **17**:379g–380d
	14:46b–e	**16**:550f–551h *passim* / **17**:379f–381e
ILLUSIONS AND HALLUCINATIONS **9**:240–247		**5**:919f–g
	9:240h–244a / **14**:43a–g	**17**:378h–379b
	9:241b–e / **10**:748e–g	**11**:889h–890d
	9:241e–242f / **10**:747g–748d	**7**:112a–116a *passim* / **18**:423e–424a
	9:242f–g	
	9:242h–243a	**16**:549h–550b
	9:243a–e	
	9:243e–g	
	9:243g–244a	
	9:244a–247c	**18**:854e–g
	9:244c–245b	
	9:245b–247c	
	9:245b–c	
	9:245c–g / **16**:881h–882c	**5**:1010h–1014c *passim* / **16**:879g–880a
	9:245g–246b	**16**:880e–h
	9:246b–d	**9**:136b–137f *passim*
	9:246d–e	**16**:881e–f
	9:246e–g	**4**:548g–549b / **16**:882d–e
	9:246g–247c / **5**:1055e–1056e / **14**:200a–g / **16**:882e–g	**8**:557g–559a *passim*

I. Theories of parapsychological phenomena

articles	article sections	other references
PARAPSYCHOLOGICAL PHENOMENA, THEORIES OF **13**:1002–1004		
1. Extrasensory perception: telepathy, clairvoyance, precognition, and prophecy	**13**:1002c–1003d / **5**:916c–920a / **5**:1011c–e / **12**:786g–787c / **15**:62a–63a	**17**:511f–513e *passim*
2. Parapsychological phenomena of a nonperceptual nature: psychokinesis	**13**:1003d–1004b	**16**:640c–d
3. Theories of perceptual and of nonperceptual parapsychological phenomena: physical theories, field theories, and theories of the collective unconscious; projection hypothesis	**13**:1004b–g	

Section 434. Current internal states affecting a person's behaviour and conscious experience

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 434 deal with four main subjects: A, general activation level; B, motivational states; C, emotional states; and D, transient states affecting behaviour and experience.

The outline of subject A deals first with the nature of activation level, its internal determinants, and such indices of it as muscle tension, heart rate, or reaction time. It next treats factors affecting activation level, covering physiological factors such as hormonal condition; the action of drugs; departures from homeostasis; cyclical variations in activity level with the times of the day, months, and seasons; the causes of individual and group differences in level of activity; and the influence of social factors, such as those that arise from competitive conditions or from the degree of involvement in a pursuit of goals. Finally, it treats manifestations of activation level, as in sensory acuity and selectivity, or as in resistance to fatigue or in quality of performance.

Subject B is motivational states—needs and desires that channel a person's behaviour and experience. The outline first deals with diverse theories of motivation, such as the psychoanalytic, the incentive, and the hedonic. It then treats specific human needs and motives, covering such subjects as achievement, anxiety, aggression, and sexual motivation. It next treats situational and interactional factors that affect the strength and the effects of motivation. Finally, it deals with recent developments in and practical applications of motivation theory.

Subject C is emotional states—bodily conditions and feelings accompanying motivation and arousal conditions. The outline begins with problems about the many meanings of the term emotion and about the several approaches to the study of emotion. It then deals with diverse conceptions of emotion and with the facial, vocal, and postural manifestations of emotions.

Subject D encompasses several different transient states that affect behaviour and experience. The outline first deals with sleep, treating the nature and developmental patterns of sleep; psychophysiological variations in sleep; the effects of general and selective sleep deprivation; and the pathology of sleep. It goes on to diverse views of the nature of dreams and to methods of studying dreams and the activities that occur during dreams. It next deals with hypnosis, covering modern theories of hypnosis, the factors involved in hypnosis, and the evaluation of the applications of hypnosis. It goes on to the nature of fatigue and the environmental and personal factors leading to fatigue. Finally, it treats transient states caused by altered body chemistry—those resulting from nutritional deficiencies; from diseases, illnesses, and impairments; from biochemical imbalances; from intoxication; from respiratory alterations; and from drugs.

A. General activation level

articles	article sections	other references
1. Nature of activation level		
a. Internal determinants of responsiveness; *e.g.*, physical condition, genetic makeup, reflex activity of the central nervous system	**9**:244c–245b / **12**:991f–992a / **12**:1025h–1026h / **16**:595g–h	**6**:758e–760b *passim* / **6**:761e–766f *passim* / **9**:536g–h
b. Indices of activation level; *e.g.*, muscle tension, skin potential, heart rate, reaction time	**6**:759e–760b	**16**:878c–880a *passim*
c. Concepts related to the concept of activation level; *e.g.*, adaptation level, exploratory behaviour, refractory phase	**7**:188h–190b / **15**:159c–160a / **15**:161a–h	
2. Factors affecting activation level		
a. Physiological factors; *e.g.*, brain activity, hormonal condition	**1**:439b–440d / **2**:356b–358b / **6**:799f–802e / **7**:191f–192b / **9**:244c–245b / **12**:1035f–1036b / **12**:560c–561a / **15**:143g–145b	**4**:223g–227h *passim* / **9**:535f–537e *passim* / **12**:992a–c

	articles	article sections	other references
b. Drugs; *e.g.*, tranquillizers, stimulants, hallucinogens		**5**:1052f–1059c/ **5**:1044g–1046e/ **9**:246g–247c/ **12**:1035a–e/ **14**:200a–201e/ **15**:142g–143g/ **16**:882e–g/ **18**:282f–286a/ **18**:595g–596f	**1**:717g–719d *passim*/ **5**:392b–c/**8**:557g–559a *passim*/**12**:992c–e/ **16**:456e–457a/**17**:692e–695b *passim*
c. Departures from homeostasis; *e.g.*, food deprivation, fear, sexual tension		**4**:227a–h/ **6**:763d–766f/ **7**:190c–f/ **12**:559c–560b/ **16**:597f–598h/ **16**:880b–881c	**1**:295h–299c *passim*/ **5**:528h–529b/**8**:1015e–1017a *passim*
d. Cyclical factors: daily, monthly, seasonal, annual, and other cyclic variations in activity level		**6**:803e–805a/ **16**:877f–878b/ **18**:422a–c	**14**:69e–75a *passim*/ **12**:559e–g
e. Individual and group differences in level of activity			
i. Cultural and national differences in general activation level		**2**:355f–356a	**15**:350g–351c
ii. Demographic differences: age, sex, ethnic background, and economic class		**16**:877f–878b	**14**:125e–f
iii. Physiological, personality, and ability correlates of general activity level		**4**:219b–h/ **9**:246e–g/ **15**:161a–h	**2**:355h–356a/**14**:125f–h/ **16**:961h–962h
f. Social factors			
i. Social facilitation: contagion			**2**:355g–h/**9**:135b–c/ **16**:961h–962d
ii. Competition, stress, and frustration		**1**:297b–298a	**7**:190f–191e *passim*
iii. Involvement, goal directedness, and level of aspiration		**2**:15c–h/ **12**:561a–d	**12**:562a–e/**14**:126c–d/ **15**:355g–h
3. Manifestations of activity level; *e.g.*, sensory acuity and selectivity, reaction time, quality of performance		**2**:354h–355f/ **16**:543f–544c	
B. Motivational states: needs and desires that channel a person's behaviour and experience	MOTIVATION **12**:556–565		**15**:149c–d/**15**:161a–e
1. Historical overview		**12**:557a–g/ **17**:778a–779c	
2. Diverse theories of motivation: psychoanalytic, drive, arousal, incentive, and hedonic theories		**12**:557g–561f/ **8**:1142d–1143h/ **9**:503f–505c/ **10**:758a–b/ **15**:161a–h	**6**:760f–766f *passim*/ **14**:123c–e
3. Specific human needs and motives *with special attention to*		**12**:562a–563a	
a. Achievement		**12**:562b–e	**8**:1143e–g
b. Anxiety		**12**:562e–g	**8**:1139g–1140c/**8**:1142g–1143b
c. Aggression		**12**:562g–563a/ **19**:544b–e	**1**:295h–299c *passim*/ **5**:266f–267c/**6**:763f–g/ **8**:1143b–e
d. Sexual behaviour			
i. Normal sexual behaviour: the complex interaction of physiological, psychological, social, and cultural factors	SEXUAL BEHAVIOUR, HUMAN **16**:593–601	**10**:479c–g	**4**:523e–524c/**6**:802e–805a *passim*/**7**:156e–g/**15**:161d–e/ **17**:1039h–1040a
ii. Sexual deviations	SEXUAL DEVIATIONS **16**:601–610	**10**:479g–480g/ **10**:481c–d/ **13**:867f–g	
4. Situational and interactional factors: stresses in stimulus field, cognitive evaluation, balance and congruity, and cognitive dissonance		**12**:563d–564c/ **2**:361g–362c/ **4**:851c–e/ **17**:780f–781b	**4**:1010b–c/**7**:190c–191e *passim*/**14**:125c–e/**15**:42a–f
5. Recent developments and practical applications of motivation theory: emphasis on reinforcement and instinct; the use of token systems		**12**:564c–565c/ **17**:781c–e	
C. Emotional states: bodily conditions and feelings accompanying motivation and arousal conditions	EMOTION **6**:757–766		**4**:1008g–h

	articles	article sections	other references
1. The nature of emotion		**6**:757c–f	
2. Diverse conceptions of emotion: the roles of the nervous system		**6**:757f–760e	
a. Emotions as conscious feeling states: analysis of introspective reports		**6**:757f–h	**12**:228c–h / **12**:562e–563a / **13**:866h–867c *passim*
b. Emotions as remnants of previous adaptive behaviour: evolutionary conceptions of emotion		**6**:757h–758a	
c. Identifiable patterns of emotional expression: classification of emotions		**6**:758b–e / **9**:5d–f / **9**:6c–7h	**8**:1139g–1140c
d. Emotions as bodily sensations		**6**:758e–760b	
i. The role of the autonomic nervous system: visceral correlates of subjective emotional states		**6**:758g–759e / **12**:988d–h / **12**:1035f–1039g	
ii. Physiological detection of emotion; *e.g.*, galvanic skin response, respiratory signs, muscle tone		**6**:759e–760b / **12**:1038a–1039a	**9**:5e–f / **12**:988f–g
e. Instinct theories of emotion		**6**:760b–d	**15**:161a–c
f. The behavioral approach to the study of emotions		**6**:760d–e / **15**:148d–g	
g. The role of the central nervous system: integration of subjective and expressed emotions		**6**:761e–762f	
h. Activation theory: the integrative role of the midbrain		**6**:762f–763d / **9**:244c–245b	
i. Regulatory theory: emotion as related to homeostatic mechanisms of the hypothalamus, the limbic system, and the frontal lobes		**6**:763d–766f / **6**:810g–811f	**15**:144e–145b / **15**:161c–h
3. Expression of emotions: the startle response; facial, vocal, and postural manifestations		**1**:59f–62a	**2**:542c–d / **9**:5d–7h *passim* / **15**:161e–h
D. Transient states affecting behaviour and experience			
1. Sleep	SLEEP **16**:876–883		
a. The nature of sleep: problems in defining sleep		**16**:876h–877e	**6**:762g–763a *passim*
b. Developmental patterns of sleep and wakefulness: age-related changes in sleep		**16**:877f–878b	**14**:74e–75a
c. Psychophysiological variations in sleep; *e.g.*, rapid and nonrapid eye movement, light and deep sleep patterns, dreaming		**16**:878c–880a / **5**:1012c–1014c / **9**:244h–245b / **9**:245c–g	
d. Effects of general and selective sleep deprivation		**16**:880b–881c / **9**:245h–246b	
e. Pathology of sleep: various disturbances related to or accentuated during sleep		**16**:881c–882e	**5**:1013f–1014b / **16**:593h–594a / **18**:357h–358c
f. Drugs and sleep: the effect of hypnotics, caffeine, and alcohol on sleep patterns		**16**:882e–g / **5**:1057b–d	**16**:456e–457b
g. Theories of sleep: diverse views concerning the role of the central nervous system and other peripheral factors; the question of neural centres regulating sleep and wakefulness; the question of whether sleep is an active or a passive state; the role of sleep in recuperation and adaptation		**16**:882h–883h	
2. Dreams	DREAMS **5**:1010–1014		
a. Diverse views of the nature of dreams; *e.g.*, dreams as a source of divination, as a curative, as extensions of the waking state, as reflections of the unconscious		**5**:1010h–1012c / **18**:357h–358c	**15**:62a–c / **15**:596f–g
b. Methods of studying dreams		**5**:1012c–1013f	
i. Dream reports		**5**:1012c–g	
ii. Physiological dream research		**5**:1012g–1013f	**16**:878c–880a *passim*
c. Dreamlike activities; *e.g.*, nightmares, sleepwalking, effects of drugs		**5**:1013f–1014c / **9**:245d–g / **14**:200a–201e / **16**:881c–882g	**16**:456f–g
3. Hypnosis and related states of altered consciousness	HYPNOSIS **9**:133–140		

	articles	article sections	other references
a. The nature of hypnosis and induced suggestibility: historical development of the concept and modern theories		**9**:133f–135c	**15**:155e–f
b. Factors involved in hypnosis		**9**:135c–139a	
i. Techniques and aids used by the hypnotist		**9**:135c–136b / **14**:123h–124d	
ii. Hypnotic and posthypnotic phenomena; *e.g.*, perceptual distortions, alterations of memory, posthypnotic amnesia, physiological alterations, posthypnotic suggestions		**9**:136b–137f / **9**:246b–d	
iii. Limitations and potentialities of the subject; *e.g.*, hypnotizability		**9**:137g–139a / **14**:125e–h	
c. Uses of hypnosis		**9**:139a–140a	
i. Medical and psychotherapeutic applications		**9**:139a–d	**13**:867d–e / **15**:148e–g
ii. Nonmedical applications: the question of training and qualifications of the hypnotist		**9**:139e–f	
iii. The effectiveness of hypnosis as a method of interrogation and as a means of augmenting performance: the possibility of inducing a subject to perform antisocial acts under hypnosis		**9**:139g–h	
4. Fatigue	FATIGUE **7**:188–193		
a. The nature of fatigue: transient impairment and psychological fatigue		**7**:188h–190b	
b. Environmental factors leading to fatigue: physiologically limiting conditions; occupational demands		**7**:190c–191e / **15**:775e–776b	
c. Personal factors leading to fatigue: state of health; psychiatric factors		**7**:191f–193a	
5. Transient states caused by altered body chemistry			
a. Altered nutrition; *e.g.*, avitaminosis, protein deficiency, starvation		**5**:860e–861a	**13**:408a–412e *passim* / **13**:417b–420d *passim*
b. Diseases, illness, and impairments: immediate and long-range effects		**1**:440d–441b / **5**:846h–847g / **7**:55c–59b / **8**:1016g–1017a / **9**:530g–532a / **15**:770c–778b	**9**:548a–559a *passim* / **10**:1271g–1272a / **11**:1049a–1060h *passim* / **14**:606g–h
c. Biochemical imbalances; *e.g.*, hormonal, enzymatic		**5**:859g–860d / **9**:246g–247c	**6**:802e–817g *passim* / **7**:190d–f / **8**:1015e–f
d. Intoxication: physiological and psychological effects	ALCOHOL CONSUMPTION **1**:437–441	**15**:178e–f	**5**:851d–852d / **10**:1273d–f
e. Respiratory alterations; *e.g.*, gases, hyperventilation, oxygen deficiency		**9**:530g–531c / **15**:745g–747d	**5**:857g–858a / **7**:190a–b / **15**:767b–770b *passim*
f. Drug-induced states		**5**:1049f–1051e	**1**:718a–719d *passim* / **5**:852d–g / **5**:1055e–1059c *passim* / **12**:788b–c / **12**:992c–e

Section 435. Persisting capacities that integrate human behaviour and conscious experience

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 435 deal with five main subjects. Subjects A and B involve general treatments of the nature of human capacities and of the assessment of human abilities. Separate treatment is given to C, sensorimotor abilities, and D, intellectual abilities. Subject E is the distribution of intelligence.

The outline of subject A treats the distinction between native abilities and acquired skills, the general determinants of human ability, and the modifiability of innate potentials.

The outline of subject B treats general problems concerning psychological measurement; the many types of instruments and methods; the development of standardized tests; and the methods used for the assessment of test results.

Subject C is sensorimotor abilities—bodily skills and mechanical abilities. The outline begins with the range and variety of sensorimotor skills and with the complex set of relationships denoted by the term sensorimotor skill. It then treats the simple components of bodily skills; factors that influence the integration of sensorimotor components; and factors that influence the retention of motor skills.

Subject D is intellectual abilities. The outline first deals with diverse definitions of intelligence—biological, psychological, and operational. It next deals with empirical studies of the organization or structure of human abilities, treating, in this connection, controversies about the concept of general intelligence, of primary abilities, and of intelligence as multidimensional. The outline goes on to the percentages of human variation in measured intelligence ascribable to genetic differences and to environmental factors, and to issues about the correlation of intelligence levels with socioeconomic classes. After dealing with the devel-

opment, stages, and decline of intellectual growth, the outline concludes with the influence of computer performances on current theorizing about the nature of human intelligence.

Subject E is the distribution of intelligence. The outline first deals with the statistical characteristics of a theoretical normal distribution, which involves dense clustering around a mean on a Gaussian curve, and with the factors that cause deviations from this normal curve. It next deals with the extremes of mental retardation and superior endowment, treating in each case the different levels of retardation and superior endowment, and their prevalence; their causes; the social adjustments that the retarded and the gifted make; and the special programs devised for them. Finally, the outline deals with group differences in intelligence, treating the measurement and interpretation of differences in intelligence ascribable to age, socioeconomic class, race, occupation, and sex.

A. The nature of human capacities

1. Potentialities, abilities, and aptitudes as distinguished from acquired skills, achievements, learned performance, and knowledge
2. General determinants of human ability: the question of the relative weights of genetic endowment and environmental influences and opportunities
3. The modifiability of innate potentials
[see 436.A.]

B. The assessment of human abilities

1. General problems of psychological measurement; *e.g.*, measurement scales, validity, reliability, scoring, response sets
2. Types of instruments and methods; *e.g.*, psychophysical tests, psychometric tests, written group tests, oral individual tests, self-appraisal, appraisal by others, sociodrama, psychodrama
3. Development of standardized tests: item development and analysis, cross validation, differential weighting, and identification of norms
4. Assessment of test results: factor analysis and its alternatives; profile analysis

C. Sensorimotor abilities: bodily skills and mechanical abilities

1. The range and variety of sensorimotor skills: the complex set of relationships denoted by the term sensorimotor skill
2. Simple components of bodily skills: sensory and motor aspects; *e.g.*, stimulus duration and intensity, reaction time, movement speed, fine and gross motor skills
3. Factors influencing the integration of sensorimotor components; *e.g.*, the quality and quantity of feedback, the duration and placement of instruction and practice
4. Factors influencing the retention of motor skills; *e.g.*, the amount of rhythm involved in the task, the quality of training, incentive conditions

D. Intellectual abilities

1. Diverse definitions and conceptions of intelligence: biological, psychological, and operational definitions
2. Structural theories of intelligence: the controversy about the concepts of general intelligence, specialized abilities, and primary abilities; intelligence as multidimensional; research on creativity
3. The percentages of human variation in measured intelligence ascribable to genetic differences and to environmental factors; issues about their interpretation; correlation of intelligence levels with socio-economic classes; issues about "culture-fair" cognitive tests
4. Development, decline, and stages of intellectual growth: Piaget's overall picture of human cognitive development up to adolescence

articles	article sections	other references
	6:409b–d / **9**:677h–678c	**8**:1148d–1149b / **16**:955a–c
	6:1025c–e	**8**:1148d–1149a / **9**:673c–d / **16**:544a–c
MEASUREMENT, PSYCHOLOGICAL **11**:734–739	**16**:545d–f	
	11:735b–736c / **14**:108a–e / **14**:113d–114d	**11**:743c–e
	11:736c–738a / **14**:108f–113c	
	11:738b–739a / **16**:545e–f	
	11:739a–739f / **16**:545e–f	**14**:117h–118e
SENSORIMOTOR SKILLS **16**:543–545		
	16:543c–e	
	16:543f–544c / **14**:40g–42a / **16**:550f–551h	**16**:545g–547c *passim*
	16:544c–545c	
	16:545b–c	
INTELLIGENCE, THEORIES OF **9**:677–679		
	9:677h–678c / **12**:224e–229c	**15**:149g–h
	9:678c–f	
	9:678f–679b	**7**:1002c–1003h *passim* / **8**:1148d–1149a / **16**:955a–c
	9:679b–e / **4**:1063e–1064a / **8**:1137c–f	**6**:375b–d / **13**:548b–c

5. The influence of computers on current theories of intelligence: computers generating mathematical models of intelligence, simulating complex, cognitive performances, playing games, and solving logical problems
6. The measurement of intelligence
[see B., above]

E. The distribution of intelligence
[see also A.2., above]

1. Problems concerning the establishment of intelligence standards and intelligence distribution: assumptions that underlie the intelligence quotient as a measure of the representation of human abilities; distribution on a Gaussian (normal) curve; factors causing deviations from the normal curve
2. Retardation
   a. Different levels of retardation and their prevalence
   b. Causes of retardation: sociocultural and medical causes
   c. Social adjustments of the retarded; special programs for their aid
3. The gifted
   a. Different levels of superior endowment and their prevalence
   b. Social adjustment of the gifted
4. Group differences in intelligence: the measurement and interpretation of differences in age, socio-economic class, race, sex, and other factors

articles	article sections	other references
	9:679e–f/ **4**:1057b–1058b/ **12**:224g–225d	**11**:76d–e
INTELLIGENCE, DISTRIBUTION OF **9**:672–677		
	9:672h–673d	**11**:738f–739a
	9:673d–675b	
	9:673d–674a/ **6**:431e–f	**7**:1004b–e
	9:674a–g/ **2**:1073b–1074b/ **6**:823g–824d/ **12**:1044f–1045h	**5**:849d–g/**7**:1004a–1005g *passim*/**11**:1051f–1053g/ **15**:162h–163b
	9:674g–675b/ **6**:434a–e	
	9:675c–676c	
	9:675c–h/ **11**:890f–891a	
	9:675h–676c	
	9:676c–677f/ **9**:678f–679d	**6**:1025e–h/**8**:1150b–d/ **13**:548b–c/**15**:355g–h/ **16**:955a–c/**19**:908a–c

Section 436. Development of a person's potentials: learning and thinking

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 436 deal with six main subjects. Subject A is diverse theories of human learning. Subjects B, C, and D are, respectively, psychomotor, perceptual, and conceptual learning. Subject E is memory—the retention and the forgetting of what has been learned. Subject F is the higher thought processes.

The outline of subject A begins with problems about the definition of learning, given the range of phenomena called learning. In dealing with the state of learning theories, the outline treats various attempts at comprehensive theories of learning and behavioral theories of learning, such as attempts to discuss the conditions that produce and control behaviour. The outline goes on to major issues in learning theory, covering association and anti-association theories; differences about the role of motivation in learning; the question of whether a basic process underlies the varieties of learning; questions about the stages of learning; the role of memory in learning; and current trends in learning theory. Finally, the outline of A deals with questions about the transfer of training—the positive or negative, the facilitative or impairing, influence of training in one activity on the execution of another activity. It treats the applications in educational practice of assertions and denials that transfer is general and comprehensive. It covers experimental and physiological analyses in connection with issues about the transfer of training.

The outline of subject B first deals with the devices, tasks, and measurements used in laboratory research on human psychomotor learning. It goes on to the phenomena of psychomotor learning. The outline next deals with factors that affect psychomotor learning, such as the complexity of the task, the amount of relevant feedback received in the learning process, the effects of a proportioning of work and rest, the motive and incentive conditions, and the environmental conditions for practice and performance. Finally, the outline treats group differences in psychomotor learning and performing, based on such variables as age, sex, race, and intelligence quotient.

The outline of subject C treats the forms of perceptual learning; the factors influencing perceptual learning; and the adaptation in perceptual learning that results from exposure to contradictory sensory data.

The outline of subject D first treats the nature of concept formation; the factors that influence conceptual learning; and conceptual behaviour at various stages of human development. It then deals with language in relation to concept formation, and with the moot question of concept formation in nonhuman animals and in machines.

Subject E is the retention and forgetting of learned habits and content. The outline treats the adaptive role of remembering and forgetting; the experimental measurement of retention factors; time-dependent aspects of retention; theories of forgetting; correlates of the rate of forgetting; and such abnormalities of memory as amnesia, paramnesia, and hypermnesia.

The outline of subject F, the higher thought processes, begins with the range of psychological activities involved in thinking and with diverse definitions of thinking. It goes on to diverse theories about the roles of the several elements of thinking and to diverse theories concerning the sequence of thought processes. It next treats the motivational aspects of thinking. Finally, it deals with the types of thinking—convergent thinking, problem solving, and divergent thinking—as types of realistic thought determined by goal-directed activities; and with free association, fantasy, dreaming, and pathological thinking as types of autistic thinking, determined by subjective emotional—motivational impulses. The role of language in the higher thought processes is covered in Section 442.

	articles	article sections	other references
A. Diverse theories of human learning	LEARNING THEORIES **10**:754–759	**6**:408f–409f / **13**:1099g–1101g	
1. Definitions of learning: the range of phenomena included in learning		**10**:754f–755e / **2**:810e–811h / **6**:408g–409f / **10**:749f–751d / **15**:161h–162h / **16**:543c–e	**10**:731a–739d *passim* / **15**:149f–g / **18**:355a–357c *passim*
2. Modern learning theories		**10**:755e–756c / **10**:737c–738c	**14**:992b–c
a. Comprehensive theories of learning: learning viewed as continuous or discontinuous; as a gradual or a one-trial process; as having a relationship to stimulus-response connections, to perceptual understanding, and to reinforcement		**10**:755e–g	
b. Behavioral theories of learning: attempts to discover the conditions that produce and control behaviour; the search for intervening variables and hypothetical constructs to describe the development of learning		**10**:755g–756c	
3. Major issues in learning theories		**10**:756c–759f	
a. Association theories: efforts to determine the synthesizing principles of laws of learning		**10**:756c–757d / **6**:408g–h	**6**:375d–e / **10**:732c–736h *passim* / **13**:1100e–f / **18**:353b–e
b. Anti-association positions: perceptual ability as an organizing principle; the error-factor theory		**10**:757d–h / **13**:1101d–g	**13**:1101a–c
c. The role of motivation in learning, practice, and performance		**10**:758a–b / **6**:408h–409b / **10**:737f–738b	**12**:564g–565c
d. The question of whether a basic process underlies the varieties of learning		**10**:758b–d / **6**:409d–e	**4**:1063a–d
e. The question of stages of learning: the implications of classical conditioning and verbal learning studies		**10**:758d–g / **8**:1137c–f	**13**:1101c–d
f. Remembering and forgetting: the role of memory in learning; the process of information retrieval; the function of proactive and retroactive inhibition in forgetting [see also E., below]		**10**:758g–759c / **10**:738d–739d / **11**:888c–889a / **11**:893c–894h	**1**:439f–g / **15**:162c–f
g. Current trends in learning theory: renewed interest in the study of inherited behaviour; the use of introspective data; the study of individual differences		**10**:759c–f / **6**:409e–f / **13**:1100g–1101a	
4. Transfer of training	TRANSFER OF TRAINING **18**:596–600		
a. Positive, negative, and zero transfer: the influence the learning of one skill has on the learning or performance of another		**18**:596g–597b	
b. Applications to educational practices: formal discipline training and the transfer of logical effectiveness; the role of general principles and identical task elements in the positive transfer of training		**18**:597c–f	**13**:1100b–c
c. Experimental analysis of factors that influence the degree and direction of training: stimulus and response similarity, task similarity, stimulus predifferentiation, transposition, learning to learn, and reversal learning		**18**:597f–599e	**11**:893d–894c
d. Developmental processes related to transfer: age differences in solving reversal-shift problems		**18**:599e–600a	
e. The physiological basis of transfer: cross education and its implications for discovering the neurophysiological foundations of learning		**18**:600a–f	
B. Psychomotor learning [see also 342.B.]	LEARNING, PSYCHOMOTOR **10**:748–754	**16**:544c–545f	
1. Laboratory research in psychomotor learning: devices and tasks that measure skilled behaviour; the validity of psychomotor measurement		**10**:749c–f / **18**:421g–422a	**10**:756c–759f *passim*

2. Phenomena of psychomotor learning; *e.g.*, the rate of skill acquisition, the operation of generalization and transfer, the degree of retention, differences in performance with or without practice, reaction time
3. Factors affecting improvements in psychomotor skills: practice, feedback, task complexity, work and rest distribution, motive-incentive conditions, environmental situations, and inhibitory factors
4. Group differences in psychomotor performance and learning; *e.g.*, age, sex, race, personal characteristics, intelligence

C. Perceptual learning
[see also 342.B.]

1. The process of perceptual learning: diverse definitions and theories
2. Factors influencing perceptual learning: practice; assumptions concerning the environment and sensory experience
3. Adaptation: perceptual learning that results from exposure to contradictory sensory data

D. Conceptual learning

1. The nature of concept formation
2. Factors influencing conceptual learning: memory, degree of abstraction, the number and types of concepts to be identified, and the nature of the learning task
3. Conceptual behaviour: stages of development in the young; the influence of instruction; concept formation in adults
4. Language in relation to concept formation
5. Concept formation in nonhuman animals and in machines

E. Retention and forgetting of learned habits and content

1. The adaptive role of remembering and forgetting
2. The experimental measurement of retention factors: recall, recognition, and learning
3. Time-dependent aspects of retention: factors involved in storage and retrieval of information; *e.g.*, short-term and long-term memory, encoding and decoding variables, perceptual attributes as retrieval cues
4. Theories of forgetting: the question of the decay of memory trace in the brain; the function of retroactive and proactive inhibition as sources of interference
5. Correlates of the rate of forgetting: the effect of reminiscence and practice on the degree of learning; the effects of the use of mnemonic systems in verbal learning; the relationship of forgetting to learning ability
6. Abnormalities of memory
with special attention to
   a. Amnesia
   b. Paramnesia and confabulation: errors and illusions of memory
   c. Hypermnesia: enhancement of memory

articles	article sections	other references
	10:749f–751d	
	10:751d–752h / **10**:747c–g / **10**:756h–758b / **16**:544c–545c	**12**:564d–e
	10:753a–754d	
LEARNING, PERCEPTUAL **10**:746–748	**14**:40g–42a	**17**:901g–h / **18**:421g–423c *passim*
	10:746h–747c	
	10:747c–748d / **9**:241e–242f / **14**:281g–282c	
	10:748e–g / **9**:241b–e	**15**:160h–161a
CONCEPT FORMATION **4**:1062–1064		
	4:1062b–e / **6**:943h–944g / **18**:352b–e	**8**:1152g–1153c / **15**:162h–163b / **18**:355h–356a
	4:1062e–1063d / **10**:740d–g	
	4:1063e–1064a	
	4:1064a–c / **6**:943h–946b	**1**:800g–801c / **6**:929h–931b *passim* / **18**:352e–f
	4:1064c–f / **10**:738c / **10**:740g–h	
MEMORY: RETENTION AND FORGETTING **11**:891–894	**10**:758g–759c	
	11:891b–d	
	11:891d–892c / **10**:738d–739d	**10**:750e–g
	11:892c–893c / **10**:738d–g / **15**:162c–h	**4**:1062g–h / **8**:1141g–h / **10**:758g–759b / **15**:42a–d / **18**:600d–f
	11:893c–894c / **11**:886d–g	
	11:894c–h	**11**:886h–888c *passim* / **11**:889b–890f *passim* / **14**:126b–c
MEMORY, ABNORMALITIES OF **11**:886–891	**9**:136g–137b / **15**:168e–h	
	11:886h–889h	
	11:889h–890f	
	11:890f–891a / **11**:894e–g	

F. The higher thought processes

1. The psychology of higher thought processes

   a. The range of psychological activities involved in thinking: diverse definitions of thinking

   b. Elements of thinking: diverse views concerning the role of sensory excitation, verbal and nonverbal acts, motor responses, neuromuscular concomitants, brain activity, symbolic representation, and perceptual patterning

   c. Thought processes: diverse theories concerning the sequence of thought processes

   d. Motivational aspects of thinking: factors that govern the initiation and direction of thinking; the motivational effects of novelty, surprise, complexity, incongruity, ambiguity, and uncertainty in thought processes

2. The role of language in the higher thought processes [see 442.A.]

3. Meaning [see 442.B.4.]

4. Types of thinking

   a. Realistic thinking: types of thought determined by goal-directed activities

      i. Convergent thinking: processes that utilize a person's abilities to assemble and organize information; *e.g.*, judging, conceptualizing

      ii. Problem solving: processes utilized in exploring and organizing resources to reach a goal; *e.g.*, trial and error, insight, inductive and deductive reasoning

      iii. Divergent thinking: processes that lead to the production of new information or previously undiscovered solutions; *e.g.*, creative thinking

   b. Autistic thinking: types of thought processes determined by subjective emotional–motivational impulses

      i. Free association: verbal responses that reflect aroused emotional impulses

      ii. Fantasy: well-organized sequences of thinking in which sensory imagery prevails

      iii. Dreaming: diverse views concerning the significance of autistic thinking during sleep

      iv. Pathological thinking: general patterns or categories of thought displayed by persons with behaviour disorders, neuroses, or psychoses

articles	article sections	other references
THOUGHT PROCESSES, THEORIES OF **18**:352–354	**6**:766g–768d / **8**:1137b–f / **8**:1140c–1142d / **12**:224e–229c	**13**:1101a–c
	18:352b–e / **18**:354f–355a	
	18:352e–353b	**8**:1140e–h
	18:353b–354b / **4**:1062a–e / **8**:1140h–1142d	
	2:361a–f / **12**:225d–226f / **18**:354b–e	**8**:1142d–1143h *passim* / **12**:563g–564c
THOUGHT PROCESSES, TYPES OF **18**:354–358	**8**:1140h–1142d	**18**:353b–354b
	18:355a–357c	**1**:151h–154h *passim*
	18:355a–356a	
	18:356a–f / **11**:72h–73g	**11**:28b–29g *passim* / **15**:147c–g
	18:356f–357a	
	18:357d–358g	
	18:357d–f	
	18:357f–h	
	18:357h–358c / **5**:1012a–c / **9**:245d–g	
	18:358c–g / **9**:243g–244a / **11**:889h–890f	**9**:246e–g / **15**:173e–179b *passim*

Section 437. Persisting inclinations that guide and organize human behaviour and conscious experience

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 437 deal with three main subjects: A, personal propensities and idiosyncrasies affecting behaviour and experience; B, attitudes; and C, persuasion and change of attitude.

The outline of subject A begins with the concept of personal style, treating its essential characteristics and the influence of tastes and preferences in determining personal style. It then treats individual and group styles, and personal styles in language, expressive movement, and manner of thinking.

The outline of subject B first deals with the definition of attitudes; with concepts related to attitudes; and with the cognitive, conative, and affective components of attitudes. It goes on to the instrumental, noetic, expressive, and ego-defensive functions of attitudes. Finally, it treats the factors involved in the development of attitudes, and the methods of measuring attitudes.

The outline of subject C first deals with the relationship of persuasion to communication and social control and with the distinction between verbal communication, as cause, and associated changes in attitudes and behaviour, as effects. It goes on to diverse theories of persuasion, diverse views concerning the relation between education and persuasion, and diverse views concerning the roles of perception, of motivation, and of emo-

tion in the process of persuasion. It next treats, as the components of persuasion, such factors as source, message, channel, receiver, and destination. Finally, it deals with ways of developing resistance to persuasion.

	articles	article sections	other references
A. Personal propensities and idiosyncrasies affecting behaviour and experience			
1. The concept of personal style: its essential characteristics; the influence of tastes and preferences in determining personal style		**7**:473d–474d	**1**:150h–157h *passim* / **2**:123a–127g *passim* / **2**:360g–362c *passim*
2. Individual and group styles		**1**:63d–h / **2**:13h–14b / **9**:10a–11d / **10**:202e–h / **10**:205e–g / **15**:651b–f / **16**:790h–793g / **18**:252c–253g	**2**:127h–132c *passim* / **14**:114g–h / **14**:117g–118d *passim* / **16**:948g–950g *passim*
3. Personal styles in language, expressive movement (body language), and manner of thinking		**2**:128c–129a / **5**:452g–453e / **10**:650c–654e / **10**:1044d–f / **10**:1050g–1051g / **13**:454b–h / **14**:275d–f	**2**:44c–e / **5**:696d–701c *passim* / **18**:355d–f
B. Attitudes	ATTITUDES **2**:360–362	**9**:194b–195b / **15**:593f–594a	
1. The nature of attitudes		**2**:360b–361a	
a. Attitudes as predispositions that classify sets of objects or events with a degree of evaluative consistency		**2**:360c–e	
b. Concepts related to attitudes; *e.g.*, values, opinions, knowledge, beliefs		**2**:360e–g	
c. The cognitive, conative, and affective components of attitudes		**2**:360g–361a / **12**:231f–232d	
2. The functions of attitudes		**2**:361a–f	**15**:212a–c
a. Instrumental functions: attitudes as means to other ends		**2**:361a–b	**12**:563g–564c *passim* / **17**:445d–e
b. Noetic functions: attitudes as ways of thinking and understanding		**2**:361c	**12**:563d–564c *passim* / **18**:355a–357c *passim*
c. Expressive functions: attitudes as means for emotional release		**2**:361d–e	**12**:558d–559b *passim* / **12**:562e–563c *passim*
d. Ego-defensive functions: attitudes as symptoms of psychiatric disturbance		**2**:361e–f	**4**:1010b–c / **14**:123c–e / **15**:363g–364a / **18**:358d–g
3. The development of attitudes		**2**:361f–362c / **15**:360f–361b	**14**:123h–126g *passim*
a. The role of hereditary factors and bodily states		**2**:361f–h	
b. The effect of direct experience and communication		**2**:361h–362c / **4**:1010a–d / **8**:1143h–1145a / **9**:195h–196d / **15**:36g–38c / **15**:648a–g	**8**:1145d–g / **14**:125c–e
4. The measurement of attitudes: the use and validity of questionnaires, interviews, sampling techniques, opinionnaires, and content analysis		**2**:362c–h / **15**:214a–216e	**11**:739d–e
C. Persuasion and change of attitude	PERSUASION **14**:122–126		
1. The relationship of persuasion to communication and social control		**14**:122f–g	
2. The distinction between verbal communication as cause or stimulus and the associated changes in attitudes and behaviour as effect or response		**14**:122h–123b	
3. Theories of persuasion: diverse views concerning the similarity between education and persuasion; the role of perception in persuasion; the functions of motivation, emotion, and conflict resolution; the relationship of persuasion to information processing [see also 524.C.]		**14**:123b–f / **13**:281d–g / **15**:38c–39h	**15**:211h–213c *passim*

	articles	article sections	other references
4. Components of persuasion		**14**:123f–126c / **9**:195h–196d / **15**:39h–44f / **19**:695c–e	
a. Source factors: the influence exerted by the credibility, attractiveness, and power of the persuader		**14**:123h–124d / **1**:104c–105g / **17**:446f–447b	**9**:135c–136a / **4**:843f–844b *passim* / **16**:978a–c / **15**:40e–41a
b. Message factors: the influence exerted by the content, style, and organization of the message		**14**:124d–h / **1**:104c–107c	**3**:1083e–1090b *passim* / **4**:847b–d / **15**:41b–g
c. Channel factors: the relative efficacy of the written versus the spoken word; the effect of the media used; the degree of interpersonal contact involved		**14**:124h–125e / **1**:104c–107c / **15**:212e–g / **15**:803f–805b	**15**:37e–38c / **15**:41h–42e
d. Receiver factors: the relationship of age, intelligence, and personality to the persuadability of the receiver		**14**:125e–h / **9**:138h–139a	**4**:843c–844a *passim* / **4**:1010a–d / **15**:42e–f / **15**:212a–c
e. Destination factors: distinctions between verbalized attitude and overt behaviour changes; long-term versus short-term effects of persuasion		**14**:125h–126c	**15**:40b–c / **15**:42f–43c
5. Developing resistance to persuasion: various resistance techniques		**14**:126c–g / **15**:43e–44f	

Section 438. Personality and the self: integration and disintegration of the person as a whole

[for Part Four headnote see page 209
for Division III headnote see page 241]

The articles and parts of articles referred to in Section 438 deal with four main subjects: subjects A and B are definitions of personality and the measurement of personality; subject C is personality functioning and adjustment; and subject D is persisting disturbances of personality.

The outline of subject A deals with diverse definitions and theories of personality, the concept used in psychology to stress the integrated functioning of a person as a recognizable unity with distinctive traits, drives, attitudes, beliefs, and habits. The outline treats various physiological theories that posit types of personality; psychoanalytic theories of personality; social analytic theories; and various current theories, such as role theory and factor analytic studies.

The outline of subject B deals with the methods of assessing personality and the problems of evaluating the results of different techniques of assessment.

The outline of subject C begins with the subjective aspect of personality—the stages in the development and awareness of self. It then treats the several kinds of strains put on adequate personality functioning and the various responses to environmental strains on personality functioning.

Subject D is persisting psychiatric disturbances of personality. The outline first deals with the various kinds of functional and organic psychoses—major disturbances involving loss of self-identity or of insight regarding the disorder. It next treats the several kinds of psychoneuroses, which involve distress and loss of efficiency but not loss of self-identity or insight. The outline goes on to the prevalence of psychiatric disturbances, treating their frequency in the general population and their differential incidence in various subpopulations. Dealing with psychiatric treatment, the outline covers chemotherapeutic treatment; neurophysiological treatment; the various forms of psychodynamic therapy; and the various forms of behavioral therapy and sociotherapy. Finally, it deals with the history of the treatment of the mentally disturbed and with the organization of programs and institutions of mental health to prevent psychiatric disturbances.

	articles	article sections	other references
A. Definitions of personality	PERSONALITY, THEORIES OF **14**:114–118	**8**:1136h–1137b	**8**:1149c–h / **14**:108a–e *passim* / **15**:149h–150b / **18**:355d–f / **19**:907h–908a
1. Physiological theories of personality: theories based on body humours, somatotypes, physiognomy, and phrenology		**14**:115c–116a	**5**:365d–g / **15**:155a–b
2. Psychoanalytic theories of personality: the importance of id, ego, superego, life and death instincts, and the collective unconscious		**14**:116a–117a	**8**:1136h–1137a / **15**:41e–f / **15**:146a–g / **15**:155f–g
3. Social analytic theories of personality: the importance of drive to power, need achievement, and functional autonomy		**14**:117b–d / **2**:11f–12a	**15**:146g–147b / **19**:908f–h
4. Recent eclectic theories of personality: role theories; factor analysis of personality traits		**14**:117d–118e / **15**:157g–h / **15**:651b–f	**11**:739a–f / **19**:908f–h
B. Measurement of personality	PERSONALITY, MEASUREMENT OF **14**:108–114		
1. Methods of assessment		**14**:108f–113c / **11**:736c–738a **14**:108f–110b	
a. Personality evaluation without tests: interview, behavioral observation, rating scales, factual information			

	articles	article sections	other references
b. Personality tests	**14**:110c–113c		**14**:117g–118e *passim*
i. Personality inventories		**14**:110d–112b	**14**:117c–d
ii. Projective techniques: Rorschach Inkblot Test, Thematic Apperception Test, word-association techniques, and sentence-completion techniques		**14**:112b–113c	**14**:117b–c
2. Evaluating assessment techniques		**14**:113d–114d / **11**:739a–g	**14**:118b–e
C. Personality functioning and adjustment			
1. The subjective aspect of personality: development of awareness of self		**12**:232d–g / **19**:1091h–1092h	**3**:426c–g / **13**:550a–b / **15**:648g–649a / **16**:603b–e
a. Projections of the self on the environment		**15**:177c–e	
b. Development of conscience		**8**:1143h–1144e	
c. Loss and impairment of the self concept		**15**:176a–177a	**14**:1102a–c / **15**:167h–173a *passim*
2. Strains and challenges put on adequate personality functioning: physical, psychological, and social stresses; *e.g.*, frustration, conflict, personal inadequacy, deprivation of accustomed gratification		**4**:851c–e / **5**:268d–h / **6**:434a–e / **9**:674a–g / **13**:548e–g / **15**:163c–e / **16**:602c–f / **16**:978d–f	**1**:574h–575d / **13**:415h–416b / **14**:938g–h / **14**:1101h–1102c / **15**:166h–173c *passim*
3. Responses to environmental strains on personality functioning: reactions, defense mechanisms, and adjustment dynamisms for coping with environmental demands		**1**:575g–576c / **2**:361d–f / **5**:861e–862a / **9**:243g–244a / **9**:246e–g	**5**:269d–271c *passim* / **8**:1144c–e / **15**:167h–173a *passim* / **15**:174b–177g *passim* / **15**:212a–c / **18**:357d–358g *passim*
D. Persisting disturbances of personality integration: psychiatric disturbance			
1. The psychoses: major disorders of which the individual has no insight *with special attention to*	PSYCHOSES **15**:173–179		**16**:882d–e / **18**:358e–f
a. Schizophrenia		**15**:174b–176a	**7**:1003d–f / **8**:1149d–f / **17**:490d–e
b. Affective psychoses		**15**:176a–177a	
c. Involutional psychoses		**15**:177a–c	
d. Paranoia		**15**:177c–e	
e. Senile psychoses		**15**:177g–178a	
f. Arteriosclerotic psychoses		**15**:178b–c	**11**:887h–888b
g. General paresis		**15**:178c–d	
h. Alcoholic psychoses		**15**:178e–f	**1**:440e–441b *passim* / **11**:887d–f
i. Psychosis associated with Huntington's chorea		**15**:178f–g	**7**:1004h–1005a
j. Psychosis associated with epilepsy		**15**:178g–h	
2. The psychoneuroses: lesser disorders involving distress and loss of efficiency but not loss of self-identity or insight *with special attention to*	PSYCHONEUROSES **15**:166–173		**15**:163d–e / **18**:358d–e
a. Anxiety reactions		**15**:167h–168d	**12**:562e–g
b. Dissociative reactions: amnesia, somnambulism, depersonalization, fugue states		**15**:168e–h / **11**:886h–890f	
c. Phobic reactions		**15**:168h–169d	
d. Obsessive–compulsive reactions		**15**:169e–h	
e. Depressive reactions		**15**:169h–170c	**7**:192e–f
f. Character reactions		**15**:170c–f	
g. Fatigue reactions: neurasthenia		**15**:170f–171a	**7**:192b–h *passim*
h. Hypochondriacal reactions		**15**:171a–c	**17**:692e–695b *passim*
i. Conversion reactions: hysteria		**15**:171d–g	**11**:889c–e
j. Related disorders		**15**:171g–173a	
i. Traumatic, soterial, and military reactions		**15**:171g–172e	**7**:192c–d / **11**:887a–c

	articles	article sections	other references
ii. Transient reactions and special syndromes		**15**:172g–173a	
iii. Sexual deviations	SEXUAL DEVIATIONS **16**:601–610	**13**:867f–g	**16**:593e–g
3. Prevalence of psychiatric disturbance: epidemiology		**1**:446f–447c / **6**:431e–f / **15**:167f	**9**:673g–h / **11**:912d–e
4. Psychiatric treatment	PSYCHIATRIC TREATMENT, CONCEPTS OF **15**:141–148	**15**:155a–g / **16**:602b–c	
a. Biological approaches: transformation of the patient by direct physiological treatment		**15**:142g–145b	
i. Chemotherapeutic treatments: the use of drugs to induce physiological and emotional changes		**15**:142g–143g / **1**:447d–h / **18**:595g–596f	**16**:457b–d / **17**:692e–695b *passim*
ii. Neurophysiological treatment: techniques that induce or result in changes in the function of the nervous system and endocrine glands; *e.g.*, electroconvulsive therapy, insulin treatment, neurosurgery		**15**:143g–145b	
b. Psychotherapeutic approaches: treatment by communication with the patient		**15**:145b–148g / **1**:447h–448g	**5**:692e–g / **14**:108f–113c *passim* / **14**:1100g–h / **15**:167g–173c *passim*
i. Principles and forms of psychodynamic therapy; *e.g.*, psychoanalysis, analytic psychotherapy, individual psychotherapy, group therapy		**15**:145d–148d	
ii. Principles and forms of behavioral therapy: retraining, aversion therapy, deconditioning with hypnosis		**15**:148d–g	**1**:447f–g / **9**:139c–d
c. Sociotherapy		**8**:686g–687c	**14**:1098a–b
5. Prevention of psychiatric disturbance: mental hygiene	MENTAL HEALTH AND HYGIENE **11**:910–914		**5**:692e–g / **17**:490b–c
a. History of the treatment of the mentally disturbed		**11**:910h–912c	
b. Services for children and youth		**11**:912f–914a / **16**:928b–929b	**6**:432h–434e *passim*
c. Professionals in the field of mental health		**11**:914a–e	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ARISTOTLE **1**:1162
DESCARTES, RENÉ **5**:597
FREUD, SIGMUND **7**:738
HUME, DAVID **8**:1191
JAMES, WILLIAM **10**:27
JUNG, CARL **10**:335
LOCKE, JOHN **11**:12
PAVLOV, IVAN PETROVICH **13**:1095

Division IV. Communication and language

[for Part Four headnote see page 209]

The outlines, and articles and parts of articles referred to, in the two sections of Division IV deal with the methods and forms of communication and with traditional and modern studies of language.

The articles and parts of articles referred to in Section 441 deal with the general analysis, the theoretical models, the technology, and the types of communication.

The articles and parts of articles referred to in Section 442 treat the nature and functions of language generally; the physiology of speech; phonetics; grammar; semantics; onomastics; the forms of writing; and linguistics, the scientific study of language and language development. At the end, articles are referred to that separately treat thirty-six languages and groups of languages in world history.

Section 441. Methods and forms of communication 264
442. Language 265

Section 441. Methods and forms of communication

[for Part Four headnote see page 209
for Division IV headnote see page 263]

The articles and parts of articles referred to in Section 441 deal with four main subjects: A, the process of communication; B, the technological aspects of communication; C, information systems; and D, the nature and development of public communication through print media.

The outline of subject A begins with the general analysis of communication and with theoretical models of communication—linear-quantitative and dynamic-psychological models. Dealing with the types of communication, it treats nonvocal communication; vocal communication; laughter as a form of communication; the forms and effects of mass communication; and parapsychological forms of communication. Finally, it deals with the psychology of communication, involving efforts to determine the role of communication in the modification of human behaviour.

Subject B involves communication engineering, treated in Section 10/37; and communicating devices, treated in Section 735.

Subject C is information systems. The storage, manipulation, and retrieval of information are dealt with in Section 735. Indication is made of the sections that deal with accounting, inventory control, and medical information systems. The articles and parts of articles referred to in Section 441 treat libraries as information systems, including the "classical" library, the automated library, and the science of library systems; dictionaries and lexicons; encyclopaedias; and atlases and map collections.

Subject D, the nature and the development of public communication through print media, deals with the nature of publishing and the characteristics and development of book publishing, newspaper publishing, and magazine publishing.

	articles	article sections	other references
A.	The process of communication		
1.	The analysis of communication	COMMUNICATION **4**:1005–1010	
2.	Theoretical models of communication	**4**:1005a–g	
a.	Linear-quantitative models: systems using the concepts of noise, message, channel, feedback, and control	**4**:1005g–1007b / **17**:477h–478a	**7**:77a–b
b.	Dynamic-psychological models: systems devised to predict, describe, and analyze the cognitive, emotional, and artistic aspects of communication as they occur in sociocultural matrices	**4**:1005g–1006d / **13**:632h–633e **4**:1006e–f	**9**:574f–580f *passim*
3.	Types of communication	**4**:1007c–1009h / **4**:1010g–1011b / **19**:1033c–1034h	
a.	Nonvocal communication: the use of signals, signs, and symbols to convey meaning	**4**:1007c–1008b / **10**:647h–648d / **14**:1045b–f / **17**:900f–905b / **19**:1033e–1034h	**4**:496f–h / **15**:37e–38a / **15**:996g–997a
b.	Vocal communication: speculations regarding the origin of speech and the variety of languages	**4**:1008b–1009a / **10**:645f–647g / **16**:790h–793g / **17**:905c–e	**17**:478d–485f *passim*
c.	The phenomenon of laughter as a form of communication: the stimulus of wit and humour	HUMOUR AND WIT **9**:5–11	**4**:1008g–h
i.	The logical structure of humour: the common pattern underlying the range of laughter-provoking experiences	**9**:5f–6c	
ii.	The emotional dynamics of humour: the emotions discharged in laughter	**9**:6c–7h	
iii.	The types of humour: verbal humour; situational humour	**9**:7h–10a	
iv.	Style and technique in humour: the criteria for quality in humour	**9**:10a–c	
d.	Mass communication: prerequisites for its development; formal and informal controls; the effects of mass communication on societal and personal values, attitudes, and beliefs	**4**:1009b–h	**1**:108c–109h *passim* / **15**:41h–42a / **15**:42f–44f *passim* / **15**:211d–h / **15**:212d–h
e.	Parapsychological forms of communication: telepathy [see 433.I.]		
4.	The psychology of communication: efforts to determine the role of communication in the modification of human behaviour	**4**:1010a–d / **2**:361h–362c	**15**:42a–e / **15**:212a–c / **15**:213b–c
B.	The technological aspects of communication		
1.	Communication engineering [see 10/37.B.5.d.]		
2.	Communicating devices; *e.g.*, television, radio, magnetic tape [see 735]		

	articles	article sections	other references
C. Information systems: libraries; dictionaries and encyclopaedias			
1. The storage, manipulation, and retrieval of information [see 735.H.]			
2. Diverse types of information systems			
a. Accounting systems [see 10/36.D.3.d]			
b. Abstracts, bibliographies, and reviews [see 735.H.1.b. and 10/41.B.2.a.iii.]			
c. Medical information systems [see 10/35 B.4.b.]			
d. Libraries as information systems			
i. The "classical" library		**10**:856g–859a	
ii. The automated library		**10**:873b–874a	**2**:979h–980b
iii. Information centres		**10**:872c–f	**9**:573d–f
iv. Inter-institutional information networks		**10**:866a–e	**10**:865f–g
v. The science of library systems	LIBRARY SCIENCE **10**:867–875		**2**:979f–980b
e. Dictionaries and lexicons	DICTIONARY **5**:713–722	**16**:511f–h	**10**:246h–247d/ **19**:720e–721d *passim*
i. Kinds of dictionaries; *e.g.*, general-purpose dictionaries, scholarly dictionaries, specialized dictionaries		**5**:717f–719f	
ii. Features and problems of dictionaries; *e.g.*, establishment of the word list, questions of spelling and pronunciation, social attitudes affecting dictionary approach		**5**:719f–722b	
f. Encyclopaedias	ENCYCLOPAEDIA **6**:779–799	**3**:1083e–f	**5**:723f–724b
i. The role of encyclopaedias; *e.g.*, in relation to one another, to their readership, to the contemporary world		**6**:782e–784h	
ii. The making of encyclopaedias: editing and publishing		**6**:784h–787f	
iii. Kinds of encyclopaedias; *e.g.*, general encyclopaedias, children's encyclopaedias, specialized encyclopaedias		**6**:787g–799c	
g. Atlases and map collections		**2**:230g–232d/ **11**:478e–479e	**11**:470e–475b *passim*
D. Nature and development of public communication through print media	PUBLISHING, HISTORY OF **15**:221–257		
1. The nature of publishing: selection, preparation, and marketing of printed material; the role of the publisher		**15**:221f–222f	
2. Types of publishing: characteristics and development of publishing in different media		**15**:222g–257c	
a. Book publishing		**15**:222g–235g/ **18**:813g–824a	
b. Newspaper publishing		**15**:235g–247g	**1**:104d–e
c. Magazine publishing		**15**:247h–257c	**1**:104f–h

Section 442. Language

[for Part Four headnote see page 209
for Division IV headnote see page 263]

The articles and parts of articles referred to in Section 442 deal with five main subjects: A, the nature and functions of language; B, the structure of speech and language; C, written language; D, linguistics; and E, the classification of languages.

The outline of subject A begins with definitions of language, social attitudes about language, and historical and political uses of language. It goes on to the complex nature of language structure and composition, to the nonverbal dimensions of language, and to such variations of verbal language forms as dialects, slang, and pidgin. It next treats the functions of language—in intellectual work and communication, and for the expression of emotions and attitudes. It further treats the relation of language

to culture; the nature of language learning and literacy; writing systems as extensions of language; and the factors operative in linguistic change.

The outline of subject B begins with the physiology of speech, treating the production of voice sounds, the production of speech, and speech disorders. The treatment of phonetics covers standards of pronunciation; articulatory, acoustic, linguistic, and experimental phonetics; and the history of phonetics. The outline next deals with grammar. It treats diverse conceptions of grammar; the development of the study of grammar; the question of grammaticality; models of grammatical description; and features of grammatical analysis. The outline goes on to semantics. Here it first treats philosophical views on meaning, in relation to reference, truth, use, and thought. It then deals with meaning in linguistics, covering semantics in language theory and in language learning, lexicography, and generative semantics. The outline of subject B concludes with onomastics, the study of personal names and place-names.

Subject C is written language: systems of notation. The outline first deals with the nature, evolution and typology, and general characteristics of writing systems. Dealing with specialized forms of written notation, articles are referred to that separately treat hieroglyphics, Braille, cryptology, and shorthand. The outline concludes with the scope, methods, and historical development of the study of writing. It treats the component and cognate disciplines involved in such study; cross-disciplinary studies of writing; and the development of punctuation systems.

Subject D is linguistics—the scientific study of language and language development. The outline first deals with the nature, scope, and historical development of linguistic theory. The treatment of the methodology distinguishes the various linguistic methods concerned with the analysis of language at any given time from the methods concerned with the historical development of language and of language change between successive points in time. Finally, the outline deals with the relationship of linguistics to other disciplines. It treats psycholinguistics, sociolinguistics, linguistic anthropology, linguistic geography, computational linguistics, mathematical linguistics, and the analysis of language by the literary critic, the philosopher, and the educator.

Subject E is the classification of the languages of the world. The general article first referred to treats the methodology of language classification. Articles then are referred to that separately treat thirty-six languages and groups of languages, covering languages spoken in Europe and areas of European colonization; languages of Asia and Oceania; languages of Africa and the Middle East; Indian languages of the Americas; and five extinct languages. At the end the outline treats constructed languages—special international or universal languages, such as Esperanto, Interlingua, or Basic English; and machine languages, such as Fortran or Algol.

	articles	article sections	other references
A.	The nature and functions of language		
	LANGUAGE **10**:642–662		
1.	Definitions of language: preliminary considerations and distinctions	**10**:642c–643a	
2.	Language and society		
a.	Attitudes toward language: taboos in language usage; myths that ascribe a divine origin to language; views concerning the interdependence of language and thought	**16**:126c–f **10**:643c–644d	**4**:1008b–1009a *passim* **6**:943h–946b *passim*/ **13**:212e–g/**18**:352e–f/ **19**:902a–c
b.	The connection of language with history: language as an instrument in the investigation of the evolution of civilization	**6**:920d–924b/ **10**:1088b–e/ **11**:961e–962f/ **13**:212e–213b/ **19**:1038g–1040c **15**:36g–37b	**8**:393d–395g *passim*/ **12**:796h–797a/**15**:629d–g/ **15**:863f–866g *passim*
c.	The use of language as a political instrument	**10**:644d–645e	
3.	The complex nature of language structure and composition	**10**:645f–648d	
4.	The diverse forms of language		
a.	Verbal language forms	**10**:645f–647g	**4**:1007e–g
i.	Variations that arise naturally: dialects	DIALECTS **5**:696–701	**10**:645g–646h/ **15**:1025h–1027f	**10**:661f–h
ii.	Variations that arise in specialized contexts: specialized vocabularies of professions, occupations, and cultural subgroups; *e.g.*, slang, argot, jargon	SLANG **16**:850–853	**10**:646h–647e/ **5**:257b–d	**14**:1102d
iii.	Variations that facilitate interlingual communication: pidgin, creoles	PIDGIN **14**:452–454	**10**:647f–g/ **15**:1029h–1030d/ **17**:109e–g
b.	Nonverbal dimensions of language: bodily gestures and posture, facial expressions, nonword utterances; computer languages	**10**:647h–648d/ **4**:1007c–1008b/ **4**:1054d–1058f/ **15**:866d–g	**4**:1053b–c/**19**:1033e–h
5.	The physiological basis of speech [see B.1., below]		
a.	Speech production [see B.1.a.]		
b.	The role of biological inheritance in language acquisition, language use, and grammar construction	**10**:649e–650c/ **4**:1064a–c/ **15**:350c–g	
6.	The functions of language: cross-cultural comparisons	**10**:650c–654e	
a.	The use of word selection, word order, word form, syntactic structure, and the placement of pitch and stress to convey meaning	**10**:650d–652g	**16**:509f–512b *passim*
b.	The articulation of conceptualization and abstract relationships	**10**:652h–653e/ **6**:943h–946b	

	articles	article sections	other references
c. The expression of personal emotions and attitudes to arouse responses in others: the use of style in written and oral language; the functions of language as a form of play		**10**:653e–654e / **9**:7h–8f / **15**:803f–805b	
7. The relation of language to culture		**10**:654f–657e / **4**:1008b–1009a / **11**:962b–d / **13**:212e–213b	
a. The role of language in the transmission of culture		**10**:654h–655d	**10**:1050g–1051b
b. The role of language in differentiating and unifying social and occupational groups		**10**:655d–656a / **5**:700e–701c	
c. The role of language in cross-cultural relations		**10**:656a–657e	
i. The relation between cultural features and linguistic patterns		**10**:656a–f	
ii. Interlingual communication: the complex nature of the translator's task		**10**:656f–657e	
8. The nature of language learning and literacy: differences between the acquisition of first and second languages; factors operative in attaining literacy		**10**:657f–658g	
9. Writing systems as extensions of language		**10**:658h–660b	
a. Evolution of writing systems [see C.2., below]			
b. Spelling: difficulties involved in orthographic representation of sound		**10**:659d–g	**6**:879d–f
c. The relation of spoken to written language		**10**:659g–660b	
10. Dynamics of language: factors operative in linguistic change		**10**:660b–662f / **5**:697g–699c / **10**:1006h–1008a / **15**:1027f–1028b	**16**:852b–853b *passim* / **17**:111f–112a
B. The structure of speech and language			
1. The physiology of speech	SPEECH, PHYSIOLOGY OF **17**:477–492	**10**:648d–649e	**4**:1009a
a. Production of voice sounds		**17**:478d–483e / **14**:275f–276c / **16**:789c–e	
i. Respiratory mechanisms		**17**:478d–h	
ii. The larynx: cartilages, muscles, and vocal cords		**17**:478h–480e / **15**:764h–765c	
iii. Voice registers: chest voice, midvoice, and head voice		**17**:480h–481h	
iv. Vocal attributes: frequency, harmonic structure, and intensity		**17**:481h–483e	
b. Production of speech		**17**:483e–486c / **10**:648g–649e	
i. Articulation		**17**:484b–f / **14**:276c–278e	
ii. Acoustic analysis: perceptual recognition of speech sounds		**17**:484f–h / **14**:278f–279h	**14**:281g–282c
iii. Neural regulation: language centres in the brain		**17**:484h–485f	
iv. Artificial speech sounds: esophageal voice, artificial larynx, and speech synthesizers		**17**:485f–486c / **14**:279f–h	
c. Speech disorders		**17**:486c–492a	
i. Voice disorders: dysphonia		**17**:487g–488a	
ii. Language disorders: cluttering, lisping, stuttering, dysphasia, and aphasia		**17**:488a–489g	
iii. Symptomatic speech disorders		**17**:489g–490g	
iv. Speech impediments		**17**:490h–492a	
2. The sound system: phonology	PHONETICS **14**:275–283	**10**:644f–645a	
a. Standards of pronunciation		**14**:275d–f	
b. Articulatory phonetics: speech organs used in producing consonants and vowels, and suprasegmentals (*e.g.*, stress, tone, length)		**14**:275f–278e / **17**:484b–f	

	articles	article sections	other references
c. Acoustic phonetics: pitch, amplitude, quality, and vowel and consonant formants		**14**:278f–279h / **17**:484f–h	
d. Linguistic phonetics: phonological rules, phonemes, allphones, and distinctive features; *i.e.*, sets of phonetic properties		**14**:279h–281c	
e. Phonetic transcription: the International Phonetic Alphabet		**14**:281c–e	
f. Experimental phonetics; *e.g.*, attempts to discover the cerebral processes involved in speech and to analyze the temporal structure of speech production		**14**:281f–282c	
g. History of phonetics: contributions of ancient Indian and Greek grammarians; modern systematic approaches		**14**:282d–283a	
3. Grammar: the investigation of the formal features of a language and of the rules that govern their combination, reference, and interpretation	GRAMMAR **8**:265–274	**10**:645a–e	
a. Diverse conceptions of grammar		**8**:265f–266c	
b. The development of the study of grammar		**8**:266d–269c	
i. Non-Western traditions: the influence of the Sanskrit tradition on Western thought		**8**:266d–f	
ii. Classical antiquity: the role of philosophy and criticism in the emergence of theoretical grammar		**8**:266f–267b	**1**:1167a–d
iii. The Middle Ages: the importance of scholastic philosophers in discriminating categories and parts of speech		**8**:267b–g	
iv. The Renaissance: the influence of vernacular and exotic languages on the development of prescriptive grammar		**8**:267g–268c	
v. 19th and early 20th centuries: the development of comparative and historical studies; the influence of other disciplines; the emergence of the structural or descriptive school of grammar		**8**:268c–g	**8**:1178f–g
vi. Contemporary studies: the development of transformational grammar; current trends in transformational grammar		**8**:268h–269c / **8**:273f–274e	
c. The question of grammaticality: diverse definitions and views		**8**:269d–270a	
d. Models of grammatical description		**8**:270b–271a	
i. Universal grammar: the use of mathematical models to investigate the grammatical rules that natural languages hold in common		**8**:270b–c	
ii. Taxonomic (structural) grammar: item-and-arrangement, item-and-process, and word-paradigm models		**8**:270c–g	
iii. Transformational models: sets of rules that generate all possible grammatical sentences in a given language		**8**:270g–271a / **16**:511h–512b	**16**:511d–e
e. Features of grammatical analysis		**8**:271a–273f	
i. Distribution: the analysis of positions or the sum of positions held by an element or a combination of elements in chains or sequences		**8**:271b	
ii. Classes: the analysis of sets of elements sharing a common property		**8**:271c–e	
iii. Levels: the division of grammar into various subdivisions, usually hierarchically arranged; *e.g.*, phonology, morphology, syntax		**8**:271e–f	
iv. Segmentation: the procedure whereby units of languages are divided and classified into stems, bases, and affixes		**8**:271f–273a	
v. Categories: the analysis of words or phrases according to form and function		**8**:273a–c	
vi. Constituents: the analysis of sentences, phrases, and words into their component parts		**8**:273c–f	
4. The principles of semantics: philosophical and scientific study of meaning	SEMANTICS **16**:506–512		

	articles	article sections	other references
a. Philosophical views on meaning: meaning in relation to reference, truth, use, and thought		**16**:507f–510c / **1**:804e–805a / **6**:944h–946b / **12**:16e–17f / **12**:815g–816f	**11**:29g–32b *passim* / **12**:32e–f
b. Meaning in linguistics		**16**:510d–512b	
i. Semantics in language theory: the study of encoding; the determination of meaning and meaning changes such as metaphors, similes, euphemisms		**16**:510d–511a	**16**:851g–h
ii. Semantics in language learning: meaning, structure, and context		**16**:511a–e	
iii. Lexicography: semantic concern with the form and adequacy of dictionary entries		**16**:511f–h	**5**:717c–722b *passim*
iv. Generative semantics: the relationship between semantic and syntactic components		**16**:511h–512b	
5. Onomastics: the study of names	NAMES **12**:814–819		
a. Personal names		**12**:817d–819a	
b. Place-names		**12**:819a–g	
C. Written language: systems of notation	WRITING, FORMS OF **19**:1033–1044		
1. The nature of writing systems: the relationship between signs and language		**19**:1033c–1034h / **17**:904b–f	
2. The evolution and typology of writing systems		**19**:1034h–1040e / **10**:658h–660b	
a. The use of pictures before writing		**19**:1034h–1035c	
b. Semasiographic writing: the use of descriptive, representational, and identifying mnemonic devices without linguistic association		**19**:1035c–h	
c. Phonographic writing: systems in which visual signs have partial or nearly full correspondence with phonological elements		**19**:1035h–1038e	**17**:939c–e
i. Logographic writing: the development of systems using one sign or a combination of signs to express a single word or element of meaning		**19**:1035h–1036f / **19**:1037f–g / **16**:804c–805a	**11**:968h–969b
ii. Syllabic writing: the development of systems using signs (syllables) that contain a vowel or vocalic nucleus		**19**:1036f–h / **19**:1037h–1038c	
iii. Alphabetic writing: the development of systems of signs (letters) that stand for single phonemes of a language	ALPHABETS **1**:618–627	**19**:1036h–1037b / **19**:1038c–e / **2**:483g–484d / **6**:1018h–1019c / **8**:393b–d	**12**:915g–h
d. Metagraphic writing: systems of signs that are supplemental to the signs of writing; *e.g.*, punctuation		**19**:1038e–g	**15**:274h–277b *passim*
3. General characteristics of writing systems		**19**:1038g–1040c	
4. Specialized forms of written notation			
a. Forms of historical significance			
i. Hieroglyphics	HIEROGLYPHIC WRITING **8**:853–857	**11**:962e–f	**1**:832b–h / **11**:945h–946b
ii. Cuneiform		**5**:368g–369b / **17**:797b–h	**1**:831b–832b / **11**:964e–969c *passim*
b. Forms in contemporary use		**19**:1040c–e	
i. Notation for the blind: Braille	BRAILLE **3**:110–111		
ii. Codes and ciphers: cryptography	CRYPTOLOGY **5**:322–331		**8**:855d–f
iii. Abbreviated business language: forms of shorthand	SHORTHAND **16**:709–711		
5. The study of writing: scope, methods, and historical development		**19**:1040f–1044d	
a. Component and cognate disciplines			

	articles	article sections	other references
i. Grammatology and its subdisciplines: subgraphemics, graphemics, and metagraphemics		**19**:1041b–1042b	
ii. Epigraphy and paleography		**19**:1042b–f / **2**:941a–942d / **6**:915c–920d / **6**:923e–924h	**3**:645h–669g *passim* / **13**:911g–914d *passim*
b. Cross-disciplinary studies of writing; *e.g.*, in psychology, in anthropology, in aesthetics		**19**:1042f–1043g / **2**:941a–942g	
c. History of the study of writing		**19**:1043h–1044d	
d. The development of punctuation systems	PUNCTUATION **15**:274–277		**2**:941g–942a
D. Linguistics: the scientific study of language and language development	LINGUISTICS **10**:992–1012		
1. The nature and scope of linguistics		**10**:992f–h / **16**:510d–511a	
2. The development of linguistic theory		**10**:993b–996b / **14**:282d–283a / **16**:506h–507e	
a. Origins of Western linguistic theory: early development in Greece and Rome; the influence of medieval and post-Renaissance thought		**10**:993b–f / **8**:266d–268c	**8**:1176d–f
b. The 19th century: development of the comparative method of language reconstruction; theories concerning the nature of language and the development of language		**10**:993g–994g / **8**:1178a–h	**8**:268c–e
c. The 20th century: the rise of rival systems of linguistic analysis; *e.g.*, structuralism, the Prague School, transformational-generative grammar, tagmemics		**10**:994g–996b	**8**:268e–g
3. The methodology of linguistics			
a. Theoretical, descriptive (synchronic) linguistics: methods concerned with the analysis of language at a given point in time		**10**:996b–1006g	
i. Structural linguistics: descriptive analysis of phonology, morphology, syntax, and meaning		**10**:996b–1000h / **8**:270c–g / **14**:279h–281c	
ii. Transformational-generative grammar: systematic analysis of sentence structure and of the components of sentences		**10**:1000h–1004b / **8**:268h–269c / **8**:270g–271a	
iii. Tagmemics: the analysis of modes and levels of language and of patterns of human language behaviour		**10**:1004b–g	
iv. Stratificational grammar: the analysis of layers or strata of language		**10**:1004h–1005g	
v. The Prague School: the method of analysis that combines structure and function		**10**:1005g–1006g	
b. Historical (diachronic) linguistics: methods concerned with the historical development of language and language change between successive points in time		**10**:1006h–1010b	
i. The analysis of internal and external changes: changes in sound, grammar, and meaning within a language; changes caused by the influence of other languages		**10**:1006h–1008a	
ii. The reconstruction of earlier languages by means of the comparative method and internal reconstruction		**10**:1008a–1009g	
iii. Language classification techniques		**10**:1009g–1010b	**10**:662h–671b *passim*
4. The relationship of linguistics to other disciplines			
a. Psycholinguistics: the application of linguistic principles to studies of language learning by children, speech perception, and language disorders		**10**:1010b–1011a / **14**:281f–282c / **19**:1043d–e	**8**:269b–c
b. Sociolinguistics: the application of linguistic principles to the study of the sociological dimensions of dialect variations		**10**:1011b–g / **5**:700e–701c	
c. Linguistic anthropology: the study of the relationship between language and culture		**10**:1011g–h / **19**:1043b–d	**4**:1008c–f / **8**:268d–g
d. Linguistic (dialect) geography: the mapping of language factors that reflect distribution patterns, dialect boundaries, and the cultural development of people		**10**:1011h–1012b / **5**:699c–700c	

e. Computational linguistics: the use of computers in linguistic research

f. Mathematical linguistics: the study of linguistic statistical data and the construction of mathematical models of language components

g. Stylistics, semantics, and applied linguistics: the analysis of language by the literary critic, the philosopher, and the educator

E. The classification of language

1. The methodology of language classification: typological and genetic classification; the use of geographical comparisons and contrasts

2. Languages spoken in Europe and areas of European colonization

a. Indo-European languages

i. Indo-Iranian languages
[see E.3.a.i., below]

ii. Celtic languages

iii. Italic languages
[see E.6.c., below]

iv. Romance languages

v. Greek language

vi. Baltic languages

vii. Slavic languages

viii. Germanic languages

ix. English language

x. Albanian language

xi. Armenian language

xii. Tocharian language
[see E.6.e., below]

b. Non-Indo-European languages

i. Uralic languages

ii. Basque language

3. Languages of Asia and Oceania

a. Languages of Asia

i. Indo-Iranian languages

articles	article sections	other references
	10:1012b–c	
	10:1012d–e / **2**:502c–503g / **8**:270b–c	
	10:1012f–h / **1**:157h–159c / **1**:799g–802d / **6**:944h–946b / **7**:61f–g / **16**:507f–510c	**1**:802f–807g *passim* / **6**:978f–989d *passim* / **11**:76h–77a / **14**:273b–d
LANGUAGES OF THE WORLD **10**:662–672	**10**:660d–661b	
	10:662h–663d / **10**:661h–662f	**1**:220e–f / **8**:590g–h / **10**:663d–671b *passim*
	10:663d–664f	**17**:388c–f
INDO-EUROPEAN LANGUAGES **9**:431–438	**10**:663f–664b / **8**:392e–h	**3**:1018b–d / **6**:1063d–f / **11**:935c–d
CELTIC LANGUAGES **3**:1064–1068		**1**:625g–626a / **18**:873g–h
ROMANCE LANGUAGES **15**:1025–1044		**1**:624f–627c *passim* / **17**:388c–e
GREEK LANGUAGE **8**:392–398	**1**:623e–624c	
BALTIC LANGUAGES **2**:660–664		**9**:431g–h
SLAVIC LANGUAGES **16**:866–873	**1**:624c–f	**2**:661a–e / **9**:431g–h
GERMANIC LANGUAGES **8**:15–30		**1**:625b–e / **8**:54g–55a
ENGLISH LANGUAGE **6**:874–886	**8**:20e–g	**18**:873h–874b
ALBANIAN LANGUAGE **1**:422–423		
ARMENIAN LANGUAGE **2**:23–24		
URALIC LANGUAGES **18**:1022–1032	**10**:664b–c	
BASQUE LANGUAGE **2**:762–764		
	10:664f–669f	**17**:223d–h
	10:664f–669a	**2**:176h–177d / **4**:270g–273a / **9**:285c–286g / **13**:897c–h
INDO-IRANIAN LANGUAGES **9**:438–456	**10**:664f–h / **10**:666g–h / **1**:622f–623e	**9**:285e–286c / **9**:431b–c

	articles	article sections	other references
ii. Dravidian languages	DRAVIDIAN LANGUAGES **5**:989–992		**9**:285d–e
iii. Austro-Asiatic languages	AUSTRO-ASIATIC LANGUAGES **2**:480–484	**10**:668d–e	
iv. Sino-Tibetan languages	SINO-TIBETAN LANGUAGES **16**:796–806	**10**:667f–g / **10**:668e–f	**4**:270g–272f
v. Tai languages	TAI LANGUAGES **17**:989–992		
vi. Japanese language	JAPANESE LANGUAGE **10**:93–97		**10**:43g–44c
vii. Korean language	KOREAN LANGUAGE **10**:527–530		
viii. Altaic languages	ALTAIC LANGUAGES **1**:635–639	**10**:665f–666c / **10**:667d–e	**4**:272f–h
ix. Uralic languages [see E.2.b.i., above]			
x. Paleosiberian languages	PALEOSIBERIAN LANGUAGES **13**:914–916	**10**:666c–e	**16**:724h–725b
xi. Caucasian languages	CAUCASIAN LANGUAGES **3**:1011–1014	**10**:667b–c	
b. Languages of Oceania		**10**:668a–669f / **13**:469e–g	
i. Austronesian languages	AUSTRONESIAN LANGUAGES **2**:484–493	**10**:668a–c / **10**:668g–669a	
ii. Australian Aboriginal languages	AUSTRALIAN ABORIGINAL LANGUAGES **2**:430–431	**10**:669e–f	
iii. Papuan languages	PAPUAN LANGUAGES **13**:977–978	**10**:669c–e	
4. Languages of Africa and the Middle East		**10**:669g–670g / **8**:22h–23f	**1**:209e–g / **1**:281c–g / **11**:573d–f
a. African languages	AFRICAN LANGUAGES **1**:218–231	**10**:670d–g	**6**:109g–110d / **8**:473b–c
i. Niger-Congo languages		**1**:221g–225e / **10**:670e–g	**10**:853c–e / **13**:82e–f / **13**:90b–f / **16**:1060d–e
ii. Chari-Nile and Nilo-Saharan languages		**1**:225e–228f / **10**:670d–e	
iii. Khoisan languages		**1**:228f–231d / **10**:670g	
b. Hamito-Semitic languages	HAMITO-SEMITIC LANGUAGES **8**:589–597	**10**:670b–c	**11**:294b–d
i. Semitic languages		**8**:592c–595g / **1**:621b–622f	
ii. Egyptian language		**8**:595g–596c	
iii. Berber languages		**8**:596c–e	
iv. Cushitic languages		**8**:596e–597d	
v. Chadic languages		**8**:597d–h	
5. Indian languages of the Americas		**10**:670h–672e	
a. Eskimo-Aleut languages	ESKIMO-ALEUT LANGUAGES **6**:962–964		**1**:1126h–1127c
b. North American Indian languages	NORTH AMERICAN INDIAN LANGUAGES **13**:208–213	**13**:204h–205d	**10**:671c–h / **13**:223f–h / **17**:218e–g

	articles	article sections	other references
c. Mexican and Central American Indian languages	MESO-AMERICAN INDIAN LANGUAGES **11**:956–963	**12**:164g–165a	**10**:671h–672a / **11**:947e–f / **13**:245d–f
d. South American and Caribbean Indian languages	SOUTH AMERICAN INDIAN LANGUAGES **17**:105–112	**10**:672b–e	**17**:95h–96b
6. Extinct languages of the world			
a. Anatolian languages	ANATOLIAN LANGUAGES **1**:830–835		
b. Etruscan language	ETRUSCAN LANGUAGE **6**:1018–1019	**9**:1077h–1078e	
c. Italic (non-Romance) languages	ITALIC LANGUAGES **9**:1074–1076	**9**:1077h–1078e	
d. Sumerian language	SUMERIAN LANGUAGE **17**:797–798		**11**:968g–969c
e. Tocharian language	TOCHARIAN LANGUAGE **18**:467–468		
f. Sources of other ancient languages: ancient epigraphic remains	ANCIENT EPIGRAPHIC REMAINS **1**:837–839	**2**:548f–g / **6**:1018c–g / **9**:1077h–1080f / **11**:945g–946b / **11**:1001h–1002g	**2**:189h–190b / **11**:719e–g
7. Constructed languages			
a. Special international or universal languages, including Esperanto and Interlingua; Basic English	INTERNATIONAL LANGUAGE **9**:741–743		
b. Machine languages: Fortran, Algol [see 735.D.4.b.]			

Division V. Aspects of man's daily life

[for Part Four headnote see page 209]

The outlines, and the articles and parts of articles referred to, in the two sections of Division V treat the means of subsistence and the forms of play.

Section 451 treats the conditions of work and its environmental and economic effects. It then deals with the daily necessities and with the human actions taken for the satisfaction of the needs for food and drink, for clothing, and for shelter.

In Section 452, articles are referred to that separately treat physical games and sports; the forms of mental exercise and play; and the kinds of hobbies.

Section 451. The means of subsistence 273
452. Leisure and play 275

Section 451. The means of subsistence

[for Part Four headnote see page 209]

The articles and parts of articles referred to in Section 451 deal with two main subjects: A, human work; and B, the daily necessities and the human developments to which they give rise.

The outline of subject A treats the organization and the physical environment of work; diverse conceptions of the effect of technology on man's environment; and the production and consumption of wealth.

The outline of subject B begins with food and drink. It covers man's need for food; the basic foods and drinks; the world's food supply; the preparation of food and drink; ways of partaking of food and drink; and the nonmedicinal uses of drugs. Going on to clothing and adornment, the outline treats the major sources of human clothing; the history of the design and use of clothing and adornment; special types of clothing and body coverings; and various methods for the adornment and decoration of the body. The treatment of shelter deals with the effects of the materials used and with the effects of climate on dwelling styles and designs; the exterior design of buildings and their environment; environmental control within buildings; and the interior decoration of buildings.

	articles	article sections	other references
A. Human work			
1. The conditions of human work			
a. The organization of work: its relationship to social factors and to the degree of technological development	WORK, ORGANIZATION OF **19**:932–941	**2**:513b–f / **3**:491b–e / **6**:770f–771h / **9**:495d–499b / **16**:854f–855g / **16**:859d–860b / **16**:949e–950a / **18**:24f–25e	**6**:278h–279b / **19**:1094d–1095a
b. The physical environment of work		**7**:190f–191e	**4**:729f–h / **8**:1168c–1169f *passim* / **9**:504c–d / **9**:528h–530g *passim*
2. Diverse conceptions of the effect of technology on man's environment	TECHNOLOGY, CONCEPTIONS OF **18**:21–24		
3. The production and consumption of wealth			
a. Measures and standards of economic productivity	PRODUCTIVITY, ECONOMIC **15**:27–33		**9**:503g–504c / **10**:566c–g
b. The measurement of wealth and income		**19**:673e–674b	
B. The daily necessities and the developments to which they give rise			
1. Food and drink			
a. Man's need for food as a source of energy and as a prerequisite for body building and maintenance: the nutrients that are essential for normal growth and good health	NUTRITION AND DIET, HUMAN **13**:417–427	**13**:416c–f / **19**:488g–h / **19**:492c–g	
b. The basic foods and drinks [see 731.B.]			
c. The world's food supply	FOOD SUPPLY OF THE WORLD **7**:498–504	**13**:501f–502a	**10**:1279d–g
		7:362d–e / **7**:498c–499d	
i. The problem of food supply: special difficulties facing the developing countries	FOOD, NEW SOURCES AND PRODUCTS **7**:481–484	**1**:365c–366f / **7**:499e–504b	
ii. Attempts to increase the production and utilization of food supplies: the quest for new sources of food protein			
d. The preparation and serving of food and drink	GASTRONOMY **7**:940–947		
i. Historical development of gastronomy		**7**:940c–944a	
ii. National and regional cuisines		**7**:944b–947d	
iii. The preparation of a varied choice of dishes to be served in public dining rooms	RESTAURANT **15**:778–779		
e. The partaking of food and drink *with special attention to*			
i. Symbolic and ceremonial partaking of food and drink: feasts and festivals	FEAST AND FESTIVAL **7**:197–202		
ii. Religious and moral regulations concerning diet and the partaking of food and drink	DIETARY LAWS AND FOOD CUSTOMS **5**:728–736		**1**:441d–442b / **1**:449b–450a
f. The nonmedicinal use of drugs		**5**:1052c–f / **14**:199e–201e	**5**:392b–c / **5**:1048e–1049b / **9**:247b–c
i. Kinds of drugs widely smoked or ingested: tobacco; coco leaves; peyote and other hallucinogenic plants		**5**:1052f–1059c / **8**:559b–560b / **14**:200a–g / **15**:777a–f	**5**:1046a–b / **13**:963f / **16**:414g–h / **18**:467a–b
ii. Symbolic and ceremonial use of drugs [see 829.F.4.]			
iii. Religious and moral regulations concerning the use of drugs		**5**:1059d–h / **14**:202f–203b	
iv. Drug addiction [see 522.C.9.]			

	articles	article sections	other references
2. Clothing and adornment			
a. Major sources of human clothing		**4**:752b–e / **5**:1015h–1016e / **7**:257g–258f / **18**:187f–h	**3**:69g–h / **6**:170e–f / **7**:271f–272b / **7**:811d–e
b. History of the design and use of clothing and adornment	DRESS **5**:1015–1039		
c. Special types of clothing and body covering *with special attention to*			
i. Protective clothing; *e.g.*, space suits, diving suits [see 738.B.3.b. and 738.C.2.b.ii.]			
ii. Armour	ARMOUR **2**:27–30	**2**:30e–31e / **8**:784h–785e	**19**:582g–h
iii. Religious vestments	RELIGIOUS DRESS AND VESTMENTS **15**:634–639	**3**:1175b–d / **11**:580d–583b	
d. Adornment and decoration of the body *with special attention to*			
i. Cosmetics, perfumes, and deodorants	COSMETICS INDUSTRY **5**:196–198		**3**:935b–c
ii. Hairdressing and depilation		**5**:197c–h	**5**:1017e–g / **5**:1023g–1024d / **5**:1032a–b
iii. Plastic surgery		**17**:821e–g	
3. Shelter			
a. Home-building materials		**1**:1095h–1097c	**3**:162h–163e / **3**:164g–165c / **3**:452e–456a *passim*
b. Effects of the material used on dwellings: effects of climate on dwelling styles and designs		**1**:1093h–1094f / **7**:885e–887e / **9**:698h–699b	**1**:1123g–1124a / **4**:729d–f / **9**:4d–5c *passim* / **19**:791a–b
c. Exterior design of buildings and their environments		**7**:888e–889h	**1**:1108h–1110b *passim* / **3**:463b–464d / **7**:903b–905c *passim*
d. Environmental control within buildings		**8**:711g–728a	**1**:1094g–1095e / **3**:465e–466e / **10**:926f–927c
e. Interior decoration of buildings	INTERIOR DESIGN **9**:687–730		
i. Floor and wall coverings: rugs, carpets, tile, tapestries, and mosaics		**7**:406a–407c / **16**:15f–16g / **17**:1055d–f	**3**:461e–g / **12**:465h–474b *passim*
ii. Furniture and accessory furnishings	FURNITURE AND ACCESSORY FURNISHINGS **7**:794–807		

Section 452. Leisure and play

[for Part Four headnote see page 209
for Division V headnote see page 273]

The articles and parts of articles referred to in Section 452 deal with four main subjects: A, the creative pursuits of leisure; B, physical exercise and play; C, mental exercise and play; and D, hobbies and avocations.

With regard to subject A, cross-references are made to the sections in Part Five and in Part Six that deal with the various ways in which leisure is creatively pursued.

The outline of subject B begins with the early history, development, and functions of games and other forms of physical exercise. It goes on to deal with Classical athletic games and contests, modern regional games, and modern Olympic Games. It next treats amateurism and professionalism in sports. Articles are then referred to that separately treat major team and competitive sports. Articles are next referred to that separately treat major outdoor recreational activities—camping, sport fishing, sport hunting, mountaineering, and riding and horsemanship. Separate treatment is given to the sports and games of children.

Subject C is mental exercise and play—games, gambling, and mental recreation. After treating the history of games, the outline deals with the history, the theory, the prevalence and control, and the principal kinds of gambling, for example, betting and bookmaking, and lotteries. Articles are then referred to that separately treat games for recreation and gambling—card games, dice games, board and tile games, word and letter games, and mathematical and number games.

The outline of subject D first deals with the evolution and growth of hobbies. It then treats kinds of hobbies—those related to art, such as painting or music; to the past, such as antique collecting; to nature, such as bird-watching; and to handicrafts, such as needlework or woodworking.

articles	article sections	other references
A. The creative pursuits of leisure [see 561.A.3. and Part Six]		
B. Physical exercise and play: competitive and spectator sports and physical recreation		

	articles	article sections	other references
1. Games and other forms of physical exercise: their early history and development; their functions as physical outlets, displays of skill, entertainment for spectators, and pastimes bringing men and women together socially	GAMES, HISTORY OF **7**:870–874	**2**:989g–990b / **3**:86g–87g / **7**:504f–505c / **8**:984a–e / **18**:538g–h	**2**:210c–e
2. Athletic games and contests	ATHLETIC GAMES AND CONTESTS **2**:274–293	**18**:539e–f	
a. Classical Games		**2**:274f–275d / **17**:513h–514a	**6**:325c–e / **8**:346h–347b / **11**:941d–g / **13**:566b–e / **18**:538d–e / **19**:1025d–f
b. Modern regional games; *e.g.*, British Commonwealth Games, Highland Games, Hibernian Games, Maccabiah Games		**2**:276c–g	
c. Modern Olympic Games		**2**:277a–279h / **15**:839g–h / **19**:1027d–g	**2**:754a–b / **2**:1169e–1170c / **19**:885h–890c *passim*
3. Amateurism and professionalism in sports	SPORTS, AMATEUR AND PROFESSIONAL **17**:513–515	**18**:134b–g	
a. Amateur codes: the problem of support; differences in interpretation of amateurism among various countries and sports		**17**:514d–515c / **2**:731a–e / **3**:94c–f / **8**:251d–f	**2**:277h–278a / **18**:541h–542b
b. Problems of professionalism: effects of the expansion of leagues, sponsorship, and television on the role and image of the professional athlete		**17**:515d–g / **2**:735e–736h / **3**:94f–95a / **7**:518d–519c	**8**:249e–g
4. Major sports			
a. Water sports			
i. Swimming, diving, water polo, water skiing, surfing, and skin diving	SWIMMING AND AQUATIC SPORTS **17**:859–867		
ii. Boating, rowing, canoeing, yachting, and motorboating	BOATING AND YACHTING **2**:1157–1173	**7**:372g–373a	**7**:373f
b. Track-and-field sports: running, hurdling and jumping; throwing events	TRACK-AND-FIELD SPORTS **18**:537–552		
c. Motor sports; *e.g.*, motoring, automobile racing, motorcycling	MOTOR SPORTS **12**:565–576		
d. Aerial sports; *e.g.*, air racing, gliding, parachuting, ballooning	AERIAL SPORTS **1**:123–129		
e. Shooting: trap and skeet, rifle, handgun, and shotgun	SHOOTING **16**:702–708	**8**:500h–501b	
f. Gymnastic and weightlifting sports	GYMNASTIC AND WEIGHTLIFTING SPORTS **8**:513–517		
i. Gymnastic events: horizontal bars, parallel bars, side horse, long horse, stationary rings, and calisthenics		**8**:513b–516c	
ii. Weightlifting: the press, the snatch, and the clean and jerk		**8**:516d–517d	
g. Winter sports; *e.g.*, ice skating, bobsledding, tobogganing, curling	WINTER SPORTS **19**:884–890	**7**:366c–d / **12**:162f–165b / **16**:835c–838d	
h. Other team and competitive sports and events *with special attention to*			
i. Archery	ARCHERY **1**:1082–1087		
ii. Association football (soccer)	ASSOCIATION FOOTBALL (SOCCER) **2**:210–213		
iii. Baseball	BASEBALL **2**:728–746		
iv. Basketball	BASKETBALL **2**:750–757		

	articles	article sections	other references
v. Billiard games	BILLIARD GAMES **2**:989–993		
vi. Bowling	BOWLING **3**:86–91		**7**:871e–f
vii. Boxing	BOXING **3**:91–96		
viii. Bullfighting	BULLFIGHTING **3**:476–478		
ix. Cricket	CRICKET **5**:256–264		
x. Cycling	CYCLING **5**:390–392		
xi. Falconry	FALCONRY **7**:152–154		
xii. Fencing	FENCING **7**:224–231		
xiii. Football, American and Canadian	FOOTBALL, AMERICAN AND CANADIAN **7**:504–520		
xiv. Golf	GOLF **8**:242–252		
xv. Handball and fives	HANDBALL AND FIVES **8**:600–602		
xvi. Hockey (Field)	HOCKEY (FIELD) **8**:983–985		
xvii. Horse racing	HORSE RACING **8**:1092–1104	**8**:1090g–1091g	
xviii. Ice hockey	ICE HOCKEY **9**:161–165		
xix. Jai alai	JAI ALAI **10**:6–7		
xx. Lacrosse	LACROSSE **10**:580–582		
xxi. Polo	POLO **14**:760–762		
xxii. Rackets	RACKETS **15**:366–368		
xxiii. Rodeo	RODEO **15**:981		
xxiv. Rugby	RUGBY **16**:4–10		
xxv. Skiing	SKIING **16**:834–838		
xxvi. Table tennis	TABLE TENNIS **17**:981–982		
xxvii. Tennis and allied court games	TENNIS AND ALLIED COURT GAMES **18**:131–140		**7**:870h–871b
xxviii. Volleyball	VOLLEYBALL **19**:510–511		
xxix. Wrestling and allied sports	WRESTLING AND ALLIED SPORTS **19**:1024–1028		
5. Major outdoor recreational activities			
a. Camping	CAMPING **3**:708–711		
b. Fishing	FISHING, SPORT **7**:362–376		
c. Hunting	HUNTING, SPORT **9**:46–53	**8**:500g–h	
d. Mountaineering	MOUNTAINEERING **12**:584–588		
e. Riding and horsemanship	RIDING AND HORSEMANSHIP **15**:835–839	**8**:1090g–1092c	

	articles	article sections	other references
6. Sports and games of children	CHILDREN'S SPORTS AND GAMES **4**:242–246		
C. Mental exercise and play: games, gambling, and mental recreation			
1. History of games			
a. Ancient games		**2**:1149h–1150c / **3**:900h–901e / **4**:195g–196d	**5**:702c–f
b. Modern games		**3**:166b–169b / **3**:901e–903c / **4**:198a–g / **13**:345g–347b / **15**:1167d–e / **16**:24f–h	**19**:926c–f
2. Gambling	GAMBLING **7**:866–869		
a. History of gambling		**7**:866g–867g / **3**:902g–903a / **8**:1093g–h / **11**:113h–114g / **14**:623b–d / **15**:1167d–e	**5**:703e–g
b. The theory of gambling: the laws of chance, probability, and odds as applied to games and gambling		**7**:867h–868g / **14**:624g–625a	**5**:703b–c
c. Prevalence, legislation, and control of gambling		**7**:868h–869h	
d. The principal kinds of gambling			
i. Betting and bookmaking		**8**:1103b–1104h / **14**:623g–624a / **15**:1168a–f	**7**:868f–g
ii. Lotteries	LOTTERY **11**:113–115		
iii. Dice games [see 3.b., below]			
iv. Card games [see 3.a., below]			
v. Roulette	ROULETTE **15**:1167–1168		
3. Games for recreation or gambling			
a. Card games	CARDS AND CARD GAMES **3**:900–904		
i. Bridge	BRIDGE **3**:165–173		
ii. Poker	POKER **14**:623–625	**13**:625h–627b	**3**:903g–h
iii. Rummy	RUMMY GAMES **16**:24–25		
iv. Cribbage	CRIBBAGE **5**:255–256		
v. Pinochle, Baccarat, Blackjack, Faro, Casino, and other card games		**3**:903c–904c	
b. Dice games; *e.g.*, Craps, Chuck-a-Luck, Hazard, Poker, Dice	DICE AND DICE GAMES **5**:702–706		**7**:866h–867b / **13**:862g
c. Board and tile games	BOARD AND TILE GAMES **2**:1149–1155	**13**:353f–356a / **13**:628a–c	
i. Board games		**2**:1149h–1154h / **13**:353f–354b	**5**:705d–706b
ii. Chess	CHESS **4**:195–205	**13**:354b–356a / **2**:1151g–h	
iii. Tile games		**2**:1155a–g	
d. Word and letter games	WORD AND LETTER GAMES **19**:926–928	**2**:1154g–h	**9**:5d–11d *passim*
i. Origins of word and letter games		**19**:926b–f	
ii. Riddles		**19**:926f–h	

	articles	article sections	other references
iii. Word play based on twisted meaning		**19**:926h–927b	
iv. Puns		**19**:927b–f	
v. Letter games		**19**:927f–928f	
e. Mathematical and number games	NUMBER GAMES AND OTHER MATHEMATICAL RECREATIONS **13**:345–357		
i. Arithmetic and algebraic recreations: number patterns, digital problems, cryptarithms, paradoxes, and fallacies		**13**:347b–350e	
ii. Geometric and topological recreations: optical illusions, mazes, geometric dissections, graphs, and networks		**13**:350f–353f	
iii. Manipulative recreations: puzzles, chessboard problems, polyominoes, and Soma Cubes		**13**:353f–356a / **4**:202f–203e	
iv. Problems of logical inference: logical puzzles and logical paradoxes		**13**:356b–357f	
D. Hobbies and avocations: their history, character, and prevalence	HOBBIES **8**:973–981		
1. Evolution and growth of hobbies		**8**:973b–974c / **14**:149d–e	
2. Kinds of hobbies		**8**:974c–981b	
a. Hobbies relating to art; *e.g.*, painting, music, photography, writing		**8**:974e–976c / **14**:315h–316c	
b. Hobbies relating to the past: antique collecting, numismatics, philately, and collecting of memorabilia		**8**:976c–978a / **12**:574h–575a	
c. Hobbies relating to nature; *e.g.*, bird-watching, collecting rocks, shells		**8**:978a–979c	
d. Hobbies relating to handicrafts: modelmaking, needlework, ceramics, and woodworking		**8**:979c–980g	

Introduction to Part Five:

Man the social animal

by Harold D. Lasswell

We are part of society when we share in comprehensive arrangements for living with one another and for managing the environment. The simplest societies are the primitive bands who to this day live in jungles and deserts, and on isolated mountains and beaches around the globe. The most complex technological societies bind the world's cities together as part of an evolution that, barring catastrophe, is forming a planetary society of mankind.

Whether primitive or civilized, all societies must cope with the parallel problems that are generated by the urgencies of human nature and the necessities of a common life. Arrangements are made for kinship and procreation; for safety, health, and comfort; for producing and consuming commodities and services. Arrangements also develop latent talent into skills of communication, body movement, and environmental management. Institutions specialize in the gathering and dissemination of news and images of the natural and social environment. Some institutions give respect or disrespect to individuals and groups on a temporary or permanent basis, and distinguish between what is considered to be responsible or irresponsible conduct. Government, law, and politics seek to resolve the conflicting demands that arise within or among communities.

At first glance we are less likely to be impressed by the parallels than by the differences among societies. The differences are conspicuous, if we consider, say, a horde of big-city commuters as compared with a band of technologically handicapped people who are continually in search of the next meal. An anthropologist who lived with such a band a few years ago in the rain forests of eastern Bolivia reported that apart from the hammocks they slept in, three-foot digging sticks, and cumbersome long bows and arrows, these naked seminomads carried no material objects with them. Modern urban dwellers usually feel some contempt for these bearers of an Old Stone Age culture and speculate on a possible weakness of the brain to account for their lack of technological progress. Such speculations are dismissed by modern anthropologists as without foundation. As we get acquainted with primitive societies it dawns upon us that they have met some of the same problems that we have by adopting solutions whose ingenuity equals or even excels our own. This may apply, for instance, to arrangements for transmitting political authority from one generation to the next, or for preventing violently aggressive behaviour.

Societies do indeed differ from one another in the degree that they encourage specialization. In the simplest societies everybody does everything, with exceptions that are closely linked to differences of sex and age. On the other hand, many tribes use professional specialists, such as warriors, medicine men, blacksmiths, potters, weavers, musicians, and carvers. The world that we call civilized appeared with the invention of writing. Literacy provides a means of storing and retrieving information without relying exclusively on the memory of the old. Records and education multiply the number of learned professions. Urban civilization marks the emergence of such institutions as the territorial state, formal legislative codes of law, regular taxes, bureaucratized civil and military services, monumental public works, complex systems of taxation, and official records.

One way to bring out the degrees of likeness and difference among societies, whether primitive or civilized, is to compare the priorities that are given to institutions of the same kind. No one doubts that every society must concern itself to some extent with food. It is only in bands of the kind mentioned above that near-total preoccupation with hunger deemphasizes, although without abolishing, all other interests. Where existence is less hard the accumulation of wealth may become the principal value sought, as among some merchant cities and trading tribes. War and preparation for war may take top priority as it did for millennia among the shepherds of Inner Asia and the river-valley agriculturalists who were conquered by herdsmen-warriors. Some agricultural societies emphasize worship and encourage forms of knowledge, like astronomy, that enhance religion. In some societies, notably in East India, the accent is on ritual purity or impurity, and every kin group is assigned a position in the respect system of caste and class.

While priorities may remain stable for generations in a given society, this is not necessarily the case. At one time the peoples of Scandinavia were warriors and brigands. Today we perceive them as among those who are most involved with the values of civil society. In the United States, the early colonizers of New England were heavily oriented toward religion, morality, and political freedom. More recently, the most general trend has been toward secular activities, especially those connected with wealth. Throughout the contemporary world, "development" often carries the connotations of economic modernization, political independence, scientific education and research, personal freedom, and social justice.

Besides allocating priorities, every society strikes a temporary or durable balance between the accumulation and the immediate enjoyment of every value. The modes of accumulation depend on the value in question. Investment in wealth production, for instance, may involve adding fertilizers to the soil, or building an infrastructure of roads and bridges, or inculcating the values of saving and investment. Expanded educational opportunity implies that more per capita hours of teaching and learning, and more physical equipment, are made available, and that the importance of education is successfully communicated. If health opportunities are to be multiplied, it is necessary to add facilities and to spread the practice of personal hygiene. A society cultivates public enlightenment with installations for scientific and scholarly purposes, and for mass communication. Human relations improve as the roles of love, friendship, and loyalty expand in "an era of good feeling," and as social discrimination wanes. Levels of responsible conduct typically rise as opportunities become more available for worship and more people join in formulating and applying moral standards. During a given period the institutions of government, law, and politics sometimes accumulate more support.

The examples mentioned above refer to the "positive" accumulation of a valued outcome. Accumulations may be "negative," as when disasters destroy property, spread epidemics, or interfere with education.

All societies necessarily make arrangements for the sharing of wealth, power, and other values. Among individuals and groups these arrangements exhibit all degrees of equality and inequality. Wealth and income are sometimes widely

distributed. By contrast, they may be monopolized in the hands of a few. Political participation may be dispersed or concentrated. Opportunities may be equalized or monopolized for health, education, and information; or for respect, affection, and responsible conduct.

Characteristic of every society is the attempt to maintain itself by controlling the minds of young and old. People not only hunt or plow, trade or fight. They are also likely to believe in what they do and how they do it. It is not necessarily true that in a system of inequality those who occupy any particular station, however exalted or lowly, entertain any doubts about the justification of the system. A stable society carries on within the framework of a common map of perception, belief, and identity. In such a setting the individual learns from earliest infancy to think, feel, and act in ways that bring positive rather than negative consequences from the social and natural environment. Socialization is the process by which private motivations are channelled into acceptable public acts.

In civilized societies reliance on the results of early education is heavily supplemented by government, law, and politics. The legal system is made up of several sets of authoritative and controlling prescriptions. One set is constitutive. It prescribes "who decides what and how." It centralizes or decentralizes formal and effective power, and it separates power among agencies and groups. Structures may be differentiated to plan, to promote, to legislate, to execute, or to review and appraise. Regulation defines the degree of protection given to the fundamental institutions of every sector of society. Tradition alleges that a legal order is blind to values and practices that lie outside the established beliefs, faiths, and loyalties ("ideologies") of the society with which it is involved. In consequence, legal systems may defend widely different balances between value accumulation and enjoyment, and sharply contrasting patterns of equality and inequality in the sharing of political power, wealth, respect, or any other value. The legal order may protect economic systems whose structures are capitalistic, socialistic, or cooperative; family systems that permit one or more members of the sexes to marry and raise children; religious faiths that exalt monotheism and polytheism; and so on through the infinite variety of human practices.

One set of prescriptive norms is supervisory. Individuals and groups may be given wide latitude to make private contractual agreements or to seek redress of private wrongs. Nonetheless, the decision makers of the community are prepared to play a supervisory role by enforcing common norms if an unsettled private controversy is brought to their notice by the parties. Prescriptions also lay down the principles and procedures to be followed if the body politic organizes and administers a continuing enterprise, of which services of transportation, communication, banking, insurance, and housing are examples. A legal system includes correctional or sanctioning measures to obtain compliance with prescribed norms. Value deprivations are imposed on those who have failed or are expected to fail to comply. Deprivations range in severity from capital punishment, confiscation of property, or life imprisonment, to a light fine or reprimand.

A legal system is stabilized when the effective elements in society perceive themselves as relatively better off by continuing the system than by adopting alternative arrangements. To some extent a legal order may exhibit cyclical fluctuations, as when deviations are tolerated within limits which, if exceeded, generate reform activities that restore the former situation with little change. In a capitalist economy "creeping monopoly" may invade trade unions, employers' associations, or natural resource and industrial enterprises. In a socialist economy "black markets" may introduce "creeping competition." In either case, cyclical movements may restore the original relationship before they have quietly stabilized a structural innovation, or prepared the way for violent revolutionary change.

If the view is correct that worldwide interdependence is increasing, the traditional blindfold of legal systems must be put aside long enough to give explicit consideration to competing value goals and practices around the globe. Interdependence implies that whether they like it or not, the members of an emerging planetary society must take one another into account. Being taken into account implies that beliefs, faiths, and loyalties, as well as overt behaviours, are examined by public and private decision makers. The demand to be better informed about the social environment creates an enormous opportunity and responsibility for those who study society.

We expect anthropologists to provide us with knowledge of primitive societies and other specialists to focus on the processes and institutions of civilized society. Political scientists and legal scholars concentrate on government, law, and politics. Economists specialize in the production and distribution of wealth. The role of educators is relatively clear. So, too, is the role of sociologists who concern themselves with a sector of society, such as the family, social class and caste, professions and occupations, communication, public health, or comparative morals and religion.

Social scientists are continually under pressure to provide a map of the past and probable future impact of the forces that shape society. They are asked, for instance, to explain the causes of war and other forms of violence, and to suggest strategies that lead to "victory" in a specific conflict or to show how war itself may be eliminated as an instrument of public policy. Social scientists are asked for explanations of why an economy experiences inflation, or how it generates changing levels of employment and unemployment. Specialists are expected to discover the sources of alienation that separate young and old or threaten the unity of a family, a school, a church, a political party, or a national state. These examples suggest the wide-ranging demands that confirm the importance of adding to our knowledge of society.

We recognize the existence of a problem when we perceive that our goals are inconsistent with one another or when there are discrepancies between what we want and what we have or expect. In public policymaking, the first step is to answer the question, "Whose values are to be realized?" The social scientist who participates in tackling or solving a policy problem has an option: he may adopt the criteria of a "client" or he may rely on his own values.

The study of social institutions is sometimes affected by diverging norms of professional responsibility. No conflict need arise if a social scientist is personally committed to a line of research that happens to be popular with influential members of the body politic. No anxiety or guilt is felt if the findings are applied by current decision makers. A frequent example is the study of administrative agencies according to their "dollar efficiency" or according to the accuracy and speed of communication between central offices and field stations.

In contrast to this harmonious relationship is the inner and perhaps visible turmoil of social scientists whose research interests are unacceptable to many members of the current establishment. The researchers may want to study the effect of military expenditures on society. The problem may be to find how a given level of military outlay modifies the structure of the civilian economy and influences both the production and delivery of services specialized for health, education, public information, family welfare, and other social outcomes. If the information gathered in the course of a given project is classified as secret, no scientist can lawfully report his findings. Perhaps the investigator will violate the letter of the law in the hope of mobilizing an effective demand for change. But it may be that such a strategy will backfire. Instead of arousing community protest against authority, the revelations may result in established leaders successfully taking advantage of an alleged "breach of security" to suppress inquiry and discussion.

Another complication affecting the social investigator is the degree of genuine consent that he must obtain from those whom he proposes to study. Physicians, surgeons, and biologists confront similar questions when they plan to give a test, run an experiment, administer a drug, or perform an operation. Is it always necessary to explain to a prospective subject the risks he will run? Is the investigator professionally or legally bound to make sure that the language of explanation can be understood by the individual concerned? If a social scientist plans to study the facts of life in a prison or a mental hospital, should he reveal his purpose, even when it would be easier to gain confidence by posing as a fellow prisoner or a fellow patient? Similar issues rise in connection with field studies of primitive tribes, of peasant communities, of foreign societies, and of many other social settings.

In recent times, professional opinion has emphasized the importance of obtaining "shared participation" in the pursuit of knowledge. Many investigators willingly accept the challenge of cultivating group demand for a project and for a hand in data gathering and analysis. At every stage, arrangements are made for laymen to work side by side with professional sociologists, social psychologists, political scientists, and other investigators. As a result, some communities have learned to study themselves, assessing the degree to which they are involved in ethnic and other forms of discrimination. Unusual groups have joined in self-study. For instance, murderers and persons who have survived as targets of murderous assault have cooperated in scientific research on the causes and consequences of murder, and on possible strategies of prevention. Instead of resenting the role of "guinea pig" in science, it is typical for those who choose to participate in programs of self-observation to improve their individual insight while contributing to the enhancement of society's stock of knowledge.

Whether the client or the investigator is the source of the value criteria adopted for a policy problem, questions of value priority are bound to arise. The relative importance of political, economic, and other aims cannot be satisfactorily settled in programs of national or regional development unless the full range of possible goals is considered. It is essential to take timing into account. When a new nation-state first secedes from an empire, political power has top priority. The "ex-colony" tries to ensure its independence of external control, to obtain support from outside powers, and to unify its people. Economic development occupies a high priority position. Other targets seem to be less urgent, such as health, education, the expressive arts, and environmental protection. The allocation of manpower and facilities to various institutions depends on the priority of the specific outcomes in which they specialize.

Social scientists have an indirect influence on priorities by asking questions about them, and also by presenting a factual map of past trends, causes, and future contingencies. Scientists often devise small-scale pretests in order to try out solutions that may eventually be applied on a larger scale.

In adapting to the needs of this interdependent world, the scientists of society require of themselves that they measure the direction and intensity of the value demands of political, economic, ethnic, and all other identifiable groups anywhere on the globe. Acknowledging the perils of a divided and militant world, the most compelling task is to discern and make public the conditions under which a world public order of government and law could become a more perfect instrument of human dignity, security, and welfare. Many small-scale programs show how to reduce the human cost of transforming today's inadequate institutions into more effective systems of communication and organization.

For the first time in history it can be truly asserted that the scientists of society have been provided with technological instruments of sufficient sophistication to assist in meeting the demands that are made upon them. Retrieval and dissemination make it possible to map past, present, and future events. Social analysts know that the key question for the future is to resolve whether or not the spectacularly changing technology of knowledge, and especially knowledge of society, will be in the hands of a limited class or caste that seeks to serve its own advantage. The alternative is to share the control of information widely among all territorial and pluralistic groups. Unless individuals and groups are able to obtain access to comprehensive stocks of information, they will be blind judges of public policy. Without adequate access, their criticism will be dismissed as exercises in ignorance and bias. Critics will be in no position to develop realistic alternatives to the plans of governmental or private monopolists of knowledge. "Knowledge is power"; if there is to be self-control, there must be prompt and total access to information.

The chief novelty about the computer and other technically advanced means of processing and transmitting information is that, in principle, everyone can be given prompt access to a selective "map of the whole." An image of the total deployment of man in space or of the total activities of a corporate enterprise can be made available to everyone from the highest official to the humblest worker. The salient facts can be made vivid, concise, and substantially accurate in images that may be supplemented in whatever detail is desired. The range of possible expenditures for any political, economic, or social program can be summarized and related to its potential impact on society.

Human society has attained an unparalleled height of danger and opportunity. The study of society shares in both. The unprecedented accumulation of knowledge enables us to recognize that the scale of our problems is also without precedent.

Part Five. Human society

All studies of mankind take account of the effect of man's being a social animal. This is true of the treatment in Part Four of man's evolution, his health, his general nature and behaviour, his language, and his daily life. It is also true of the treatments, in subsequent parts, of man's art, his technology, his religion, his history, and his sciences and philosophy.

A special set of interrelated sciences, however, take society and social behaviour as their direct subject of inquiry. The outlines, and the articles and parts of articles referred to, in the six divisions and the twenty-five sections of Part Five are concerned with the complementary work of these social sciences.

The social sciences have themselves been the object of historical and analytical study. These studies are presented in the articles referred to in Section 10/36 of Part Ten. The outline in that section covers the history of the social sciences generally, and the nature, scope, methods, and interrelations of anthropology, sociology, economics, and political science.

The social sciences have become increasingly interdependent and interpenetrating, and no regulative agreement exists about how their distinction should be understood. Nevertheless, the diverse domains are, in practice, distinguishable. The breakdown of Part Five into six divisions reflects the currently operative distinction between cultural and social anthropology, the several branches of sociology, economics, political science, jurisprudence and law, and educational philosophy and science.

Division I. Culture 283
II. Social organization and social change 294
III. The production, distribution, and utilization of wealth 311
IV. Politics and government 332
V. Law 352
VI. Education 371

Division I. Culture

The outlines, and the articles and parts of articles referred to, in the two sections of Division I set forth anthropological accounts of the development and the variety of sociocultural forms.

The articles referred to in Section 511 deal first with primitive and other nonurban cultures and second with the cultures of civilized societies. They then treat issues and general theories about social and cultural change.

Section 512 deals first with diverse theories of culture and with conceptions involved in the analysis of culture. It goes on to treat the major cultural components of human societies, such as social, economic, kinship, and aesthetic systems. Fifty-one articles are then referred to that treat regional cultures in all parts of the world.

Section 511. The development of human culture 283
512. The variety of sociocultural forms 286

Section 511. The development of human culture

The articles and parts of articles referred to in Section 511 deal with two main subjects: A, cultural development; and B, the processes of cultural change.

The outline of subject A begins with the cultures of primitive and nonurban societies, treating the distribution and characteristics of the cultures of hunters and gatherers, of pastoralists and herdsmen, and of peasants and settled agriculturalists. It goes on to deal with the cultures of civilized societies. Here, it first treats early theories, 19th- and early 20th-century theories, and recent theories about the origin and evolution of the cultures of civilized societies. Finally, it deals with the development of modern industrial civilization, treating the nature of modernization; the emergence of modernization in nonmodern societies; the processes of modernization in modern societies; and the patterns of transition to modernity.

The outline of subject B treats the basic concepts of cultural change, and the basic inducements of cultural change, covering various forms of acculturation or cultural adaptation.

	articles	article sections	other references
A. Cultural development			
1. Cultures of primitive and non-urban societies	HUMAN CULTURES, PRIMITIVE AND NON-URBAN **8**:1159–1167	**14**:988a–h	
a. Cultures of hunters and gatherers: distribution and characteristics		**8**:1159c–1162a / **2**:424d–428f / **3**:1090f–1091g / **5**:730f–731b / **9**:46h–48b	**14**:839c–f / **16**:638c–641e *passim* / **17**:927b–928b *passim*
i. Nomadic hunting and gathering societies		**8**:1159c–1160h / **1**:696d–h / **11**:935h–936c / **13**:205d–207b / **13**:216g–218c / **13**:224e–227a / **16**:725b–726d / **17**:112f–116a / **17**:116e–g / **17**:706d–708b	**1**:694h–695d / **2**:195e–g / **16**:1060a–b
ii. Settled hunting and gathering societies		**8**:1160h–1161d / **1**:1126b–h / **13**:228a–230a / **13**:251h–254f / **17**:116g–117d / **19**:789e–791h	**1**:695d–g / **10**:450f–451a
iii. Horticultural societies: societies in which primitive agriculture is supplemental to hunting and gathering		**8**:1161d–1162a / **3**:620h–622g / **6**:169f–172e / **12**:122c–126a / **13**:218d–g / **13**:470b–h / **14**:778a–h / **17**:121d–124h / **17**:218g–222b / **17**:305h–308g	**1**:855h–856a / **10**:451g–452c
b. Cultures of pastoralists and herdsmen: distribution and characteristics		**8**:1162a–1163a / **1**:628b–631a / **1**:1126h–1127f / **3**:1119h–1121g / **6**:110d–114d / **6**:133d–134g / **10**:449c–e / **12**:170b–f	**6**:1013f–g / **11**:574e–g / **19**:798h–799a
c. Cultures of peasants and settled agriculturalists		**8**:1163b–1167f / **1**:826f–828g / **9**:863b–866g / **11**:936c–937a / **18**:26g–28b / **19**:796g–798h	**8**:42a–e
i. Distribution and characteristics of peasant societies, ancient and modern		**8**:1163b–1164c / **6**:414e–g / **17**:117d–118e	**3**:1120b–c / **6**:1013d–e / **15**:47c–d
ii. Types of peasant societies: the community of self-serving households; the village with internal specialization and exchange; closed regional market systems		**8**:1164c–1167a / **1**:284a–c / **6**:126f–127f / **6**:1063h–1065d / **6**:1126e–1127e / **11**:852f–853h / **11**:865d–f / **11**:936f–937a / **11**:938e–h / **11**:954g–956e / **12**:169e–170b / **13**:218g–220e / **13**:245h–248b / **14**:711c–f / **16**:27a–d / **17**:128f–130e / **17**:224d–228h	**1**:325f–g / **2**:193g–195e / **4**:391b–f / **6**:125a–e / **6**:1123g–1124a / **9**:864c–h / **11**:295g–296a / **11**:573c–574e / **12**:165b–g / **18**:1075e–f / **19**:798d–f
iii. The role of the peasantry in political revolutions, past and present		**8**:1167a–f / **4**:384g–386e / **15**:47c–d	**7**:652d–e / **8**:459a–462e *passim* / **11**:466f–g / **11**:558f / **16**:66e–69b *passim*

	articles	article sections	other references
2. Cultures of civilized societies: theories of their origin and evolution	CIVILIZATION AND CULTURAL EVOLUTION **4**:657–660	**1**:697d–h / **10**:485a–c / **11**:301b–h	**8**:1153c–g
a. Early theories: human progress and perfectibility		**4**:657c–f	**15**:787c–788d *passim* / **18**:808e–g
b. 19th- and early 20th-century theories: unilinear evolution; rationalized or telic progress; cultural diffusion		**4**:657f–659e / **1**:970d–972f / **7**:867b–f / **16**:955e–956d	**9**:194d–195h *passim* / **15**:788d–789a
c. Recent theories: cyclical history, urban revolution, and multilinear evolution		**4**:659e–660e / **16**:956d–g / **19**:933e–g	**6**:203d–206g *passim* / **10**:485b–c / **15**:789a–c
3. The development of modern industrial civilization	INDUSTRIALIZATION AND MODERNIZATION **9**:520–527		
a. The nature of modernization		**9**:520f–521f / **6**:229e–230a / **6**:770g–771h	**16**:373h–374b
b. The emergence of modernization		**9**:521f–523f / **1**:631a–f / **2**:428g–429e / **3**:622g–623e / **3**:906c–g / **3**:1108b–h / **6**:134h–135f / **6**:1016d–1017b / **6**:1065d–g / **8**:476c–f / **9**:866g–867b / **11**:854b–d / **11**:869g–870b / **13**:227a–d / **13**:230a–c / **13**:248d–249a / **13**:254g–255d / **14**:783e–784e / **16**:726d–727b / **17**:124h–125e / **17**:308g–309e / **19**:799g–800a	**1**:283g–284a / **6**:202h–203b
c. Processes of modernization		**9**:523f–525f / **12**:126a–127a	
i. Ideological changes		**9**:523g–h / **6**:115d–e / **18**:704h–705b	**1**:285d–e
ii. Economic changes		**9**:523h–524b / **4**:391f–393c / **6**:115a–d / **6**:202c–210e / **6**:230b–235h / **6**:236h–242a / **6**:315f–316c / **12**:175c–f / **15**:29g–31g / **15**:39b–h / **16**:29d–f / **18**:1076e–1077c	**1**:100h–101b / **1**:631c–f / **1**:828h–829a / **1**:1023a–b / **4**:394e–395b / **4**:1005c–f / **4**:1009h / **6**:272b–c / **11**:577f–g / **11**:601g–602a / **12**:126c–d / **13**:471f–g / **19**:792b–d
iii. Political changes		**9**:524c–e / **6**:114e–115a / **6**:277b–f / **17**:447c–449b	**1**:284h–285a / **2**:199h–200a / **12**:126d–e
iv. Social changes		**9**:524e–525f / **4**:851h–852a / **4**:852f–h / **6**:168e–g / **6**:235h–236h / **7**:157f–158a / **7**:165b–c / **16**:29f–30c / **16**:952g–953a / **17**:130e–h / **18**:1078d–1079c / **19**:911d–912a	**1**:285a–b / **1**:829a–c / **2**:200a–b / **8**:865f–h / **9**:194b–197e *passim* / **10**:477d–e / **11**:577h–578d / **12**:126e–127a / **13**:470h–471e / **13**:1049f–1051f *passim* / **14**:816f–g / **16**:924b–f / **16**:956e–g / **18**:24h–25e / **19**:906h–907c

	articles	article sections	other references
d. Patterns of transition to modernity		**9**:525f–527d	
i. In various types of societies		**9**:525h–526d / **3**:1121h–1122e / **6**:127g–128d / **11**:297a–f / **12**:170f–171a	**14**:244f–245b
ii. As common patterns effecting an international system of societies		**9**:526d–527a / **12**:127a–e / **14**:716b–g / **16**:30e–h / **17**:229e–230b / **18**:569h–570g	**6**:236h–242a *passim*
iii. Changes in modernization patterns: a comparison of the patterns occurring in emerging nations and the traditional patterns of the West		**9**:527a–d / **4**:1123a–f / **6**:128d–129h	**4**:670b–f / **6**:203h–210e *passim* / **6**:255e–263e *passim*
e. Problems and prospects of modern civilization: man's adjustment to societal changes		**9**:527d–g / **1**:829c–h / **11**:577d–578b / **11**:603g–604e / **16**:27e–28b / **16**:375e–f	**6**:1080f–1081c / **17**:125c–e / **18**:22c–24e *passim*
B. Processes of cultural change	SOCIAL AND CULTURAL CHANGE **16**:920–923		
1. The basic concepts of cultural change: culture and society; change and stability		**16**:920b–922c / **4**:659e–660e / **8**:1156d–g	
2. The basic inducements of cultural change		**16**:922c–923d / **11**:1017g–1018a / **16**:977d–978d	
a. Acculturation or adaptation to foreign influences		**16**:922c–f	**8**:1155e–f
b. Adaptation to conflict		**16**:922f–g	
c. Responses to the environment		**16**:922g–923b	
d. Adaptation to demographic conditions		**16**:923b–d	

Section 512. The variety of sociocultural forms

[for Part Five headnote see page 283]
for Division I headnote see page 283]

The articles and parts of articles referred to in Section 512 deal with four main subjects: A, diverse theories of culture; B, the major cultural components of human societies; C, peoples and cultures of the world; and D, the controversy about the concept of cultural areas.

The outline of subject A, after dealing with various definitions of culture, treats conceptions involved in the analysis of culture. It covers conceptions of the influence of the cultural milieu on the individual; conceptions involved in the comparisons of cultures; conceptions of the causes and forms of cultural adaptation and change; conceptions about patterns and configurations of culture; and conceptions about cultural institutions.

The outline of subject B, the major cultural components of human societies, first deals with social systems. It here treats the varieties of group organization within societies, and the varieties of status organizations, with special attention to class systems, caste systems, and systems containing slavery or serfdom. The outline goes on to economic systems. Here it deals first with the nature of economic systems in nonliterate societies. It then treats the cultural effects of different forms of production; of exchange, distribution, and wealth; of property and property rights; and of different patterns in the changing of economic systems. The outline next deals with the functions, types, and cultural effects of kinship systems and with the cultural effects of different types of aesthetic systems. The outline further indicates other sections that treat, as cultural components, educational systems, belief systems, legal systems, and linguistic systems.

Subject C is the peoples and cultures of the world. Here fifty-one articles are referred to that treat cultures in various parts of the Arctic, North America, Middle America, South America, Europe, the Middle East and North Africa, Asia, sub-Saharan Africa, and Oceania.

Subject D deals with the concern of geographers, anthropologists, and historians with the concept of a "cultural area"—the concept involving a socially or culturally identifiable human population; a "natural" environment; and some postulated, implied, or identified interaction between the two. The article referred to treats the design and purpose of cultural areas, and sketches theories, from the earliest times to the present, about the manner in which cultural areas are determined.

	articles	article sections	other references
A. Diverse theories of culture: conceptions involved in the analysis of culture	HUMAN CULTURE **8**:1151–1158	**5**:365d–368d	
1. Definitions of culture		**8**:1152a–1154b	

	articles	article sections	other references
2. Culture and personality: the influence of the cultural milieu on the individual		**8**:1154b–e/ **9**:524e–525f/ **14**:44e–f/ **16**:991a–c	
3. Cultural comparisons: ethnocentrism; cultural relativism; evaluative grading		**8**:1154e–1155b	
4. Cultural adaptation and change: ecological change; acculturation; evolution		**8**:1155b–1156a/ **1**:697d–h/ **4**:1123a–f/ **6**:168e–g/ **6**:1124a–e/ **11**:557f–578d/ **13**:207c–g/ **14**:1033a–h/ **14**:1035b–f/ **16**:921d–923d/ **17**:222b–d/ **18**:698b–699c	**8**:1004h–1007c/**9**:522e–g/ **9**:524d–e/**13**:194g–h/ **17**:221d–e
5. Cultural patterns and configurations: traits, areas, and types		**8**:1156a–d/ **6**:1123g–1124e/ **7**:867b–f/ **8**:473d–g/ **9**:521e–523f/ **15**:350c–351c	**1**:279c–e
6. Cultural institutions		**8**:1156d–1158h	
B. Major cultural components of human societies [see also 511]			
1. Social systems			
a. Varieties of group organization within societies		**5**:1070e–f/ **6**:1119a–c/ **8**:1159c–1167a/ **11**:853a–c/ **11**:946f–h/ **12**:123g–124a/ **12**:263c–265e/ **16**:946c–947a/ **16**:955c–956g/ **19**:933g–h	**1**:628f–h/**3**:904h–905b/ **3**:1074g–1075b/ **6**:133h–134b/**9**:523b–c/ **9**:525b–f/**9**:1078h–1079b/ **9**:1083b–1084h *passim*/ **10**:481g–485c *passim*/ **11**:294h–295b/**11**:578b–d/ **13**:252b–f/**17**:114e–115b/ **17**:121h–122a/**19**:798a–b
b. Varieties of status organization	SOCIAL DIFFERENTIATION AND STRATIFICATION **16**:953–959	**1**:122a–b/ **1**:827g–828a/ **1**:851g–852b/ **3**:621b–e/ **4**:1120h–1122f/ **6**:123d–h/ **6**:170f–172a/ **7**:871c–g/ **9**:863g–864h/ **13**:225b–d/ **13**:470c–d/ **16**:29f–30c/ **16**:600f–601c/ **16**:639b–e/ **16**:725b–d/ **16**:948g–952f/ **19**:934h–935b	**1**:629b–c/ **6**:317f–319a *passim*/ **8**:1159h–1160b/**9**:523c–e/ **11**:295d–e/ **11**:951g–953b *passim*/ **11**:978h–979a/**12**:264c–f/ **14**:782a–c/**17**:122c–d/ **17**:219g–220b/**17**:228e–g/ **19**:797c–f
i. Class systems [see also 523.B.]	SOCIAL CLASS AND MOBILITY **16**:946–953		
ii. Caste systems	CASTE SYSTEMS **3**:982–991	**5**:731g–732a/ **5**:735g–736d/ **6**:166c–167f/ **8**:904a–c/ **8**:910g–h/ **16**:857g–858a/ **17**:126h–127f	**1**:837a/**5**:734c–e/**8**:909a–c/ **8**:912h–913b/**8**:1164e–g/ **9**:347e–h/**12**:263g–264b/ **14**:846g–h/**15**:300e–f/ **16**:746e/**17**:130e–g
iii. Systems containing slavery or serfdom	SLAVERY, SERFDOM, AND FORCED LABOUR **16**:853–863	**17**:282f–283c	**6**:126c–d/**8**:341e–h/ **8**:1164g–1166a *passim*/ **11**:972b–c/**13**:195g–196a/ **16**:320a–c/**17**:278e–279f/ **19**:766h–772b *passim*

	articles	article sections	other references
2. Economic systems [see also 531.E.6.a. and 712.A.]	ECONOMIC SYSTEMS, PRIMITIVE **6**:278–280		**6**:273h–274a
a. The nature of economic systems in nonliterate societies		**6**:278b–g / **2**:427b–h / **6**:133d–g / **8**:1156g–1157g / **12**:124e–125a / **13**:253b–254b / **16**:725e–h	**1**:847e–h / **3**:621g–h / **4**:1119c–f / **8**:1159c–1167a *passim* / **11**:295g–296a / **13**:225g–226b / **13**:247b–g / **17**:275c–f / **18**:1075e–g
b. Production: motivation of production; division of labour; role differentiation		**6**:278h–279e / **1**:696f–h / **3**:905d–h / **4**:1122f–g / **6**:167g–168a / **12**:265f–266d / **14**:779d–780d / **17**:220f–221e / **19**:932f–933e	**1**:629g–630c / **3**:621g–622a / **8**:1164c–1167a *passim* / **11**:296b–c / **11**:853c–d / **11**:866d–e / **12**:170a–b / **16**:955g–956c / **17**:123c–f / **17**:129a–e / **18**:1076e–f / **19**:790d–e / **19**:798f–799a
c. Exchange, distribution, and wealth		**6**:279e–280b / **1**:122b–e / **5**:731e–f / **8**:1164c–1167a / **11**:955g–956c	**1**:630c–e / **3**:622a–c / **8**:1156h–1157c / **8**:1161b–d / **11**:867f–868a / **12**:125c–e / **13**:226c / **14**:781a–c / **19**:799b
d. Property and property rights		**6**:280c–f / **6**:168a–c / **6**:1015a–e / **15**:46d–47c	**1**:629e–g / **6**:1128f–1129e / **8**:1157c–g / **8**:1161e–f / **9**:585g–586a / **9**:866b–d / **11**:853d–e / **11**:867e–f / **12**:125b–c / **12**:169f–g / **13**:247g–248a / **14**:780d–781a / **17**:123f–g
e. Traditional and modern patterns of change in economic systems and relationships		**6**:280f–h / **6**:210a–e / **6**:770g–771h / **8**:1167a–f / **9**:523h–524b	**8**:1166f / **14**:820b–g / **14**:821b–d
3. Kinship systems: their functions and types	KINSHIP **10**:477–485	**7**:155b–156h / **7**:169a–173c	**5**:31f–h / **6**:1127e–g / **14**:839d–f
a. General aspects of kinship		**10**:477a–479c	**8**:1159g–1160b / **19**:909a–c
i. Elementary families and genealogies		**10**:477f–478b / **7**:155b–g / **7**:166f–167a	**6**:1013g–1014a / **11**:574h–575a / **14**:781g–782a / **17**:228a–b
ii. Kin terms: names for various relations among kin		**10**:478b–d	
iii. The domestic family		**10**:478d–479c / **11**:853e–f / **16**:29a–c	**1**:628h–629b / **1**:828c–d / **3**:905d–f / **6**:111a–c / **8**:475c–d / **12**:123c–d / **17**:127f–h / **17**:307a–c / **17**:307f–g
b. Sexual activity and marriage		**10**:479c–481g / **16**:599e–600f	**13**:206b–c / **16**:594a–f
i. Laws and customs regarding mate selection, marriage, incest, exogamy, endogamy, marriage alliances, and customary exchanges of property and services accompanying marriage		**10**:479c–481c / **6**:111g–112b / **7**:155g–156a / **7**:158c–159h / **7**:169a–172c / **13**:1051d–f / **16**:607d–g	**1**:695g–h / **1**:828d–e / **2**:425g–426c / **3**:1179h–1180b / **4**:1121h–1122c / **6**:111c–d / **6**:134d–e / **7**:201b–d / **9**:865a–d / **11**:575b–d / **11**:868b–d / **12**:123e–f / **13**:224f–h / **17**:115b–c / **17**:122b / **17**:128a–c / **17**:220b–d / **19**:789g–790a / **19**:797g–h
ii. Laws and customs regarding adultery, wife lending, divorce, and legitimacy		**10**:481c–g / **7**:162d–164e / **7**:167g–168d / **7**:172d–h	**3**:905b–d / **11**:575d–e / **13**:246f–h / **19**:790a–b
c. Kinship and the community		**10**:481g–483a / **14**:1038f–1039f	**10**:449g–h / **10**:451c–g
i. Rules of residence; *e.g.*, virilocal, uxorilocal, neolocal		**10**:481g–482a	

	articles	article sections	other references
ii. Customary behaviour among kin: traditional specifications of respect, familiarity, avoidance, and joking among kin		**10**:482a–c	**1**:828a–c/**11**:868b–c/ **13**:224g–225a
iii. Procreation and paternity: laws and customs regarding motherhood and fatherhood		**10**:482c–g/ **1**:828f–g/ **16**:927c–928f	**2**:426c–d/ **6**:413a–414d *passim*/ **7**:166d–169a *passim*/ **9**:591a–b/**11**:575e–f/ **11**:576d–f/**11**:868f–g/ **17**:220d–e/**19**:798b–c
iv. Quasi-kin relations: fictive or ritual kin; *e.g.*, godparents		**10**:482g–h	
v. Nepotism		**10**:483a	
d. Descent systems: unilineal, cognatic, and variant systems		**10**:483b–484b/ **2**:424f–425c/ **3**:1120e–g/ **4**:1119f–1120h/ **6**:111d–g/ **6**:123h–124c/ **6**:166g–167d/ **11**:868a–d	**6**:125f–126c/**9**:863g–864b/ **9**:1078h–1079b/**11**:295b–d/ **13**:224h–225b/**13**:228f–h/ **13**:1048c–e/**14**:781c–g/ **17**:306a–c/**19**:909a–b
e. Control of resources, inheritance, and succession: the family as a centre for transmission of economic, political, religious, and other attributes		**10**:484b–h/ **4**:1121g–1122f/ **6**:112b–d/ **6**:1119c–h/ **7**:171d–172c/ **9**:587a–595b/ **12**:124a–c/ **13**:225d–f	**9**:865d–f/**11**:295f–g/ **11**:575g–576a/**13**:247a–b/ **13**:252f–253a/**15**:49h–50b/ **17**:115d–g/**17**:227c–d
f. Ancestor worship and totemism		**10**:484h–485a/ **1**:835f–836b/ **4**:1122h–1123a/ **6**:127b–f/ **6**:134f–g/ **6**:167d–f/ **12**:884a–d/ **14**:1046d–f/ **18**:529b–530c	**6**:113h–114b/**7**:312d–g/ **11**:869c–d/**14**:1041d–1042f/ **16**:876a–e/**17**:129f–130b/ **19**:791b–f/**19**:799c–e
g. Kinship and theories of social evolution: kinship as an evolving social institution		**10**:485a–c/ **2**:426d–427a/ **3**:1120g–1121a/ **5**:731b–e/ **14**:711a–c/ **17**:128c–f	**6**:1014a–c/**8**:42a–43c/ **8**:475e–h/**13**:251h–252b/ **17**:122e–g
4. Education and socialization: formal and informal enculturation [see 521.C. and 563.D.]			
5. Systems involving belief		**6**:172b–e/ **6**:1128b–c/ **8**:898c–899f/ **8**:1158b–e/ **10**:449e–f/ **12**:919a–h/ **14**:1041g–1043a/ **15**:864f–865d	**10**:451b–c/**12**:797g–798b/ **12**:801b–e
a. Religion [see 811]			
b. Magic and witchcraft [see 812.B.1. and D.6.]			
c. Folklore	FOLKLORE **7**:461–466	**6**:906h–907d/ **10**:1046a–b/ **12**:794b–795g/ **16**:167g–h	**8**:407g–408b
6. Systems of law [see 551.B.]			
7. Cultural aesthetic systems [see also 611, 612, and 613]		**2**:81f–82c	
a. The development of style in the arts: the idea of cultural styles		**5**:982h–985f/ **12**:670e–671c/ **14**:1032g–1033a	**1**:1102d–e/ **2**:127h–132c *passim*

	articles	article sections	other references
b. Cultural functions of art		**1**:1102e–1104b / **2**:106f–109b / **4**:959f–960c / **7**:463h–465h / **13**:280g–283a / **13**:861c–e / **14**:804g–805e / **14**:1034g–1035a / **17**:743e–744d / **19**:175g–176c	**1**:235c–h / **5**:981b–d / **7**:470f–480g *passim*
c. Differing canons of critical judgment in the arts		**2**:44f–56d / **2**:82c–h / **2**:103b–104b / **13**:297h–298e / **14**:1031d–1032c / **14**:1034b–f / **14**:1035h–1036c / **17**:744d–f	**1**:149g–162b *passim* / **2**:88c–89d *passim* / **10**:1037b–1041d *passim* / **14**:804g–806e *passim*
d. Differing professional attitudes of artists		**2**:100b–h / **2**:102c–e / **2**:132b–c / **14**:806a–c	
e. The interaction of artist and audience		**1**:1104h–1108g / **2**:100h–102b / **2**:110h–112d / **5**:987e–988b / **14**:805e–806e	**5**:981d–g
f. The relationship between a culture's subsistence level and its art		**2**:109b–110h / **2**:132f–h / **7**:465a–h / **12**:670e–671c / **14**:1032g–1033a	**1**:234f–235c
g. The effect of social organization on artistic styles		**2**:104b–105e / **2**:129g–130a / **2**:132f–133a / **5**:985c–f / **11**:945d–g / **13**:448g–450b / **13**:861d–e / **14**:804h–805e / **14**:1032c–d	**1**:233h–234e / **1**:1089f–1090d / **7**:463b–c / **13**:456g–457b / **19**:175d–f / **19**:249h–250b
h. The effect of religious organization on artistic styles		**1**:1090d–1091g / **2**:115h–117b / **2**:130g–131a / **2**:428b–f / **3**:440g–441b / **3**:1178a–h / **4**:959f–h / **8**:906a–f / **9**:923e–924e / **11**:1005f–1006b / **11**:1006e–f / **12**:783f–784g / **12**:798b–799c / **14**:1032e–g / **17**:969h	**1**:234e–f / **1**:677d–h / **5**:983c–d / **5**:983g–984a / **7**:474e–475d / **8**:410c–e / **8**:913b–c / **8**:915c–d / **9**:260c–g / **9**:983h–984h / **11**:296h–297a / **11**:944d–g / **12**:729e–g / **14**:1045e–f / **19**:259c–h / **19**:345d–363d *passim*
i. The geographic distribution of the various types of aesthetic systems		**2**:130c–e / **7**:465a–466e / **7**:476e–480g	**5**:982h–985c *passim*
8. Linguistic systems [see 442]			
C. Peoples and cultures of the world			
1. In the Arctic	ARCTIC PEOPLES AND CULTURES **1**:1123–1130		
a. In the eastern Arctic	EASTERN ARCTIC CULTURES **6**:132–135	**1**:1126h–1127f / **3**:1139c–1140a	**1**:1129e–f
b. In the western Arctic	WESTERN ARCTIC CULTURES **19**:789–792	**1**:1126b–h	**1**:1129h–1130f / **8**:412g–h

	articles	article sections	other references
2. In North America	NORTH AMERICAN PEOPLES AND CULTURES **13**:213–223	**1**:658d–f / **1**:679b–684h / **3**:611h–612b / **7**:478e–479d / **14**:847c–h / **14**:928g–929a	**13**:194c–f / **16**:793c–e
a. In the sub-Arctic	AMERICAN SUB-ARCTIC CULTURES **1**:694–697	**6**:1065a–b	**1**:411c–h / **1**:659g–660a / **1**:666a–b / **1**:672e–f / **1**:682g–683c / **5**:730g–731b / **18**:702g–h
b. On the Northwest Coast	NORTHWEST COAST INDIANS **13**:251–255	**8**:1160h–1161d	**1**:660a–d / **1**:673h–674c / **1**:683c–684h / **18**:702c–e
c. In California	CALIFORNIAN INDIANS **3**:620–623		
d. On the Plateau	NORTH AMERICAN PLATEAU INDIANS **13**:227–230		
e. In the Great Basin	NORTH AMERICAN GREAT BASIN INDIANS **13**:204–207		
f. In the Southwest	SOUTHWEST AMERICAN INDIANS **17**:305–309	**1**:679c–680b / **18**:1069a–d	**1**:660e–661b / **1**:667b–f / **1**:674c–675a / **15**:303d–e / **18**:702e–f
g. On the Plains	NORTH AMERICAN PLAINS INDIANS **13**:223–227		**1**:661e–g / **1**:666g–h / **1**:673e–h / **1**:680b–681e / **8**:1160d–h
h. In the eastern woodlands	EASTERN WOODLANDS INDIANS **6**:169–173		**1**:661b–d / **1**:666b–f / **1**:672g–673e / **18**:701h–702c
i. In the Southeast	SOUTHEAST AMERICAN INDIANS **17**:218–222		**6**:1141f–g / **7**:426c–d
3. In Middle America	MIDDLE AMERICAN PEOPLES AND CULTURES **12**:164–167	**1**:684h–687f / **14**:847c–h / **14**:929b–e / **18**:1069d–1070c	**1**:675a–h / **7**:479d–g / **13**:194d–f
a. In northern Mexico	NORTH MEXICAN INDIAN CULTURES **13**:245–249	**3**:610h–611d	**1**:667g–668b
b. In Meso-America	MESO-AMERICAN INDIAN CULTURES **11**:954–956	**3**:609c–610g / **11**:961e–962f	**1**:668b–e / **11**:934f–947b *passim*
c. In Central America and the northern Andes	CENTRAL AMERICAN AND NORTHERN ANDEAN CULTURES **3**:1106–1108		**1**:661h–662c / **6**:733c–g
d. In the Caribbean	CARIBBEAN CULTURES **3**:904–906	**1**:687d–f	**18**:701f–h
4. In South America	SOUTH AMERICAN PEOPLES AND CULTURES **17**:116–120	**1**:662c–f / **1**:675h–676d / **1**:688b–691f / **14**:847c–h / **14**:929f–930a / **17**:106a–109g / **17**:111f–112b	**18**:701b–f

	articles	article sections	other references
a. In the central and southern Andes	ANDEAN CULTURES **1**:854–856	**1**:847e–854a / **3**:611d–g	**1**:668g–669a
b. In the tropical forest	SOUTH AMERICAN TROPICAL FOREST CULTURES **17**:120–125		
c. Among the South American nomads	SOUTH AMERICAN NOMAD CULTURES **17**:112–116		
5. In Europe	EUROPEAN PEOPLES AND CULTURES **6**:1121–1125	**1**:325h–326b / **1**:443g–444g / **9**:47e–48c / **14**:58h–61b / **14**:64a–65a / **14**:842b–f / **17**:706d–708b / **19**:897g–899b	
a. On the Atlantic fringe	EUROPEAN ATLANTIC COAST, FOLK CULTURES OF THE **6**:1063–1065	**3**:476a–g	**7**:478c–d / **16**:793c–e
b. On the plain	EUROPEAN PLAIN, FOLK CULTURES OF THE **6**:1126–1129	**3**:1064h–1065c / **7**:310b–311c / **18**:1024g–1025c / **18**:1025g–1026a / **19**:345g–346b	**7**:477a–478c / **16**:792h–793b
c. Along the Mediterranean	MEDITERRANEAN FOLK CULTURES, WESTERN **11**:852–854	**1**:238d–f / **5**:406a–d / **18**:1067a–g / **19**:277h–282e	**7**:476f–477a / **19**:284f–300c *passim*
d. On the Alpine climax	ALPINE FOLK CULTURES **1**:627–631		
6. In the Middle East and North Africa	MIDDLE EASTERN AND NORTH AFRICAN PEOPLES AND CULTURES **12**:167–171	**5**:1020c–e / **11**:963h–969e / **14**:842f–843b / **18**:1065h–1066f	**9**:973b–982e *passim* / **17**:502c–e
a. In the Maghrib: northwestern Africa	MAGHRIB, CULTURES OF THE **11**:293–297	**19**:344b–345d	**1**:562f–563e / **2**:305d–306c / **13**:145g–146d
b. In the Mashriq: northeastern Africa and southwest Asia	MASHRIQ, CULTURES OF THE **11**:573–578	**9**:952c–954a / **9**:982e–983e	**1**:325a–e
c. In Iran	IRANIAN CULTURES **9**:862–867	**9**:450d–456f / **18**:1066f–1067a	**9**:824b–d
d. In Turkey	ANATOLIAN CULTURES **1**:825–829	**1**:834a–835b / **2**:23c–24a	**1**:113b–122h *passim* / **18**:786h–788d
7. In Asia	ASIAN PEOPLES AND CULTURES **2**:193–200	**7**:479h–480g / **14**:61b–62c / **14**:65a–f / **14**:845c–846c / **18**:238h–239e / **18**:550g–531b / **18**:703h–704e	**16**:638c–641e *passim*
a. In Siberia	SIBERIAN CULTURES **16**:724–727	**2**:195h–196a / **18**:1025c–g / **18**:1026h–1027d	
b. In Central Asia	CENTRAL ASIAN CULTURES **3**:1119–1122	**1**:638e–g / **2**:196b–e / **3**:1122f–h	**8**:885f–886a / **10**:410f–411a

	articles	article sections	other references
c. In East Asia	EAST ASIAN CULTURES **6**:122–129	**2**:197c–198a / **4**:410f–414h / **4**:1098g–1099c / **5**:1035d–1038h / **10**:97d–98b / **10**:1050b–e / **16**:796f–797f / **18**:1068d–1069a / **19**:174b–175a / **19**:207d–f / **19**:215d–216f	**10**:530e–534c *passim* / **10**:1050g–1073c *passim* / **17**:778g–h / **19**:175d–177b
d. In South Asia	SOUTH ASIAN CULTURES **17**:125–130	**2**:196e–197c / **3**:983g–987f / **3**:988h–991b / **5**:1038h–1039f / **8**:898c–899f / **8**:927h–928d / **17**:131c–132c / **18**:530h–531b / **18**:1067h–1068d	**6**:885g–h / **17**:132h–206h *passim*
e. In Southeast Asia	SOUTHEAST ASIAN CULTURES **17**:222–230	**2**:198a–d / **17**:230g–233g / **18**:530g–h	**2**:486h–489a *passim* / **3**:506c–e / **11**:372f–373a / **17**:233h–273a *passim*
8. In sub-Saharan Africa	AFRICAN PEOPLES AND CULTURES **1**:278–285	**1**:232g–256e / **1**:289d–f / **6**:885h–886b / **14**:65f–66a / **18**:702h–703h / **18**:1070h–1071c	**14**:62c–f / **16**:791f–g / **16**:792e–h
a. In the western Sudan	WESTERN SUDAN, CULTURES OF THE **19**:796–800	**1**:256e–262d	
b. In the eastern Sudan	EASTERN SUDAN, CULTURES OF THE **6**:165–168	**1**:256e–262d	
c. On the Guinea coast	GUINEA COAST, CULTURES OF THE **8**:472–476	**1**:262d–268c	**10**:853c–f
d. In the Congo	CONGO, CULTURES OF THE **4**:1118–1123	**1**:221g–225e / **1**:271c–276c / **14**:843b–h	**9**:1176h–1177g / **13**:89f–90f
e. In central and lower East Africa	EAST AFRICAN CULTURES **6**:109–115	**1**:269b–h	**1**:280c–h / **10**:374c–e / **12**:597b–c
f. In the East African Horn	ETHIOPIAN AND SOMALIAN CULTURES **6**:1012–1017	**1**:268d–g	**16**:1058e–1060f
g. Among the Khoisan peoples: Hottentots and Bushmen	KHOISAN CULTURES OF AFRICA **10**:448–452	**1**:228f–231d / **14**:843h–844b	**1**:280h–281b / **10**:374f–375a / **19**:57g–58a
9. In Oceania	OCEANIAN PEOPLES AND CULTURES **13**:468–471	**13**:448d–454b / **13**:828a–f / **14**:844b–845c / **18**:704e–h	**2**:63d–e / **2**:485g–486b / **2**:489g–490c / **13**:454c–467e *passim* / **16**:792b–e
a. In Australia	AUSTRALIAN ABORIGINAL CULTURES **2**:424–429	**6**:885c–f / **13**:466f–467e / **14**:844b–e / **18**:530c–e	**2**:404h–405c / **13**:243h–244a
b. In Melanesia	MELANESIAN CULTURES **11**:864–870	**13**:454h–455e / **13**:461g–463g	**2**:491a–492b / **7**:296e–h / **8**:1161f–h / **12**:1089e–f / **13**:828c–e
c. In Polynesia	POLYNESIAN CULTURES **14**:777–784	**13**:455f–456c / **13**:464c–466c	**2**:492c–d / **2**:492g–493c / **13**:46d–f / **13**:828b
d. In Micronesia	MICRONESIAN CULTURES **12**:122–127	**13**:463h–464c	**2**:493c–f / **13**:828c

	articles	article sections	other references
D. The controversy about cultural areas: various theories about the nature of the interaction between human populations and their environments	CULTURAL AREAS, THEORIES ABOUT 5:364–368		

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BOAS, FRANZ 2:1155
MALINOWSKI, BRONISLAW 11:386
TYLOR, SIR EDWARD BURNETT 18:808

Division II. Social organization and social change

[for Part Five headnote see page 283]

The outlines, and the articles and parts of articles referred to, in the five sections of Division II present general sociological theories of social order and social change, and sociological studies of basic social institutions, social processes, and social problems.

The articles referred to in Section 521 treat the structure of society; the social effects of bureaucratic and industrial specialization; social control; and the process of social change.

Section 522, on the group structure of society, treats the various types of groups; the social effects of racial and ethnic prejudice; some special social problems arising from group structure and various social differences; and social and welfare services.

Section 523, on social status, treats the processes of social differentiation and social stratification, and the varieties of social stratification and social mobility.

Section 524 treats the nature and forms of collective behaviour; the concept of mass society and its characteristics; the formation of public opinion; and the expression of collective behaviour in the form of social movements.

Section 525 treats the determinants, composition, and change of human populations; historical and contemporary theories and policies concerning population; the development of modern cities; and the development of modern rural societies.

Section 521. Social structure and change 294
522. The group structure of society 297
523. Social status 303
524. Collective behaviour and mass society 305
525. Human populations: urban and rural communities 307

Section 521. Social structure and change

[for Part Five headnote see page 283]

The articles and parts of articles referred to in Section 521 deal with four main subjects: A, the structure of society; B, the social effects of bureaucratic and industrial specialization; C, social control; and D, the process of social change.

The outline of subject A begins with various ways to discern and describe or state fundamental patterns in social affairs. It treats one by one the major models or approaches: the culture-pattern model, the structure-function model, the conflict model, the physical-science model, and the mathematical or logical model. The outline next deals with the types of organized social structures or communities, and it treats, as influencing the organization of communities, kinship or tribal institutions, religion, political and territorial factors, and economic factors.

The outline, after indicating that the social effects of industrialization and modernization have been treated in Section 511, goes on to the social effects of organizational specialization. Here it treats the conception and historical development of bureaucracy; classical and managerial theories of bureaucracy; and recent functionalist and conflict theories of the structure and dynamics of organizations. The outline further deals with the social effects of industrial specialization and automation. Here it treats conceptions of the worker and the manager; the structure of work careers; factors affecting workers' and managers' attitudes and behaviour; and conflict and conflict resolution between labour and management.

The outline of subject C, social control, begins with the process of socialization, treating the aims of socialization, the agencies of socialization, and different views of its effects. It goes on to theories of alienation, covering definitions, causes, and manifestations of alienation and proposed solutions for it. The outline then deals with resocialization and social conversion—the regulation of behaviour that departs from social norms. It treats first the purposes and major forms of the punishment, rehabilitation, and reform of criminals. It then treats resocialization by psychological therapy and by various forms of persuasion.

Subject D is the process of social change. The outline indicates that definitions and broad theories of social change are treated in Section 511. It goes on to the phases of social change—innovation, selection, and integration. It then deals with factors operative in change: ideology, contact with other cultures, environment, demography, art, religion, science, philosophy, economics, and technology.

	articles	article sections	other references
A. The structure of society: diverse theories of social structure and organization; various types of social structure	SOCIAL STRUCTURE AND ORGANIZATION **16**:991–993	**8**:1156d–1158h / **8**:1159a–c	**3**:495c–g
1. The culture-pattern model: the theory that characterizes society according to the purposes, motives, emotions, and values of individual personality types		**16**:991c–g / **8**:1154b–e / **8**:1156a–d	
2. The structure-function model: the theory of society as representing collective categories (communities) to which the individual is subordinate		**16**:991g–992c	
3. The conflict model: the theory that views the social structure and its elements as products of conflict between groups or individuals competing for power		**16**:992d–h / **3**:495h–496e / **16**:922f–g	
4. The physical-science model: the theory that systematic relationships and social structure can be analyzed from empirical data		**16**:992h–993b	
5. The mathematical, or logical, model: the theory that human relationships can be expressed and analyzed in mathematical terms		**16**:993b–e	
6. Types of organized social structures or communities		**9**:521f–525f	**4**:657h–660c *passim* / **13**:251h–252f
a. The influence of kinship or tribal institutions on the organization of communities		**1**:694h–695g / **6**:170f–172a / **10**:481g–485a / **11**:946f–h / **13**:224e–f / **14**:711a–f / **15**:47a–c	**6**:110d–h / **6**:1013g–1014c / **6**:1126f–1127f / **8**:1159c–1167a *passim* / **9**:346e–f / **9**:864a–d / **10**:449c–452c *passim* / **13**:205d–206a / **13**:245d–246d
b. The influence of religion on the organization of communities		**4**:508f–511a / **9**:912b–g / **12**:335h–336d / **12**:337g–339f / **15**:605f–606a / **15**:649c–e	**3**:985d–h
c. The influence of political and territorial factors on the organization of communities		**11**:951g–953d / **15**:47d–h	**9**:526d–527a / **13**:849c–e / **14**:707f–713b *passim* / **18**:894f–g
d. The influence of economic factors on the organization of communities [see 531.E.]			
B. The social effects of bureaucratic and industrial specialization			
1. The social effects of industrialization and modernization [see 511.A.3.]			
2. The social effects of organizational specialization	BUREAUCRACY **3**:484–496	**1**:92b–e	**4**:658h–659a / **14**:1101d–h
a. The nature of bureaucracy: an "ideal" conception		**3**:485b–e / **2**:9g–11f	
b. Historical development of bureaucracy: the bureaucratization of the state in western Europe		**3**:485f–487g / **12**:156h–157h	**4**:667g–668g
c. Classical theories of bureaucracy dealing with the effect of large-scale organizations on the power structure of society: Marxist, Weberian, and oligarchic theories		**3**:487g–491a / **11**:554d–557a	**16**:947f–948g *passim*
d. Managerial theories of bureaucracy dealing with organizational efficiency and productivity; *e.g.*, scientific management, formalist theories of administration, human relations, and decision making		**3**:491b–494b / **14**:122d–e / **15**:25c–27f / **19**:939e–940c	**7**:189a–191e *passim*
e. Recent converging trends: functionalist theories of systemic and integrative aspects of the organization; conflict theories of groups and group strategies within the organization		**3**:494b–496f / **16**:922f–g	**14**:700d–701a
3. The social effects of industrial specialization and automation	INDUSTRIAL AND ORGANIZATIONAL RELATIONS **9**:495–512	**2**:513b–h	**4**:659a–c
a. The evolution of industrial relations: conceptions of the worker and the manager		**9**:495d–499b / **9**:505c–507c / **14**:118h–119e	
b. Comparisons of organizational behaviour in various national and regional social structures		**9**:499c–501h	

	articles	article sections	other references
c. Work careers: the structure of work careers; social mobility between classes of workers		**9**:501h–503b / **16**:949e–950a	**14**:119h–121f *passim*
d. Worker behaviour and formal organization: various factors affecting workers' attitudes and behaviour; characteristics of managerial leadership		**9**:503c–507c / **3**:491b–494b / **5**:185f–186d / **14**:121c–122c / **16**:961f–964h / **19**:939e–940c	**2**:513d–e / **15**:186a–d
e. The relationship between technological innovation and organizational changes [see also 712]		**9**:507d–508f / **1**:1021e–1022d	**18**:46g–h
f. The roles of scientists and engineers in industrial organization		**9**:508g–510d	**8**:1168a–1169h *passim*
g. Conflict and conflict resolution between labour and management [see also 534.C.1.b. and g.]		**9**:510e–512b / **1**:1076c–1077a / **3**:495h–496f	
C. Social control			
1. The process of socialization: the transmission of patterns of normative behaviour			
a. The aims of socialization; *e.g.*, social roles, social disciplines, goals, skills		**2**:12h–13g / **6**:413b–414d / **12**:189e–g / **12**:262e–h / **15**:649c–e / **16**:599e–600f / **19**:1094d–1095a	**7**:466c–d / **8**:1160c–d / **13**:1050c–1051a *passim* / **14**:1097e–1098b *passim*
b. Socializing agents or agencies		**1**:696a–c / **2**:426c–427a / **6**:112b–d / **8**:1158e–h / **11**:955c–956e / **12**:649f–650b / **14**:667g–668f / **14**:782d–g / **15**:593g–h / **17**:308a–d	**3**:1085g–1090b *passim* / **7**:464g–465a / **9**:926c–933a *passim* / **13**:228h–229a / **13**:252f–253a / **14**:662a–b / **15**:609f–h
i. The role of the family		**7**:156d–h / **15**:281c–h / **19**:1093f–1094d	
ii. The role of peer groups		**2**:13h–14b / **5**:272h–273d / **6**:416d–f	**8**:1145d–f
iii. The role of education		**6**:416d–f / **6**:417g–418f / **8**:1157g–1158b / **14**:989g–990a / **18**:12g–14b	**6**:316d–f
c. Views of the effects of socialization		**5**:268d–h / **8**:1143h–1144e	**7**:21a–f / **9**:521a–b / **14**:1040d–1047d *passim* / **15**:300g–301c / **15**:593h–594a
2. Theories of alienation: definitions, causes, manifestations, and proposed solutions	ALIENATION **1**:574–576	**5**:267c–e / **15**:364h–365b / **16**:958g–959a	**11**:554d–555a / **11**:602g–603a
3. Resocialization and social conversion: the regulation of behaviour that departs from social norms			
a. By punishment, rehabilitation, and reform of criminals	PRISONS AND PENOLOGY **14**:1097–1103		**2**:785h–786b
i. The punishment of criminal behaviour: the purposes of punishment; major forms of punishment		**14**:1097e–1099a / **5**:272a–c / **15**:283d–284d	
ii. The rehabilitation and reform of criminals: the influence of the social structure and penal practices on the penal community; probation and parole as forms of supervision and correction outside prison		**14**:1100b–1103g / **5**:273h–274f / **16**:932b–933a	
b. By psychological therapy		**11**:912f–914a / **15**:142g–148g / **16**:931g–932a	
c. By persuasion: factors influencing a person's attitudes or behaviour; factors influencing a person's resistance to persuasion		**14**:123b–126h	

	articles	article sections	other references
D. The process of social change	SOCIAL AND CULTURAL CHANGE **16**:920–923	**9**:520e–521f	
1. The concept of change: definitions, issues, and theories [see 511.B.]			
2. Phases of social change: innovation, selection, and integration		**16**:921d–922c / **16**:977d–978d	
3. Factors operative in social change		**16**:922c–923d / **4**:851h–852a / **15**:365f–h / **15**:789a–790g / **16**:978d–979a	**14**:726b–728c *passim*
a. The role of ideology in social change	IDEOLOGY **9**:194–198		**15**:40b–c
i. The relationship between ideological politics and civil politics: the importance of ideology to a political or social movement		**9**:195h–196d / **4**:378f–380h / **15**:790c–g	**15**:787c–789a *passim* / **16**:974g–h
ii. The relationship between ideology and violence: impassioned commitment to social change		**9**:196d–h / **13**:851b–e	**4**:847h–848b / **8**:460b–461d *passim* / **12**:266g–h / **15**:790c–e
iii. The uses of ideology to promote or prevent social change		**9**:196h–198c / **4**:381b–389b	**11**:1017g–1018a / **12**:262h–263a
b. Contact with other cultures as a factor in social change		**16**:922c–f / **2**:428g–429e / **3**:906c–g / **12**:126a–127a / **12**:262e–h / **13**:254g–255d / **17**:124h–125e	**8**:1155e–f / **10**:654f–656f *passim* / **12**:166f–167a / **13**:245f–g
c. The influence of environment as a factor in social change		**16**:922g–923b	
d. The role of demographic factors in social change		**16**:923b–d	**3**:750f–g / **6**:1124c–e
e. The role of art in social change: art as an ideological instrument		**2**:114a–115b / **6**:907g–908c / **13**:282a–d	**16**:270e–271g *passim*
f. Religion as a factor for and against social change		**4**:512f–514a / **7**:202d–e / **8**:918h–920a / **12**:792h–793c / **14**:1007g–1008b / **15**:608h–611g / **15**:649c–e / **15**:986b–e	**5**:732a–736d *passim* / **11**:1021a–1022a *passim* / **15**:593a–b / **16**:599a–d / **18**:698b–f / **19**:896d–e / **19**:1015b–c
g. The role of intellectual factors in social change		**13**:282a–d	**6**:315f–316a / **8**:865f–867d *passim* / **9**:194b–197a *passim*
h. The relationship of economic factors to social stability		**6**:202c–203c / **6**:214b–217d / **9**:522e–524b	**12**:175c–f / **14**:935a–936a *passim* / **14**:938g–939e *passim* / **16**:955g–956f
i. Technological factors in social change		**7**:165d–e / **9**:523g–h / **13**:470e–h / **15**:29g–31g / **18**:22g–24e	**4**:1009b–c / **4**:1009g–h / **6**:315d–f / **6**:315h–316c / **8**:865f–867d *passim*

Section 522. The group structure of society

[for Part Five headnote see page 283
for Division II headnote see page 294]

The articles and parts of articles referred to in Section 522 deal with four main subjects: A, the various types of groups; B, the social effects of racial and ethnic prejudice; C, special social concerns; and D, social and welfare services.

The outline of subject A first deals with two ways of classifying groups: dichotomous or contrasting classifications, and classifications bearing on the nature of membership or interpersonal relations. It goes on to deal with small groups—groups characterized by extensive interpersonal relations. It treats the essential determinants of the small group and the major areas of concern in small groups. Dealing with the modern family, the outline covers the diverse types of families and marital unions; patterns of human sexual behaviour; the history of the Western family; the development and organization of the modern family; and changes in the form and structure of the modern family caused by social and technological developments. The outline next deals with the types, motivation, structure, and political activities of special-interest groups and with the power, strategy, and tactics of pressure groups. Finally, it deals with minorities and ethnic groups. Here it treats the nature of minorities and ethnic groups; the characteristics of cultural diversity; the types of societies with cultural divisions; and the functions of minorities and ethnic groups.

The outline of subject B begins with definitions of race, racism,

ethnic group, and ethnocentrism. It then treats theories about the causes of racial prejudice and discrimination and about the effects of racial discrimination; laws regarding racial restrictions; and issues about the reduction of racial discrimination.

Subject C comprises certain special social concerns involving various groups or categories of people. The outline treats problems and concerns that arise from these social groupings: adolescents, the aged, women, the poor, criminals and delinquents, sexual deviants, prostitutes, drug users, and suicidal persons.

Subject D is social service, afforded by organized public and private activities addressed to human wants and needs. The outline first deals with the historical and modern influences affecting the appearance and characteristics of social and welfare services. It then deals with the various fields of social service. Here it treats family welfare, child welfare, youth welfare, group welfare, disaster relief, community development, medical and psychiatric social services, school social services, and correctional services—probation, parole, and delinquency control.

	articles	article sections	other references
A. The various types of groups: patterns of group relations	SOCIAL GROUPS **16**:959–964		**16**:850e–f
1. Classifications of groups		**16**:959e–960h / **8**:1156d–g	
a. Dichotomous or contrasting classifications		**16**:959e–960c	
i. Primary and secondary groups		**16**:959e–g / **17**:445d–g	**2**:13e–g / **3**:491h–492c / **9**:495d–496b
ii. *Gemeinschaft* and *Gesellschaft*: community and society		**16**:959g / **16**:27a–d	
iii. In-group and out-group		**16**:959h	
iv. Membership group and reference group		**16**:959h–960a / **16**:974e–975c	**15**:42d–e / **16**:27f–28b
v. Social group and statistical group or category		**16**:960a–c	
b. Classifications bearing on the nature of membership or interpersonal relations		**16**:960c–h	
i. Artificial aggregates: statistical categories		**16**:960c	
ii. Unorganized aggregates: audiences, crowds, and publics		**16**:960d / **4**:846e–848d / **4**:849c–e	
iii. Social units with patterned relationships: cultures, subcultures, and kinship groups		**16**:960d–e / **10**:477a–478d	
iv. Structured social units: societies, communities, and families		**16**:960e–f / **16**:29a–c	
v. Deliberately designed social units: organizations, suborganizations, and task groups		**16**:960f	**2**:13e–g / **3**:491h–492c / **9**:495d–496b
vi. Less deliberately designed social units: voluntary associations and friendships		**16**:960g	**17**:445d–g
2. Groups characterized by extensive interpersonal relations: the small group		**16**:960h–964h	**15**:42d–e
a. Essential determinants of the small group		**16**:960h–961b	
b. Major areas of concern: interacting factors		**16**:961f–964h	
i. The individual in the group: social facilitation		**16**:961g–962d	
ii. Group composition: personality, ability, and performance level		**16**:962d–h	
iii. Other factors: power, influence, conformity, communication, attraction, and conflict		**16**:962h–963g / **14**:699h–700c	
iv. Norms and roles: definitions and functions		**16**:963g–964c / **2**:13h–14b / **16**:974e–975c	**8**:1145d–f
v. Problem-solving effectiveness: the individual versus the group		**16**:964c–f / **18**:357a–c	**15**:148b–d
3. The modern family: its organization and functions	FAMILY AND MARRIAGE **7**:155–166		
a. General characteristics of kinship systems [see 512.B.3.]			
b. The diverse types of families and marital unions		**7**:155b–156h / **1**:284c–e / **6**:111a–112b / **10**:477a–480g	**13**:246d–247a / **6**:471f–g / **11**:955c–d / **13**:1048c–e / **14**:781g–782a
c. Patterns of human sexual behaviour: the range of societal influences, attitudes, and values as evidenced in premarital, marital, and extramarital behaviour	SEXUAL BEHAVIOUR, HUMAN **16**:593–601	**7**:156e–g / **10**:479c–481g	**7**:156e–g / **9**:865a–d / **12**:920g–921a / **14**:778f–h / **14**:818e–822a *passim* / **15**:75h–78e *passim* / **15**:298h–304a *passim* / **17**:1039h–1040a / **19**:915d–f / **19**:1095e–h
d. History of the Western family		**7**:157a–158c	

	articles	article sections	other references
i. Premodern families		**7**:157a–f / **2**:425c–426c / **15**:556g–h	**4**:409d–g / **5**:369h–370c / **6**:502c–g / **8**:400a–e / **8**:747h–748a / **8**:1159c–1167a *passim* / **13**:206a–c / **15**:1056h–1057d / **19**:909d–910d *passim*
ii. Effects of industrialization and urbanization on the family		**7**:157f–158a	**10**:477d–e / **14**:819f–822a *passim* / **16**:926c–927c *passim* / **18**:1079b / **19**:910d–912a *passim*
iii. The family in contemporary society		**7**:158a–c / **19**:915a–f	
e. The development and organization of the modern family		**7**:158c–165a / **9**:920c–f	
i. Mechanisms of mate selection		**7**:158c–159f / **10**:479c–e	
ii. The marriage ceremony: religious and civil aspects		**7**:159f–h / **13**:1051d–f	**7**:201b–d
iii. The life cycle of the family		**7**:160a–161a / **13**:547g–h / **19**:915a–f	**13**:1049f–1052a *passim*
iv. Roles of the family members throughout the life cycle of the family		**7**:161a–162c / **8**:1144e–1145a / **10**:482c–g	**13**:549e–f / **19**:913g–914f / **19**:1092f–h
v. Family conflicts; ideological disputes between parents and children		**7**:162d–163e / **7**:166a–b	
vi. Divorce and remarriage in modern society		**7**:163e–165a / **7**:171h–172d / **10**:481e–f	**15**:999b–c
f. Changes in the form and structure of the modern family caused by social and technological developments		**7**:165b–166b / **15**:1001d–e	**10**:477d–e
i. Effects of technology on the family		**7**:165d–e / **16**:600f–601c / **19**:911d–912a	**9**:524e–g
ii. The movement toward female equality		**7**:165f–166a / **7**:170d–172c / **19**:911d–915f	
4. Special-interest groups	SPECIAL-INTEREST GROUPS **17**:445–449	**16**:975g–h	
a. Motivation, structure, and political activities of special-interest groups		**17**:445d–446b / **4**:850f–g	
b. Various types of special-interest groups		**17**:445d–446b	
i. Vocational groups: unions, guilds, professional associations, and vocational organizations		**17**:445d–f / **5**:436a–d / **9**:510e–h / **15**:204f–205b	**6**:383a–c
ii. Voluntary groups; *e.g.*, recreational, economic, religious, cultural, philanthropic		**17**:445f–g / **6**:296a–h / **6**:740h–741f / **8**:1092a–c / **12**:336b–d / **12**:337g–339f	**1**:448d–f / **4**:201b–e / **7**:374h–375h / **12**:660h–661a
iii. Political groups: parties and pressure groups		**17**:445h–446b / **14**:677h–681d	
c. Pressure groups: power, strategy, and tactics		**17**:446c–447b / **9**:510e–512b / **14**:680a–681d	**9**:195h–197e *passim* / **15**:38b–c
5. Minorities and ethnic groups	MINORITIES AND ETHNIC GROUPS **12**:260–267		
a. The nature of minorities and ethnic groups		**12**:260h–262c / **15**:360b–f	**16**:219h–220e / **18**:928c–929e
b. Characteristics of cultural diversity: types of adjustments		**12**:262c–263b / **15**:355f–356c / **15**:361b–363d	**2**:428g–429e / **5**:700f–h / **8**:1149h–1150d / **14**:114g–h
c. Types of societies with cultural divisions: pluralistic societies		**12**:263c–265e / **16**:948g–950g	

	articles	article sections	other references
i. Relatively stratified societies		**12**:263e–264e / **3**:983g–989g / **13**:470c–d	**16**:954f–h
ii. Relatively unstratified societies		**12**:264f–265e	
d. Functions of minorities and ethnic groups		**12**:265e–267f	
i. Economic roles		**12**:265f–266d	
ii. Political roles		**12**:266d–267d	**3**:729a–c / **18**:928f–929a
iii. Roles in challenging existing values		**12**:267d–f	
B. The social effects of racial and ethnic prejudice	RACISM **15**:360–365		**4**:520e–h
1. Definitions of race, racism, ethnic group, and ethnocentrism		**15**:360a–f / **13**:468h–469b	**12**:261h–262c / **15**:355h–356a
2. Racial discrimination and prejudice		**15**:360f–361b / **2**:361h–362c / **8**:1149h–1150d / **17**:291g–293f	**16**:954f–955a
3. History of racism		**15**:361b–363b / **15**:355h–356c	**6**:1023f–1024a / **12**:262a–b
a. In non-European countries		**15**:361b–362a / **16**:857h–858a	**3**:983d–985d *passim* / **9**:347e–h
b. In European countries		**15**:362a–c / **16**:863h–864h	
c. In European colonial countries		**15**:362c–363b / **2**:428g–429e / **4**:888h–889d / **6**:394g–395h / **9**:416c–417g / **10**:695a–696c / **13**:469g–470a / **16**:860f–863b / **17**:295d–296f	**1**:405g–h / **2**:404g–405c / **7**:875d–876d / **9**:409d–f / **10**:698g–699a / **10**:700c–g / **11**:567f–g / **11**:616b–g / **12**:936f–940a *passim* / **13**:195g–196a / **15**:818h–819a / **15**:820h–822c *passim*
4. Theories about racism		**15**:363b–365d / **3**:982h–983f	
a. Causes of racial prejudice and discrimination: psychological, socio-economic, political, religious, and cultural factors		**15**:363d–364g / **3**:750c–g	
b. Effects of racial discrimination; *e.g.*, cultural exclusion, physical separation, psychological effects		**15**:364g–365d / **5**:733b–c	**5**:267f–h / **6**:417g–418a / **6**:772f–g / **9**:674e–g / **9**:676f–677a / **11**:110e–h / **12**:941b–942a *passim* / **18**:928f–929e
5. Laws regarding race; *e.g.*, miscegenation, formal segregation, apartheid, immigration restrictions		**3**:989g–991b	**6**:1024a–b / **11**:616c–d / **14**:822b–d / **17**:70d–73a *passim* / **17**:295d–296f *passim*
6. The reduction of racial discrimination		**15**:365d–h	**8**:1187h–1188b / **14**:125c–e / **17**:96c–f
C. Special social concerns			
1. The adolescent	YOUTH, SOCIAL ASPECTS OF **19**:1090–1097	**5**:272c–e / **5**:1059h–1060b / **11**:912f–914a / **16**:927c–929b	**16**:954c–e
a. Biological, psychological, and social aspects of adolescence		**19**:1091b–1092h / **8**:1145a–h	**16**:596a–597d *passim*
b. Status and function of youth: in primitive, traditional, and modern industrial societies		**19**:1092h–1093e / **1**:828f–g	**2**:194b–e
c. Socializing agents: family, education, and work [see 521.C.1.b.]			
d. Changing roles and attitudes; *e.g.*, youth as consumer, youthful sexual behaviour		**19**:1095a–1096b	
e. Trends in youthful behaviour: types of conformity and nonconformity [see also C.6.d., below]		**19**:1096b–1097d	
2. The aged	OLD AGE, SOCIAL ASPECTS OF **13**:546–552		

	articles	article sections	other references
a. Status of the aged in modern society		**13**:546c–547h	**14**:816h–817a /**16**:954c–f
b. Biological, psychological, and social effects of aging		**13**:547h–550f / **1**:305f–310a / **5**:862b–g	
c. Programs for the aged		**13**:550f–551h / **8**:249g–h / **19**:746b–749c	**16**:927b–c
d. Future status of the aged		**13**:551h–552c	**14**:822h–823a
3. Women	WOMEN, STATUS OF **19**:906–915	**7**:165f–166a	**15**:80f–h /**16**:953h–954c
a. Theories and beliefs regarding male–female differences [see also 523.A.2.a.i.]		**19**:906a–908h	
b. Historical perspectives: ancient civilizations to the 19th century		**19**:908h–911c / **5**:1070c–d / **12**:148a–c / **15**:76c–h	**4**:523b–d /**6**:351b–c / **6**:363f–g /**6**:366g–h / **6**:502b–e /**12**:340a–c / **16**:953h–954a
c. Contemporary cross-cultural perspectives: political rights, education, employment, marriage, and family		**19**:911c–915f / **3**:478f–g / **18**:539c–d	**1**:828a–c /**6**:529a–b /**8**:475c–d / **8**:1188c /**9**:409b–d / **9**:864h–865d /**10**:568c–d / **15**:78f–80h *passim* /**16**:28g–h
4. Cultural minorities [see A.5., above]			
5. The poor	POVERTY **14**:935–939	**5**:267h–268a / **19**:753h–754e	**5**:272e–g / **16**:923f–929h *passim*
a. Types of poverty		**14**:935c–936c	**6**:771h–772h *passim* / **8**:1163e–f
i. Cyclical poverty		**14**:935c–e	**6**:771g–h
ii. Collective poverty: generalized and concentrated		**14**:935e–936a / **6**:202c–e	**12**:266b–d /**14**:821b–c
iii. Case poverty: individual inabilities or handicaps		**14**:936a–c	**8**:690d–f
b. Attitudes toward poverty		**14**:936c–938g	
i. Traditional views; *e.g.*, laissez-faire theory, poverty as essential to economic growth, the "survival of the fittest"		**14**:936c–h	
ii. Changing attitudes in the 19th and 20th centuries: "friendly visitors" and the growth of settlement houses		**14**:936h–938c / **16**:924b–926c	
iii. The mid-20th-century rediscovery of poverty and affluence: the necessity for action		**14**:938c–g / **19**:677f–h	
c. Causes of poverty		**14**:938g–939e	
i. The life of the poor: confusion between cause and effect		**14**:938g–939b / **12**:175f–176c	**9**:674e–g
ii. Importance of economic institutions: the relations between unemployment, employment, poverty, and increasing automation		**14**:939b–e / **6**:202c–203c / **6**:771d–h / **12**:175c–f	
d. Future treatment of poverty: plans and programs		**14**:939e–h / **6**:772h–773e	**14**:821d–822a
6. Criminals and delinquents	CRIME AND DELINQUENCY **5**:265–274		
a. Measurement and analysis of crime		**5**:265g–269d / **5**:277b–279a / **5**:282b–f / **5**:283f–285a	**15**:79h–80a
b. Criminal classifications		**5**:269d–271c	**5**:284d–e
c. Control of crime		**5**:271c–272c / **14**:667g–668f / **14**:1097e–1099a / **14**:1100b–1103g / **15**:77a–78e / **16**:932b–933a	
d. Analysis of and responses to juvenile delinquency		**5**:272c–274f / **11**:913d–f	**8**:1145g–h /**14**:1099h–1100b / **16**:932g–933a
7. Sexual deviants	SEXUAL DEVIATIONS **16**:601–610		**16**:600e–f

	articles	article sections	other references
a. General aspects of sexual deviations: frequencies, therapies, causes, and dynamics		**16**:601h–603e	
b. Homosexuality		**16**:603e–605h / **15**:80c–f	**14**:1102a / **14**:1102e–f
c. Deviations focussing on gender identity: transsexualism, transvestism, and intersexuality		**16**:606a–h	
d. Deviations focussing on special sexual objects: pedophilia, fetishism, incest, bestiality, and necrophilia		**16**:606h–608a	
e. Deviations focussing on special patterns of acts: exhibitionism, voyeurism, sadism, masochism, rape, and satyriasis and nymphomania		**16**:608a–609h / **13**:867f–g	
f. Other deviations; *e.g.*, abstinence, deviational masturbation		**16**:609h–610e	**3**:1040h–1041a / **4**:523e–524d / **16**:593f–g
8. Prostitutes	PROSTITUTION **15**:75–80		
a. Cultural aspects of prostitution		**15**:76b–78e	
b. Social and psychological aspects of prostitution		**15**:78f–80h	
9. Drug users	DRUG PROBLEMS **5**:1048–1060		**5**:392b–c / **5**:1046a–b
a. Users of narcotics		**5**:1049f–1054h / **12**:842g–843b	
b. Users of nonnarcotic drugs; *e.g.*, hallucinogens, barbiturates, cocaine, amphetamines, tranquillizers, cannabis		**5**:1054h–1059c / **12**:788b–c / **14**:202c–e	**8**:557g–560c *passim* / **16**:457d–f
c. Users of alcoholic beverages	ALCOHOL CONSUMPTION **1**:437–450	**5**:271a–c / **15**:178e–f	**5**:729h–730b
10. Suicidal persons: problems concerning definition, classification, statistical data, and motivation	SUICIDE **17**:777–782		
D. Social service: organized public and private activities to alleviate human wants and needs	SOCIAL AND WELFARE SERVICES **16**:923–933		
1. The background of social and welfare services: modern and historical influences		**16**:924b–926c / **4**:516d–518d / **6**:432d–g / **8**:690f–691b / **11**:910h–912c / **14**:936c–938g / **14**:1099b–1100b / **19**:743e–749c	**9**:497b–498h *passim*
2. Fields of service		**16**:926c–933a / **14**:939e–h	
a. Family welfare: marriage counselling; maternal care and family planning; family-life education and home-help programs; old-age programs		**16**:926c–927c	**13**:550h–551f / **14**:821d–822a
b. Child welfare: child health care and protective services; care of unwed mothers and their children; day care; foster care and adoption		**16**:927c–928f / **5**:274e–f / **11**:912f–913c / **11**:913g–914a	
c. Youth welfare: cultural, social, recreational, vocational, and counselling programs		**16**:928g–929b / **11**:912f–913f	
d. Group welfare; neighbourhood social-welfare agency services for migrants, aliens, and transients; for ethnic and minority groups; for the handicapped; for military veterans		**16**:929c–930d / **15**:571d–572b	**5**:1054f–h / **12**:176b–c / **14**:822b–d
e. Disaster relief		**16**:930d–931a / **4**:844h–845d	
f. Community development		**16**:931a–e	
g. Medical and psychiatric social services		**16**:931f–932a / **11**:914a–e / **15**:204f–209g	**1**:448d–f / **5**:595b–d
h. School social services [see also 563.D.]		**16**:932a–b	
i. Correctional services: probation, parole, and delinquency control		**16**:932b–933a / **5**:273h–274f / **11**:913d–f / **14**:1102h–1103c	

Section 523. Social status

[for Part Five headnote see page 283
for Division II headnote see page 294]

The articles and parts of articles referred to in Section 523 deal with two main subjects: A, social differentiation and stratification; and B, the varieties of social class and social mobility.

The outline of subject A begins with the distinction between and the interrelation of two concepts—on the one hand, the concept of social differentiation, used to determine individual differences that result in groupings with social significance; and on the other hand, the concept of social stratification, used to express the ranking of social groups in various occupational, prestige, or social power hierarchies. The outline goes on to a broad distinction between biological differentiating factors and differentiating factors that arise from social or cultural conditions. Dealing with the biological factors, it treats sex differentiation, age differentiation, racial differentiation, and intellectual differentiation. Dealing with the process of stratification, the outline treats economic differences as the basis for stratification, and class, status, and power as forms of stratification. Finally, it treats the ways in which the relations between individuals and society are affected by the phenomena of social differentiation and social stratification.

Subject B is the varieties of social class and social mobility. The outline begins with problems about defining social class and about its distinction from and relation to other concepts such as the concepts of caste, of status, and of elites. It goes on to theories of social class—divergent conceptions of the importance of classes in social structure and of the nature of class relationships. It next treats the types, characteristics, and comparisons of modern social classes. Turning to social mobility, the outline treats the nature, determinants, and consequences of social mobility; the idea of a classless society; and, as factors of social immobility, the historical and contemporary forms of slavery, serfdom, and forced labour.

articles	article sections	other references
SOCIAL DIFFERENTIATION AND STRATIFICATION **16**:953–959		**3**:904h–905b/**7**:22f–g/**15**:609h–610b
A. Social differentiation and stratification	**16**:953d–g/**10**:753c–e	
1. The concepts of differentiation and stratification: distinctions and interrelationships	**16**:953h–956d/**10**:753a–c	
2. The process of social differentiation: factors producing social, economic, and cultural differences; concomitant inequalities	**16**:953h–955c	
a. Biological factors	**16**:953h–954c/**5**:652h–653c/**14**:44c–e/**16**:595a–596f/**19**:906a–908h	**5**:653c–656b *passim*/**8**:1159h–1160b/**11**:576d–f/**19**:908h–915f *passim*
i. Sex differentiation: physical and psychological factors that contribute to differences between the sexes; popular conceptions; scientific studies	**16**:954c–f/**13**:546g–552c/**19**:1090g–1091a	**8**:475e–f/**16**:28e–f
ii. Age differentiation: attitudes toward age groups in various societies	**16**:954f–955a/**8**:1149h–1150d/**13**:468h–469b/**15**:355f–356c	**9**:676f–677a/**12**:264c–f
iii. Racial differentiation: historical and political influences	**16**:955a–c/**7**:162a–b/**9**:676c–677f/**10**:1046f–1047f	**8**:1148d–1149a
iv. Intellectual differentiation: its role in stratification	**16**:955c–956d/**1**:285a–b/**5**:730f–732a/**5**:1070e–f/**12**:263c–265e/**14**:935c–936c/**14**:1038f–1040a/**16**:29f–30c/**16**:948g–950g	**1**:233h–234e/**8**:1150c–d/**8**:1159c–1167a *passim*/**9**:676e–677d *passim*/**11**:978h–979a/**14**:817f–g/**15**:611a–f
b. Social and cultural factors: differentiation among civilizations, nations, and types of societies; differentiation within societies		
3. The development of social differentiation	**16**:956d–959a/**10**:753e–754b	
a. The relationship of differentiation to social change [see 521.D.]		
b. The relationship of differentiation to mass society [see 524.B.]		
c. The process of stratification: its relationship to differentiation	**16**:956h–958f	**6**:1014d–1015a/**9**:521c–f/**13**:228d–e/**14**:782a–c
i. Economic differentiation: the basis of stratification	**16**:956h–957c/**7**:661h–662d/**16**:947f–950e	
ii. Class, status, and power as forms of stratification	**16**:957c–958a/**4**:328h–329b	**8**:1161f–h/**15**:364c–d/**16**:119a–121f *passim*/**16**:992f–g/**18**:928a–929e

d. The relation of the individual to society: the effects of differentiation and stratification

B. Varieties of social stratification and social mobility

1. The concept of social class: problems of definition; the relation of social class to other concepts—*e.g.*, caste, status, elites
2. Theories of social class: divergent conceptions of the importance of classes in social structures and of the nature of class relationships
   a. Classical, neoclassical, and other pre-Marxian theories of social class
   b. The Marxian theory of social structure: the mode of production as the determinant of social class
   c. Various post-Marxian theories of social classes and social conflict
3. Types and characteristics of and comparisons among modern social classes: upper class, working class, and middle class; the special case of the peasant class
4. Social mobility: the upward or downward movement of individuals, families, or groups between different sectors of society
   a. The nature of social mobility
   b. The determinants of social mobility: intelligence; education; degree of "openness" of the system; rate and quality of social change; population changes
   c. The consequences of social mobility: positive and negative aspects
5. The idea of a classless society: approximations to an equality of conditions
6. Social immobility: slavery, serfdom, and forced labour
   a. Forms of involuntary servitude
   b. Servitude and slavery from antiquity to the late 19th century
      i. Slavery in the ancient Near East, Greece, and Rome
      ii. Servitude in ancient India, China, and Japan
      iii. Servitude in the Muslim world
      iv. European servitude from the Middle Ages through the late 19th century
      v. Plantation slavery in North and South America: exploitation of Indian labour; development of the African slave trade; factors influencing the treatment of slaves; movements toward the abolition of slavery
   c. Servitude in the late 19th and 20th centuries
      i. International efforts to suppress slavery and forced labour
      ii. Forced labour in modern states; *e.g.*, the Third Reich, the Soviet Union
      iii. Contemporary efforts to reduce forced labour

articles	article sections	other references
	16:958g–959a / **2**:105e–109b / **19**:1096b–1097d	**18**:926h–928a
SOCIAL CLASS AND MOBILITY **16**:946–953		
	16:946c–947a / **12**:263c–264f / **16**:956h–958a	**4**:1092f–h / **8**:1156e–g / **16**:953f–g
	16:947b–948g / **16**:955g–956d / **16**:956h–958a	**10**:71h–73a
	16:947b–f	
	16:947f–948a / **11**:555a–556d / **16**:966c–f	**16**:956h–957a
	16:948a–g / **16**:957b–958a / **16**:992d–g	
	16:948g–950g / **5**:267h–268a / **5**:272e–h	**9**:674e–g / **9**:864d–h / **14**:938g–939b / **17**:514a–d
	16:950h–952f / **9**:502h–503b	**9**:525b–f / **12**:264c–265e *passim* / **16**:958b–f / **17**:130f–g / **18**:11d–e
	16:950h–951f	**16**:958b–d
	16:951f–952c	**2**:194a / **9**:364b–d / **12**:264c–f / **16**:958d–f
	16:952d–f	
	16:952f–953a / **1**:808a–809g / **12**:264f–265e / **17**:314a–c	**11**:556a–c
SLAVERY, SERFDOM, AND FORCED LABOUR **16**:853–865		
	16:853g–855g	
	16:855g–863b / **4**:513a–d	**8**:474b–c
	16:855g–857f	**5**:369g–h / **11**:972b–c / **18**:29g–h
	16:857g–858g	**10**:60h–61a
	16:858g–859b / **11**:399d–401a	**9**:366d–e / **13**:780c–d
	16:859b–860e / **7**:650c–g / **12**:147d–g	**16**:58h–59d
	16:860f–863b / **4**:888h–889d / **19**:768e–769h	**1**:283b–c / **3**:145h–146b / **10**:684g–686a *passim* / **10**:700c–g / **17**:97f–g / **17**:278e–279f *passim* / **18**:711e–f / **18**:965g–974c *passim*
	16:863b–865e / **17**:291g–293f	
	16:863b–g	**8**:1184b–1185e *passim*
	16:863g–864f	
	16:864g–865e	**8**:1187d–e

Section 524. Collective behaviour and mass society

[for Part Five headnote see page 283
for Division II headnote see page 294]

The articles and parts of articles referred to in Section 524 deal with four main subjects: A, the nature and forms of collective behaviour; B, mass society; C, the formation of public opinion; and D, the expression of collective behaviour in social movements.

The outline of subject A begins with elementary forms of collective behaviour, such as those exhibited by aimless but agitated milling crowds or by the spreading of rumours. It goes on to major forms of collective behaviour, exhibited in patterns of collective response to disasters, fads or crazes, and collective panic. Finally, it treats different theories concerning the causes and effects of collective behaviour and the means of controlling it.

The outline of subject B, mass society, begins with the origin and evolution of the concept of mass society. It goes on to various uses of the concept—to examine the characteristics of modern, industrial society; to examine the forces responsible for that society; and to determine the influences and effects of those forces on modern man. Finally, it treats certain problems concerning the uses and the scope of the concept of mass society.

The outline of subject C begins with the history and with current conceptions of public opinion. Then, after dealing with personal and environmental factors that affect the formation of public opinion, it treats propaganda, covering its characteristics and components, various theories about it, the measurement of its effects, and the ways of controlling it. Finally, it deals with the influence of public opinion on governmental processes and with the methods of public opinion polling.

Subject D is social movements—purposeful, organized, sustained forms of collective behaviour aiming to effect major transformations of the society and the prevailing culture. The outline begins with the characteristics of social movements. It goes on to treat various types of social movements—movements centred on religious concepts or personalities; humanitarian and reform movements; interest group movements; revolutionary movements; and nationalist movements.

articles	article sections	other references
COLLECTIVE BEHAVIOUR **4**:842–853		
A. The nature and forms of collective behaviour	**4**:842f–844d	
1. Elementary collective behaviour	**4**:842g–843a	
a. Milling: agitated aimless movement	**4**:843b–844b	**15**:211h–213c *passim*
b. Rumour	**4**:844b–d	
c. General social unrest: conditions of widespread milling and rumour	**4**:844d–851a	
2. Major forms of collective behaviour	**4**:844d–845d	
a. Responses to disaster: the disaster cycle	**4**:845d–846e / **13**:282g–283a / **16**:166g–167a	**15**:211d–e
b. Collective obsessions; *e.g.*, fads, contagions, crazes, deviant epidemics	**4**:846e–848d	
c. Active and expressive crowds	**4**:848d–849b	
d. Panic	**4**:849c–e	**4**:1009b–h / **15**:211c–h
e. Publics and masses	**4**:849e–851a / **1**:809g–812b / **13**:282d–g / **13**:849g–850a / **16**:974c–980a	**15**:787a–791b *passim*
f. Social movements [see also D., below]	**4**:851a–852a / **16**:976a–f	**15**:787c–e / **16**:974b–975c *passim*
3. Theories of collective behaviour	**4**:851c–e / **16**:978d–f	**1**:575e–576b / **19**:1096g–1097d
a. Individual motivation theories: frustration and alienation	**4**:851e–h / **16**:978d–f	
b. Interaction theories: contagion and convergence	**4**:851h–852a / **16**:974d–e / **16**:978g–979a / **16**:992d–g	
c. Social change theories: collective behaviour as normal in periods of social change	**4**:852b–h / **16**:979b–g	
4. Effects of collective behaviour	**4**:852h–853b / **8**:462e–463e / **14**:669e–670a	
5. Attempts to control collective behaviour		
B. Mass society: the concept used to connote the main features of modern industrial society		
MASS SOCIETY **11**:600–604		**4**:659a–c / **18**:1078d–1079c
1. Origin and evolution of the concept: the influence of 18th-century egalitarianism, and of 19th-century liberalism, romanticism, and nationalism; the use of the concept in contemporary theories	**11**:600f–602e	
2. Various uses of the concept of mass society	**11**:601g–604e	

	articles	article sections	other references
a. The examination of characteristics of modern, industrial society; *e.g.*, large centralized institutions, transitoriness of human relations, estrangement of modern man from traditional loyalties		**11**:602b–603c / **9**:520f–521f	**16**:951g–952c / **18**:940e–941e
b. The examination of forces responsible for modern industrial society; *e.g.*, the Industrial Revolution, urbanization, extension of the franchise		**11**:601c–602e / **4**:1009b–h / **6**:528e–529b / **7**:661h–662d / **14**:805e–806a	**1**:107d–108a / **4**:1005c–f / **5**:698b–c / **9**:523f–527d *passim* / **15**:37e–42d / **16**:851e–f / **16**:956f–g / **16**:958e–f / **17**:515f–g / **18**:943a–d / **18**:1077g–h
c. The determination of the influences and effects of these forces on modern man: sociological and psychological views		**11**:602e–603c / **7**:158a–c / **14**:30f–31b	**16**:952d–f
3. Problems concerning the concept of mass society: the question of its reality, of modern man's susceptibility to totalitarianism, and of the relevance of the concept to various groups		**11**:603c–604e / **16**:958g–959a	
C. The formation of public opinion	PUBLIC OPINION **15**:210–216		
1. Historical development of public opinion		**15**:210a–211b	**9**:197e–198c *passim*
2. Current definitions and conceptions of public opinion		**15**:211c–h / **4**:849c–e / **15**:39b–h	
3. Factors affecting the formation and change of public opinion		**15**:211h–213c / **4**:851c–h	**4**:843b–844b *passim* / **4**:1009e–g / **14**:123h–126h *passim*
a. Personal and environmental factors		**15**:211h–213c	
b. Propaganda	PROPAGANDA **15**:36–44		**13**:852f–g
i. Characteristics of propaganda: connotations of the term; related terms		**15**:36h–38c / **14**:122f–g	
ii. Various theories of propaganda		**15**:38c–39h	**1**:809g–h / **14**:123b–f
iii. Components of propaganda: goals; social system conditions; the propagandist and his agents; symbols and communications media used; the reactors		**15**:39h–42f / **1**:105g–106h / **4**:204f–h / **14**:123h–126c / **19**:695c–e	**4**:1009f–h / **15**:212d–213b / **16**:978a–c
iv. Measurement of the effects of propaganda		**15**:42f–43e	
v. Control of propaganda: countermeasures and public control		**15**:43e–44f / **14**:126c–g	**4**:1009c–e
4. Public opinion and government		**15**:213d–h	
5. Public opinion polling: polling methodology; criticisms and justifications of opinion polling		**15**:214a–216e / **15**:39b–h	**1**:104g–105d
D. The expression of collective behaviour in the form of social movements	SOCIAL MOVEMENTS **16**:974–980		
1. Characteristics of social movements		**16**:974c–975c / **4**:849e–g	**17**:445d–446b *passim*
a. Relationship to social change		**16**:974d–e / **11**:1017g–1018a / **14**:727f–728c	**4**:851h–852a / **15**:790c–g / **16**:920d–922g *passim* / **16**:952a–c
b. Membership		**16**:974e–975c / **8**:462c–e	
c. Comparison with associations, crowds, publics, interest groups, and political parties		**9**:975d–h / **4**:849e–g / **14**:677f–h / **14**:679b–681b	
2. Types of social movements *with special attention to*		**16**:976a–977c / **4**:849e–851a	
a. Movements centred on religious concepts or personalities		**4**:849g–850d / **13**:849g–850a	
i. Followings and cults		**2**:1093c–1094e / **4**:849g / **14**:30d–32b / **14**:34d–35d / **16**:167b–c	**12**:942b–944a *passim*

	articles	article sections	other references
ii. Primitive and millenarian movements		**4**:849h–850b / **10**:132c–g / **11**:1017f–1018a / **11**:1021a–1022c / **12**:442c–e / **12**:443c–444b	**1**:101d–103a *passim* / **12**:200d–203f *passim*
iii. Movements of the spirit		**4**:850b–d / **8**:686d–g	**4**:506a–507f *passim* / **4**:562f–564a *passim*
b. Humanitarian and reform movements	PACIFISM AND NONVIOLENT MOVEMENTS **13**:845–853	**4**:850d–f / **9**:418b–d	**1**:812c–d / **7**:876h–878g *passim* / **13**:801d–802b
c. Interest group movements	SPECIAL-INTEREST GROUPS **17**:445–449	**4**:850f–g	
d. Revolutionary movements	REVOLUTION, POLITICAL **15**:787–791	**1**:809g–812b / **4**:850g–h / **8**:1167a–f / **9**:196d–h	**4**:359h–366d *passim* / **7**:649d–670a *passim* / **8**:458g–463g *passim* / **9**:769c–g / **14**:680a–d
e. Nationalist movements [see also 541.E.3.d.vii.]	NATIONALISM **12**:851–853	**4**:850h–851a	

Section 525. Human populations: urban and rural communities

[for Part Five headnote see page 283
for Division II headnote see page 294]

The articles and parts of articles referred to in Section 525 deal with three main subjects: A, the composition and change of human populations; B, the development of modern cities; and C, the development of modern rural societies.

The outline of subject A begins with the major determinants of population—human fertility, human mortality, and migration. After dealing with historical changes in population, the outline goes on to theories of population. Here it first treats the theories of population involved in major economic doctrines. It then deals with modern theories of population, concerned with optimum population size and optimum rates of population growth, and with ecological theories concerning the relationship between human population growth and the conservation of natural resources. Finally, it treats governmental policies regarding population growth and composition; current population projections; and current concerns about the population explosion.

The outline of subject B begins with the initial factors conducive to urbanization—a pattern of increase in the percentage of city-dwellers in a total population. It goes on to the patterns of urbanization in the premodern period and in the modern period, treating, with regard to the latter, the developing structure of urban areas in the 19th and 20th centuries, and the social and political consequences of rapid urbanization. The outline next deals with the technical and social aspects of urban planning and redevelopment. Finally, in dealing with trends in urbanization, it treats the growth of the megalopolis; suburbanization; regional integration; the role of technology in extending the dominance and influence of urban concentrations; the problems of population control in relation to urban growth; and the problems of environmental change arising from pollution and urban climatic change.

The outline of subject C begins with the delineation of modern rural society, treating global variations in the rural–urban continuum and the characteristics of traditional rural societies and of transitional "urbanized" rural societies. It goes on to the major components and determinants of rural society, treating settlement and demographic patterns; kinship structures; economic, technological, and sociocultural influences on modern rural life; rural organization and the dynamic elements in rural society; and rural planning.

	articles	article sections	other references
A. The composition and change of human populations	POPULATION **14**:814–823		**14**:825g–h
1. Determinants of population		**14**:814h–815d / **14**:817c–818d	**6**:1057f–1058a / **15**:207d–g / **16**:28h–29a / **18**:874e–h
a. Human fertility		**14**:817c–e	**9**:1095e–g / **17**:103d–f / **17**:338h–340a / **18**:930c–g
i. Natural increase in population		**14**:814h–817h	
ii. Human reproduction controlled by natural and artificial methods	BIRTH CONTROL **2**:1065–1072		**4**:524d–g / **6**:1025g–1026g / **7**:165g–166a / **7**:1006h–1007c / **14**:815a–f / **14**:817d–e / **14**:821f–822a / **14**:823c–g / **14**:977f–g
b. Mortality: death rates and longevity		**14**:817f–h / **7**:22g–23a / **10**:911f–913a	**2**:187e–f / **5**:10g–h / **9**:1095g–1096b / **18**:929g–h
c. Migration	MIGRATION, HUMAN **12**:185–189		
i. The dynamics of migration		**12**:185d–186d / **14**:817h–818d / **4**:659d–e	**1**:1129c–e / **4**:506h–507b / **7**:592f–593c / **9**:1096c–h / **17**:389g–390b

	articles	article sections	other references
ii. Traditional forms of migration		**12**:186d–188a / **8**:1159c–1160h / **8**:1162a–1163a	**9**:741e–g / **14**:1098e
iii. Modern migration: refugee movements; urbanization and suburbanization	REFUGEES **15**:568–573	**12**:186h–187b / **12**:187g–188a	**1**:697d–e / **2**:187b–c / **3**:722h–723b / **3**:738d–g / **7**:593c–594a / **8**:1188d–e / **9**:1096h–1097f / **14**:818c–d / **18**:930g–931a
iv. Determinants of migration and assimilation of immigrants		**12**:188a–189g / **12**:175c–176c / **12**:262h–263b / **15**:568b–570b / **15**:572b–573a	**1**:697e–h / **4**:274d–275g / **5**:698c–e / **6**:1058b–d / **7**:466c–e / **9**:741c–d / **13**:468g–471e *passim* / **14**:822b–d / **16**:929e–h / **18**:931a–b
2. Historical changes in population		**14**:815e–817b	
a. Premodern times to the 17th century		**14**:815e–h / **4**:329b–e / **4**:351c–g / **17**:119g–120b	**4**:273a–c / **6**:220d–f
b. Modern times		**14**:815h–817b / **13**:546d–g	**2**:1070b–d / **6**:1025h–1026d
i. The first demographic revolution: in the Western world		**18**:963d–964a	**2**:820f–821d / **3**:132g–134c / **3**:722e–723f / **4**:251c–e / **4**:869e–870d / **5**:403c–e / **5**:414h–415f / **5**:584b–g / **6**:1057a–1058d / **7**:595d–f / **8**:10f–11c / **9**:884c–e / **9**:1094h–1097f / **12**:71c–72a / **13**:47d–e / **13**:200h–202c / **17**:102g–104c / **17**:340g–h / **17**:389d–390e / **17**:847b–e / **18**:876g–877d / **18**:929f–931b / **18**:1096d–g / **19**:64d–h
ii. The second demographic revolution: in the non-Western world		**6**:209d–e	**1**:215e–216h / **1**:419f–g / **2**:186g–187h / **4**:273c–275g / **4**:356h–357a / **6**:451f–452d / **9**:287h–288f / **9**:824d–h / **10**:44f–45f / **10**:879a–e / **13**:898d–899a / **18**:203c–g / **18**:788a–d / **18**:828e–h
3. Theories of population		**14**:818e–821d	**16**:982g–h
a. Premodern beliefs: pronatalism versus birth control		**14**:818e–g / **2**:1070a–1071b	
b. Mercantilist theory		**14**:818g–h / **5**:377b–c	**6**:227b–228h *passim*
c. Laissez-faire theory		**14**:818h–819a / **5**:377d–e / **10**:847a–g	**14**:936d–f
d. Malthusian theory		**14**:819a–d	**2**:1065g–1066d / **11**:395a–e / **14**:936e
e. Marxist theory		**14**:819d–f	**11**:554b–556b
f. Modern theories of population; *e.g.*, optimum population size, optimum rate of population growth, relationship between population and demographic movements		**14**:819f–821d / **2**:1067a–c / **6**:206b–g	
g. Ecological theories concerning the relationship between human population growth and the conservation of natural resources	CONSERVATION OF NATURAL RESOURCES **5**:39–44		
4. Governmental policies influencing population growth and composition		**14**:821d–822e	
a. Policies of pronatalism and birth control		**14**:821d–822a / **2**:1066g–1067a	**2**:1069c–f
b. Policies affecting mortality		**14**:817f–h / **14**:822a	
c. Policies affecting migration		**14**:817h–818d / **14**:822b–d / **15**:571d–h	**8**:1188d–e / **12**:188g–189a

	articles	article sections	other references
5. The future of the world's population: population projections and problems of the population "explosion"		**14**:822e–823h / **2**:1067a–c / **6**:209d–e / **6**:1026d–g / **15**:355c–f / **19**:646b–g	**2**:187g–h / **2**:1070b–c / **7**:502g–503a
B. Development of modern cities	URBANIZATION **18**:1073–1080		
1. Characteristics of urbanization		**18**:1073h–1074f	
a. Population growth and distribution		**18**:1073h–1074c	**16**:25h–27a
b. Initial factors conducive to urbanization		**18**:1074d–f / **4**:659h–660c	
2. Patterns of urbanization		**18**:1074g–1079c	
a. The premodern period: antiquity; the Middle Ages; the Renaissance		**18**:1074g–1076e / **9**:1123c–1124c / **11**:576h–577f / **11**:954g–955b / **12**:146h–147d / **12**:149c–150d / **17**:930e–933f / **18**:1065d–1073a	**11**:969c–h / **14**:711f–712b / **15**:662g–663b / **15**:668c–e / **18**:28c–29h *passim* / **19**:305g–306d
b. The modern period		**18**:1076e–1079c / **12**:187g–188a	**14**:818c–d / **18**:38a–52f *passim*
i. Effects of the Industrial Revolution: the mutual influences of industrialization and urbanization; the development of transportation and communication		**18**:1076e–1077c / **6**:229e–230a / **18**:656b–658b / **18**:962c–963c	**3**:261f–h / **11**:601g–602a
ii. The developing structure of urban areas in the 19th and 20th centuries		**18**:1077c–1078d / **11**:577f–578d / **18**:1081g–1082e	**3**:260h–261a / **6**:115c–d / **12**:185h–186a / **18**:921g–922b
iii. Social developments: effects of increased population size, density, and heterogeneity; the growth of mass society		**18**:1078d–1079c / **5**:267c–e / **6**:235h–236h / **11**:601g–603c / **14**:662h–663b / **14**:720g–721d	**14**:30h–31b / **16**:924b–f / **18**:922f–923a
iv. Governmental developments: effects of the expansion of urban services		**6**:631b–632a / **7**:321h–323b / **14**:662c–663b / **14**:667g–668f / **14**:720g–721d / **15**:573g–575a / **15**:575e–h / **18**:657f–658b / **19**:653b–f	**4**:644b–653f *passim* / **14**:712c–f / **15**:205b–209g *passim* / **18**:572a–574b *passim* / **18**:659b–663e *passim*
3. Patterns of urban planning	URBAN DESIGN **18**:1053–1073		
a. Methods and materials of urban planning and redevelopment		**18**:1065d–1073a	
i. Historical practices, to the Renaissance		**18**:1053f–1065d	
ii. Modern practices			
b. Social aspects of urban planning and redevelopment	URBAN PLANNING AND REDEVELOPMENT **18**:1081–1084		
i. Historical movements for urban improvement		**18**:1081c–1082g / **1**:1093h–1095e / **18**:1065d–1073a	**18**:1076e–1080g *passim* / **19**:305g–306d
ii. Governmental controls and planning		**18**:1082h–1084c / **1**:396g–397a	**18**:1061d–1064c *passim*
4. Trends in urbanization		**18**:1079d–1080g	
a. Megalopolis: the coalescence of several metropolitan areas into a contiguous agglomeration of people and activity		**18**:1079d–g	**18**:923b–c

	articles	article sections	other references
b. Suburbanization: the growth of politically separate but economically dependent residential communities surrounding large cities		**18**:1079g–1080b	
c. Regional integration: levels of economic and cultural interaction between the city and its hinterland		**18**:1080b–d / **18**:1084b–c	
d. The role of technology in extending the dominance and influence of urban concentrations		**18**:1080d–f / **18**:53f–54d	**14**:749e–756b *passim* / **18**:21e–24e *passim*
e. Problems of urban growth and population control		**18**:1080f–g	**14**:822e–823h *passim*
f. Problems of environmental change *with special attention to*			
i. Problems of pollution	POLLUTION CONTROL **14**:749–756	**5**:49c–50h / **12**:119f / **18**:1049g–1051h	**14**:433c–d
ii. Problems of climatic change	URBAN CLIMATES **18**:1045–1051	**2**:319d–f	**5**:49h–50b / **14**:433b–d
C. Development of modern rural societies	RURAL SOCIETY, CONTEMPORARY **16**:25–30		
1. The delineation of modern rural society		**16**:26b–28b	
a. Global variations in the rural–urban continuum		**16**:26b–27a / **5**:267c–e	
b. Characteristics of traditional rural societies: *Gemeinschaft*, or community relations		**16**:27a–d	**18**:1078f–g
c. Characteristics of transitional and "urbanized" rural societies		**16**:27d–28b / **14**:662f–h	**6**:414e–h / **18**:1078f–h
2. Major components of rural society		**16**:28b–30e / **2**:195a–g	**6**:1063h–1064g
a. Settlement patterns: traditional influences and their effects on modern rural life		**16**:28b–e / **1**:284a–c	**3**:721a–b / **4**:269f–270a / **8**:52h–53e / **9**:465c–467d / **9**:1092f–1093b / **10**:43a–c / **11**:295g–296a / **11**:573g–574g *passim* / **13**:896d–f / **17**:334g–336b / **17**:873g–874d / **18**:919b–920d
b. Demographic patterns; *e.g.*, age structures, sex ratios, birth and death rates		**16**:28e–29a / **14**:817c–818d	**12**:186a–d
c. Kinship structures: basic and extended families and their influence on land ownership, inheritance, and courtship and marriage customs		**16**:29a–c / **1**:284c–e	**7**:157d–158a / **10**:477a–485c *passim* / **12**:169e–g
d. Economic and technological influences affecting modern rural life		**16**:29d–f / **1**:283f–284a / **1**:317c–322d / **1**:337h–339a / **7**:176e–177b	**1**:348c–366f *passim* / **18**:920g–921b
e. Sociocultural influences: *e.g.*, status, rank, folklore		**16**:29f–30c / **1**:237d–239a / **7**:465h–466e / **14**:662f–h	**11**:600g–601b / **16**:948h–949a
f. Rural organization: formal and informal groupings		**16**:30c–e	
3. Dynamic elements in rural society: effects on rural life of changes in demography, ecology, and the economics of modern society		**16**:30e–f / **1**:316f–317c / **5**:39g–42a / **5**:60a–61b / **11**:297a–f	**3**:261a–d / **9**:884d–e / **12**:175a–f / **12**:185a–189g *passim* / **18**:920e–921b
4. Rural planning: origin, nature, and theories of planning; types of planning agencies		**16**:30g–h / **7**:175a–176a	**1**:315f–322d *passim*

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BAGEHOT, WALTER **2**:583
COMTE, AUGUSTE **4**:1058
DURKHEIM, ÉMILE **5**:1093
MALTHUS, THOMAS ROBERT **11**:394
OWEN, ROBERT **13**:800
SAINT-SIMON, HENRI DE **16**:176
SPENCER, HERBERT **17**:492
WEBB, SIDNEY AND BEATRICE **19**:711
WEBER, MAX **19**:714

Division III. The production, distribution, and utilization of wealth

[for Part Five headnote see page 283]

The outlines, and the articles and parts of articles referred to, in the seven sections of Division III deal with the economic order in human society.

The articles referred to in Section 531 treat basic concepts of economics; the levels of economic analysis; basic issues of economic policy and fact; economic issues predominantly involving political, social, and moral considerations; and the comparison of different economic systems.

Section 532, on human wants and their economic expression, treats the economic analysis of scarcity, utility, and value; and the character and causes of consumer tastes and consumer spending.

Section 533 treats the workings of the market in a mixed economy and of the price system in capitalist economies.

Section 534, on the organization of production and distribution, first deals with the general theory of economic production and distribution. It goes on to deal with the various inputs of the productive process and with institutional arrangements that facilitate production and output. It next treats agricultural economics, international trade, and the role of government in production. Finally, it treats methods of business organization, advertising, the distribution of risk through insurance, and consumer credit.

Section 535 deals with the distribution of wealth and income by categories of the population, and with the routes by which government affects the distribution of wealth and income.

Section 536, on macroeconomics, treats national income and employment theory; international financial equilibrium and disequilibrium; business fluctuations and countercyclical policy; and inflation and deflation.

Section 537 treats the nature and causes of economic growth, and planning for economic growth and stability.

Section 531. Economic concepts, issues, and systems 311
532. Human wants and their economic expression 314
533. Markets, pricing, and the mechanisms for distributing goods 315
534. The organization of production and distribution 316
535. The distribution of income and wealth 325
536. Macroeconomics 328
537. Economic growth and planning 330

Section 531. Economic concepts, issues, and systems

[for Part Five headnote see page 283]

The articles and parts of articles referred to in Section 531 deal with five main subjects: A, some basic concepts of economics; B, the different levels of economic analysis; C, issues of policy and fact; D, economic issues that predominantly involve political, social, and moral considerations; and E, the comparison of different economic systems.

The outline of subject A sets forth eight concepts basic to the descriptive and explanatory studies of economic phenomena.

The outline of subject B presents the concepts of microeconomics, dealing with the economic decisions of individuals, households, and firms; sectoral economics, dealing with the economic arrangements of industries, groups, and regions; and macroeconomics, dealing with the aggregates of income, employment, and price levels in the economy of a nation as a whole.

The outline of subject C sets forth thirteen issues of policy that are the subjects of controversy in economic literature and economic counselling—issues such as the role of money supply and interest rates in the achievement of stable economic growth; the relation of inflation to full employment; diverse views concerning international currency reform; and the relative efficiency of planned and free enterprise economies.

The outline of subject D sets forth eight economic issues that predominantly involve political, social, and moral considerations—issues such as the proper distribution of income and wealth; priorities in the production process; and the optimum rate of economic growth.

Subject E is the comparison of different economic systems. The outline begins with the characteristics that differentiate modern economic systems—the size of the public and private sectors; the kind of ownership of the means of production; the extent of planning; and the ends governing economic activity. It then treats three archetypal economic systems—the pure private enterprise economy; the centrally planned economy; and the mixed economy with various degrees of economic planning. The outline next refers to descriptive accounts of Western-type market economies, of Soviet- and socialist-type economic systems, and of mixed economies in developing countries. Finally, the outline treats economic systems in nonliterate and feudal societies.

articles	article sections	other references
A. Some basic concepts of economics		
1. The concept of economic activity as a process of choosing among scarce resources	**14**:1004d–1006a	**19**:3h–5c
2. The concept of division of labour	**14**:1005d–g	**16**:906b–f/**16**:955f–956d/**16**:956h–958a/**16**:964a–f/**19**:932f–941f *passim*

	articles	article sections	other references
3. The concepts of diminishing returns and optimization		**5**:906b–g / **6**:269f–270a / **15**:19g–21f / **19**:6a–7d	
4. The concept of marginality		**3**:800b–e / **5**:905f–906b / **10**:568h–569d / **15**:20d–21f / **19**:4b–5c	**6**:200f–h
5. The concept of capital		**3**:799e–801d / **5**:906c–907c	
6. The concept of competition		**11**:512e–513g / **12**:376c–379d	
7. The concept of comparative advantage		**18**:553a–554h	
8. The concepts of growth and development		**6**:214b–215c / **15**:27g–29g	**6**:202c–206g *passim*
B. Levels of economic analysis			
1. Microeconomics: the economic decisions of individuals, households, and firms		**6**:200d–h / **6**:268g–270a	
2. Sectoral economics: the economic arrangements of industries, groups, and regions		**6**:271c–272c	
3. Macroeconomics: the economy as a whole		**6**:201b–g / **6**:270b–271a / **9**:264c–h	**6**:771h–773e *passim*
C. Issues of policy and fact			
1. Diverse views about the economic motivation of individuals, households, and firms		**5**:106c–107d / **19**:3e–5c	
2. The debate over the roles of money supply and interest rates in the achievement of stable economic growth		**5**:100b–g / **6**:217d–218g / **15**:195f–198a	**12**:356g–358a *passim*
3. The question of the efficiency of government discretionary action		**3**:539e–540b / **7**:326d–327h / **15**:201b–202a	
4. The problem of the relation of inflation to full employment		**6**:250d–251b / **9**:565b–567b	**7**:327b–d
5. The effect of technological progress on employment and hours of work		**5**:907h–908a / **6**:770g–772h / **9**:504c–g / **9**:507d–508a / **15**:29g–31g	
6. The question to what degree it is possible to change the distribution of income		**5**:908a–b / **17**:1079c–d / **19**:677h–678h	
7. The issue of balanced economic development versus priority to some sectors over others		**6**:204c–206g	**15**:23c–24c
8. The issue of the relative efficiency of planned and free enterprise economies [see also 537.B.]		**6**:273h–275h / **10**:847a–g / **17**:755f–h	**6**:258e–261h *passim* / **14**:724f–725b
9. The question whether equilibrium in the balance of payments is incompatible with full employment		**7**:30d–31h	**7**:324g–325a / **9**:565c–566a
10. Diverse views concerning international currency reform		**6**:249h–250d / **7**:27c–28e	**7**:32h–35a *passim* / **16**:448h–449b / **18**:901a–g
11. The advantages and disadvantages of entering regional economic unions [see also 534.F.3.]		**5**:379b–385c	
12. The relative merits of free trade and protection for developing countries		**5**:383b–f / **6**:206h–208e / **17**:1069a–f / **19**:555g–557f	
13. The problem of interpersonal comparisons of satisfaction or utility		**5**:106c–107d / **19**:4b–6a	
D. Economic issues that predominantly involve political, social, and ethical considerations			
1. The question of the proper distribution of income and wealth: the issue of social justice			

	articles	article sections	other references
a. The debate about special measures for economically disadvantaged groups		**12**:175g–176g / **14**:936c–939h / **19**:751d–752h / **19**:753h–754e	
b. The debate about what constitutes equality of economic opportunity and status		**19**:677h–679h	**10**:849f–851a *passim*
2. The question of whether national economic planning is preferable to free enterprise [see also C.8., above]		**6**:273h–275h / **17**:755f–h	**15**:23f–24c
3. The debate over the character of production: the question of what kinds of goods ought to receive priority in the production process		**6**:257b–h / **6**:259h–261h / **17**:754g–755h	**15**:19c–22c *passim*
4. Diverse opinions on the optimum rate of economic growth		**6**:209d–210a	**6**:203d–206g *passim* / **6**:219b–e
5. The advantages of centralized versus those of decentralized control of economic institutions		**6**:258e–259a / **6**:261a–h / **6**:273h–276g	
6. The question of the worth of industrialization: the gains and costs of industrial society		**9**:523h–524b / **9**:527d–g / **15**:29g–31g	**9**:526d–527a
7. The issues arising from international business expansion and capital export: the question of national control		**4**:904h–905e / **4**:995g–h / **4**:996h–997b	**7**:525c–e
8. Issues involved in economic and military aid to underdeveloped countries by rich countries		**7**:522c–523h / **7**:525b–526a / **9**:737d–738b	**4**:904h–905e *passim*
E. The comparison of different economic systems	ECONOMIC SYSTEMS **6**:273–277		
1. The variable characteristics of a modern economic system: the relative size of the public and private sectors; the kind of ownership of the means of production; the extent of planning; the ends governing economic activity		**6**:273h–274c / **1**:321b–322d / **6**:255f–256b	**15**:23d–24c
2. Archetypal economic systems		**6**:274c–275h / **9**:523h–524b	
a. The pure private enterprise economy: a theoretical model		**6**:274c–h / **10**:847a–g	
b. The centrally planned economy: the pure socialist model		**6**:275a–e / **3**:444g–445a / **3**:540a–b / **6**:256c–e	**17**:342g–347d / **18**:568f–569a
c. The mixed economy with various degrees of economic planning		**6**:275e–h / **6**:259b–261e / **17**:613f–614a	**15**:198f–199c / **16**:971e–972d *passim*
3. Western-type market economies [see also 537.B.3.]		**6**:275h–276d / **2**:110d–h / **6**:259a–261h / **14**:1004d–1006c	**18**:553a–555e *passim*
4. Soviet- and socialist-type economic systems [see also 537.B.2.]		**6**:276d–277b / **1**:319a–c / **6**:256c–259a / **11**:514h–515b / **17**:318b–d	
5. Mixed economies in developing countries [see also 537.B.4.]		**6**:277b–f	
6. Other economic systems		**11**:295g–296e	**19**:798f–799b
a. Primitive economic systems	ECONOMIC SYSTEMS, PRIMITIVE **6**:278–280	**6**:1015a–e / **8**:1155b–h / **8**:1156g–1157g / **9**:521f–522e / **17**:220f–221e	**3**:622b–c / **6**:169f–170b / **8**:1160h–1163a *passim* / **11**:947h–948a / **11**:955g–956b / **12**:124e–h / **13**:225h–226c / **17**:123b–h / **19**:790d–f
b. Feudal economic systems		**6**:1126e–1127e / **8**:1164d–1166a / **9**:1125a–h / **11**:932f–933a / **16**:855d–e / **19**:934g–936h	**9**:363e–h / **10**:70h–75g *passim* / **12**:148e–152d *passim* / **16**:312c–e

Section 532. Human wants and their economic expression

[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 532 deal with two main subjects: A, scarcity, utility, and value; and B, the behaviour of consumers in satisfying their material wants.

The outline of subject A begins with a general account of the explanations, in classical and modern value theory, of how prices of goods and services are determined. It goes on to the effects, on the value of goods, of the limitations in the supply of economic resources, and to the necessity of allocating these resources among different uses. Turning to the demand side in the analysis of price and value, it treats the concept of utility as reflecting consumer tastes and preferences, and the concept of marginal utility, defined as the amount of additional utility provided by an additional unit of some economic good or service. The outline next deals with the theory of the indifference schedule and diminishing marginal rate of substitution as determinants of demand and consumer behaviour. Finally, it treats, as a factor in the analysis of consumer choice, the amount the consumer has available to spend and the concept of consumer's surplus.

The outline of subject B first deals with national private sector consumption levels. It goes on to deal with factors that influence consumer tastes and spending. Here it treats the effect of the distribution of income and wealth on consumer spending; rationality and irrationality in the formation of consumer tastes; the influence of advertising on consumer taste and spending; and the changing relationship, with the development of new products, between necessities and luxuries. Finally, the outline deals with the protection of consumer interests, treating the scope of consumer protection laws and the development of private consumer organizations in various countries.

	articles	article sections	other references
A. Scarcity, utility, and value	UTILITY AND VALUE, ECONOMIC **19**:3–7		
1. Theories of economic value: comparison of classical and neoclassical value theory		**19**:3e–h / **6**:265f–266a / **14**:818g–819f	**5**:107e–108b
2. Limitations in the supply of economic resources: the necessity of allocating these resources among different uses; economic and social consequences of changes in relative scarcity		**19**:3h–4b / **5**:39g–42a / **7**:498g–499d / **14**:1004g–1005d / **15**:27g–28h	**7**:923g–924b / **15**:22g–23b / **18**:901g–902c
3. The maximization of utility and the analysis of value: measurement of marginal utility; mathematical analysis of prices and demand		**19**:4b–5c / **6**:200d–e	**9**:262d–264b *passim* / **11**:745a–c
4. The theory of the indifference schedule and diminishing marginal rate of substitution as determinants of demand and consumer behaviour		**19**:5c–6a	
5. Prices and income: diagrammatic analyses of consumer income and expenditures; the concept of consumer's surplus; price changes as related to the income effect and the substitution effect		**19**:6a–7d / **5**:106c–107d	
B. The satisfaction of material wants: the behaviour of consumers	CONSUMPTION, ECONOMIC **5**:104–108		
1. National consumption levels in the private sector: trends in expenditures for goods and services		**5**:104f–106c / **7**:498g–499d / **11**:505g–506b / **14**:1002d–1003d	**17**:343h–344f
2. Factors influencing consumers' tastes and spending		**5**:106c–108c / **2**:109b–g	**4**:1009b–h
a. The effect of the distribution of income and wealth on consumer spending: the consumer's effort to maximize his satisfaction within a given budget		**5**:106c–107a / **6**:200d–e / **19**:4b–5c / **19**:674a–d	**5**:99b–100g *passim*
b. Rationality and irrationality in the formation of consumers' tastes and the influence of advertising on consumer taste and spending		**5**:107b–d / **5**:100h–101c / **5**:102a–103b / **11**:510b–e / **19**:5c–7d	**1**:105g–108a *passim* / **14**:1006h–1007c
c. The changing relationship between necessities and luxuries: new industries and new products		**5**:107e–108c / **5**:198h–199h / **11**:509e–510b	**19**:1095a–d
3. The protection of consumer interests	CONSUMERISM **5**:100–104		
a. The scope of consumer protection laws		**5**:101c–103b	**18**:528d–f
i. Controls on manufacturing and design: legal restrictions on food and drug manufacturers; standard-setting institutions		**5**:101c–102a / **5**:199b–h / **7**:489b–g / **8**:698d–g	**8**:700b–c

articles	article sections	other references
	5:102a–h	**15**:43h–44c/**19**:731a–735c *passim*
	5:102h–103b	**18**:560c–g
	5:103b–104b/ **5**:187a–b	

ii. Controls on advertising and labelling of products: regulation of weight and price labelling

iii. Controls on sales methods: the elimination of deceptive sales practices

b. The consumer movement: the development of private consumer organizations in various countries; consumerism as a grass roots movement

Section 533. Markets, pricing, and the mechanisms for distributing goods

[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 533 deal with two main subjects: A, markets as an economic institution in a mixed economy; and B, the price system in capitalist economies.

The outline of subject A first deals with the classification of markets by reference to the kinds of competition in them. It goes on to the major types of markets—markets for primary commodities, for manufactured goods, for money and capital, and for labour and services. It next treats the counterpart of the market under total economic planning—markets under socialism. It goes on to deal with the historical development of markets and of market theory, the relationship of the market to social welfare and politics, and markets in international trade. Finally, it treats the function of the market in the establishment of equilibrium between supply and effective demand.

Subject B is the price system in capitalist economies. The outline first deals with the theory of the price system as a means of organizing economic activity: as determining, in its workings, what is to be produced, how it is to be produced, and who gets the product. It next deals with limitations on and failures of the price system and with areas in which the price system does not function. Here, it treats price fixing by business; government-established price controls and subsidies, public utilities regulation, and bank interest rate regulation; economic relationships not susceptible to control by prices—"externalities" such as air pollution and highway congestion; and imperfect knowledge on the part of buyers as to alternative uses of their buying power. Finally, the outline treats the role of the public sector in the distribution of goods and services, and the effects on distribution of government budgets.

articles	article sections	other references
MARKETS **11**:511–515		
MONOPOLY AND COMPETITION **12**:376–380	**5**:152h–153d/ **6**:268h–270a/ **15**:216h–217f	**6**:266e–g/**13**:1071a–c
	11:511f–g/ **12**:376d–377c/ **5**:185a–f/ **6**:271f–272a/ **11**:508d–f	**18**:932d–e/**18**:976c–d
	12:377c–378h/ **10**:847a–g	
	12:378h–379d	
	12:379d–380e/ **3**:312a–313a/ **13**:1074a–c/ **14**:1006c–e/ **15**:200b–201b/ **15**:218f–220g	**3**:310b–d/**18**:934f–h/ **18**:979h–980a
	11:511c–g	
COMMODITY TRADE, INTERNATIONAL **4**:994–997	**11**:511d–e	
FUTURES **7**:816–818	**4**:994f–995h/ **7**:178c–f/ **14**:1000h–1001d	
	4:995h–997f	**18**:669e–g
	11:511f–g/ **11**:508d–f	
	11:513f–g/ **2**:707f–708b/ **5**:98f–100g/ **7**:25b–27c/ **7**:299f–301c/ **16**:448e–452h	**12**:356h–360h *passim*/ **15**:195a–196h

A. Markets as an economic institution in a mixed economy

1. Markets classified by reference to competition and monopoly

a. Purely competitive markets as distinguished from markets of imperfect competition: monopoly, oligopoly, and monopolistic competition

b. Influences affecting the behaviour of sellers under various competitive conditions

c. The concept of workable competition

d. Government regulation of monopolistic practices

2. Major types of markets

a. Markets for primary commodities; *e.g.*, raw materials, food crops, minerals, wool, fur

i. The operation of primary commodity markets: trading for primary commodities to be delivered at a future time

ii. Efforts to stabilize prices in international commodity trade through action by individual countries or by international cooperation

b. Markets for manufactured goods

c. Markets for money and capital: the market for short-term loans; the securities market

	articles	article sections	other references
d. The market for labour and services [see 534.C.1.]			
3. The counterpart of the market under full-scale economic planning: markets under socialism [see also 537.B.2.b.]		**11**:511g–512d	
4. The historical development of markets: the market in economic theory; the relationship of the market to social welfare and politics		**11**:512e–515b/ **17**:754g–755h	**11**:554d–556b/**15**:24f–h
5. Markets in international trade [see 534.F.]			
6. The function of the market in the establishment of equilibrium between supply and effective demand		**11**:511c–g/ **9**:262e–264b	
B. The price system in capitalist economies	PRICE SYSTEM **14**:1004–1007		
1. The price system as a means of organizing economic activity: coordination of the decisions of owners of resources, manufacturers, and consumers		**14**:1004d–1006c/ **1**:345h–346h/ **6**:200d–e/ **9**:262d–264b/ **14**:1002g–1004c/ **15**:27g–29b	**6**:274c–f
a. The determination of what is to be produced		**14**:1005g–1006a	**6**:622f–623b/**14**:1004g–h/ **19**:3h–4b
b. The determination of how goods are to be produced		**14**:1005a–b	
c. The determination of who gets the product		**14**:1005b–d	
2. Limitations on and failures of the price system: areas in which the price system does not function		**14**:1006c–1007c/ **7**:31d–f/ **9**:564e–566b/ **11**:511c–g	**5**:106c–107d *passim*/**15**:39b–d
a. Control of prices by business: price fixing [see A.1.a., above]			
b. Government-established price controls and subsidies: regulations concerning public utilities and bank interest rates [see 543.B.2.c., 535.B.3.b., and 535.B.5.b.ii.]			
c. Economic relationships not susceptible to control by prices: "externalities" such as air pollution and highway congestion [see 543.B.2.g., 734.A.2., and 737.C.1.]			
d. Imperfect knowledge on the part of buyers as to alternative uses of their buying power [see 532.B.2.b. and 534.I.5.]			
3. The role of the public sector in the distribution of goods and services: government budgets [see 534.G.1. and 535.B.1.]			

Section 534. The organization of production and distribution
[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 534 deal with eleven main subjects that divide into four groups. In the first, there are two subjects: A, the general theory of economic production; and B, the general theory of economic distribution. The second group also has two subjects: C, the inputs of the productive process; and D, institutional arrangements that facilitate production and output. The third group has three subjects: E, agricultural economics; F, international trade; and G, the role of government in production and distribution. The last group contains four subjects: H, methods of business organization; I, advertising; J, the distribution of risk; and K, consumer credit.

The outline of subject A treats the influences determining costs and output in the short run and in the long run.

The outline of subject B treats the relation between the productive process and the incomes derived from it, and the influences affecting the earnings of land, labour, and capital employed in the productive process.

The outline of subject C begins with labour as a factor in the productive process. Here, it first treats the size and quality characteristics of a work force, and its deployment in different industries and occupations. It goes on to the methods of fixing rates of pay; to the differences in the earnings of various occupations; and to changes in the general level of pay. Further topics dealt with are the issues raised by unemployment; the inferior status of migrant labourers; the organization of unions and their influence on the supply of labour, wages, and output; the capital elements in labour—education and training; and the economic role of managers and entrepreneurs. The outline of subject C next deals with physical factors. Here it treats issues about the conservation of natural resources; the economics of land, air, and water use; and the economics of the extractive industries and of the power industry. Finally, the outline deals with capital as a factor in the productive process, treating the development of the theory of capital in the production of goods, and the theory of interest and its relationship to capital.

Subject D is institutional arrangements that facilitate produc-

tion. The outline begins with the basic functions and various forms of money and with classical, neoclassical, and Keynesian theories of money. Dealing with banks and banking, the outline covers the structure of modern national banking systems; the principles and functions of commercial banking systems and of central banks; the various markets for short-term and long-term funds; international monetary institutions; and the nature and functions of government credit agencies. It next treats the use of economic statistics in the measurement and forecasting of national production and output. Finally, it treats the historical development of the business corporation and the structure of business corporations in the United States, Europe, and Japan.

The outline of subject E covers the relationship between agricultural and economic development; efforts to control prices and production in agriculture; the effect of the behaviour of farm prices on the incomes of farmers; the effect of technology on world agriculture; and the various levels of farm organization.

Subject F is the geographical distribution of resources and markets. The outline treats classical and contemporary theories of international and interregional trade; the national and regional factors influencing trade; and international trade arrangements—trade agreements, customs unions, and economic communities.

Subject G is the role of government in production and distribution. The outline treats the theory of public expenditures; the justification of the government's claim to share in resource use; the growth in government spending in the 19th and 20th centuries; and government operation of basic industries.

The outline of subject H, methods of business organization, treats accounting; the short- and long-term management of business funds; personnel administration; the administration and control of production; and the functions, stages, and processes of marketing and merchandising.

The outline of subject I treats advertising—its historical background, purposes, media, strategies, organization, and economic and social effects.

The outline of subject J, the distribution of risk, treats insurance—its nature, purposes, kinds, legal aspects, and historical development.

The outline of subject K treats the types, historical development, and dimensions of consumer credit.

	articles	article sections	other references
A.	The organization of the production of goods		
1.	Analysis of costs and output in the short run: the production function; substitution; the relationship of marginal cost to market price; marginal product	PRODUCTION, THEORY OF **15**:19–22	**9**:523h–524b / **18**:553a–554h
			15:19c–21f / **6**:200e–h / **6**:268h–270a / **11**:511c–g / **19**:4b–5c
2.	Analysis of costs and output in the long run for profit maximization and cost minimization		**15**:21f–22c / **18**:553a–554h — **6**:239h–240b
B.	The organization of the distribution of goods	DISTRIBUTION, THEORY OF **5**:905–908	**19**:673e–674d
1.	The relation between the productive process and the incomes derived from it [see also 535.A.2. and A.3.b.]		**5**:905b–906g / **18**:553a–555e — **10**:847c–g
2.	The earnings of land, labour, and capital employed in the productive process		**5**:906h–908b / **3**:799h–801d / **6**:200d–201a / **6**:279e–280b / **6**:311f–g / **10**:568g–569d / **15**:27g–29g / **19**:674d–675b — **10**:634h–635h *passim* / **11**:554d–556a / **16**:905h–906f / **16**:955f–956d
C.	The inputs of the productive process		
1.	Labour as an input in the productive process	LABOUR ECONOMICS **10**:563–569	**15**:29g–31a
a.	The labour force: size, quality, and deployment of work force		**10**:563c–564b / **6**:231a–h / **18**:1076e–g — **1**:316f–317b / **6**:315d–f / **7**:190c–191e *passim* / **13**:546g–547a / **16**:906b–f / **16**:955f–956d
b.	Methods of fixing rates of pay		**10**:564c–567a
i.	Custom and individual bargaining between employer and employee		**10**:564c–e / **10**:571e–f
ii.	Collective bargaining between union and employer		**10**:564e–567b / **1**:1076c–1077a / **9**:510e–512b / **17**:318d–g — **18**:564b–568c *passim* / **18**:991b–d
iii.	Public regulation: minimum wage laws and government arbitration		**10**:567b–g / **1**:1076e–1077a / **7**:327e–g
c.	The structure of pay: differences in the earnings of various occupations		**10**:567g–569d / **5**:905d–906g / **6**:201a / **6**:271c–f / **9**:566h–567b / **10**:571f–h / **15**:27g–29b — **3**:799h–800a / **14**:1005e–g

	articles	article sections	other references
d. Changes in the general level of pay		**10**:569d–h / **9**:503f–504c / **15**:28h–29b / **19**:677h–678h	**7**:327b–d
e. Employment and unemployment	EMPLOYMENT AND UNEMPLOYMENT **6**:770–773	**6**:205f–206a / **10**:571d–f	**13**:548h–549b
i. The changing character of the labour force: technology and unemployment		**6**:770g–771h / **2**:513b–h / **15**:30d–f / **19**:940d–941f / **19**:1094d–1095a	**6**:205b–f / **6**:277e–f / **13**:546g–547a / **14**:821b–d
ii. Methods of measuring unemployment and underemployment: rates of unemployment		**6**:771h–772h / **9**:495d–496c / **9**:498c–f	
iii. Government efforts to increase employment; *e.g.*, manpower policies, fiscal and monetary policies, national economic planning		**6**:772h–773e / **10**:567e–g / **19**:751d–752b	**7**:325a–b / **7**:325e–h / **18**:990b–c
f. The inferior economic and social status of temporary, seasonal migrant labourers	MIGRANT LABOUR **12**:175–177		
g. The organization of unions	TRADE UNIONISM **18**:563–571	**5**:907a–b / **9**:504g–505c / **10**:564e–567a / **16**:968d–f	**18**:935d–f
i. The origins and development of trade unions in industrialized nations		**18**:563f–569h / **1**:810c–g / **1**:1021e–1022d / **6**:223a–e / **9**:510e–512b / **19**:935d–h	**2**:112a–b / **3**:273h–274b / **4**:672a–e / **7**:601a–c / **9**:1102e–h / **9**:1166a–c / **10**:690e–h / **13**:801h–802b / **17**:346c–f / **17**:351f–g / **18**:14h–16b *passim* / **18**:881f–882a / **18**:976g–977b / **18**:991b–d
ii. The origins and development of trade unions in emerging nations		**18**:569h–570g	**3**:138c / **4**:282a–d / **9**:294b–f
iii. Various international labour organizations [see also 552.B.2.e.i.]		**18**:570g–571d / **8**:1185c–d	**8**:1184f–g
h. The influence of the union on the supply of labour, wages, and output		**10**:564e–567b / **3**:316h–317a / **10**:572h–573b	
i. Capital elements in labour: education and training		**10**:563e–564b / **1**:1021e–1023f / **6**:312e–g / **11**:599h–600d / **19**:1094d–1095a	**9**:501h–502g
j. The economic role of managers and entrepreneurs		**5**:185f–186d / **5**:187e–g / **6**:216a–b / **9**:496c–499b / **9**:508g–509g / **9**:510h–512b / **14**:121c–122c	**5**:188d–f / **19**:937d–g
2. Other inputs of the productive process			
a. Land and raw materials [see also 724]	CONSERVATION OF NATURAL RESOURCES **5**:39–62	**7**:527g–528d / **7**:533g–534e / **14**:1005g–1006a	
i. The importance of conserving the world's natural resources: development of public and private conservation activities		**5**:39g–44a	**1**:197g–198b / **6**:1049d–1050a / **17**:90h–91a
ii. Economics of land use: conservation of soil, plants, and animals; preservation of the ecosystem		**5**:44a–45c / **5**:46g–48e / **6**:284g–285a / **9**:49d–50b / **11**:625e–626b	**5**:51c–56c *passim* / **6**:282h–283a / **18**:932a–b / **19**:1161f–h
iii. Economics of air and water use: problems of air and water pollution		**5**:45d–f / **5**:48e–50c / **6**:621d–h / **6**:623d–g / **11**:626e–f	**5**:58e–61g *passim* / **18**:1075d–e

	articles	article sections	other references
iv. Economics of the extractive industries: conservation of fossil fuels, nuclear fuels, and minerals; recycling of minerals		**5**:45g–46f / **5**:50c–51c / **4**:778e–779a / **12**:256e–g / **13**:193c–f	**6**:618d–e / **6**:622f–623b / **7**:923e–924b / **11**:623d–625e *passim* / **14**:165f–166d / **18**:931f–h
b. Economics of the power industry: economic considerations concerning the use of natural gas, coal, oil, waterpower, and atomic energy [see also 732.G.1.]		**4**:781h–782d / **5**:45g–46f / **5**:50c–51c / **6**:618f–619a / **6**:630b–h / **6**:857a–858e / **7**:923g–924b / **13**:192h–193c / **14**:175a–f / **15**:220c–f	**6**:634d–637e *passim*
c. Capital as an input in the productive process	CAPITAL AND INTEREST **3**:799–803		
i. The development of the theory of capital and its role in the production of goods; various types of capital		**3**:799e–801d / **5**:905f–907e / **6**:215e–216a	
ii. The development of the theory of interest and its relationship to capital; governmental use of interest rates in the control of inflation [see also 536.A.3.c.]		**3**:801d–803a	
D. Institutional arrangements that facilitate production and output			
1. The nature and characteristics of money	MONEY **12**:349–356		
a. The basic functions of money: as a medium of exchange; as a measure of value; as a store of value		**12**:349f–350b / **7**:33h–35a / **9**:263b–264b	**7**:24c–25a
b. Various forms of money: metal coins; paper currency; wampum and other tokens of commodity money; bank checks and other demand deposits; commercial paper		**12**:350b–353a / **2**:700d–701b / **2**:706d–707c / **4**:352d–e / **4**:821h–824a / **4**:991g–992c / **6**:249h–250d	**6**:168b–c / **6**:278f–g / **9**:356c
c. The quantity theory of money		**12**:353a–356e / **5**:100b–g / **6**:225g–226g / **9**:263c–264b / **9**:266d–267a / **9**:566c–h	**7**:24a–28e *passim*
i. The views of classical and neoclassical monetary theorists		**12**:353a–354d / **9**:264h–268f / **9**:566c–e	
ii. The opposed views of Keynesian income theorists		**12**:354d–356e / **9**:268f–269e / **9**:566e–h	
2. The monetary functions of commercial banks and central banks	BANKS AND BANKING **2**:699–712	**12**:357b–358a	
a. Historical development of banking systems		**2**:700d–701b	**12**:160h–161b / **15**:1162e–1163c
b. The structure of modern national banking systems		**2**:701b–706a	**8**:320b–d
i. Unit banking: the U.S. banking system		**2**:701d–f / **12**:358a–359a	**2**:710d–711b / **18**:933h–934a
ii. Branch banking: the British banking system		**2**:701f–h / **12**:359a–360a	**2**:407f–408a / **2**:711c–g / **2**:712d–g / **18**:879f–880b
iii. Hybrid banking systems of France, West Germany, Italy, India, and Japan		**2**:701h–704e / **12**:360b–h	**2**:711g–712b / **5**:188b–d / **7**:599e–g / **8**:57f–58a / **9**:292f–g / **9**:1100f–h / **10**:48c–f
iv. The Gosbank system of the Soviet Union; other socialist-type banking systems		**2**:704e–706a	**17**:344h–345a
c. Principles and functions of commercial banking systems		**2**:706b–708g	
i. The handling of deposits and reserves		**2**:706b–707c / **12**:352c–e / **12**:357b–e / **12**:359a–h	**2**:699h–700b

	articles	article sections	other references
ii. Short-, medium-, and long-term industrial financing		**2**:707d–708b / **4**:993a–c	**7**:299f–g
d. Principles and functions of central banking systems		**2**:708b–712h / **7**:324c–e / **12**:352a–353a	
i. The relationship between central banks and commercial banks		**2**:708c–g	**3**:136f–h / **12**:357d–g / **15**:189f–g
ii. The central bank and the national economy: the role of the central bank in stabilizing domestic monetary fluctuations; its role as banker to the government		**2**:708g–709h / **7**:29g–30d / **12**:357g–358a / **15**:187f–188d	**7**:25c–26b
iii. Methods of indirect credit control by the central bank: open-market operations and discount policy		**2**:710a–g / **12**:352f–353a	**15**:190e–198a *passim*
iv. Methods of direct credit control by the central bank: reserve requirements; accommodation ceilings; general credit ceilings		**2**:710g–712h / **15**:190b–f	
e. The money market: various national and international markets for short-term funds	MONEY MARKET **12**:356–360	**2**:707f–708b / **7**:25b–27c / **12**:351b–353a	**2**:707b–c / **2**:708g–709c / **15**:195a–h
f. International monetary institutions: proposals for future monetary cooperation and an international currency unit		**4**:992g–993a / **7**:32b–35a / **14**:1002e–1003d	**7**:27c–29g *passim* / **7**:524g–525b / **7**:525f–526a / **16**:448h–449b / **18**:901a–g
g. The market for long-term funds: the role of the private capital market in the supply and use of savings		**3**:800h–801b	
i. The stock and bond market	SECURITIES TRADING **16**:447–452	**3**:801d–h / **3**:802d / **7**:300d–301c / **15**:188b–189a	**9**:1100h–1101a / **11**:513f / **15**:195b–196b
ii. Specialized savings institutions; *e.g.*, savings and loan associations, credit unions, mortgage institutions, farm cooperative banks, insurance institutions, mutual funds, pension funds		**3**:531b–e / **3**:801d–g / **9**:651c–652b / **9**:653e–h / **11**:461h–462g / **19**:746b–749c	**5**:99d–g / **18**:934b–c
h. The nature and functions of government credit agencies: intervention in the capital market to promote economic growth or stability; the use of small business loans, mortgage credit, and agricultural credit		**1**:318c–320c / **15**:196b–198a	
3. The use of economic statistics in the determination of production and output			
a. National income statistics	NATIONAL INCOME ACCOUNTING **12**:847–850	**5**:104f–106c / **6**:201a–e / **9**:264c–h	**19**:673e–h
b. Price statistics: the use and construction of indexes of retail and wholesale prices	PRICES, STATISTICS OF **14**:998–1004	**9**:564b–565a / **15**:219c–h	
c. Economic forecasting	ECONOMIC FORECASTING **6**:210–213	**15**:27g–29b	
i. The subjects of economic forecasting: the gross national product (government expenditures, private investment spending, and consumer buying); individual industries or firms		**6**:211c–212f / **5**:100b–g / **8**:692e–693g / **12**:847f–848d / **15**:29b–g	**5**:106a–c / **19**:673h–674b
ii. Techniques of forecasting the gross national product (GNP) and its elements		**6**:212g–213d / **3**:539e–f / **6**:201b–g / **12**:848d–850g / **14**:999g–1001g	
iii. The accuracy of economic forecasts; sources of error		**6**:213e–g / **12**:849g–850h / **15**:32g–33e	
4. The business corporation	CORPORATION, BUSINESS **5**:182–189		**3**:530f–531b / **15**:50f–g
a. Historical development of the business corporation		**5**:182h–183h / **3**:531e–532b / **18**:947a–948a	**6**:224h–225g / **6**:234g–235b / **6**:240h–241c / **15**:245d–246a
b. The structure of business corporations in the U.S.		**5**:183f–187b	**18**:934f–h

	articles	article sections	other references
i. Trusts, holding companies, and conglomerates		**5**:183f–184e / **7**:301d–h	**15**:243e–f / **18**:932d–e / **18**:976c–d
ii. Separation of ownership and control: managerial decision making; the modern business executive		**5**:184e–187b / **9**:496c–499b / **9**:501h–502d	
c. The structure of business corporations in western Europe: separation of ownership and control; the modern business manager		**5**:187b–g / **3**:535h–536d	**3**:532c–d / **9**:1101g–1102b / **15**:245g–246a
d. The structure of business corporations in Japan: control by families and banks; professionalization of management		**5**:187g–189e	**9**:500e–501a / **10**:88a–c
E. Agricultural economics	AGRICULTURAL ECONOMICS **1**:315–322	**7**:177d–178a	**1**:323f–g
1. The relationship between agricultural and economic development		**1**:315f–317c / **5**:381e–g / **6**:208f–h / **6**:272a–c / **6**:1126e–1127e / **10**:635f–h	**1**:333g–334a / **16**:29d–f
2. Efforts to control prices and production in agriculture: government price supports, subsidies, and acreage limitations		**1**:317c–319f / **1**:345h–346h / **7**:178f–179e / **11**:508g–509a	**7**:501e–502f / **16**:86f–g / **17**:754h–755c
3. The behaviour of farm prices and the consequences for the incomes of farmers		**1**:319g–320c / **11**:511d–e	**7**:816f–818e *passim* / **11**:512b–d
4. The effect of technology on world agriculture: the increase in acreage and in crop yields		**1**:320c–321b / **1**:334d–335b / **1**:365c–366f / **4**:997c–f / **5**:55h–56c / **6**:770g–771h / **7**:178b–f / **7**:499e–500c / **15**:31b–d	**1**:324a–c / **1**:335g–342f *passim* / **10**:636d–g / **15**:30f–g
5. The organization of farming		**1**:321b–322d / **7**:179e–181b / **8**:1160h–1162a	**2**:705b–d / **10**:634h–635h *passim*
a. Private, cooperative, collective, and state-owned farms		**1**:321b–e / **16**:74h–75f	**4**:391b–f / **7**:180a–d / **10**:639b–d / **10**:639g–641h *passim* / **11**:512b–d / **17**:317e–f / **17**:342g–343d
b. Family farming, tenant farming, and industrial farming		**1**:321f–322d / **11**:853c–e	**10**:635h–636d / **10**:638e–641h *passim*
F. The geographical distribution of resources and markets: international trade	TRADE, INTERNATIONAL **18**:552–557		**2**:533f–534c
1. Classical and contemporary theories of international and interregional trade		**18**:552g–555e / **5**:376c–379a / **6**:227b–228b / **6**:271a–c / **17**:1069c–f	**6**:225g–226c
2. National and regional factors influencing trade		**18**:555f–557b / **6**:239c–h	
a. Tariffs, embargoes, and quotas imposed to obtain revenue, protect domestic industry, and secure a favourable balance of payments		**18**:555f–557b / **1**:318f–319a / **4**:995a–f / **6**:209a–d / **17**:1067e–1068a / **17**:1069a–d	**1**:345h–346h / **7**:29g–32b *passim* / **19**:553b–e
b. Changes in the conditions of production: costs, labour, and technology		**18**:556a–c / **6**:206h–208e / **18**:667a–668a	**18**:934d–f
c. Price movements		**4**:995b–c / **9**:262d–263a / **14**:1001h–1002c	
d. National domestic taxes and subsidies [see also 535.B.3.b.]		**1**:317g–318e / **17**:753h–755d / **17**:1085f–1086f	**18**:555f–556a

	articles	article sections	other references
3. International trade arrangements; *e.g.*, trade agreements, customs unions, economic communities	CUSTOMS UNIONS AND TRADE AGREEMENTS **5**:376–385	**18**:557b–g / **7**:32b–35a / **9**:526d–527a	**16**:448h–449b
a. The scope and purpose of trade agreements: economic reciprocity and most-favoured-nation treatment		**5**:376c–377b	
b. Historical development of modern international trade		**5**:377b–385c	
i. 16th- and 17th-century mercantilism, or economic nationalism: establishment of colonies and strictly controlled colonial trade		**5**:377b–c / **18**:552g–553a / **6**:227b–228b / **14**:818g–h	**4**:888c–f / **10**:697a–f / **10**:846f–g
ii. 18th- and 19th-century economic integration: abolition of internal tariffs among members of economic and political federations and between mother country and colonies		**5**:377d–f / **5**:379h–380b / **4**:888g–h / **4**:890b–891b / **8**:106h–107f / **9**:398c–399b	**3**:302e–g / **4**:894e–897a *passim* / **6**:98g–101e *passim* / **6**:235b–e / **7**:727d–728a / **17**:753g–754a
iii. 20th-century world trade: the leading role of U.S. trade; multilateral trade agreements since World War II		**5**:377f–379a / **5**:379d–f	
iv. Regional economic integration in western Europe: the establishment of the Benelux economic union; European Economic Community, or Common Market; European Free Trade Association		**5**:379b–383b / **5**:384c–385c / **18**:557c–d / **1**:318f–319a / **6**:104g–105c / **6**:249h–250d / **9**:732e–g / **17**:1068f–1069a / **18**:563a–d / **19**:547c	**6**:251b–c / **7**:600a–b / **9**:731e–h / **9**:756b–d / **13**:1075c–e / **14**:708h–709b / **17**:1085d–e
v. Regional economic integration in Latin America, Asia, and Africa		**5**:383b–f / **18**:557d–e / **17**:1069a–f	**1**:214b–215a / **2**:185h–186f / **17**:102b–e
vi. Economic integration among Communist countries: the Council for Mutual Economic Assistance (CEMA)		**5**:383f–384c / **18**:557f–g	**6**:248h–249b / **17**:345a–f
G. The role of government in production and distribution	PRODUCTION AND CONSUMPTION, GOVERNMENT'S ROLE IN **15**:22–25		
1. The theory of public expenditures: the role of taxation in the budgetary process and problems of effective tax administration		**15**:22f–23b / **3**:441f–443g / **9**:273d–e / **15**:56h–58f / **15**:60g–61g / **17**:1085e–1087a / **19**:743e–749c	**17**:1078e–1081d *passim*
2. The justification of the government's claim to share in resource use: problems of balancing resource consumption between the public and private sectors		**15**:23c–24e / **10**:850c–g / **12**:849e–g / **19**:553e–554b	**15**:198b–200b
3. The growth in government spending in the 19th and 20th centuries: the rise in military and social welfare expenditures		**15**:24e–25a / **8**:692f–693g / **17**:753g–754c / **19**:549b–554b / **19**:966d / **19**:1013d–e	**19**:746b–754g *passim*
4. Government operation of basic industries	PUBLIC ENTERPRISES **15**:198–202		
H. Methods of business organization			
1. The keeping of accounts	ACCOUNTING, PRINCIPLES OF **1**:36–42		**17**:1085f–h
a. Accounting as an information system	BOOKKEEPING **3**:37–38	**1**:36a–b / **1**:42f–h / **1**:36b–38b	**15**:219c–220a *passim*
b. Various types of company financial statements; *e.g.*, the balance sheet, the income statement			

	articles	article sections	other references
c. Principles of accounting measurement: asset and cost measurement		**1**:38c–39g / **3**:38a–c / **3**:800f–h	
d. Cost accounting: formulation of budgetary plans; performance reports; profit analyses		**1**:39g–42e / **7**:298e–299e / **17**:1085f–1086f	
2. The management of business funds	FINANCE, BUSINESS **7**:298–302	**15**:219c–220b	
a. Short-term and intermediate-term financial operations: planning and control; the cash budget; accounts receivable; inventories		**7**:298e–300d / **3**:37g–38c	
i. Short-term financing: trade credit, bank loans, and commercial paper		**7**:299f–300a / **2**:707f–708b / **4**:991g–992c	
ii. Intermediate-term financing: term loans, conditional sales contracts, and the leasing of equipment		**7**:300a–d	
b. Long-term financial operations: the design of capital structure and the issuance of securities		**7**:300d–301c / **2**:707d–f / **12**:461e–462g / **16**:448e–452h	
c. Consolidations and mergers		**7**:301d–302a / **5**:182d–185f / **5**:187b–e / **5**:187g–188d	**3**:535d–h / **15**:243e–f / **15**:245d–246a
3. The management of human resources	PERSONNEL ADMINISTRATION **14**:118–122	**3**:491b–496f / **19**:939e–940c	
a. Personnel departments: their functions and services		**14**:118h–119h	
b. Manpower planning, recruitment, and placement		**14**:119h–121c / **16**:454f–455b	**6**:773b–c / **9**:528d–f
c. Employee training and development		**14**:121c–f / **9**:501h–502h	**9**:498c–499b
d. Methods of maintaining employee incentive and commitment		**14**:121f–122e / **9**:510h–512b	**15**:28h–29b / **16**:946a–f
4. The administration and control of production	PRODUCTION MANAGEMENT **15**:25–27	**2**:507a–508a / **7**:188h–191e / **8**:1168a–1169a / **9**:505c–507c / **15**:28e–h / **19**:940d–941a	**2**:531f–534c
a. The flow channels of information and materials		**15**:25b–h / **3**:37g–38c	**2**:506a–f
b. The control function: maintaining conformity between operations and the plan		**15**:25h–26c / **9**:508g–510d / **13**:634f–636b	**2**:532h–533c
c. Production scheduling		**15**:26c–27a / **15**:27c–f	
d. Inventory adjustment		**15**:27a–c / **3**:800f–h / **7**:299d–e	
5. The distribution of goods	MARKETING AND MERCHANDISING **11**:505–510	**17**:708f–710f	
a. The functions of a marketing department in a large firm: pricing, product determination, market research, distribution and promotion		**11**:505e–506c / **5**:199b–f / **6**:200d–e	**15**:492b–g
b. Retailing: the selling of goods in supermarkets, chain stores, department stores, discount houses, and mail-order houses		**11**:506c–507h / **5**:102h–103b	
c. Wholesaling: the selling of goods to other firms for resale or business use		**11**:507h–508d	
d. Marketing goods to industry; marketing farm products		**11**:508d–509a / **7**:179b–e / **7**:764a–g	**7**:923e–f
e. The application of market research techniques to merchandising: product development, design, and packaging; advertising as market promotion		**11**:509a–510h / **1**:105g–106h / **5**:102a–h / **5**:198h–199f / **13**:859h–860a / **14**:124d–125e	**13**:857c–858e *passim* / **15**:235d–g

	articles	article sections	other references
I. Advertising	ADVERTISING **1**:103–108		
1. Historical background of advertising		**1**:103g–104c / **1**:109h–111e / **15**:251d–253a	
2. Advertising media: newspapers; magazines; television and radio; mail and outdoor displays		**1**:104c–105g / **1**:108c–g / **1**:109b–g / **11**:507f–h / **15**:37e–38c	**15**:235f–g / **15**:251f–253a
3. Advertising strategy: motivation and market research, product introduction programs, and controlled field experiments		**1**:105g–106h / **3**:313d–e / **11**:509a–e / **11**:510d–e / **14**:124d–125e / **15**:39b–h	**15**:42f–43e / **15**:235d–g
4. Advertising agencies		**1**:106h–107c / **1**:108h–109a	
5. Economic and social effects of advertising		**1**:107d–108a / **5**:102a–f / **15**:251d–253a	**2**:111c–112a / **4**:1009c–h / **14**:1006h–1007c / **15**:256g–257a
J. The distribution of risk	INSURANCE **9**:645–658		
1. The nature of insurance		**9**:645b–e	
2. Fire and marine insurance		**9**:645e–647f / **3**:965c–d / **11**:502h–503e / **18**:666h–667a	**4**:988a–c / **11**:500d–e
3. Casualty and surety insurance		**9**:647f–651b	
a. Liability insurance: automobile, business, and personal liability		**9**:647f–648e / **14**:1006a–c	**18**:525a–d / **18**:527d–528a
b. Theft insurance		**9**:648f–h	
c. Aviation insurance		**9**:648h–649b / **1**:398e–399c	
d. Workmen's compensation or industrial injury insurance		**9**:649b–h / **10**:572d–h / **19**:752h–753h	**8**:697b–e / **18**:524g–525a
e. Credit insurance		**9**:649h–650b	
f. Title insurance		**9**:650b–d	
g. Suretyship: fidelity and surety bonds		**9**:650e–651b	
4. Private life and health insurance		**9**:651c–653h	**8**:690g–692c *passim* / **8**:1115b–d
a. Types of life insurance: whole life, term, and endowment		**9**:651c–652b	
b. Individual and family health insurance		**9**:652b–g	**8**:692b–c
c. Group life, health, and annuity insurance		**9**:652g–653h	
5. Government-sponsored and/or government-administered health insurance [see 535.B.3.c.iv.]			
6. Underwriting of risks: rate making		**9**:653h–655d / **16**:138f–139b	
7. Legal aspects of insurance: government regulation of insurers; requirements for valid insurance contracts; insurable liabilities		**9**:655e–657a / **1**:398e–399c	**18**:525a–g / **18**:527d–528a
8. Historical development of insurance		**9**:657a–658b	**11**:503b–g
K. Consumer credit	CONSUMER CREDIT **5**:98–100		
1. Types of consumer credit: installment loans and noninstallment, or single-payment, loans		**5**:98f–99a	
2. Historical development of consumer credit in industrialized countries		**5**:99a–100b / **3**:801d–803a	**12**:459h–462c *passim*

articles	article sections	other references
a. Lending institutions and the question of interest rates	**5**:99b–g / **2**:710a–g / **3**:801h–803a / **4**:993a–c	**2**:707h–708b
b. Costs and hazards of consumer credit	**5**:99g–100b	
3. Efforts to protect the consumer: the dimensions of consumer credit	**5**:100b–g / **5**:102h–103b	

Section 535. The distribution of income and wealth
[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 535 deal with two main subjects: A, the distribution of wealth and income by categories of the population; and B, the routes by which government affects the distribution of wealth and income.

The outline of subject A begins with the nature and measurement of wealth and income. It goes on to methods of classifying the distribution of wealth and income. Here, it deals first with wages, profits, interest, and rent as accruing to the various factors of production. It then treats their distribution according to the number of persons in various classes of wealth and income. The outline next deals with patterns of wealth and income distribution among various countries and among persons within a country. Finally, it treats the methods of representing the distribution of wealth and the inequality of incomes among the lower, the middle, and the upper income sectors of society.

The outline of subject B begins with the national budget as the program of the government's revenues and expenditures. It treats budget theory, involving cost–benefit analysis and the theory of public goods; alternative approaches to the budget; and the budgetary processes of the United States, the United Kingdom, Japan, and the Soviet Union.

The outline of subject B next deals with the tax system. It treats the nature, purposes, and kinds of taxes; the history and principles of taxation; the effect of progressive and regressive taxes on the distribution of income; issues about the burden of taxation; and the characteristics of national tax systems. The outline then treats the effects on the distribution of income and wealth of the various kinds of governmental subsidies and tax concessions, and the many kinds of welfare programs sponsored and administered by governments.

The outline of subject B goes on to the effects of the financing of budgetary deficits and surpluses. It treats the economics of the public debt; arguments for and against government borrowing; the historical development of government borrowing as a source of government revenue; debt retirement policies; and short- and long-term government policies for the management of the public debt.

Dealing with direct governmental controls over the economy, the outline treats price, wage, and profit controls; antitrust, public utilities, and labour legislation; and war and defense economics.

Finally, dealing with land reform and tenure, the outline treats the economic, social, and political objectives of land reform and the redistribution of land tenure; the different methods of land reform; the criteria for evaluating the success of land reforms; and the historical development of land reform.

articles	article sections	other references
A. The distribution of wealth and income by categories of the population	**3**:441f–g / **5**:106c–107d	
WEALTH AND INCOME, DISTRIBUTION OF **19**:673–680		
1. The nature and measurement of wealth and income	**19**:673e–674b / **3**:801d–802f / **6**:201a–e / **17**:1085f–1086f	**12**:847h–848d / **15**:610b–h / **17**:1079c–1081d *passim*
2. Methods of classifying the distribution of wealth and income	**19**:674c–675b / **6**:311b–g	
a. Distribution by factor shares: wages, profits, interest, and rent	**19**:674e–g / **3**:799h–800e / **5**:906h–907e / **14**:1005d–g	**9**:565e–h / **11**:554d–556a / **15**:28b–29b
b. Distribution according to the number of persons in various classes of wealth and income	**19**:674g–675b	
3. Patterns of wealth and income distribution among various countries and among persons within a country	**19**:675b–680c / **6**:202c–203c	
a. Frequency distributions: the Lorenz diagram; the Gini and Pareto coefficients	**19**:675c–677f / **6**:201a	
b. Comparisons among wealth and income groups	**19**:677f–680c / **5**:905b–f / **10**:567g–569d	**15**:364a–d / **16**:956d–959a *passim*
i. Racial and regional comparisons of incomes below the poverty line	**19**:675f–h / **19**:677f–h / **12**:175f–176g	**6**:772f–g / **12**:266b–d / **14**:938c–939h *passim*
ii. Distribution of incomes among middle class taxpayers; income discrimination against female workers	**19**:677h–678h	**10**:567g–568d / **13**:547a–c / **16**:949e–950e *passim* / **19**:914g–915a

	articles	article sections	other references
iii. Distribution of high personal incomes and wealth; investments as a factor in high income returns		**19**:678h–680c / **16**:949a–e / **17**:1078e–1080b / **17**:1085f–1086f	**2**:109b–f / **18**:935b–d
B. The routes by which government affects the distribution of wealth and income			
1. The national budget as the program of the government's revenues and expenditures	BUDGETS, GOVERNMENTAL **3**:441–445	**6**:314d–315a / **15**:56h–57f / **15**:187f–190f / **15**:901e–g	**15**:23d–24e
a. Budget theory: program budgeting; cost-benefit analysis and the theory of public goods		**3**:441f–442e / **12**:849e–g / **19**:553e–554b	**6**:260c–261a / **6**:314b–d
b. Alternative approaches to the budget: the administrative budget, the capital budget, the cash budget, and the national accounts budget		**3**:442f–443g	
c. The budgetary processes of the United States, the United Kingdom, Japan, and the Soviet Union		**3**:443h–445a / **6**:261a–e	
2. The tax system	TAXATION **17**:1076–1082		
a. The nature and purposes of taxation		**17**:1076e–h / **9**:272c–273e	**15**:23d–e / **17**:1084c–1087g *passim*
b. Kinds of taxes		**17**:1076h–1077f	**18**:935b–d
i. Taxes on real and personal property	PROPERTY TAX **15**:56–61	**4**:351h–352b	
ii. Sales and excise taxes	SALES AND EXCISE TAXES **16**:178–179	**17**:1077b–c	
iii. Tariffs and export taxes	TARIFFS **17**:1067–1069	**1**:345h–346h	**5**:376c–385c *passim* / **17**:754h–755c / **18**:555f–557b *passim* / **18**:980b–c
iv. Taxes on personal income and capital gains	INCOME TAX, PERSONAL **9**:272–276	**17**:1085f–1087a	**15**:195h–196b
v. Taxes on corporation income and excess profits	INCOME TAX, CORPORATION **9**:269–272		**17**:346b–c
vi. Death and gift taxes	DEATH AND GIFT TAXES **5**:530–532		**9**:586f–h
vii. Social security and payroll taxes		**10**:572e–h / **19**:747b–749c	
c. History of taxation		**17**:1077g–1078e / **4**:351h–352c / **5**:530b–c / **9**:269h–270c / **9**:275c–f / **15**:57c–f / **16**:855e–g	**1**:852c–e / **4**:354h–355a / **7**:628d–h / **9**:351e–f / **9**:919c–d / **12**:160b–g
d. Principles of taxation; *e.g.*, adequacy, adaptability, universality, ability to pay		**17**:1078e–1080b / **5**:530d–e / **9**:272d–273e	**9**:270a–c
e. The effect of taxes on the distribution of income: progressive and regressive taxes		**17**:1077e–f / **9**:272f–273e / **16**:179b–e	**9**:270f–g / **15**:59b–c
f. The burden of taxation: the problem of shifting and incidence		**17**:1080b–1081d / **9**:270c–271b / **16**:179a–b	**5**:532b–h / **15**:58f–59a
g. Characteristics of national tax systems: comparisons of tax burdens		**17**:1081d–1082d / **5**:530f–h / **9**:271c–272a / **9**:273e–275b / **9**:275f–276a / **15**:60c–61f / **15**:190g–192e / **16**:178e–g	**3**:137h–138b / **9**:1102d–e / **17**:346b–c
3. Transfers and subsidies			
a. Interest payments on the public debt [see B.4.d., below]			
b. Subsidies and tax concessions	SUBSIDIES **17**:753–755	**1**:345h–346h / **3**:441f–g	**6**:233f–g / **9**:270g–271b

	articles	article sections	other references
i. Direct subsidies; *e.g.*, grants of money to transportation and to local governments		**17**:754c–g	**15**:491d–492c/**18**:975a–c
ii. Indirect subsidies to business and agriculture; *e.g.*, tax relief and price supports		**17**:754g–755f/ **1**:317g–318e/ **1**:319h–320c/ **5**:381e–g/ **17**:1067e–1068e/ **17**:1069c–f	**9**:271f–h
iii. Indirect subsidies to individuals and households; *e.g.*, tax exemptions and tax credits		**17**:755d–f/ **9**:273e–275b	
c. Government-sponsored and government-administered welfare programs	WELFARE AND SECURITY PROGRAMS **19**:743–754	**16**:926c–933a/ **17**:613f–614a	
i. Historical development of national welfare programs		**19**:743e–744d/ **3**:274c–g/ **8**:690f–691b/ **8**:695g–696g/ **14**:936c–938c/ **15**:203b–204f/ **16**:924b–926c	**6**:243h–244c
ii. Scope and organization of national welfare programs		**19**:744d–746a/ **8**:697e–698d/ **15**:205b–208g	**5**:586f–g/**16**:332f–h/ **18**:939e–h/**18**:990b–c
iii. Social security schemes in various countries: old-age, disability, and survivor benefits		**19**:746b–749c/ **10**:572e–h/ **13**:550f–551d	**16**:927b–c
iv. Medical and hospital care; maternity benefits		**19**:749c–751d/ **8**:690b–691b	**5**:595b–f/**14**:821d–822a/ **16**:926f–927h
v. Unemployment insurance		**19**:751d–752b/ **9**:649b–h	
vi. Family allowance systems		**19**:752b–h	
vii. Work-injury or workmen's compensation		**19**:752h–753h/ **8**:697a–e/ **8**:698h–699c	**18**:524g–525a
viii. Public assistance as distinguished from social insurance programs		**19**:753h–754g	**17**:318h–319b
4. The financing of budgetary deficits and surpluses	PUBLIC DEBT **15**:187–198		**15**:23d–24e
a. Government borrowing: economics of the public debt		**15**:187f–189a	
b. Arguments for and against government borrowing		**15**:189a–190f	
c. Historical development of government borrowing as a source of revenue		**15**:190g–193d	
d. Debt retirement policies		**15**:193d–194d	
e. Considerations in managing the public debt		**15**:194d–198a	
5. Direct controls over the private sector		**1**:345h–346h/ **13**:1071a–c	**14**:724f–725a
a. Price, wage, and profit control		**1**:317c–320c/ **5**:99a–100b/ **14**:1006c–e/ **15**:219c–220g	**18**:934h–935b
b. Control of restrictive practices [see also 533.A.1.d.]		**3**:312a–313a/ **12**:379d–380h	**3**:309h–310g/**3**:1074a–c
i. Antitrust legislation imposed on commerce and industry			**12**:379d–380b/**18**:976c–d/ **18**:979h–980a
ii. Regulations imposed upon public utilities	PUBLIC UTILITIES, U.S. **15**:216–221	**15**:491d–h	**6**:631b–e/**6**:634d–635c/ **18**:979e–f
iii. Labour legislation imposed on unions		**10**:567b–g/ **10**:572h–573b	**18**:564b–568c *passim*
c. Economic mobilization for war	WAR AND DEFENSE ECONOMICS **19**:548–554	**2**:14c–15c	**15**:190g–191f/**19**:543g–544a
i. The rise in military expenditures; problems of economic mobilization during World War I and during World War II		**19**:548e–551b/ **6**:242a–d/ **19**:971b–d	**11**:83f–84c/**15**:24c–e/ **15**:194g–195a/**16**:78b–c/ **18**:992c–h
ii. World expenditures for defense: modern military budgets		**19**:551b–554b/ **2**:15a–c/ **19**:595e–h	

	articles	article sections	other references
6. Land reform: the redistribution of land tenure	LAND REFORM AND TENURE **10**:634–641		
a. The economic, social, and political objectives of land reform		**10**:634h–635h	**7**:501g–h/**16**:61g–62b/**17**:317c–g
b. Methods of land reform: confiscation, expropriation, division, and consolidation; criteria for evaluating the success of land reforms		**10**:635h–638a	**16**:63b–g
c. Historical development of land reform		**10**:638a–641h	**10**:60d–e/**10**:62f–g
i. In the ancient world		**10**:638a–e/**15**:1000c–h	**8**:261g–262d/**8**:341e–h/**9**:1123g–1124c/**15**:1130d–e
ii. In the Middle Ages			**3**:562g–563b/**6**:1127c–e/**10**:70h–71b
iii. From the 16th through the 18th century		**10**:638e–g/**4**:351g–h	**6**:232g–233b
iv. In the 19th and 20th centuries		**10**:638g–641h	**3**:261c–d/**4**:377f–g/**4**:386b–e/**7**:180a–d/**10**:87g–88a/**16**:61g–62b/**16**:63b–g/**16**:321a–c/**18**:979c–d

Section 536. Macroeconomics

[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 536 deal with four main subjects: A, national income and employment theory; B, international economic and financial equilibrium and disequilibrium; C, business fluctuations and countercyclical policy; and D, inflation and deflation.

The outline of subject A begins with changes in aggregate output, employment, and prices as constituting the concern of income and employment theory, and with the differences between classical and Keynesian theories of effective demand and of unemployment as guides for government stabilization policies. It goes on to treat the circular flow of income and expenditure. It then deals with the analysis of fluctuations in national income, using several different theoretical models.

The outline of subject B begins with the problems raised by alternative monetary standards and by fixed and fluctuating exchange rates in foreign exchange markets. In relation to these problems it treats movements in the balance of payments and the mechanisms of adjustment; proposals for more flexible international exchange rates; balance of payments accounting; and methods for adjusting to fundamental disequilibrium. The outline of subject B then deals with the international institutions set up to handle payments problems and to deal with economic and financial crises.

Subject C is business fluctuations and countercyclical policy. The outline begins with the statistical study of business cycles—the identification and measurement of cycles, and the determination of their duration and phases. It goes on to treat theories that attribute cyclical fluctuations to external factors, such as harvest fluctuations, movements of group psychology, or political, technological, and demographic changes. It next treats theories attributing cyclical fluctuation to internal factors, such as uncoordinated changes in money supplies and interest rates, overproduction and underconsumption, or investment imbalances. It also covers appraisals of mathematical models. The outline then turns to the types of governmental actions and interventions taken to regulate the economy and minimize cyclical fluctuations. It treats the origin and development of compensatory fiscal policy, relating to taxes and governmental expenditures; and the origin and development of compensatory monetary policy, relating to the financial market, the supply of credit, money, and other financial assets. The outline further treats the theoretical basis of fiscal and monetary policy, and the characteristics of government use of such policies to regulate the economy and reduce inflation.

The outline of subject D treats the definitions and characteristics of inflation and deflation; their effects on a country's economy; and different theories concerning the causes and mechanisms of inflation.

	articles	article sections	other references
A. National income and employment theory	INCOME AND EMPLOYMENT THEORY **9**:262–269		
1. The concern of income and employment theory with changes in aggregate output, employment, and prices		**9**:262b–264b/**3**:441f–442e/**9**:566b–567e	**6**:276a–d/**7**:327b–d/**18**:934h–935b
a. The classical law of markets contrasted with the Keynesian theory of effective demand		**9**:262c–263c/**6**:200d–e/**6**:266g–267a	**5**:107e–108b/**16**:905h–906f
b. The classical and Keynesian theories of unemployment		**9**:263c–264b/**11**:512e–513a	**6**:276a–b/**6**:771h–773e *passim*/**7**:325a–d/**10**:448a–c/**11**:514e–g/**14**:939c–e/**16**:987f–g
2. The circular flow of income and expenditure: national product as goods and as earnings		**9**:264c–h	
3. Analyses of fluctuations in national income		**9**:264h–269e/**3**:443d–f/**12**:847f–849g/**17**:1079c–g	**7**:325c–e

	articles	article sections	other references
a. The simple income–expenditure model: output and income as determined by aggregate demand; the multiplier and the consumption function		**9**:264h–266d / **3**:538a–f / **6**:217d–219e / **6**:270b–d	**19**:675c–677f *passim*
b. The simple quantity of money model: the supply and demand for money as determinants of economic activity		**9**:266d–267f / **9**:566c–h / **12**:353a–354d	
c. Synthesis of the income–expenditure and monetary models: the interest rate as related to investment and the supply of money		**9**:267f–269e / **3**:539b–e / **3**:801d–803a / **9**:566e–h	**2**:708c–710g *passim* / **5**:99b–100f *passim*
B. International economic and financial equilibrium and disequilibrium	EXCHANGE AND PAYMENTS, INTERNATIONAL **7**:23–35	**6**:271a–c	
1. Foreign exchange markets: problems of alternative monetary standards and fixed and fluctuating exchange rates		**7**:24a–32b / **12**:351b–353a	**2**:708g–709c / **7**:328c–d / **18**:556f–h
a. Equilibrating movements in the balance of payments and the mechanisms of adjustment: arbitrage, short-term movements, interest rates, and forward exchange		**7**:24d–26c	
b. Disequilibrating movements as a response to currency devaluation: covering, hedging, and speculation		**7**:26c–27c	
c. Proposals for more flexible international exchange rates: freely floating rates, flexible rates with government intervention, and crawling and adjustable peg systems		**7**:27c–28e	
d. Balance of payments accounting: current and capital accounts; long- and short-term flows; the Eurocurrency market		**7**:28e–30d	
e. Methods for adjusting to fundamental disequilibrium: fiscal and monetary policy, incomes policy, devaluation and revaluation, and restrictions on capital movements		**7**:30d–32b / **2**:711e–712h	**7**:324g–325a / **7**:327d–e / **9**:567c–e
2. International monetary and financial institutions: the International Monetary Fund, the Group of Ten, and other attempts at international cooperation		**7**:32b–35a / **6**:239g–h / **12**:357f–358a	**5**:376c–385c *passim* / **18**:901a–g
a. Problems of maintaining adequate gold and currency reserves: gold crises; special drawing rights		**7**:33d–35a / **6**:249h–250d	**6**:239g–h / **18**:556f–h
b. The aftermath of major wars: economic and financial crises; economic nationalism		**5**:377b–c / **5**:377g–378a / **6**:227b–228b / **6**:242e–243d / **6**:245c–247b	**15**:190g–192d *passim*
C. Business fluctuations and countercyclical policy	BUSINESS CYCLES **3**:536–540		
1. The statistical study of cycles: the identification and measurement of business cycles; various cyclical theories		**3**:536h–538f / **5**:100b–g	
a. Early cyclical theories: the identification of cycles of various durations; the description and identification of the phases of the cycle		**3**:536h–537f	
b. Deviations from cycle patterns: lead and lag indicators		**3**:537f–538a / **16**:452f–h	**6**:201b–e
c. The concepts of the multiplier and the accelerator: the dynamic relationship between investment and consumption		**3**:538a–f / **6**:217h–218e / **9**:265e–266d	
2. Theories of the business cycle and business cycle models		**3**:538g–540b / **6**:201b–g	
a. Theories attributing cyclical fluctuations to external factors		**3**:538g–539b	
b. Theories attributing cyclical fluctuations to internal factors		**3**:539b–e	
c. The explanatory value of mathematical models of the business cycle		**3**:539e–540b / **9**:264h–269e	**18**:934h–935b
3. Countercyclical monetary and fiscal policy	FISCAL AND MONETARY POLICY **7**:324–328	**3**:539f–540a	

	articles	article sections	other references
a. The origin and development of compensatory fiscal and monetary policy		**7**:324g–325b / **7**:30h–32b / **12**:355c–356e / **14**:935c–e	**18**:989e–990c
b. The theoretical basis of fiscal and monetary policy		**7**:325c–f	
c. Governmental use of countercyclical fiscal and monetary policies to regulate the economy and reduce inflation		**7**:325g–328d / **3**:539e–540b / **6**:245c–247b / **6**:261a–e / **17**:1079e–g	**2**:709c–e / **3**:138d–139c / **5**:99b–100g *passim* / **6**:773c–e / **10**:567e–g / **17**:1085a–b / **18**:934h–935b / **18**:989e–990a
D. Inflation and deflation	INFLATION AND DEFLATION **9**:564–567	**5**:907f–g / **12**:355g–356e	
1. Increases in the general price level and the supply of money as distinguished from chronic inflation and hyperinflation		**9**:564e–565a / **14**:1003d–1004c	**18**:934h–935a
2. Characteristics of deflation: deflationary measures		**9**:565b–e / **7**:31a–h / **7**:325g–326g / **7**:327e–h	
3. Effects of inflation and deflation on a country's economy		**9**:565e–566b / **6**:242e–243d	
4. Theories concerning the causes and mechanisms of inflation		**9**:566b–567e	**6**:201e–g

Section 537. Economic growth and planning

[for Part Five headnote see page 283
for Division III headnote see page 311]

The articles and parts of articles referred to in Section 537 deal with two main subjects: A, the nature and causes of economic growth; and B, planning for economic growth and stability.

The outline of subject A begins with the definition of economic growth and with factors that influence it. It goes on to the various theories and models of economic growth, to the practical functions of growth theory and mathematical growth models, and to the social costs and benefits of economic growth. It next deals with special problems of economic growth in developing countries, with various theories of national economic development, and with post-World War II economic advances in Asia, Africa, and Latin America. Finally, it treats the concept and the measurement of economic productivity.

The outline of subject B first deals with the nature of economic planning. It then treats the history, structure, and results of economic planning in Communist countries, in developed non-Communist countries, and in developing non-Communist countries.

	articles	article sections	other references
A. The nature and causes of economic growth	ECONOMIC GROWTH **6**:213–219		
1. Definition of economic growth		**6**:214b–215c / **5**:104e–106c / **6**:203e–204c / **6**:211c–212f / **6**:272c–f / **6**:770g–771d	**10**:636d–g
2. Various factors influencing economic growth; *e.g.*, technology, markets, the supply of capital, the labour force, governmental fiscal policies		**6**:215c–217d / **6**:259b–h / **6**:311h–312d / **6**:771d–h / **6**:772h–773e / **7**:324a–f / **9**:501e–h / **15**:29b–32g	**6**:313f–h / **9**:526d–527g / **18**:564b–570g *passim*
3. The theory of economic growth and models of growth		**6**:217d–219e / **14**:818g–819f / **15**:32g–33e	**16**:906c–f
a. Various models of economic growth: supply-determined models, demand-determined models, and target-instrument models		**6**:218c–g / **6**:204c–206g / **9**:566h–567e	
b. The practical functions of growth theory and mathematical growth models		**6**:218h–219e / **6**:201b–g / **6**:203e–204c	**6**:267a–c
4. Social costs and benefits of economic growth		**6**:217c–d	

	articles	article sections	other references
5. Economic growth in developing countries	ECONOMIC DEVELOPMENT **6**:202–210	**1**:315f–317c / **4**:996h–997b / **5**:383b–f / **6**:115a–d / **6**:251e–254a / **6**:261h–262e / **6**:315f–316c / **9**:501e–h / **18**:569h–570g	**5**:105f–106c
a. The relationship between economic underdevelopment and low per capita income: the rate of increase of gross domestic product (GDP) as compared to population growth		**6**:202c–203c / **1**:366d–f / **6**:262f–263e / **14**:819f–821d / **14**:823b–h / **19**:677f–h	
b. Various theories of national economic development and economic retardation		**6**:203d–208e	
i. Growth economics as compared to development economics		**6**:203e–204c / **6**:272c–f	
ii. The missing-component theory: underdevelopment as caused by a lack of capital, material resources, or human skills		**6**:204c–205f	
iii. Surplus material and human resources as a source of economic advancement: the critical minimum effort theory for raising per capita income		**6**:205f–206g	
iv. The development of domestic industry as compared to the expansion of international trade as factors in economic development		**6**:206h–208e / **7**:31h–32a	**9**:565h–566b / **18**:556a–c
c. Post-World War II economic advances in Asia, Africa, and Latin America		**6**:208f–210e / **4**:904h–905e / **6**:104g–105c / **9**:738h–740b / **10**:639g–641h / **17**:1069a–b	**1**:1140a–c / **1**:1142c–e / **3**:137e–h / **7**:522c–526a *passim* / **10**:87g–88e / **11**:998d–h / **13**:794f–g / **17**:98e–102f *passim* / **19**:782f–783b
6. Changes in economic efficiency as measured by changes in output per unit of input	PRODUCTIVITY, ECONOMIC **15**:27–33	**1**:39h–42f / **6**:211c–213d	
a. Uses of productivity indexes; factors that influence levels of productivity		**15**:28b–29g	**6**:200f–h / **10**:636d–f
b. Historical trends in productivity: comparisons of national productivity levels		**15**:29g–32g	
c. Problems and limitations of productivity measurement		**15**:32g–33e / **12**:849e–850g	
B. Planning for economic growth and stability	ECONOMIC PLANNING **6**:255–263		
1. The nature of economic planning		**6**:255f–256b / **6**:772h–773e / **15**:23c–24e	
2. Economic planning in Communist countries		**6**:256c–259a / **6**:275a–e / **6**:276d–277b	**11**:511h–512d / **17**:340h–341d / **17**:342g–347d
a. Origins of planning in the Soviet Union: economic controversies of the 1920s and the First Five-Year Plan		**6**:256c–h / **6**:247b–248c / **16**:72a–d	**16**:74c–g / **17**:578a–b
b. Structure of the Soviet planning system: the Gosplan and proposed economic reforms		**6**:256h–257h / **1**:319a–c / **2**:704e–705d / **3**:444g–445a / **6**:248d–h / **16**:86f–87b / **17**:318b–d	**11**:508b–d / **11**:514h–515b / **16**:74c–g / **17**:345g–347d / **17**:579a–c
c. Planning in other Communist countries and assessment of Soviet-type economic planning		**6**:257h–259a / **2**:676a–c / **3**:540a–b / **6**:276g–277b	**2**:1199a–b / **4**:391a–f / **6**:248h–249c / **9**:42c–e
3. Economic planning in developed non-Communist countries		**6**:259a–261h / **6**:211c–213g / **9**:501e–h	

	articles	article sections	other references
a. Origins and objectives of economic planning in western Europe and the United States		**6**:259b–h / **1**:317c–319a	**3**:443h–444g *passim* / **8**:320e–321b
b. Stages of economic planning		**6**:259h–261e	
c. Assessment of planning in developed countries		**6**:261e–h / **6**:250d–251e / **15**:199c–200b	**6**:274f–h / **15**:31h–33e *passim*
4. Economic planning in developing non-Communist countries		**6**:261h–263e / **2**:703f–h / **5**:383b–f / **6**:251e–254a / **6**:277b–f / **7**:180h–181b / **17**:1069a–b	**2**:408c–g / **11**:998d–h / **14**:935f–h
a. Approaches to development planning		**6**:262b–263a / **19**:780b–782f	**4**:904h–905e
b. Difficulties in development planning: the balance of payments problem and the allocation of available resources		**6**:263a–e / **6**:209a–210a	**3**:138d–139c / **9**:294f–295d

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BAGEHOT, WALTER **2**:583
BENTHAM, JEREMY **2**:837
HAMILTON, ALEXANDER **8**:584
HUME, DAVID **8**:1191
KEYNES, J.M. **10**:446
MALTHUS, THOMAS ROBERT **11**:394
MARX, KARL **11**:549
OWEN, ROBERT **13**:800
RICARDO, DAVID **15**:825
SMITH, ADAM **16**:904
VEBLEN, THORSTEIN **19**:39
WEBER, MAX **19**:714

Division IV. Politics and government

[for Part Five headnote see page 283]

The outlines, and the articles and parts of articles referred to, in the four sections of Division IV treat general theories of the state and of government; the structure, branches, and offices of government; the functioning of government; and international relations in peace and war.

The articles referred to in Section 541 treat traditional philosophical theories concerning the origin, nature, and ends of the state and concerning the nature, institutions, and operations of government; the national state as viewed in political theory; patterns of political action; and major political concepts, ideologies, and problems.

Section 542, on political institutions, deals first with the overall organization of government, the levels of government, and contemporary forms of government. It then treats the three functional branches of government—legislative, executive, and judicial. Finally, it deals with public administration—the organization of governmental operations.

Section 543, on the dynamics of the political process, first deals with the internal and external security functions of government; its supervisory and regulatory functions; its law enforcement and corrective functions; and its enterprising functions, such as the provision of public health agencies and of educational facilities. It goes on to treat government responsibility for regulating the economy and allocating economic resources. Then, after dealing with the electoral process, it treats the factors that determine stability and instability in government and the methods by which the form of government is changed.

Section 544 first deals with the politics of international relations. It then treats the degrees and kinds of war; modern theories of the causes of war; the consequences of war; the structure of armed forces; and the conduct of war.

Section 541. Political theory 333
542. Political institutions: the structure, branches, and offices of government 340
543. The functioning of government: the dynamics of the political process 342
544. International relations: peace and war 346

Section 541. Political theory

[for Part Five headnote see page 283
for Division IV headnote see page 332]

The articles and parts of articles referred to in Section 541 deal with five main subjects: A, the philosophical conception of civil society, or the political community, including traditional theories of the state; B, the national state as viewed in political theory; C, philosophical theories concerning the nature, institutions, and operations of government; D, patterns of political action as viewed in political theory; and E, political concepts, ideologies, and problems.

Dealing with major themes and theories in traditional political philosophy, the outline of subject A treats diverse theories of the origin of the state; of the nature of the state; of the ends or purposes of the state; of the societal structure of the state; of the kinds of states; of the causes of the rise and decline of states; and of relations among states and nations.

Dealing with the national state as viewed in modern political theory, the outline of subject B treats the properties of statehood, with special attention to the concept of sovereignty, the relations of the state and the individual, and the national state in the international community.

Subject C is philosophical theories concerning the nature, institutions, and operations of government. The outline begins with diverse views of the nature and ends of government and diverse theories regarding the normative classification of the forms of government. It goes on to various conceptions of the limits of political authority and responsibility and to various conceptions of the bases of the legitimacy and authority of government. Finally, it deals with theories of constitutionalism and with modern constitutional governments. Here, it first deals with the origins, with the theories of constitutional government, and with the defining features of constitutional government. It then deals with the methods of constitutional growth, covering the constitutions of Great Britain and the United States; continental constitutionalism; the constitutions of Latin American, African, and Asian states; and the constitutions of the Soviet Union and other socialist states.

Subject D is patterns of political action as viewed in modern political theory. After dealing with political action within small groups, villages, or communities, the outline goes on to political action by organized parties; to the procedures involved in the selection of candidates and party leaders and in maintaining party discipline; and to the structure and functions of parties within various political systems. The outline next deals with political action by nonparty political groups having common interests. The outline treats the types of nongovernmental groups with actual or potential political influence; the role of interest groups in various political systems; and the various means by which interest groups can influence the political process. Finally, the outline of subject D deals with the political influence of public opinion. It treats the historical background of modern public opinion; the ways in which public opinion forms and changes; the influences of public and government; and the methodology of public opinion polling.

Subject E is political concepts, ideologies, and problems. The outline first deals with the concept of political power and with the concept of political rights. It goes on to deal with modern ideologies. Here, it begins with the origins and characteristics of ideology and with the problem of defining it and its relationship to political philosophy. It goes on to the importance of ideology to political systems or movements, and to theories regarding the interplay of ideology and the political process. Articles are then referred to that separately treat current political ideologies and tendencies—anarchism, Communism, Conservatism, Fascism, Liberalism, Marxism, Nationalism, and Socialism. Finally, the outline deals with contemporary issues. It covers the contemporary form of the problem of church and state; the political problems posed by increased urbanization; the problem of international cooperation and integration; the issue of political honesty; problems of communication between government and the public; the issue of centralization of power versus decentralization; the problem of adapting traditional political forms to changing conditions; and the problems about responsive government posed by the increased bureaucratization of governments.

	articles	article sections	other references
A. The philosophical conception of civil society, or the political community: traditional theories of the state		**17**:609d–614f	
1. Theories of the origin of the state		**5**:93c–94h / **17**:310h–311e / **17**:610c–612g	**14**:703b–c
a. The state as a creation of nature: man as a social and political animal; the state as necessary for the realization of human potentialities			**1**:976e–981c *passim* / **1**:1169h–1170d / **3**:501h–502b / **11**:554b–d / **14**:686e–h / **17**:611c–d **6**:891f–892a / **6**:892e–g
b. The state as a creation of man: the state as conventional			
i. The state as founded by a social contract; diverse conceptions of the social contract		**5**:93h–94h / **5**:226d–g / **17**:310b–311c / **17**:610g–612b	**5**:63e–g / **6**:893b–e / **6**:991h–992a / **7**:631b–c / **8**:971d–e / **9**:352h–353a / **10**:215a–d / **10**:717b–d / **11**:613f–g / **12**:865a–d / **14**:267h–268c / **14**:689c–691e *passim* / **15**:1171h–1172b
ii. The state as founded by a constitution		**5**:84d–85g / **5**:93c–h / **14**:690a–691a	**5**:94h–96g *passim* / **14**:715g–716a
c. The state as the historical realization of the divine idea for man's life on Earth		**8**:962a–c	**1**:981e–h / **4**:591d–592d *passim* / **8**:731e–g / **10**:302d–f / **14**:269h–270d / **14**:693b–d / **15**:788d–h / **17**:612d–e
d. The state as a reflection of the class structure of society		**17**:612h–613c / **16**:947c–948g / **16**:956h–959a	**16**:966d–f
2. Theories of the nature of the state: the political community as a unique form of human association		**12**:851a–f / **14**:685e–688f / **17**:309h–311e / **17**:610c–614a	**9**:1142c–d / **14**:261h–262d
a. The state as identical with the whole of human society		**17**:609f–g	**17**:612d–e

	articles	article sections	other references
b. The state as identical with the institutions of government: the state as the sovereign power possessing a monopoly of authorized force		**7**:182g–183e / **17**:309g–310h / **17**:609h–611b	**14**:724a–c / **17**:614f–h
c. The relationship between the state and the individual: the state as made for man or man as subordinate to the state; the common good as superior to the individual good		**14**:688b–d / **14**:691a–e / **17**:310h–311c / **17**:611d–612g / **17**:614b–f	**5**:94d–g / **6**:893b–c / **10**:1132g–1133a / **16**:1004h–1005a / **19**:544g–545d
d. Physical and historical elements of statehood; *e.g.*, territorial borders, population, a community of language and culture, a shared history		**1**:396a–e / **6**:532c–d / **14**:709f–710b / **17**:610a–b	**6**:1066f–g / **7**:205g–206c / **9**:748g–749a / **12**:851b–d / **19**:545e–h
3. Theories of the ends or purposes of the state		**14**:688f–692f	
a. The state as serving the good of society		**14**:691e–692e	**14**:537h–538d / **14**:686e–687b
b. The state as securing the natural rights of the individual		**14**:689e–f / **14**:690a–e	**14**:725b–c
c. The state as the protector of domestic peace and order		**14**:689a–d / **17**:610g–611b	**14**:723f–724b
d. The state as the promoter of economic and cultural welfare		**17**:613f–614a	**6**:893f–h
4. The societal structure of the state [see also 523.B.]		**4**:384d–385e / **14**:713b–714b / **17**:612b–613c	**16**:948g–953a *passim* / **19**:545b–d
a. Class distinctions within society; *e.g.*, political, economic, ethnic classes		**3**:982d–983f / **9**:499c–501h / **11**:852f–853b / **14**:716b–g / **14**:718d–f / **16**:29f–30c / **16**:946a–948g / **16**:956d–959a	**1**:629b–c / **14**:677h–680a *passim* / **17**:612h–613a / **19**:798a–b
b. The notion of a classless society		**1**:808a–f / **14**:693c–e / **16**:947f–948a / **17**:613b–d	**10**:719b–c / **11**:556a–d / **11**:556g–557a / **14**:694h–695h / **15**:788g–789a
5. Kinds of states: distinctions among various types of states		**9**:779d–780e	
a. The distinction between the secular and the theocratic state		**4**:591c–592a / **9**:921d–h / **9**:1124c–1125a / **14**:687d–g	**4**:509c–510b / **4**:511b–512f *passim* / **9**:1121b–f / **12**:154c–158h *passim*
b. The distinction between the imperial and the nonimperial state		**9**:779e–780a / **14**:707f–708h	
c. The distinction between the city-state and the nation-state, federal and nonfederal		**7**:203b–205a / **9**:779f–780e / **14**:709f–710h / **17**:609f–g	**12**:851a–e / **14**:711f–712b
d. Political distinctions among states; *e.g.*, monolithic versus pluralistic states		**7**:182g–183e / **14**:717e–718d / **14**:718g–719c	**14**:677h–684c *passim*
e. Economic distinctions among states; *e.g.*, agricultural, industrial, mercantilistic states		**9**:523h–524b / **9**:779f–780a / **17**:613f–614a	**9**:526d–527a
6. Theories concerning the causes of the rise and decline of states		**9**:781f–782f / **14**:714g–716g / **14**:726b–728c / **15**:789a–791b	**1**:808a–809a *passim* / **8**:962a–964b *passim* / **9**:769c–g / **9**:1146f–1147c / **19**:544g–545h *passim*
7. Theories concerning relations among states and nations [see 544.A. and 544.B.]			
B. The national state as viewed in political theory	STATE, THE **17**:609–615		
1. Properties of statehood		**17**:609f–614a	
a. Sovereignty [see also 544.A.2.a.]	SOVEREIGNTY **17**:309–313	**17**:609h–610a / **17**:610c–613d / **5**:93h–94h	
i. Theories of sovereignty		**17**:309h–311e / **17**:610c–612b / **7**:182h–183e	**5**:64d–f / **6**:1092a–b / **7**:204a–b / **7**:205a–d / **7**:631e–g / **7**:636f–g

	articles	article sections	other references
ii. Rights and limitations of sovereignty		**17**:310a–b / **17**:311e–313f / **9**:747c–749g	**11**:229d–e
b. Definitive borders and populations: the sense of political allegiance and nationality		**17**:609h–610b / **1**:396a–e	**7**:205g–206c / **9**:748f–749a / **12**:851b–d
c. Maintenance of order and security		**17**:613e–614a / **14**:689a–d / **14**:723f–724d	
2. The state and the individual		**17**:611f–612e / **17**:614b–f	
3. The national state in the international community [see also 552.B.]		**17**:614f–615a / **9**:732e–733c / **9**:747c–749g	
C. Philosophical theories concerning the nature, institutions, and operations of government			
1. Diverse views of the nature and ends of government: its necessity or dispensability		**1**:808a–809g / **9**:1146d–1147c	**3**:501h–502b / **17**:314a–316e *passim*
2. Theories regarding the normative classification of the forms of government		**4**:381f–382c / **9**:781f–782a / **14**:713b–714b	**12**:402c–g
a. Formulations of the ideal polity or utopian society		**1**:813a–c / **9**:1021b–h / **14**:685g–686d / **17**:611f–612b	**1**:808d–809a / **2**:539c–h / **4**:382e–g / **5**:84g–85g / **10**:716a–c / **12**:438c–f / **14**:535g–536c / **15**:665d–666a
b. Infirmities and abuses to which the ideal society is subject		**14**:686d–687b	**2**:539h–540c / **14**:713b–f
c. Traditional classifications of and criteria for judging good and bad forms of government		**5**:93c–f / **15**:787c–789a	**1**:808a–f / **5**:84g–85g / **9**:1147a–c / **19**:2g–h
3. Various conceptions of the limits of political authority and responsibility		**6**:259b–261h / **7**:182g–183e / **7**:640f–641h / **14**:715d–716b	**4**:380d–f
4. Various conceptions of the bases of legitimacy and authority of government		**5**:93d–94h / **6**:1117h–1118b / **17**:309h–311e	**8**:625c–e / **9**:318a–b / **11**:970a–d / **14**:699d–e
a. Continuing consent of the governed: popular sovereignty		**17**:310h–311e / **17**:611f–612b	**6**:532c / **6**:991h–992a
b. The social contract		**5**:93h–94h / **17**:310d–311c	**5**:63e–g / **5**:85e–g / **5**:226d–228f *passim* / **6**:893b–c / **7**:631b–c / **8**:971d–e / **10**:215a–d / **10**:717b–d / **12**:865a–d / **14**:267h–268b
c. Venerable sanction: hereditary monarchy; constitutional succession		**12**:142f–143a	**4**:305f–306a / **6**:113c–e / **14**:714b–f / **16**:309e–h / **16**:313e–314b / **17**:409f–410a
d. Divine right: God as the source of political authority		**4**:590a–b / **4**:591c–592e / **5**:93f–h / **9**:921d–h / **10**:305e–306a	**3**:226e–g / **5**:519a–c / **6**:477d–g / **6**:1014f–h / **7**:631e–g / **7**:640a–c / **8**:386g–387a / **9**:323a–b / **9**:381d–e / **9**:479h–480d / **10**:302d–e / **11**:932a–d / **11**:973f–g / **12**:142 c–e / **15**:611a–e / **16**:119a–121f *passim*
5. Theories of constitutionalism; modern constitutional governments	CONSTITUTION AND CONSTITUTIONAL GOVERNMENT **5**:93–98	**5**:84d–92b / **5**:380f–381a	
a. Origins and theories of constitutional government		**5**:93d–94h	**12**:865a–d
i. Classical concepts of constitutionalism		**5**:93d–f	**5**:226d–229d *passim* / **10**:302d–f / **14**:537h–538d / **14**:686c–687b *passim*
ii. The influence of the church on medieval constitutions		**5**:93f–h / **4**:592a–d / **14**:688b–d	
iii. The social contract as the foundation of the modern constitution		**5**:93h–94h / **17**:310d–311c	**5**:63e–g / **5**:85e–g / **6**:893b–c / **10**:717b–d / **14**:268a–c

	articles	article sections	other references
b. Features of constitutional government		**5**:94h–96h / **5**:382b–e / **7**:205f–206a / **14**:718g–719c	**5**:66d–e / **14**:715g–716a
i. Procedural elements; *e.g.*, accountability, representation, separation of powers, openness and disclosure		**5**:95a–f / **10**:848b–849a	**14**:680g–681a
ii. Constitutionality: judicial and legislative review		**5**:95f–96b / **1**:92e–93f / **1**:95g–96a / **5**:220f–222f / **10**:782g–783c / **17**:316e–317b	**4**:666c–e / **10**:717e–g / **11**:537b–d / **18**:959h–960a
iii. The stability of constitutions: the constitution as fundamental law; problems of constitutional change		**5**:96b–h	
c. Methods of constitutional growth: evolution and substantive replacement		**5**:96h–98c / **5**:84d–87b / **14**:718g–719c / **16**:77a–c / **18**:956a–957h	
i. The constitutions of Great Britain and the United States		**5**:96h–97e	**3**:253e–h / **3**:740b–e / **5**:66a–f / **5**:86d–h / **10**:717e–g / **11**:537b–d / **14**:718g–719b
ii. Continental constitutionalism; *e.g.*, France, West Germany, Italy, Spain		**5**:97e–98b	**7**:603e–604b / **7**:650g–651b / **7**:657b–f / **7**:668h–669a / **7**:677d–f / **7**:678g–h / **8**:107f–111f *passim* / **8**:116e–g / **8**:122d–f / **9**:1105h–1106e / **9**:1168d–g / **14**:718b–c / **17**:393h–394e / **17**:436f–439a *passim*
iii. The constitutions of Latin America, Africa, and Asia		**5**:98b–c / **4**:8e–9b / **10**:79h–80f / **10**:87b–g / **17**:957e–h	**1**:170h–171b / **3**:139g–140h / **4**:365e–f / **9**:297f–h / **9**:420d–423e *passim* / **12**:85g–86a / **13**:788b–d / **14**:717f–h / **19**:143c–e
iv. The constitutions of the Soviet Union and other socialist republics [see 551.B.4.c.]			
D. Patterns of political action as viewed in political theory			
1. Political action within small groups, villages, or communities		**14**:699h–700c / **14**:701a–h / **14**:711a–f	**16**:30d–e / **16**:960h–964c *passim*
a. Methods of choosing leaders		**6**:1118b–f	**6**:529c–e / **14**:701d–h / **16**:962h–964c *passim*
b. Methods of settling disputes		**6**:1120c–g / **14**:662f–h	**14**:700a–c / **14**:1038c–1039f *passim*
2. Political action by organized parties	POLITICAL PARTIES **14**:677–684		
a. The origin and development of political parties; cadre and mass-based parties		**14**:677h–680a / **16**:70h–71d / **16**:72d–73c / **16**:76b–77a / **17**:446c–448g / **18**:946d–965e / **18**:959c–h / **18**:977b–e / **18**:983g–985b	**4**:291g–292h / **5**:184c–187h *passim* / **13**:787h–789d / **14**:650a–c / **16**:64d–65a
b. Parties and the struggle for political power		**14**:680a–681d / **10**:81g–82d	**6**:531f–534h *passim* / **14**:700d–g
i. The selection of candidates and party leaders: party conventions, caucuses, and elections; financing of campaigns		**14**:680a–f / **14**:699h–700c	**15**:40f–41a
ii. Party discipline and the authority of the leaders: rotating or stratified leadership		**14**:680f–681d / **4**:1021h–1022b / **16**:76b–77a / **16**:81f–82g / **17**:448f–449b	**3**:489a–e / **4**:392g–393c / **14**:683b–c / **16**:71c–d / **17**:351d–e / **17**:578c–d / **17**:579d–e
iii. Party policy and loyalty		**6**:535c–e / **17**:447c–g / **18**:965a–e	

	articles	article sections	other references
c. The nature of political parties: the structure and functions of parties within various political systems		**14**:681d–684f / **5**:66h–69a / **17**:447c–449b	**7**:206g–207a / **9**:1108a–e / **14**:718h–719a
i. The multiparty system and parliamentary coalitions		**14**:681f–682e	**2**:446h–447b / **2**:674g–675c / **7**:605e–606b / **9**:298g–h / **17**:447e–g
ii. The two-party system		**14**:682e–683d	**18**:886e–h / **18**:938f–h
iii. The single-party system		**14**:683d–684c / **16**:70h–71d / **16**:76b–77a / **17**:448f–449b	**1**:205h–206b / **4**:292h–293c / **4**:392d–f / **9**:41f–42a / **14**:717h–718a / **17**:350e–f / **17**:351d–e
3. Political action by nonparty groups having common interests	SPECIAL-INTEREST GROUPS **17**:445–449	**11**:601g–602e / **14**:705e–f	
a. Types of nongovernmental groups with actual or potential political influence		**17**:445d–g / **6**:535d–e / **13**:849f–851e / **16**:975d–h / **19**:545h–546e	**13**:549b–e / **17**:351h–352a
i. Economically oriented groups; *e.g.*, unions, guilds, professional organizations		**17**:445d–g / **5**:103c–104b / **5**:186d–f / **16**:968d–f	**18**:563e–571d *passim*
ii. Socially oriented groups; *e.g.*, philanthropic, religious, cultural, recreational groups [see also 522.A.4.b.i.]		**17**:445f–g / **4**:850d–f / **16**:968b–c / **18**:983d–984b	**4**:513h–514a / **15**:609d–610b / **16**:64d–65a
iii. Racial or ethnic groups [see 522.A.5.d.]			
b. The role of interest groups in various political systems		**17**:445h–449b / **4**:850f–851a / **14**:680a–f / **16**:970a–d	**4**:1009c–g
i. Anglo-American and Swedish patterns		**17**:447c–g / **5**:186d–f / **16**:975g–h	**16**:977b–c / **18**:983d–984b
ii. French and Italian patterns		**17**:447h–448b / **1**:810c–811h	**16**:971a–d
iii. Patterns in developing countries in Latin America, Asia, and Africa		**17**:448b–e	**13**:788g–789d / **13**:850b–g
iv. Patterns in Communist countries		**17**:448f–449b	**14**:679d–g / **19**:128a–g
c. Means by which an interest group can influence the political process		**17**:446c–447b	
i. Through propaganda, advertising, and publicity		**17**:445h–446f / **15**:43g–44f / **15**:210a–211b	**15**:39d–h / **15**:212e–213a
ii. Through lobbying to advance a special interest; through financing and electing favourable candidates		**17**:446f–447b	**14**:680d–f / **17**:448a–b
iii. Through demonstrations, passive resistance, threats of violence, and insurrection		**1**:810g–813a / **4**:846e–848d / **4**:849h–850d / **13**:850b–851e / **15**:789a–790g	**7**:877a–f / **9**:769c–g / **12**:945f–h / **13**:788g–789d / **14**:714h–715b / **16**:62d–h
4. The political influence of public opinion	PUBLIC OPINION **15**:210–216		
a. The historical background of modern public opinion		**15**:210a–211b	
b. Ways in which public opinion forms and changes: the influence of mass communications media, interest groups, and opinion leaders		**15**:211h–213c / **1**:104c–107d	**4**:1009b–g
c. Mutual influences of public and government: the formation and change of public opinion regarding governmental policy		**15**:213d–h	
d. Public opinion polling and methodology; criticisms and justifications of opinion polling		**15**:214a–216e / **15**:39b–h	**15**:43b–d
E. Political concepts, ideologies, and problems			

	articles	article sections	other references
1. The concept of political power	POLITICAL POWER **14**:697–701	**9**:781f–782f	
a. The nature and scope of political power and influence: various power relationships; approaches to classifying power and authority		**14**:697e–699g / **11**:603c–g / **14**:677f–681d / **14**:713b–714b / **14**:717c–719c / **17**:445h–447b	**2**:20e–21g *passim* / **9**:524e–525f *passim* / **9**:1146f–1147c / **11**:600g–601c
b. The exercise of political power at various levels: the distribution or concentration of power		**14**:699g–701h / **14**:662f–h / **14**:710h–713b / **17**:447c–449b	**2**:13e–g
2. The concept of human rights	HUMAN RIGHTS **8**:1183–1189		
a. Historical development of concern for the fundamental rights of man		**8**:1183e–1185e / **6**:1119a–c / **15**:1102e–h / **16**:862b–863b / **17**:960b–961b / **18**:965g–966c / **19**:555b–556g	**3**:990a–e / **4**:892c–e / **6**:486d–f / **7**:650g–651b / **8**:341e–h / **8**:399g–400a / **10**:695a–696c / **13**:112a–f / **16**:61g–62b
b. Recent movements to protect the rights of man: rights of nationality and citizenship		**8**:1185f–1189c / **15**:571d–573a / **16**:863b–g / **16**:864g–865e / **18**:899h–900b / **19**:556g–557g	**3**:990e–991b / **11**:202c–f / **16**:929e–h / **17**:312e–h / **17**:349f–g
c. Slavery and forced labour as violations of human rights	SLAVERY, SERFDOM, AND FORCED LABOUR **16**:853–865	**10**:695a–696c / **10**:700c–g / **12**:150h–151c / **15**:362c–363b / **18**:965g–966c / **18**:967g–971f	**3**:145h–146b / **3**:1094c–g / **4**:513a–d / **4**:888h–889d / **5**:369g–h / **8**:1164h–1165h / **10**:698g–699a / **12**:186h–187a / **16**:55h–56d / **16**:58h–59d / **16**:61g–62b / **19**:938c–e / **19**:769a–770h
d. The political, legal, and economic status of the alien		**8**:1188d–e / **15**:571d–573a / **16**:65a–f / **18**:899h–900b	**9**:749a–e / **12**:188f–189a / **14**:817h–818c / **14**:822b–e / **16**:929e–h
3. Modern ideologies	IDEOLOGY **9**:194–198		
a. Origins and characteristics of ideology: the problem of defining political ideology; the relationship between ideology and philosophy		**9**:194b–195h / **5**:62g–63d / **11**:1017g–1018a	
b. The importance of ideology to a political system or movement: the relationship between ideological and civil politics		**9**:195h–197e / **2**:633h–634e / **4**:378f–380c / **4**:382e–g / **4**:1020b–g / **7**:184c–185a / **7**:631b–g / **8**:106a–h / **12**:803c–d / **13**:849f–851e / **14**:678a–680a / **16**:976g–977c	**4**:363g–364b / **4**:368h–372h *passim* / **7**:913d–g / **8**:459g–462e *passim* / **12**:265a–c / **15**:789e–790c / **16**:64d–65a
c. Theories regarding the interplay of ideology and political process: ideology and international relations		**9**:197e–198c / **4**:1026b–f / **19**:544g–545h	**9**:769c–g / **9**:782c–f
d. Current political ideologies and tendencies *with special attention to*		**11**:1019g–1020a / **16**:976g–977c	
i. Anarchism	ANARCHISM **1**:808–813	**14**:692f–h / **17**:613c–d	**2**:608d–g / **15**:130f–131e / **15**:790c–e / **16**:967f–g
ii. Communism	COMMUNISM **4**:1020–1026	**4**:384b–385e / **4**:386e–388h / **6**:256c–e	**1**:809f–g / **3**:489g–490b / **4**:369a–f / **4**:375c–f / **10**:796d–797b / **14**:679d–g / **16**:77c / **16**:84e–f / **18**:568e–569a
iii. Conservatism	CONSERVATISM **5**:62–69	**2**:11f–12a	
iv. Fascism	FASCISM **7**:182–188	**8**:118f–120b / **9**:1167f–1169h / **16**:970d–e	**8**:117c–e / **12**:750c–752e / **14**:679g–680a / **14**:683g–684a

	articles	article sections	other references
v. Liberalism	LIBERALISM **10**:846–851	**5**:377d–e / **11**:600f–601g	**6**:1073g–1074b / **7**:650g–651b / **14**:270g–271a / **19**:544g–545a
vi. Marxism	MARXISM **11**:553–560	**4**:1020a–g / **6**:265c–f / **8**:1167a–f / **14**:693c–e / **14**:694h–695h / **14**:819d–f / **16**:947f–948a / **16**:966c–968b / **16**:968h–970c / **16**:987d–g / **17**:612h–613c	**3**:489g–490b / **4**:658d–f / **6**:410g–411a / **7**:78e–g / **8**:735h–736c / **8**:738b–d / **8**:963e–h / **9**:195b–h / **10**:719b–d / **10**:792g–795g / **11**:550d–552f / **14**:271a–b / **14**:272e–f / **15**:598a–d / **15**:788g–789a / **16**:956h–957c / **19**:545b–e
vii. Nationalism	NATIONALISM **12**:851–853	**2**:1193c–1194h / **3**:1098a–e / **4**:370d–372h / **4**:381b–f / **4**:382h–384b / **4**:850h–851a / **4**:902f–903a / **10**:326a–b / **16**:324h–325b / **19**:545e–h / **19**:784a–785f	**2**:178h–179f / **2**:470e–472b / **2**:473d–476d *passim* / **2**:631c–f / **3**:291a–292b / **5**:1075h–1076c / **6**:1066e–1067f / **6**:1107f–1108b / **7**:677h–678d / **9**:412g–416a *passim* / **9**:769c–g / **9**:925f–g / **9**:1160b–1162g *passim* / **14**:719e–720a / **17**:295a–298g *passim*
viii. Socialism	SOCIALISM **16**:965–973	**1**:808g–809c	**2**:868g–869e / **6**:106c–f / **6**:1071f–1072a / **7**:671b–g / **7**:669g–670a / **9**:1164g–1165a / **10**:118b–e / **10**:792g–797b *passim* / **11**:205d–206a / **13**:801e–h / **14**:679b–d / **19**:545b–e
4. Contemporary political issues and problems			
a. The problem of church and state: its background and contemporary form	CHURCH AND STATE **4**:590–595	**11**:199h–200b / **13**:848a–h / **15**:116g–117c / **15**:607g–608b	**2**:621c–d / **4**:511a–512f *passim* / **10**:697f–698a / **15**:611a–g
i. Classical and medieval relationships between church and state; the struggle between secular and ecclesiastical authorities for governmental power in the Reformation; the growth of state control		**4**:590c–593b / **3**:240c–e / **3**:1085g–1086f / **4**:476c–h / **4**:508h–510b / **6**:155h–156c / **7**:629d–631b / **7**:636b–e / **8**:1174g–1175f / **9**:1131g–1132h / **13**:957g–958a / **15**:1003f–1004d	**3**:242e–g / **6**:152f–h / **6**:330d / **9**:1128g–1130e / **19**:1050f–1051e
ii. The evolution of religious toleration; modern religious freedom and the separation of church and state		**4**:593c–595a / **8**:1184d–e	**3**:1087a–e / **4**:510b–511a / **4**:515c–e / **5**:236g–238b / **6**:357b–d / **14**:24d–25b / **15**:561h–562a
b. The urban problem: the administration of cities and metropolitan areas [see also 525.B. and 542.A.1.c.]		**4**:644a–645b / **18**:1073e–g / **18**:1077c–1080g	
c. The problem of international cooperation and integration [see also 544.A.]		**9**:732e–733c / **9**:744b–746a / **9**:748c–749g / **9**:778h–779c / **9**:780b–e	**9**:526d–527a
d. The issue of political honesty		**6**:534f–h	
e. The problem of communication between government and public: government censorship of news and information; government-directed propaganda during wartime and during political campaigns		**1**:104c–107d / **15**:36h–38c	**3**:1088f–1090a / **4**:1009c–e / **10**:867h–868b / **15**:39h–44f *passim*
f. The issue of centralization of power versus decentralization		**4**:645b–650b / **14**:662f–664b / **14**:700g–701h / **15**:190b–f	**7**:205b–e
g. The problem of adapting traditional political forms to changing conditions		**14**:680a–681d / **14**:726b–728c	**11**:600f–603c *passim*
h. Bureaucracy: the issue of responsive government [see 542.C.]			

Section 542. Political institutions: the structure, branches, and offices of government

[for Part Five headnote see page 283
for Division IV headnote see page 332]

The articles and parts of articles referred to in Section 542 deal with three main subjects: A, the overall organization of government; B, the branches of government; and C, public administration.

The outline of subject A begins with the levels of government, covering the distinctions and relations among supranational political systems, national unitary and federal political systems, and regional, urban, and rural governments. It goes on to types and models of political systems, here treating classical distinctions between political systems; distinctions based on social, cultural, economic, or psychological factors; distinctions based on the way in which power is obtained and transferred; and distinctions based on the way in which power is exercised and controlled. Finally, dealing with contemporary forms of government, the outline of subject A treats the modern monarchy; the modern dictatorship; the modern oligarchy; and modern constitutional governments—constitutional democracies, republics, and monarchies.

The outline of subject B begins with the concentration of legislative and executive functions in parliamentary rule. It then deals separately with the legislative, executive, and judicial branches of government, treating modes of appointment, tenure, responsibilities, rights, privileges, and immunities for each branch.

Subject C is public administration—the planning, organization, and coordination of governmental operations. The outline treats the historical development of public administration systems; various modern theories of bureaucratic policy and organizational methods; judicial and legislative controls over public administrative agencies; and the organization of such public administrative units as regulatory and investigatory commissions and governmental corporations.

	articles	article sections	other references
A. The overall organization of government	POLITICAL SYSTEMS **14**:707–716		
1. Levels and structures of various systems of government		**14**:707e–713b / **14**:719d–721d	
a. Supranational political systems: empires; leagues, confederations, and commonwealths; regional federations; world congresses [see 544.A.1.c.]			
b. National political systems		**14**:709f–710h / **14**:719d–720b / **5**:87b–88f	
i. The unitary nation-state system		**14**:710b–e / **5**:88d–f	
ii. The federal state system	FEDERALISM **7**:202–207	**14**:710e–h / **14**:720b–f / **5**:87d–88c / **5**:91d–92b	**5**:224b–d
c. Urban community governments	CITY GOVERNMENT **4**:644–653	**14**:711f–712f / **9**:779f–780a / **14**:701a–h / **18**:1079d–1080g / **18**:1081g–1084c	**11**:603g–604c
i. Decentralized city governments in federal systems; *e.g.*, in the United States and in the Federal Republic of Germany		**4**:645c–648c / **14**:720g–721d	**18**:921c–923c
ii. Decentralized city governments in unitary systems; *e.g.*, in Great Britain and Japan		**4**:648c–650b	
iii. Supervisory systems of city government; *e.g.*, in France and Italy		**4**:650c–651h	
iv. Integrated systems of city government; *e.g.*, in the Soviet Union and in Poland		**4**:651h–653d	
d. Other subnational political systems			
i. Tribal community governments [see 521.A.6.a.]			
ii. Rural community governments		**14**:711c–f / **14**:662f–h / **16**:30c–h	**18**:920e–921b
iii. Regional community governments; *e.g.*, provinces, cantons, counties, and states; special-purpose administrative bodies		**14**:712f–713b / **14**:720b–g / **4**:304a–305c	**14**:721b–d / **17**:350d–e / **18**:938c–d
2. Types and models of political systems		**14**:713b–716b / **5**:85h–90d / **5**:94h–98c	**14**:681d–684c *passim*
a. Classical distinctions between political systems; *e.g.*, monarchy, oligarchy, democracy		**14**:713b–f	**14**:699e–g
b. Distinctions based on social, cultural, economic, or psychological factors: Machiavellian, Marxist, and Weberian theories [see also 541.A.4.]		**14**:713f–714b	

	articles	article sections	other references
c. Types of systems as determined by the way in which power is obtained and transferred; *e.g.*, hereditary and constitutional systems, elected governments, governments based on force		**14**:714b–715d / **5**:96b–h / **6**:529b–h	
d. Types of systems as determined by the way in which power is exercised and controlled: autocratic and nonautocratic systems		**14**:715d–716b / **14**:717a–719c / **2**:22b–c	**2**:409f–410a
3. Contemporary forms of government		**14**:717a–719c / **14**:727b–e / **6**:529b–h / **9**:524c–e / **14**:699e–g	
a. The modern monarchy: the king as absolute ruler or as constitutional monarch		**14**:717c–e	**5**:88f–89a
b. The modern dictatorship: military or civilian monocratic rule		**14**:717e–718d / **2**:21g–22c / **9**:1168c–1169h / **11**:602e–603c	**1**:205h–206b / **6**:107f–108d / **10**:795f–797b
c. The modern oligarchy: elite class rule		**14**:718d–f	**14**:701d–h
d. Modern constitutional governments: constitutional democracies, republics, and monarchies		**14**:715g–716a / **14**:718g–719c / **5**:88f–89h / **5**:94h–98c / **6**:529h–530c / **11**:601c–g / **14**:681b–d	**10**:848g–849c / **14**:727c–e
B. The branches of government	POLITICAL SYSTEMS **14**:721–723	**10**:848b–849a / **15**:1087e–1089g	**5**:95d–98c *passim* / **18**:937e–938c
1. The concentration of legislative and executive functions: parliamentary rule		**5**:96h–97c	**3**:253b–h / **5**:89b–h / **7**:604b–e / **8**:62a–g / **14**:682a–e / **14**:682h–683d / **18**:885b–e
2. The legislature: the branch of government primarily responsible for the enactment of laws		**14**:721g–722c / **12**:157h–158h	**2**:410a–d / **5**:95c–d / **9**:1106e–h / **17**:349h–350c / **18**:937g–938a
a. Unicameral and bicameral deliberative bodies		**5**:89h–90d	**3**:140c–g / **7**:604b–e / **9**:298b–d / **14**:634d–f / **18**:885b–e / **18**:937g–938a
b. Selection of legislators: methods and processes of electing and appointing legislative representatives; legislative tenure		**6**:529h–534h	**7**:629a–d / **14**:680d–f / **18**:937g–938a
c. Divisions in the legislature: party alignments and coalitions		**14**:681d–684f	
d. Responsibilities of legislators as the people's representatives: legislative rights, privileges, and immunities		**6**:529b–530c / **6**:532d–533d	**18**:523h–524a
e. Parliamentary procedures: rules of order; open and secret balloting		**14**:721h–722a	
f. The relation of the legislative branch to other branches of government: areas of autonomy and overlap		**14**:722b–c / **17**:316e–317b	**1**:91e–g
3. The executive: the branch of government primarily responsible for the enforcement of laws and execution of policy		**14**:722d–h / **5**:88f–89h	
a. The chief executive as head of state or as distinct from head of state			**3**:253e–h / **5**:88g–89b / **7**:604e–g / **17**:394c–e
b. Methods by which the executive is chosen—by election or appointment; tenure of executives		**14**:714b–715d / **14**:717c–718d	**5**:89a–h / **14**:722e–f
c. Responsibilities of executives: their rights, privileges, and immunities		**3**:443h–445a	**9**:1106h–1107b
d. The chief executive as a member of a political party: partisan and nonpartisan political roles			**14**:683b–c
e. The role of the executive in foreign affairs			**15**:114c–g / **19**:565c–e
f. The process of executive administration: the delegation of authority to executive departments and commissions		**14**:722g–h / **3**:485g–487g	**4**:668b–670b *passim*
g. The relation of the executive branch to other branches of government: areas of autonomy and overlap		**14**:722b–c / **4**:672e–673e	**1**:91e–h

4. The judiciary: the branch of government primarily responsible for the adjudication and interpretation of laws [see also 552.F.1.]
   a. The organization of various types of courts: civil and criminal trial courts, courts of appeal, and courts of last resort
   b. Single and multiple jurisdictions: juridical systems in unitary and federal states
   c. The process of adjudication [see 552.F.1.a. and 553.E.4.]
   d. Methods of choosing judges—by election or appointment: judicial tenure
   e. Responsibilities of judges; their rights, privileges, and immunities
   f. Areas of judicial autonomy: the extent of judicial responsibility, authority, and influence
   g. Areas of judicial overlap: the role of the judiciary in legislative and executive functions

C. Public administration: the planning, organization, and coordination of governmental bureaucratic operations

1. Development of public administration systems
   a. From the 17th through the mid-19th century
   b. Late 19th- and 20th-century development of civil service as the personnel branch of public administration
      i. Recruitment and appointment of civil service personnel by the spoils system and the merit system
      ii. Organization of civil service departments
   c. Modern bureaucratic chains of command: various theories of bureaucratic policy and organizational methods

2. Judicial and legislative controls exercised over public administrative agencies

3. The organization of public administrative units *with special attention to*
   a. Units organized as commissions or committees; *e.g.*, regulatory and investigatory commissions
   b. Units organized as governmental corporations

articles	article sections	other references
	14:723a–c / **5**:90d–93a / **5**:220b–226c	**17**:350f–351a / **18**:938a–c
	5:222g–224d / **5**:279h–281a / **9**:734c–736c / **17**:1087a–g	**3**:140h–141c / **17**:314g–315h
	5:224b–d / **10**:782g–783c	**7**:606b–e
	5:224f–225h / **9**:734d–h	**7**:606c–d
	5:95f–96b / **5**:220f–222f	**10**:717e–g / **15**:10g–11c / **18**:938a–c
	1:95g–96a / **5**:90d–91a / **5**:220b–222b	**14**:669b–c
	1:92e–95a / **5**:222c–f / **17**:316e–317b / **17**:1087a–g	**11**:537b–d
PUBLIC ADMINISTRATION **15**:183–186	**1**:92b–e / **3**:487g–491a / **14**:725h–726b	
BUREAUCRACY **3**:484–496	**15**:183c–186g / **4**:667e–g / **12**:156e–157h	**4**:311f–312c / **13**:780g–781c
	3:486a–487g	**4**:667g–668g / **15**:183c–184b / **16**:58f–h
CIVIL SERVICE **4**:667–673	**15**:184b–186d	
	4:670f–671e / **4**:349a–h / **15**:183h–184b	**4**:332e–g / **4**:333c–g / **4**:336h–339a *passim* / **13**:780g–781c / **16**:58f–h
	4:671e–673e / **15**:201b–202a	**14**:726a–b
	3:491b–496f / **4**:670f–673e / **15**:184g–186g / **1**:92b–e / **1**:1022d–1023f	
	1:91e–95a / **4**:671e–673e / **5**:222c–e	**5**:91b–c / **5**:95e–f
	1:91b–e	**6**:772h–773c / **14**:722e–h
	15:218f–219c	**6**:634f–635c / **16**:450b–d
	14:886f–890f / **15**:198b–201b	

Section 543. The functioning of government: the dynamics of the political process

[for Part Five headnote see page 283
for Division IV headnote see page 332]

The articles and parts of articles referred to in Section 543 deal with four main subjects: A, the types of governmental functions; B, the economic roles of government; C, the electoral processes; and D, the changing of government structures.

The outline of subject A begins with the internal and external security functions of government and with the government's conduct of foreign relations. It goes on to the supervisory function of government—its role in the resolution of conflicts through mediation and the adjudication of suits. It then deals with the regulatory functions of government, involving the establishment and enforcement of standards. It next deals with law enforcement and the corrective functions of government. Finally, it treats the enterprising functions of government, such as the provision of public health and welfare agencies and educational facilities.

The outline of subject B treats governmental responsibility for regulating the economy and allocating economic resources; the types of governmental expenditures; and the sources of governmental income.

The outline of subject C begins with the origins and develop-

ment of electoral processes and with the purpose and importance of elections. It goes on to the types of elections and to the rules for deciding the winners of elections. It then treats the establishment of electoral constituencies; the administration of elections; and various factors that influence voting patterns.

The outline of subject D treats the factors that determine stability and instability in government and the methods, peaceful or violent, by which the form of government is changed.

	articles	article sections	other references
A.	POLITICAL SYSTEMS **14**:723–726	**10**:847h–848b	
1.		**14**:723f–724d	
a.		**14**:724b–d / **2**:17h–18a / **9**:682a–686d	**9**:781g–782a
b.		**14**:723h–724b / **8**:462e–463e / **14**:664b–668f / **14**:669e–670a / **14**:673a–677c / **14**:1097e–1099a / **15**:283d–284d / **15**:904d–905a / **16**:932b–933a	**17**:351b–c
2.			
	[see 544.A. and 544.B.]		
3.		**14**:723a–c / **14**:724d–f / **5**:220c–e / **15**:217f–218e	**1**:1074h–1076a *passim* / **2**:410h–411b
	[see also 552.F.1.a. and 552.F.3.]		
4.		**14**:724f–725d	**18**:934f–935b
a.		**6**:262b–263a / **5**:199b–h / **5**:1052a–b / **15**:219c–220g / **19**:549b–551b	**5**:1054c–h / **12**:379d–380b / **13**:1071a–1073f *passim* / **17**:345g–347d / **17**:754g–755d
b.		**4**:671e–672e / **8**:696g–697e / **8**:698h–699c / **9**:510e–512b / **11**:850b–851b	**10**:567b–g / **10**:572d–h / **17**:346c–f / **18**:524g–525a / **18**:528c–d / **18**:565b–d
c.	[see also 536.C.3.c.]	**3**:539e–540b / **6**:261a–e / **7**:326d–328d	**2**:709c–e / **17**:1084h–1085a
d.		**1**:396g–397f / **1**:398e–399c / **15**:900e–903a / **18**:572e–573g / **18**:639f–644b	**7**:400e–f / **15**:283h–284d / **15**:491d–h
e.	CENSORSHIP **3**:1083–1090	**2**:114a–115c / **6**:784a–c	**4**:1009c–e / **13**:297f–h / **14**:725a–b / **16**:271h–272b
i.		**3**:1083e–1087a	**2**:463b–c / **2**:464a–b / **5**:153e–g / **6**:889d–f / **15**:226d–g / **16**:59e–h
ii.		**3**:1087a–1090b / **2**:115d–g / **12**:493e–494b / **16**:87b–f	**10**:867h–868b / **15**:43e–44c / **15**:229b–c / **15**:233e–g / **15**:245b–246g *passim*
f.		**5**:92c–93a / **6**:533f–534h	**9**:749e
g.		**14**:817c–e / **14**:821d–823h / **15**:570d–571c / **16**:926c–928f	**2**:1069c–e / **8**:1188d–e / **9**:749b–e / **12**:188g–189a / **16**:929e–h
h.		**17**:753g–755d / **17**:1067e–1069d / **18**:555f–557b	**5**:378a–379a
i.		**4**:822d–825d / **19**:729d–735c	

	articles	article sections	other references
j. Issuance of currency; regulation of the banking system		**2**:704e–705d / **4**:822d–824a / **12**:352a–353a / **12**:358a–360a	**2**:708c–712h *passim*
5. Law enforcement and the corrective functions of government: sanctions, inducements, and penalties [see also 522.C.6. and 522.D.2.i.]			
a. Punishment for crimes	PUNISHMENT **15**:281–284	**5**:271g–272c / **14**:1097d–1099a	
i. The role of punishment in society: disciplinary measures inflicted by the familial authority; punishment in moral and religious thought		**15**:281c–282g / **4**:408a–e / **5**:370f–g / **6**:1120c–f / **14**:1099b–1100b / **17**:1012h–1013b	**5**:268e–h / **11**:982e–f
ii. Theories of punishment: retribution, deterrence, rehabilitation, and reformation		**15**:282h–284g / **5**:273h–274f / **11**:913d–f / **14**:1097e–1098b / **16**:932b–933a	**2**:785g–786b / **5**:281d–e
iii. Forms of punishment		**15**:283d–284a / **14**:1098b–1099a	
b. Maintenance of law-enforcement agencies			
i. Police activities	POLICE **14**:662–671	**14**:673a–675b / **15**:904f–905a	**5**:271c–f / **14**:724a–b / **18**:940c
ii. Paramilitary activities		**9**:682c–684a / **14**:669e–670a / **14**:1097e–1099a	**5**:303f–h / **12**:338e–339c / **14**:664d–h / **14**:679g–680a
iii. Security activities		**8**:462e–463g / **9**:682a–686e / **14**:670a–b / **14**:672d–673a / **16**:455b–f	**14**:1101a–h
6. Enterprising functions of government		**14**:725d–h / **15**:198c–200b	
a. Administration of service corporations or agencies: government-established and government-administered public utilities and public enterprises [see also 534.G.4. and 535.B.5.b.ii.]		**15**:198b–201b / **15**:218f–220b	**3**:137g–h / **6**:634f–635c / **14**:886f–891c *passim*
b. Promotion and preservation of public health [see 425.D.]			
c. Establishment and maintenance of educational institutions and activities [see 562.B.9. and 563]			
d. Maintenance of welfare agencies and other social services [see 522.D. and 535.B.3.c.]			
e. Exploration and conservation of natural resources [see 355.D., 534.C.2.a., and 724.A.2.a.]			
f. Scientific and technological research and development [see also B.2.g. below, and 732.I.3.]		**1**:365a–b / **14**:1006e–h / **15**:743c–h	**4**:777b–c / **15**:740g–741c
B. Economic roles of government	PRODUCTION AND CONSUMPTION, GOVERNMENT'S ROLE IN **15**:22–25		
1. Government responsibility for regulating the economy and allocating economic resources		**15**:22f–24e / **8**:690b–692d / **17**:1076e–h	**6**:274c–277f *passim* / **6**:772h–773e / **11**:554d–556b / **14**:724f–725a
a. Management of government finances: taxation and budgetary accounting procedures		**15**:22f–23b / **3**:441g–445a / **15**:57c–60c / **15**:193d–198a / **17**:1076h–1077f / **17**:1078e–1080b / **17**:1085e–1086f / **19**:553e–554b	
b. Distribution of resources between public and private sectors of the economy: the ratio between public and private consumption spending		**15**:23c–24e / **8**:692e–693g	**15**:198b–200b

	articles	article sections	other references
c. Maintenance of the public debt: procedures for borrowing and for paying the debt and the interest on the debt [see also 535.B.4.]		**3**:443h–445a / **7**:522c–523h / **15**:188c–190f / **15**:193d–196b	
2. Government expenditures		**15**:24e–25a	
a. For national defense		**15**:24c–e	**9**:682a–685g *passim* / **19**:550f–554b
b. For education [see 563.C.]			
c. For industrial and agricultural subsidies [see also A.4.h. above, and 535.B.3.b.]		**1**:319h–320c / **17**:754c–755d	**1**:318c–e
d. For welfare services [see also 522.D. and 535.B.3.c.]		**8**:690f–691b / **16**:926c–930d / **19**:745e–h	**6**:773b–c
e. For economic, technological, and military aid to foreign countries	FOREIGN AID PROGRAMS **7**:522–526	**4**:904h–905e / **7**:503g–504b / **9**:737d–740b	
f. For public services; *e.g.*, postal services, conservation, urban transportation systems [see 735.I.1., 737.A., and 534.C.2.a.]			
g. For government-sponsored research and development [see also A.6.f., above, and 732.I.3.]		**9**:784f–785c / **15**:743c–h	**8**:493a–c / **15**:740g–741c
3. Government income sources		**17**:1076e–1077f	**18**:935b–d
a. Direct and indirect taxes; *e.g.*, income, property, sales, and estate taxes; tariffs [see 535.B.2.]			
b. International loans and aid		**7**:522c–523h / **7**:525b–526a **14**:886f–890f / **15**:198c–202a	**9**:737d–740b *passim*
c. Proceeds from public-owned and/or public-operated enterprises [see also 535.B.5.b.ii.]			
C. The electoral processes: voting as a method of selecting leaders for public office and for approving and disapproving public policies	ELECTORAL PROCESSES **6**:527–535		
1. The origins and development of electoral processes: 19th- and 20th-century extension of suffrage; universal adult suffrage		**6**:527h–529b / **3**:265c–g / **3**:270e–g / **18**:964d–965e / **19**:912a–g	**3**:151a–e / **3**:253b–d / **10**:848d–849d *passim* / **17**:350e–f
2. The purpose and importance of elections: choice and reaffirmation		**6**:529c–530c	**5**:95c–d / **14**:681d–683d *passim*
3. Rules for deciding winners of elections		**6**:530d–531f	
a. Plurality rule		**6**:530d–e	
b. Majority rule		**6**:530e–g	
c. Various proportional representation systems		**6**:530g–531f	**13**:793g–794e
4. Types of elections		**6**:531f–532d / **9**:734d–h	**3**:253b–d
a. Primary elections to select candidates: general elections to select officeholders		**6**:531f–532a	
b. Recall: election for the removal of an officeholder		**6**:532a	
c. Issue elections: plebiscite and referendum		**6**:532b–d	**7**:603h–604b / **18**:984a–b
5. Establishment of electoral constituencies: geographical districting as distinguished from population apportionment: gerrymandering		**6**:532d–533d	
6. Administration of elections: use of the secret ballot; compulsory voting; electoral abuses		**6**:529f–h / **6**:533d–534h	
7. Various factors influencing voter participation and voting patterns; *e.g.*, party loyalties; economic incentives, ethnic considerations, public opinion polls [see also 541.D.2. and 541.D.4.]		**6**:534b–f / **6**:534h–535e / **15**:214a–216e	**5**:96f–h / **15**:39c–h
D. The changing of government structures and leadership through peaceful and violent methods	POLITICAL SYSTEMS **14**:726–728		
1. Factors in determining stability and instability in government		**14**:726c–728c	

	articles	article sections	other references
a. Unstable political systems: economic, social, legal, and military crises as causes of revolutions		**14**:726d–727b / **7**:649d–650c / **10**:74d–g	
b. Stable political systems: governments responsive to economic and social innovations		**14**:727b–e / **5**:94h–96h	
c. Problems of political change: shifts in the nature of the polity, the structure of the political system, and governmental policy		**14**:727f–728c	**4**:644b–650b *passim*
2. Methods of changing the form of government			
a. Peaceful changes; *e.g.*, by electoral process (plebiscite), by constitutional mandate		**5**:96b–e	
b. Violent changes		**5**:96h–97e / **6**:532c–d / **13**:849g–851b	**14**:714b–g
i. Revolution: the overthrow of a foreign governing power; civil war [see also 544.B.1.f.]	REVOLUTION, POLITICAL **15**:787–791	**8**:359e–360b / **13**:851b–e	**14**:714g–715d
		7:661h–662d / **7**:663g–666e / **8**:1167a–f / **11**:998h–1000d / **19**:584c–585a	**8**:458g–462e *passim* / **9**:769c–g / **11**:556a–d / **14**:714h–715b / **14**:723f–g / **14**:727h–728a / **16**:62d–h / **16**:69a–72a *passim*
ii. Conquest by a foreign power [see 544.B.4.]			

Section 544. International relations: peace and war
[for Part Five headnote see page 283
for Division IV headnote see page 332]

The articles and parts of articles referred to in Section 544 deal with two main subjects: A, the politics of international relations; and B, war among states.

The outline of subject A, after dealing with the major types of relationships among political regimes, treats the concept of sovereignty. Here it first deals with various theories of the source, loci, and limitations of internal sovereignty. It goes on to treat de jure external sovereignty, the legal equality of states in international law; the de facto elements of sovereign independence; and the formal limitations on the external sovereignty of satellite, client, and puppet states. The outline of subject A next deals with the many kinds of international treaties and agreements, with the aims of foreign policy, and with the functions of diplomacy in the conduct of foreign policy. It further treats the use of intelligence and counterintelligence in the preservation of national security and the conduct of international affairs; the influences of international political parties and movements; and the government-sponsored organizations that affect international relations in nonpolitical—for example, economic or cultural—spheres.

The outline of subject B begins with the degrees and kinds of war. It goes on to the concept of a just war, to modern theories of the causes of war, and to the consequences of war in all dimensions of human life. Dealing with armed forces, the outline treats the organization and structure of armed forces; the various types of soldiers; the historical development of organized military forces; the relationship between the civilian and military sectors of society; and the establishment and maintenance of various branches of the armed forces. Finally, the outline deals with the conduct of war. It first deals with the fundamentals and the development of modern military strategy, including the nature of nuclear strategy; the development of modern military tactics, including the tactics of guerrilla warfare; and the theories, elements, and development of military logistics. It further treats the effects of modern technology on the conduct of war; the effects of economic mobilization on the conduct of war; the effects of psychological warfare on troops and civilians during wartime; and international law relating to the treatment of persons during wartime.

	articles	article sections	other references
A. The politics of international relations	INTERNATIONAL RELATIONS, THEORIES OF **9**:778–785		
1. Various types of relationships among political regimes		**9**:779d–780e / **9**:745a–h	
a. The imperial system: the relationship between imperial power and colonial dependency		**9**:779e–f / **14**:707f–708a / **15**:1108g–1109d	
i. The establishment and maintenance of colonies		**3**:301h–302h / **4**:890b–891b / **4**:900f–902d / **6**:1111a–f / **6**:114e–115a	**1**:206b–208a / **4**:894e–897a *passim* / **5**:381h–382a / **6**:98g–101e *passim* / **7**:677h–678d / **9**:403a–404a / **13**:163g–166a / **16**:954f–955a / **17**:279g–295c *passim* / **19**:777c–780b *passim*
ii. The establishment and maintenance of protectorates and dependencies		**4**:902d–e	**6**:496f–500a *passim* / **13**:169a–170g

	articles	article sections	other references
b. The commercial city-state system: relations among city-states in ancient, medieval, and early modern times		**9**:779f–780b / **4**:304a–305c / **6**:1118e–f / **9**:1078h–1079d	**8**:355d–356c / **14**:711f–712b / **15**:663e–h / **17**:936f–937a
c. The modern state system: relationships among legally equal nation-states; leagues, confederations, and commonwealths		**9**:780b–e / **14**:708a–709f / **14**:719f–720b	**9**:526d–527a / **17**:311e–313f *passim*
2. Sovereignty in international relations: the legal power of a nation to conduct its external affairs	SOVEREIGNTY **17**:309–313	**14**:719f–720b / **17**:609h–610b	
a. Theories of sovereignty and the social contract between sovereign and society: various loci of sovereignty; limitations on the exercise of internal sovereignty		**17**:309h–311e / **5**:93h–94h / **7**:182h–183e / **9**:779f–780e / **14**:703e–g / **16**:985b–c / **17**:610c–612b	**5**:85e–g / **7**:205a–c / **7**:204a–b / **7**:631f–g / **8**:625c–e / **9**:745b–h / **10**:215a–d / **10**:717a–d / **12**:865a–d / **14**:261h–262d / **14**:267h–268b / **14**:687h–691e *passim*
b. External sovereignty and international law		**17**:311e–313f / **1**:396a–397a / **9**:748f–749g / **17**:614f–615a	
i. De jure sovereignty: the legal equality of states in international law; diplomatic recognition		**17**:311e–312e / **9**:747c–f	
ii. De facto elements of sovereign independence; *e.g.*, political, military, and economic autonomy		**17**:312e–313f / **2**:17h–18a / **8**:1184b–d / **9**:747c–749g / **19**:540e–541a / **19**:541b–c / **19**:545e–h	
iii. Formal limitations on external sovereignty of satellite, client, and puppet states		**17**:311e–g / **3**:305a–306g	
3. International treaties and agreements	INTERNATIONAL AGREEMENTS **9**:730–733	**5**:227a–e / **8**:1184d–1189c / **17**:312b–e	**4**:1085g–h / **5**:56g–58d *passim* / **9**:746c–d
a. Collective security: nonaggression treaties		**6**:1096c–g / **8**:340b–d / **17**:377b–f / **19**:971d–g	**19**:571g–572a / **19**:942d–945g *passim*
b. Treaties terminating wars [see B.4.a.i., below]			
c. Arms limitation and disarmament treaties		**17**:377b–f / **19**:971h–973e	**13**:327d–f / **19**:601d–e / **19**:966e–967f *passim*
d. Territorial treaties regarding the sale or transfer of land; treaties granting rights of access across land			**1**:964d–965a / **9**:749f–g / **13**:947b–d
e. Economic and commercial treaties [see also 534.F.3.]		**9**:732e–g / **1**:318f–319a / **1**:1076a–c / **1**:1077a–h / **5**:378a–379a / **5**:380c–385c / **17**:1085b–e / **18**:561g–563d	**1**:319f–h / **9**:731e–h / **13**:1074c–e
f. Communications and transportation treaties		**1**:396a–399c / **3**:310g–311e	**3**:964h–965h / **13**:947b–d / **15**:432c–g / **18**:91f–h
g. Cultural exchange treaties		**9**:737c–740h	**18**:902c–f
4. Foreign policy and diplomacy		**7**:522h–523h / **16**:77g–78a / **19**:546e–547a	**7**:525b–f / **9**:782g–783c / **15**:1143c–g
a. The aim of foreign policy: the compatibility or incompatibility of national and humanitarian interests		**9**:738d–740b / **16**:863b–864h	**9**:781g–782a / **17**:957h–958b
b. The function of diplomacy in the conduct of foreign relations			
i. Historical development of diplomatic chancelleries and diplomatic foreign services; the diplomat as an espionage or intelligence agent		**5**:809h–813c / **9**:681b–d	**6**:1082c–e / **9**:684c–d / **9**:1145c–e
ii. The education and training of modern diplomats and diplomatic personnel		**18**:904g–h	**9**:749a–b

	articles	article sections	other references
iii. The use of diplomacy in the negotiation of international disputes: public international conferences, arbitration, and mediation; secret diplomacy		**1**:1077a–h / **9**:733d–736a / **18**:896h–898g / **19**:969g–970c / **19**:971h–973e	**4**:402c–f
c. The balance of power as a deterrent to war		**6**:1082b–e / **9**:1144c–1145e / **19**:546e–548c / **19**:566f–572b	**7**:670d–g / **9**:373c–d / **9**:754a–755c *passim* / **9**:762a–e / **9**:764d–768e *passim* / **9**:777h–778d / **9**:781f–h / **9**:783a–c
d. Mutual and unilateral disarmament as a deterrent to war		**18**:897f–898e / **19**:971h–973e	**13**:327d–f / **19**:547h–548b / **19**:552e–553b
5. The use of intelligence and counterintelligence activities in the preservation of national security and the conduct of international affairs	INTELLIGENCE AND COUNTER-INTELLIGENCE **9**:679–686		
a. Historical development of intelligence activities: early intelligence systems; modern national intelligence organizations		**9**:680g–685g / **5**:332e–333f	
b. Sources for and methods of collecting intelligence data		**9**:680b–g / **9**:685h–686e / **5**:331b–332e	**9**:682g–685f *passim*
6. Development of the study of international relations [see 10/36.E.3.g.]			
7. Influences of international law on the conduct of international relations [see 552.B.]			
8. Influences of international political parties and movements; *e.g.*, Pan-Africanism, Pan-Arabism, Pan-Slavism, European federalism		**5**:384c–385c / **9**:732e–g / **9**:769c–773d / **11**:998h–1000d / **14**:679b–680a / **17**:961d–962e / **19**:962g–963g	**7**:204h–205a / **13**:788f / **13**:789e–g / **16**:328h–329a / **16**:541e–g / **16**:966f–973g *passim*
9. Government-sponsored organizations that affect international relations in nonpolitical spheres; *e.g.*, economic, cultural, technological organizations		**1**:396a–e / **1**:399d–e / **2**:1066g–1067a / **5**:378a–384c / **9**:734c–736b / **9**:738d–740h / **9**:749h–750f / **13**:400e–h / **13**:1074c–1075f / **17**:312b–313a / **18**:899b–903c / **19**:547c	**1**:963g–965f / **3**:964h–965h
B. War among states	WAR, THEORY OF **19**:542–548		
1. Degrees and kinds of war		**19**:543b–544a / **2**:14c–15c	**15**:38f–h / **19**:558e–562f *passim*
a. Limited war: armed conflict limited by territory, weapons technology, or issues; conventional war		**8**:460b–462e / **9**:762f–763e / **11**:85h–86g / **19**:541a–e	**9**:758g–760e / **9**:776f–777f / **19**:543f–g
b. Total war: armed conflict with complete mobilization of human and material resources; nuclear war		**19**:543b–e / **11**:86g–87b / **19**:694e–695b	**19**:564f–572b *passim* / **19**:979d–1013e *passim*
c. Ethnic or tribal wars		**13**:846a–f	**6**:171a–e
d. Religious wars: the *jihād*; other wars for religious supremacy		**4**:592h–593d / **7**:629h–631b / **13**:848a–h	**3**:556g–557b / **3**:564g–565e / **3**:566c–e / **5**:298d–299e / **6**:1088b–1090b *passim* / **6**:1090c–e / **9**:914g–h / **11**:224g–225h / **13**:113a–d / **17**:964e–h / **19**:772d–773h *passim*
e. National, regional, and worldwide wars		**6**:1099g–1104b / **17**:964g–965b / **18**:333g–337f / **19**:945b–966d / **19**:976d–1013d	**7**:718f–719a / **19**:549b–551b

	articles	article sections	other references
f. Intrastate warfare: guerrilla forces in civil wars and insurrections	GUERRILLA WARFARE **8**:458–463	**15**:364h–365b / **17**:441c–442d / **19**:584c–585a	**1**:810h–811g / **3**:291f–292b / **4**:375h–378f *passim* / **7**:668b–e / **9**:769c–g / **13**:851c–e / **14**:714h–715d / **14**:723f–g
i. Strategy and tactics of guerrilla warfare: motivation and organization of national liberation fronts		**8**:459a–462e / **17**:963a–g / **19**:953c–e	**2**:636b–f / **4**:373e–g / **4**:385e–h / **4**:675a–b / **7**:676f–677a / **11**:466f–468a *passim* / **13**:164g–166a *passim* / **15**:789e–791b *passim* / **16**:69a–72a *passim* / **19**:127e–131b *passim* / **19**:584c–h
ii. Counterinsurgency activities by regular government forces: legal status of captured guerrillas		**8**:462e–463g / **19**:541f–h	**19**:584h–585a
2. The concept of a just war		**9**:748e–f / **13**:845e–g / **13**:848d–849f / **19**:539e–540a	**15**:788a–f
3. Modern theories of the causes of war		**19**:544a–546e	
a. Ethological and psychological approaches: theories of collective behaviour		**19**:544b–f / **13**:846a–f	**4**:896d–897a / **13**:851c–e
b. Political causes of war		**19**:544g–546e / **9**:780g–782e	
i. Nationalism as a cause of war		**19**:545e–h	**12**:851a–e / **12**:851h–853c *passim* / **14**:719f–720a
ii. Special-interest groups as factors leading to war; *e.g.*, the military and business elites		**19**:545h–546e	**2**:21a–b / **2**:22d–e
iii. Domestic instability or disunity: differences in political ideology		**19**:544g–545e / **7**:663g–664a / **8**:459a–460b / **9**:197a–198a / **14**:726d–727b	**5**:292c–d / **16**:922f–g
iv. Disruption of a traditional balance of power: territorial disputes		**19**:540e–g / **6**:1093f–1094c / **9**:748e–f	**6**:1082b–d / **8**:357a–358f / **9**:769c–g / **16**:78e–h
v. International rivalries: traditional enmity among nations and cultures; national aggrandizement as a cause of war		**19**:977g–979a / **7**:186c–d	**7**:718f–719a
c. Economic causes of war: competition for resources, territories, and markets		**19**:545a–546e	**4**:358c–359a / **4**:895f–896d / **6**:1090d–g / **11**:555h–556d
d. Social causes of war; *e.g.*, the quest for cultural and national self-determination		**19**:545e–546c / **6**:1107f–1108b / **8**:459a–460b	**2**:631c–632f / **2**:672h–673d / **3**:291a–292b / **4**:378h–380c / **4**:895c–e / **4**:903d–904h *passim* / **6**:1066e–1067f *passim* / **19**:977g–979a *passim*
4. The consequences of war			
a. Political consequences of war			
i. The termination of war: mutual cessation of hostilities; submission of one belligerent to another; peace treaties		**8**:116h–117c / **13**:846d–847d / **19**:542e–f / **19**:966e–967f	
ii. Increased or decreased national power; domestic stability or instability; territorial changes; military occupation; shifting of alliances		**3**:292b–293a / **6**:1090c–g / **6**:1094h–1095d / **15**:569e–570e / **19**:966f–968b	**12**:195a–c / **15**:790a–c
b. Economic consequences of war		**19**:548e–549b	**15**:24c–e
i. The effect of war on the national economy: the cost of waging war; reparations; war debts [see also 535.B.5.c.]		**19**:551b–554b / **19**:971b–d	**2**:14h–15c / **6**:242e–243d *passim* / **7**:672e–763a
ii. Economic development and productivity during wartime; *e.g.*, growth or destruction of means of production, rationing of consumer goods, war contracts		**19**:549b–551b	**19**:552e–553e
iii. The effect of war on technology [see B.6.d., below]			

c. Social and moral consequences of war: the effect of warfare on a people's values

d. Other consequences of war; *e.g.*, legal, demographic, cultural consequences

5. Armed forces: military organizations designed for conquest or defense

a. The role of the armed forces in suppressing foreign or domestic enemies

b. Military bureaucracy: the hierarchical nature of rank and authority; the growth of specialist services

c. The makeup of the professional soldier: the "military mind"

d. The military community: the life-style of the officer as compared to that of the enlisted man

e. Problems of recruiting, mobilizing, and financing an army; the maintenance of moral commitment among the troops

f. Various types of soldiers

i. The professional soldier: the officer corps and the noncommissioned career soldier

ii. The volunteer soldier: the militiaman; the national guardsman or reservist

iii. The conscripted, or drafted, soldier

iv. The mercenary, or hired, soldier

v. The religious crusader or member of a paramilitary religious order

vi. The guerrilla fighter: The irregular or national liberation organization soldier
[see B.1.f.i., above]

g. Historical development of organized military forces

i. In the ancient world

ii. During the Middle Ages: the feudal army

iii. From the 16th through the 18th century: the development of royal and standing armies

iv. In the 19th and 20th centuries: the development of national armies

h. The military establishment and society

i. The relationship between the civilian and military sectors of society: the politicization of the armed forces; the militarization of politics

ii. The military coup d'etat: military intervention into and takeover of civilian governments

iii. The problem of the military-industrial complex

i. Establishment and maintenance of various branches of the armed forces

i. Ground forces

ii. Air forces

articles	article sections	other references
	8:1184h–1185a	**19**:556g–577g *passim* / **9**:756d–f
	19:554e–556g / **19**:966c–d	**8**:1187b–c / **8**:1188d–e / **12**:186h–187a
ARMED FORCES **2**:8–22		
	2:8h–9f / **2**:17e–18a	**14**:724a–c
	2:9g–11f / **2**:12a–e / **2**:12h–13g	
	2:11f–12h / **2**:13h–14a / **2**:15c–f	
	2:12e–14b / **2**:19e–h	
	2:14c–15h / **8**:462c–e	
	2:15b–17e	**18**:939a–b
	2:10e–12h / **2**:13h–14b / **2**:17b–e / **2**:19h–20c	
	2:15f–h	**19**:602h–603a
	2:15h–17b	**7**:719e–721a
	2:17b–e	**5**:303f–h / **12**:338e–339c
	2:18b–20d	
	2:18c–e / **8**:339e–340b / **19**:573g–575h	**4**:306a–c / **6**:323c–e / **15**:1101g–1102a
	2:18e–19a / **12**:153d–154b / **12**:161b–e / **19**:555h–577d	**9**:381h–382b / **10**:63h–66b *passim* / **11**:399d–401a *passim* / **12**:145c–d
	2:19a–h / **7**:719c–721a / **9**:395e–f / **19**:560a–d	**4**:354f–h / **6**:1092d–e / **7**:628b–d / **19**:577e–579e *passim*
	2:19h–20d / **2**:22d–f	**4**:293f–294f / **19**:579d–582e *passim*
	2:20e–22f	
	2:20e–21g / **8**:460b–462b / **12**:195a–d	**11**:603b–c
	2:21g–22c	**1**:205h–206b / **3**:151f–g / **4**:369h–370a / **8**:321e–322d / **10**:83b–84g / **14**:717f–718c
	2:21a–b / **2**:22d–e	**19**:546b–e
	17:1019e–1025a / **19**:573g–575h	
	1:383c–391h / **7**:401d–403a / **7**:404c–405d / **12**:894a–c / **12**:894g–895d / **19**:585e–586g	**11**:81d–f

	articles	article sections	other references
iii. Naval and amphibious forces		**12**:895d–g / **12**:896d–897g / **12**:898e–899c / **12**:900f–901c / **17**:747d–751g / **19**:583b–584b	**1**:386e–g / **19**:562h–563c / **19**:594g–595a
iv. Various auxiliary branches; *e.g.*, police, intelligence, logistics, communications, medical, and legal corps		**6**:864c–866c / **9**:680a–685g / **11**:847g–848f	**1**:146a–c / **8**:1116d–f / **12**:196b–f / **19**:586h–597f *passim*
6. The conduct of war	WARFARE, CONDUCT OF **19**:558–597	**19**:542h–544a	
a. Military strategy		**19**:558c–572b / **7**:549b–550a	
i. Fundamentals of strategy		**19**:558e–559g	
ii. Development of modern strategy in the 18th, 19th, and 20th centuries: leading military strategists		**19**:559g–566f / **7**:555b–d / **7**:727a–c / **19**:543b–e / **19**:956a–d	**4**:675a–680c *passim* / **7**:724c–f / **9**:762a–e / **19**:945d–949f *passim* / **19**:950d–952g *passim*
iii. Weapons of mass destruction: the nature and consequences of nuclear weapons; the logic of nuclear strategy, and nuclear containment and deterrence		**19**:566f–572b / **8**:497b–498b / **19**:600e–602f	**13**:324g–326a / **13**:327d–328a / **15**:929h–931f
b. Military tactics		**19**:572c–586g	**7**:549b–554h *passim* / **19**:598d–h
i. Principles of tactics: offensive and defensive tactics		**19**:572d–573g	
ii. Ancient and medieval tactics: Greek phalanx; Roman cohort; Byzantine horse-archer; medieval longbow and halberd; 15th- and 16th-century artillery tactics		**19**:573g–578h / **1**:122e–f / **8**:335b–f / **8**:488b–489f / **12**:153d–154b / **12**:887a–c / **12**:888a–e / **18**:34a–d / **19**:681b–682c / **19**:682f–683g	**1**:698e–699c / **6**:863c–h / **8**:43h–44b / **8**:625h–627h / **12**:886b–e / **16**:894g–895a / **18**:31f–h / **18**:270c–f
iii. Modern European and American military tactics: 17th-, 18th-, and 19th-century battle lines and weapons		**19**:578h–580a / **8**:489f–490g / **12**:889d–h	**1**:699c–700c / **6**:863h–864h / **16**:895h–898c / **19**:683h–685e / **19**:685h–686d
iv. 20th-century tactical advances: offensive and defensive movements in World War I and World War II; tactics in the nuclear age		**19**:580b–584b / **19**:585b–586g / **8**:460b–462b / **8**:490g–492g / **12**:896d–e / **19**:689d–g / **19**:694e–f / **19**:949f–950d	**6**:864h–866c / **19**:687a–g / **19**:954b–955c
v. Tactics of guerrilla warfare [see B.1.f.i., above]			
c. Military logistics		**19**:586h–597f / **11**:78a–87e	
i. Theories of logistics		**19**:586h–587g / **11**:77e–78h	
ii. Elements of logistics; *e.g.*, transportation of supplies, quartering of troops, maintenance of personnel services		**19**:587g–591g / **11**:83f–86g	
iii. Development of logistical systems: technical advances in the 19th and 20th centuries; logistics in the nuclear age		**19**:591h–597f / **11**:78h–87b / **12**:896c / **19**:690a–692c / **19**:693h–694f	**6**:864c–866c / **8**:494f–495b / **12**:332d–e / **18**:44h–45b
d. Effects of modern technological development on the conduct of war [see also 711.A.6.b.]		**19**:586f–g / **19**:591h–597f / **9**:685h–686d / **11**:79e–83f / **19**:598h–602f / **19**:693e–694f	**6**:865c–866c / **8**:493a–497a *passim* / **15**:929h–934g *passim* / **18**:45d–46b / **18**:52f–g / **19**:1012h–1013b
e. Economic mobilization and its effect on the conduct of war [see also 535.B.5.c.]		**19**:593h–597f / **19**:551b–554b	**4**:680e–h

	articles	article sections	other references
f. Effects of psychological warfare on troops and civilians during wartime		**19**:573a–d / **2**:21c–e / **19**:695c–e	**2**:15c–f / **4**:698a–c / **8**:460b–462a *passim* / **15**:37d–e
g. International law relating to the treatment of persons during wartime [see also 552.B.4.d.]		**8**:1184h–1185a / **12**:195a–d / **19**:547d–e	**13**:847b–d / **19**:540a–b
i. Treatment of noncombatants		**15**:568g–569d / **19**:541e–g	**8**:1187b–c / **19**:557c–g
ii. Treatment of military prisoners		**19**:541g–542d	**19**:557d–e
iii. Treatment of spies and captured guerrilla fighters		**19**:584h–585a / **8**:463f–g	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ARISTOTLE **1**:1162
BURKE, EDMUND **3**:499
CICERO **4**:607
CLAUSEWITZ, CARL VON **4**:697
DANTE **5**:481
ENGELS, FRIEDRICH **6**:858
HEGEL, GEORG WILHELM FRIEDRICH **8**:728
HOBBES, THOMAS **8**:970
KANT, IMMANUEL **10**:390
LAWRENCE, T.E. **10**:725
LOCKE, JOHN **11**:12
MACHIAVELLI, NICCOLÒ **11**:227
MAO TSE-TUNG **11**:465
MARX, KARL **11**:549
MILL, JOHN STUART **12**:197
MONTESQUIEU **12**:400
OWEN, ROBERT **13**:800
PAINE, THOMAS **13**:867
PLATO **14**:531
PROUDHON, PIERRE-JOSEPH **15**:130
ROUSSEAU, JEAN-JACQUES **15**:1170
SAINT-SIMON, HENRI DE **16**:176
TOCQUEVILLE, ALEXIS DE **18**:468
VICO, GIAMBATTISTA **19**:103
WEBB, BEATRICE AND SIDNEY **19**:711

Division V. Law

[for Part Five headnote see page 283]

The outlines, and the articles and parts of articles referred to, in the four sections of Division V treat philosophies and systems of law; the branches of public law; the branches of private law; and the profession and practice of law.

The articles referred to in Section 551 treat Western and non-Western philosophies of law; ancient and modern legal systems; and the study of the distinctions and parallels among diverse legal systems.

Section 552, on public law, first deals with laws defining and implementing the authority and power of the state, covering constitutional law and administrative law. It goes on to laws governing the relations between sovereign states, covering international law; the roles of the United Nations and the International Court of Justice; the laws of war; war crimes; and space law. It next deals with criminal law and with military law. Dealing with laws promoting the public welfare, it treats welfare and security programs; health and safety laws; and laws regulating the health, safety, and welfare of workers. It next deals with tax law. Finally, it deals with laws of judicial procedure, treating the organization and administration of the courts in the legal system; criminal procedure; administrative procedure; the jury system; and systems of arbitration.

Section 553, on the branches of private law, first deals with laws governing the right to acquire, hold, and use economic goods, covering property law; copyright, patent, and trademark law; the law of trusts; the law of mortgages; and laws concerning bankruptcy. It goes on to family law and the law of inheritance. It next deals with tort law, governing the redress of injuries to persons and property, to which the state is not a party. Dealing with laws governing economic transactions, it treats the law of contracts; the law of commercial transactions and commercial relationships in agency law; the law of business associations; labour law; and laws governing commercial transportation on land, on water, and in

Section 551. Philosophies and systems of law 353
552. Branches of public law, substantive and procedural 357
553. Branches of private law, substantive and procedural 363
554. The profession and practice of law 369

the air. Finally, it treats civil procedural law and the law of evidence.

Section 554 treats the history, composition, and general characteristics of the legal profession; the delineation of the lawyer's responsibilities in legal ethics; and the educational requirements for the legal profession.

Section 551. Philosophies and systems of law

[for Part Five headnote see page 283
for Division V headnote see page 352]

The articles and parts of articles referred to in Section 551 deal with three main subjects: A, Western and non-Western philosophies of law; B, ancient and modern legal systems; and C, the study of the distinctions and parallels among diverse legal systems.

The outline of subject A begins with Western philosophy of law. It first deals with the basic problems of the philosophy of law and with the analytical, the sociological and historical, and the ethical approaches to a theory of law or jurisprudence. It goes on to the relationship between law and morality, treating the influence of the principles of natural law and of the idea of justice; the relationship between natural law and positive law; the influence of the idea of the social contract; and 20th-century reactions against the concept of natural law. It next sets forth a historical survey of Western legal theories. Finally, it treats Islāmic, Chinese, and other non-Western philosophies of law.

Subject B is ancient and modern legal systems. Articles are referred to that separately treat primitive law—the legal systems of nonliterate peoples; ancient systems of law—Egyptian, cuneiform, Chinese, Greek, Hellenistic, Roman, and Germanic law; medieval European constitutional, private, and canon law; and modern systems of law—common law, continental civil law, and Soviet and socialist legal systems.

The outline of subject C begins with the historical background of the study of comparative law. It next treats the methods used in the systematic analyses of the laws of various countries. Finally, it deals with the uses of comparative law in national and international law and with its importance in international trade.

	articles	article sections	other references
A.	Western and non-Western philosophies of law		
1.	Western philosophy of law		
	LAW, WESTERN PHILOSOPHY OF **10**:714–722		
a.	The scope of the Western philosophy of law; its relationship to other branches of philosophy	**10**:714g–715c / **10**:720d–722a	
b.	Problems of the philosophy of law; various approaches to a theory of law or jurisprudence	**10**:714h–715h / **14**:703e–g	**17**:1087c–e
i.	The analytical approach to jurisprudence: analytical positivism	**10**:714h–715b / **10**:718d–g	**11**:77b–c
ii.	Sociological and historical approaches: historical positivism; economic interpretations of sociological jurisprudence	**10**:715b–c / **10**:718g–719f / **9**:744e–745h	**16**:288h–289c
iii.	The ethical approach: the development of the theory of justice; its relationship to natural law	**10**:715c–h / **10**:718a–d / **10**:719f–720d / **1**:95e–g / **4**:476c–h / **9**:745h–746a / **12**:863e–865d / **17**:310c–311c	**1**:1169h–1170d / **10**:302d–f / **14**:535g–536c / **14**:537h–538d / **15**:282a–d / **15**:282h–283c
c.	The relationship between law and morality: the influence of the principles of natural law	NATURAL LAW **12**:863–865 / **10**:715d–h	**5**:84g–85g
i.	The relationship between natural law and positive law: the idea of justice; reason and the state of nature; the interaction of eternal law, natural law, and human law	**12**:863e–864f / **4**:476c–h / **4**:592c–e / **5**:226d–227a	**9**:1021a–1022d *passim* / **10**:214b–c / **10**:715h–717a *passim* / **13**:847d–848h / **14**:535g–536c / **14**:686c–691e *passim*
ii.	Theories concerning the rational basis for natural law: the relationship between the law of nations and the law of nature; the state of nature and the social contract; the 20th-century reaction against the concept of natural law	**12**:864g–865g / **5**:93h–94h / **17**:610g–612g	**2**:381b–d / **3**:501h–502b / **5**:63e–g / **5**:85e–g / **6**:893c–f / **8**:971d–e / **10**:215a–d / **10**:717a–721a *passim* / **13**:849a–f / **14**:261h–262d / **14**:267h–268b / **15**:282h–283c / **15**:530a–c / **15**:788c–d / **17**:309h–311e *passim*
d.	Historical survey of legal theories	**10**:715h–721a / **9**:745a–h	
i.	In the ancient world	**10**:715h–716f / **3**:1084a–c / **8**:399d–g / **12**:863e–864b / **14**:686c–687g	**2**:901b–902b / **2**:905c–906d / **5**:226d–229d *passim* / **6**:322d–f / **8**:360g–361a / **10**:302f / **15**:282a–d

	articles	article sections	other references
ii. In the Middle Ages		**10**:716f–717a / **3**:773g–776h / **4**:591c–592e / **6**:1115h–1117b / **10**:360g–361c / **12**:158h–160a / **12**:864b–f / **14**:687g–688f	**10**:211f–212d / **15**:787f–h
iii. From the Renaissance through the 18th century		**10**:717a–718d / **7**:183c–e / **12**:864g–865d / **15**:787h–788d / **17**:310c–311e	**4**:1001e–g / **6**:893c–f / **9**:745f–h / **13**:849a–c / **14**:688f–691e *passim* / **15**:110c–e / **15**:282h–283c
iv. In the 19th and 20th centuries		**10**:718d–721a / **4**:1036e–1037b / **12**:865d–g / **15**:788d–789a / **17**:313a–f / **17**:613e–f	**16**:288h–289c
e. Contemporary trends in the philosophy of law: the revolt against formalism; growing importance of the social sciences		**10**:721a–722a	**14**:729d–e / **17**:316e–317b *passim*
2. Non-Western philosophies of law			
a. Islāmic philosophies of law		**3**:1085e–g / **9**:912h–913b / **9**:920f–921d / **9**:938e–939e / **9**:941b–942g / **9**:1021h–1022d	**2**:539c–540c / **8**:536b–537g *passim* / **9**:1019d–f / **13**:781c–e
b. Chinese philosophies of law		**3**:1083e–f / **4**:408a–e	**4**:380d–e / **6**:321d–f / **8**:625b–f
c. Other non-Western philosophies of law			**3**:989g–990a / **9**:323a–d / **9**:352b–e / **10**:60f–h
B. Ancient and modern legal systems			
1. Primitive law: the legal systems of nonliterate peoples	PRIMITIVE LAW **14**:1037–1040		
a. The relationship of law to culture and custom		**14**:1037f–h / **6**:280c–f / **12**:123c–g / **15**:47a–c	**6**:170f–172a *passim* / **8**:1158e–h / **10**:479c–482g *passim* / **17**:307a–c
b. Sanctions and procedures of primitive law		**14**:1037h–1038e / **2**:426h–427a	**11**:868h–869b / **19**:790c–d
c. Allocation of judicial authority in primitive societies		**14**:1038f–1040a / **1**:284e–285a / **5**:731e–f / **12**:123g–124a	**3**:621c–d / **12**:123b–c / **15**:281h–282a
2. Ancient systems of law			
a. Egyptian law	EGYPTIAN LAW **6**:501–503		
i. Institutions of private law		**6**:502b–g	
ii. Egyptian courts and legal procedures		**6**:503a–e	
b. Cuneiform law	CUNEIFORM LAW **5**:368–370		**6**:921g–922a
i. Origins of cuneiform law		**5**:368h–369f	**6**:916d–e / **12**:915e–f
ii. Institutions of cuneiform law		**5**:369g–370g	**9**:838f–h / **11**:976h–977c / **11**:982e–f
c. Chinese law	CHINESE LAW **4**:407–410		**4**:311f–312c
i. Distinctive features of Chinese jurisprudence		**4**:408a–e	**4**:313e–g / **6**:321d–f
ii. Chinese courts and legal procedures		**4**:408f–409a	
iii. Institutions of private law		**4**:409b–410e	**4**:322g–323a / **4**:390d–e / **6**:125a–e
d. Greek law	GREEK LAW **8**:398–402	**8**:338a–339e / **8**:747a–g	**3**:1084d–e / **6**:918g–919c / **10**:715h–716d / **14**:67d–e / **16**:1046f–g
i. Origins of Greek law		**8**:398h–399d	
ii. Distinctive features of Greek law		**8**:399d–g	**5**:93c–e / **12**:459b–c

	articles	article sections	other references
iii. Institutions of private law		**8**:399g–401g	**8**:342b–g / **10**:638a–c
iv. Greek courts and legal procedures		**8**:401g–402c	**8**:341b–342a / **8**:352e–g
e. Hellenistic law	HELLENISTIC LAW **8**:746–748		
i. Origins of Hellenistic law		**8**:746g–747d	
ii. Distinctive features of Hellenistic law		**8**:747d–g	
iii. Institutions of private law		**8**:747g–748g	
f. Roman law	ROMAN LAW **15**:1054–1059	**1**:291d–e / **3**:1084g–1085b / **9**:590a–d / **10**:779h–780b	**6**:328e–g / **6**:486a–b / **6**:919f–g / **15**:51d–e / **15**:1120e–g
i. Sources of Roman law		**15**:1055b–1056f / **15**:1088b–h / **15**:1115g–1116a	**15**:1097f–1098a
ii. Institutions of private law		**15**:1056f–1059b / **9**:593g–594a / **10**:316a–g	**4**:988b–c / **10**:638c–e / **12**:459d–e
iii. Roman courts and legal procedures		**15**:1055b–e / **15**:1059b–d / **15**:5b–d	**4**:609b–c / **8**:263b–d / **15**:1095d–g
g. Germanic law	GERMANIC LAW **8**:31–33		**8**:43a–c / **11**:133g–h / **11**:931d–e / **12**:459e–g
i. Distinctive features of Germanic law		**8**:31g–32c	**3**:775e–h / **18**:729a–c
ii. Institutions of private law		**8**:32c–g	
iii. Germanic courts and legal procedures		**8**:32g–33d	**4**:46c–e
3. Medieval European law	EUROPEAN LAW, MEDIEVAL **6**:1115–1120		**15**:47e–f
a. Origins and development of medieval European law		**6**:1115h–1117h / **4**:998b–e / **8**:31g–33d / **8**:694g–695c / **10**:780b–d	**4**:661b–e / **8**:70g–71d / **9**:745a–c / **11**:931d–e / **12**:152d–h
b. Sources and institutions of medieval constitutional law		**6**:1117h–1119a / **5**:93f–h / **6**:528c–e	**4**:665g–h
i. Laws promulgated by the king: royal court systems		**6**:1117h–1118b / **6**:1118g–1119a / **6**:1120e–g / **8**:72f–73b / **8**:1183e–f / **12**:158h–160a	**3**:562d–e / **9**:1131c–e / **15**:5d–g
ii. Feudal laws and institutions		**6**:1118c–e / **3**:204g–205a / **3**:207g–208c / **4**:998e–999e / **12**:150d–152d / **16**:859g–860b	**2**:18f–h / **8**:77d–e / **9**:1120f–1121b / **11**:931h–932a / **12**:143h–145a / **15**:47e–f
iii. Municipal charters and commercial law		**6**:1118e–f / **6**:1120a–c / **5**:124d–f / **12**:149c–150d	**5**:183a–b / **9**:1132h–1133e
c. Institutions of private law in medieval Europe		**6**:1119a–1120g / **1**:291f–g	**12**:459e–g
d. Development of canon law: the relationship between civil and ecclesiastical law	CANON LAW **3**:773–776	**6**:1116e–h / **6**:1120e–g / **4**:476c–h / **7**:1e–g / **10**:716f–717a / **12**:154c–f / **12**:155g–156c / **12**:864b–f / **15**:5d–g	**9**:1124d–1125a / **12**:143d–g / **15**:787f–h
4. Modern systems of law			
a. Anglo-American common law	COMMON LAW **4**:998–1004	**5**:124f–g	**4**:825h–826c / **5**:220f–222f *passim* / **15**:51g–52a

	articles	article sections	other references
i. Historical development of the common law		**4**:998b–1001d / **3**:205a–e / **3**:210a–b / **3**:230d–g / **5**:96h–97e / **9**:590d–e / **10**:360g–361c / **10**:780d–g / **18**:726c–f	**1**:92e–93b / **3**:208b–c / **3**:211d–e / **3**:222b–c / **3**:234g–235b / **4**:665g–h / **5**:153e–154b / **5**:812c–813a / **6**:1117f–g / **8**:555c–d / **8**:765g–766d / **11**:501b–d / **12**:459h–461d / **18**:524c–d
ii. Distinctive features of the common law		**4**:999e–g / **4**:1001b–d / **1**:293b–d / **1**:295c–e / **3**:779g–780a / **5**:156c–g / **9**:594a–595b / **10**:360g–362e / **15**:5g–6c / **15**:10f–11e / **15**:53b–h	**3**:960c–e / **5**:279h–280b / **7**:5b–c / **9**:588g–589c
iii. Political and institutional context of the common law		**4**:1000a–h / **3**:240f–241b / **5**:96h–97e	**3**:1088g–1089d / **7**:3f–5e / **15**:183g–184c
iv. Influence of the common law		**4**:1002f–1004f / **12**:461d–462g	**9**:406e–h
v. Future of the common law		**4**:1004f–h	
b. Continental civil law	CIVIL LAW **4**:660–666	**1**:292h–293b	**11**:500g–501a / **15**:51e–f
i. Historical development of continental civil law		**4**:661b–h / **4**:1036b–f / **5**:124d–f / **5**:124h–125a / **6**:1115h–1117h	**4**:1000d–h / **12**:459e–h / **17**:410h–411a / **17**:413e–g
ii. The French civil code		**4**:661h–664a / **1**:93g–94b	**3**:960e–g / **7**:659c–g / **7**:660b–c / **7**:661b–c / **9**:587h–588a / **9**:592d–f / **10**:638e–g
iii. The German civil code		**4**:664a–665a / **1**:94c–e / **9**:590f–g	**8**:62h–63c / **16**:288h–289d
iv. Extension of the civil law system to other countries; *e.g.*, Italy, Japan, the Latin American countries, various African countries		**4**:665a–f / **1**:293g–294f / **7**:1g–3d / **15**:11e–12c / **15**:53h–54e	**4**:669h–670b / **4**:987f–988f / **5**:275g–276b / **7**:6d–g
v. Comparison of civil law and common law		**4**:665g–666g / **1**:291h–294c / **3**:529h–531e / **3**:532b–535d / **4**:1086a–h / **5**:125g–127h / **7**:6d–g / **10**:360h–362d / **12**:195d–e / **15**:6f–10e / **15**:51b–52e / **18**:524b–f / **18**:559c–560a / **18**:561c–g / **18**:728h–729g	**5**:85h–90d *passim* / **5**:220f–222f *passim* / **11**:814d–f
c. Soviet and socialist law	SOVIET AND SOCIALIST LEGAL SYSTEMS **17**:313–321	**1**:94e–95a / **5**:225e–226c	
i. Historical development of Soviet law: sources of Soviet constitutional law		**17**:314a–315c / **17**:316e–317b / **4**:1020h–1021c / **16**:61g–62c / **16**:77a–c / **16**:864c–f	**5**:225e–g / **8**:1183h–1184b / **10**:638h–639c / **16**:55g–h
ii. Extension of Soviet legal principles to other socialist countries; *e.g.*, Albania, China		**17**:315d–316e / **16**:77a–c / **17**:448f–449b	**1**:420h–421a / **4**:290c–291e / **4**:669g–h

	articles	article sections	other references
iii. Substantive provisions of Soviet and socialist law regarding property, labour, insurance, copyrights and patents, economic planning, family relations, and criminal and civil procedure		**17**:317c–320h / **1**:319a–c / **4**:652a–653a / **6**:275a–e / **14**:667e–g / **16**:74h–75f / **18**:557f–g / **19**:748c–e	**4**:669c–f / **4**:673b–e / **4**:989e–f / **6**:529f–h / **9**:586g–h / **15**:52a–b / **17**:349c–h / **18**:523e–f / **18**:524a–b / **18**:568e–569a
iv. Trends in Soviet and socialist law		**17**:321a–b / **4**:1025h–1026a	**4**:293c–f / **15**:184c–d
C. The study of the distinctions and parallels among diverse legal systems	COMPARATIVE LAW, STUDY OF **4**:1035–1039		
1. Historical background of the study of comparative law		**4**:1036a–1037b / **5**:369c–f	**3**:774c–d / **3**:775b–776h *passim* / **10**:718h–719a
2. Comparative law methodology: systematic analyses of the laws of various countries; institutions of comparative legal studies		**4**:1037b–1038a / **4**:1038h–1039c	
3. Uses of comparative law in national and international law: its importance in international trade		**4**:1038b–g / **4**:1085a–h / **5**:128b–c / **9**:746e–747b	**4**:1087h–1088b / **5**:154c–156c *passim*

Section 552. Branches of public law, substantive and procedural

[for Part Five headnote see page 283
for Division V headnote see page 352]

The articles and parts of articles referred to in Section 552 deal with six main subjects: A, laws defining and implementing the authority and power of the state; B, laws governing the relations among sovereign states; C, laws governing acts viewed as crimes; D, laws promoting the public welfare; E, laws governing taxation; and F, laws of judicial procedure.

The outline of subject A begins with the basic laws governing the organization and functions of the state. It treats the origin and development of constitutional government; a functional comparison and classification of constitutions; the role of constitutional law in establishing the framework and the branches of government; and, as an illustration, the unique role of the Supreme Court in the constitutional law of the United States. The outline next deals with laws governing public administration—the regulation of the organization, powers, duties, and functions of public administrative authorities. It treats the nature of administrative law; the need for legal safeguards over public administration and bureaucracy; the judicial review of administration; and administrative procedures.

Subject B is laws governing the relations among sovereign states. The outline first treats the historical development of international law; the distinctive features and fundamental principles of international law; the subjects of international law; problems of jurisdiction; and the relationship of international to municipal or national law. It next treats the attempt to create a supranational legislative and executive authority—the United Nations; and the attempt to create a supranational judicial authority—the International Court of Justice. It further treats the attempts to impose rules of warfare; to limit and punish war crimes and other crimes against humanity; and to preserve the peaceful uses and exploration of outer space.

The outline of subject C first deals with the principles and doctrines of criminal law in common law and civil law systems, treating the limitations of the definition of criminal conduct and of the applicability of criminal law; the elements of the criminal act; and the recent influence of the behavioral sciences on the development of criminal law. It next treats laws governing offenses committed by members of military forces and by other persons subject to military discipline.

The outline of subject D, laws promoting the public welfare, covers laws providing for general social security and welfare; laws promoting public health and safety; and laws regulating the health, safety, and welfare of workers.

The outline of subject E treats the modern development of tax law; constitutional, political, economic, and other limitations on the taxing power; the administration of tax laws; and the role of the judiciary in tax cases.

Subject F is the laws of judicial procedure. The outline begins with the organization and administration of the courts in the legal system. It treats the function of the courts in the legal process; the structure and organization of trial courts or courts of original jurisdiction; appellate court systems and courts in federal systems; the selection and qualification of judges in civil law and common law systems; the structure and status of the judiciary in countries governed by the Soviet and socialist law system; and diverse views of the judicial function. The outline next deals with the methods and procedures of the law. It treats the stages of criminal procedure (civil procedure is dealt with in Section 553) and the characteristics of administrative procedure. Finally, the outline deals with methods of adjudicating litigious disputes, treating especially the jury system and various systems of arbitration.

	articles	article sections	other references
A. Laws defining and implementing the authority and power of the state			
1. Basic laws governing the organization and functions of the state	CONSTITUTIONAL LAW **5**:84–93	**14**:703e–g / **17**:1084c–1085b	
a. The origin and development of constitutional government		**5**:84d–85g / **5**:93d–96h / **8**:338a–339e / **8**:1183e–1184b / **17**:309h–311c	**14**:643b / **16**:312g–314a *passim* / **18**:956c–957h

	articles	article sections	other references
b. A functional comparison and classification of constitutions		**5**:85h–88f / **7**:205a–e / **14**:718g–719c / **16**:77a–c	
i. Flexible versus rigid constitutions		**5**:86b–87b	**5**:96b–98c *passim*
ii. The distinction between unitary and federal states		**5**:87b–h / **7**:203b–204a / **14**:720b–g	
iii. Characteristics of constitutional law in federal and quasi-federal states		**5**:87e–88c / **5**:97d–98c / **7**:205f–206g / **14**:708c–h / **14**:710e–h	**4**:1003c–d / **5**:224b–d
iv. Characteristics of constitutional law in unitary states		**5**:88d–f / **14**:710b–e	
c. The role of constitutional law in establishing the framework of government		**5**:88f–90d	
i. The formation of the executive: the parliamentary executive; the president		**5**:88f–89h / **3**:485g–487g	**3**:240f–241a / **3**:242g–249c *passim* / **14**:642a–b / **14**:644f–h / **14**:719a–b / **14**:722e–f
ii. The formation of the legislature: unicameral and bicameral legislatures		**5**:89h–90d / **12**:157h–158h	**6**:1118h–1119a / **15**:183e–184b
iii. The formation of the judiciary [see also F.1., below]		**5**:90d–91a / **1**:92e–93f / **10**:782g–783c / **14**:723a–c / **17**:314c–317b	**3**:241a–b / **4**:666b–g / **4**:1003c–d / **5**:220f–222f *passim* / **5**:224d–225d / **6**:1118g–h / **10**:717e–g / **12**:159d–160a / **18**:938a–c
d. The constitutional law of the United States and the unique role of the Supreme Court		**5**:90d–93a / **5**:97d–e / **14**:692e–f / **15**:217f–218g / **18**:956c–957h	**4**:594f–g / **4**:1003c–g / **5**:66a–f / **5**:87e–f / **5**:280g–h / **8**:698a–d / **11**:536g–537d / **14**:667b–c / **18**:937e–938c
i. The Supreme Court as guardian of the separation of powers and the federal system		**5**:91a–92b / **15**:217h–218e	**5**:221d–222b / **17**:1016d–f / **18**:959h–960a / **18**:990f–h
ii. The Supreme Court as guardian of the rights of individuals		**5**:92c–93a / **4**:1003d–g	**10**:717e–g / **14**:669b–c
2. Laws governing public administration: regulation of the organization, powers, duties, and functions of public administrative authorities	ADMINISTRATIVE LAW **1**:90–96		
a. The nature of administrative law		**1**:90g–92e	
i. Distinctions between public administration and private action		**1**:91b–e	
ii. The need for legal safeguards over public administration and bureaucracy		**1**:91e–92e	**4**:672h–673e
b. The judicial review of administration		**1**:92e–95a / **1**:95g–96a / **5**:222c–e	
i. The common law system: the development of administrative tribunals and regulatory agencies		**1**:92g–93f / **15**:217f–219c	**4**:672h–673a
ii. The council of state system: the development of separate administrative courts		**1**:93g–94e	**4**:672e–f / **4**:673a–b
iii. The procurator system in Soviet and socialist law		**1**:94e–95a	**4**:673b–e
iv. The institution of the ombudsman		**1**:96a–d	**5**:95e–f
c. Administrative procedure		**1**:95a–96a	
B. Laws governing relations among sovereign states			
1. Sources and concepts of international law	INTERNATIONAL LAW **9**:744–750	**6**:1082b–e / **9**:731a–733c	
a. Historical development of international law		**9**:745a–h / **8**:1184b–1185a / **9**:780e–782a / **19**:538f–539d	**11**:500f–g
b. Distinctive features of international law		**9**:744e–745a / **9**:745h–747b / **9**:750d–f / **19**:547d–e	**4**:1085f–h

	articles	article sections	other references
c. Fundamental principles involved in international law		**9**:747c–749g / **1**:1077d–h / **17**:311e–312a / **18**:561g–563d	
i. Sovereignty [see also 544.A.2.]		**9**:747c–d / **9**:748g–749g / **1**:396a–397b / **17**:311e–312a	**17**:614f–h
ii. Recognition		**9**:747d–f	
iii. Consent		**9**:747g–h	**9**:735c–e
iv. Good faith		**9**:747h–748b	
v. Freedom of navigation on the seas, in the air, and in outer space		**9**:748b–c / **1**:396a–g / **1**:398b–e / **5**:57e–g / **17**:376a–d / **17**:377b–f / **18**:670g–671e	**7**:727e–g / **13**:947b–d / **19**:542a–d
vi. International responsibility		**9**:748c–e	
vii. Self-defense		**9**:748e–f / **19**:540e–541a	
d. Subjects of international law		**5**:56d–58d / **13**:1075b–f	
i. Independent states		**9**:734h–735f / **17**:311e–312a	
ii. International organizations		**5**:380e–382e / **5**:383b–f / **9**:734c–735f / **10**:574a–f / **14**:885h–886c / **16**:863b–865e	**3**:306e–g
iii. Individuals		**2**:699d–f / **5**:154c–156c / **8**:1184b–d / **19**:541e–542a	**13**:1074d–f / **17**:614h–615a / **19**:555c–557c
e. Problems of jurisdiction		**1**:397g–398e / **9**:734h–735f	**4**:1085f–1086h *passim*
f. The relationship of international to municipal or national law		**9**:746g–h / **3**:964a–d / **4**:1038f–g / **5**:128b–c / **11**:503e–g / **14**:671a–b / **17**:1085b–e	**9**:735b–c
2. The attempt to create a supranational legislative and executive authority: the United Nations	UNITED NATIONS **18**:894–904	**8**:1185g–1188f / **9**:732b–e / **9**:752h–754a / **16**:864g–h / **17**:376d–377a	**12**:852h–853c
a. Purposes and membership		**18**:894f–895e / **9**:749h–750c / **14**:709c–f	
b. Principal organs: General Assembly; Security Council; Economic and Social Council; Trusteeship Council; International Court of Justice; Secretariat		**18**:895e–896h / **9**:734c–735f	**9**:753g–h
c. The role of the United Nations in maintaining peace and security		**18**:896h–898g / **17**:312e–313a / **19**:594a–e	**3**:1099f–1100a / **9**:763h–764a
i. The settlement of international disputes		**18**:896h–897f / **1**:1077d–h / **9**:734c–736a / **19**:547e–h	
ii. The attempt to regulate armaments: atomic and conventional		**18**:897f–898e / **17**:376d–377e	**19**:547c–548c
d. The role of the United Nations in developing international law		**18**:898g–899b / **9**:732d–e / **9**:750d–f	**19**:557a–c
e. The role of the United Nations specialized agencies in promoting social and economic welfare in underdeveloped and war-torn nations		**18**:899b–903c / **2**:1066g–1067a / **8**:1186c–1187b / **15**:571d–572f	**4**:670d–f / **15**:78a–e

	articles	article sections	other references
i. International Labour Organisation (ILO)		**18**:900e–901a / **8**:1185c–d / **16**:865c–e	**4**:673e–f / **10**:574c–f
i. International Bank for Reconstruction and Development (IBRD)		**18**:901a–g / **7**:32b–33h	**7**:24f–g / **7**:523a–c / **15**:194e–f
iii. Food and Agricultural Organization (FAO)		**18**:901g–902c / **7**:501e–502f	
iv. United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations International Children's Emergency Fund (UNICEF)		**18**:902c–f	**8**:1187f–g / **9**:736d–740h *passim* / **14**:820b–g
v. World Health Organization (WHO)		**18**:902g–903c / **5**:1051g–1052a / **13**:400e–h / **15**:204f–205b	**8**:699c–d
f. The role of the United Nations in the administration of non-self-governing territories: the trusteeship system		**18**:903c–904e	**2**:988b–989c *passim*
g. The internal administration of the United Nations: financial affairs, personnel, and privileges and immunities of diplomats		**18**:904e–h	**9**:749a–b
3. The attempt to create a supranational judicial authority	INTERNATIONAL COURT OF JUSTICE **9**:733–736	**9**:746e–f / **18**:896f–g	**17**:312c–f
a. Historical development of supranational judicial bodies		**9**:733d–734c / **1**:1077a–d	
b. Procedures and functions of the International Court of Justice		**9**:734c–736c	
4. The attempt to impose rules of warfare	WAR, LAWS OF **19**:538–542	**8**:463f–g	
a. Historical growth of laws of war		**19**:538h–539d / **13**:846a–f	
b. Contemporary standards of warfare		**19**:539e–540a	
c. Foundations of the law of war: maintenance of civilized standards; the principles of self-defense and self-help		**19**:540a–541a / **8**:1184b–1185a / **9**:748e–f	**19**:555c–557d *passim*
d. Limitations on the conduct of war: laws regarding the area of combat; the rights of neutral states; civilians and other noncombatants; prisoners of war		**19**:541a–542d / **8**:1184h–1185a / **15**:568g–569d	**13**:847b–d / **19**:493f–g / **19**:557c–f
e. The termination of warfare: treaties, reparations, and other forms of compensation		**19**:542d–f / **9**:748c–e / **19**:971b–d	**7**:672e–673b / **9**:749f–g / **19**:966e–968b *passim*
5. The attempt to limit and punish war crimes and crimes against peace and humanity	WAR CRIMES **19**:554–557	**16**:863g–864c	**8**:1185f–g / **19**:540c–d
a. Post-World War I efforts to define and prosecute war crimes		**19**:554g–555a	
b. Post-World War II efforts to define and prosecute war crimes: the United Nations War Crimes Commission; the Nuremberg trials; the Japanese trials; criticisms of the trials and legal arguments concerning the tribunals' jurisdiction		**19**:555b–556g	**10**:541a–c / **19**:539g–540d / **19**:542a–d
c. The Geneva Conventions of 1949 and United Nations conventions protecting war victims and outlawing genocide: major prosecutions and allegations of war crimes committed since World War II		**19**:556g–557g / **8**:1185g–1186c	**8**:1187b–c
6. The attempt to preserve the peaceful uses and exploration of outer space	SPACE LAW **17**:375–378	**16**:266f–268f	**16**:264h–265a
C. Laws governing acts viewed as crimes			
1. Principles and doctrines of criminal law: comparisons between common law and civil law systems	CRIMINAL LAW **5**:275–281	**10**:360h–362d / **4**:1004d–f / **14**:1097e–1099a	**2**:785g–786b
a. Limitations of the definition of criminal conduct: the applicability of criminal law		**5**:276c–277b / **15**:77a–78e / **16**:601c–f / **18**:523c–f	**2**:1069b–e / **14**:977f–978b / **15**:79h–80a / **16**:605a–c / **19**:556h–557a
i. Legality, or *nullum crimen sine lege*		**5**:276c–e / **7**:869d–h	
ii. Protection against double jeopardy		**5**:276e–f	

	articles	article sections	other references
iii. Statutes of limitation		**5**:276g–h	
iv. Requirements of jurisdiction		**5**:276h–277b / **1**:397g–398e	**5**:279h–280a
b. Elements of the criminal act		**5**:277b–279a / **5**:270d–271c	
i. The elements of criminal intent and of criminal negligence		**5**:277c–d / **18**:525h–526f	**18**:527d–528a
ii. The element of mental responsibility		**5**:277d–278a / **15**:177c–e / **17**:781a–b	**1**:449c–e / **6**:1023h–1024d / **15**:282d–e
iii. The mitigating elements of self-defense, necessity, and moral or physical constraint		**5**:278a–d	
iv. Degrees of participation in a crime: the responsibility of the principal actor, conspirators, and other accomplices before and after the act		**5**:278d–279a	
c. The influence of the behavioral sciences on the development of criminal law: developments in punishment and rehabilitation of criminal offenders [see also 543.A.5.a.ii.]		**5**:281b–f / **5**:265a–e / **5**:266f–269d / **5**:273h–274f / **5**:282b–285a / **15**:283h–284g / **17**:778f–779c	
2. Laws governing offenses committed by military forces and other persons subject to military discipline	MILITARY LAW **12**:194–197		
a. Historical development of military law		**12**:194g–195a	
b. Persons and offenses governed by military law		**12**:195b–e	**19**:554e–556f *passim*
c. Military trial court procedures and punishments: courts-martial		**12**:195f–197a	**7**:670b–c / **19**:557d–f
D. Laws promoting the public welfare *with special attention to*			
1. Laws providing for general social security and welfare	WELFARE AND SECURITY PROGRAMS **19**:743–754		
a. Historical development of national welfare programs		**19**:743e–744d / **16**:924g–926c	
b. The scope and organization of national welfare programs: social security, workmen's benefits, medical care, and public assistance programs		**19**:744d–754g / **16**:926c–933a	
2. Laws promoting public health and safety	HEALTH AND SAFETY LAWS **8**:693–700		
a. Historical development of health and safety laws		**8**:694c–698d / **15**:203b–208g	**16**:137e–138b
b. The scope of public health and safety programs; *e.g.*, industrial medicine and safety legislation, public assistance, sanitation, food and drug control		**8**:698d–700d / **5**:101c–102a / **5**:199b–h / **5**:1052a–b / **7**:489b–g / **15**:208g–209g / **18**:572e–573g / **18**:1082b–1084a / **19**:744d–754e	**1**:449e–g / **5**:49c–h / **5**:58e–61c *passim* / **10**:572d–h / **18**:525a–d
c. Development of laws and programs to control environmental pollution		**8**:694g–695f / **5**:43e–44a / **16**:582f–583d	**2**:535b–d / **5**:49c–h / **5**:58e–61c *passim* / **5**:189b–c / **8**:699e–700b / **18**:637a–b / **18**:659f–660a
3. Laws regulating the health, safety, and welfare of workers	LABOUR LAW **10**:570–573	**9**:649b–h / **19**:746a–749c / **19**:751d–753h	**16**:137e–138b / **18**:524g–525a / **18**:528c–d
E. Laws governing taxation	TAX LAW **17**:1083–1087	**5**:530a–h / **9**:269h–270c / **9**:272d–273e / **15**:57c–f / **17**:1067e–1068e / **17**:1076e–1077f	**15**:195h–196b

	articles	article sections	other references
1. The modern development of tax law [see also 535.B.2.c.]		**17**:1083h–1084c	
2. Limitations on the taxing power		**17**:1084c–1085e	
a. Constitutional, political, and economic constraints		**17**:1084c–1085b / **17**:1078e–1081d	
b. Resolutions of the problems of double and concurrent taxation		**17**:1085b–e / **9**:271h–272a	
3. Administration of tax laws: assessment, computation, and enforcement of the tax levy		**17**:1085e–1087a / **4**:351h–352c / **15**:57g–58f / **15**:61b–f / **16**:179a–e	**18**:935b–d / **19**:673f–674b
4. The role of the judiciary in tax cases: the interpretation of the tax law		**17**:1087a–g	
F. Laws of judicial procedure			
1. The organization and administration of the legal system: the courts and the judiciary	COURTS AND THE JUDICIARY **5**:220–226		
a. The function of the courts in the legal process		**5**:220b–222f / **5**:90d–93a	**17**:316g–317b
i. The development of law: judicial lawmaking		**5**:220f–221d	**14**:1038f–1039a
ii. Judicial supremacy: review of the constitutionality of legislation and the formulation of rules for the court system		**5**:221d–222b / **1**:92e–93f / **1**:95g–96a / **5**:90d–91a / **5**:95f–96b	**3**:241a–b / **4**:666c–e / **10**:717e–f / **11**:537b–d / **14**:669b–c
iii. Review of the decisions of administrative agencies		**5**:222c–e / **1**:92e–93f / **1**:95g–96a	**1**:94c–e
iv. Enforcement of judicial decisions		**5**:222e–f / **10**:361e–362d	
b. The structure and organization of trial courts or courts of original jurisdiction		**5**:226g–223f	**4**:1002a–d / **9**:1108h–1109a / **14**:723a–c / **18**:938a–c
i. Comparison of criminal courts and civil courts: courts of general jurisdiction		**5**:222g–223d	**4**:666e–g / **12**:195g–196c
ii. Courts of limited jurisdiction; *e.g.*, constitutional, probate, merchants, labour, tax, family, juvenile, traffic, maritime, equity courts		**5**:223d–f / **1**:93g–94e / **4**:1000b–d / **7**:173a–c / **9**:594a–g / **9**:734c–736c / **11**:500g–501d / **15**:5g–6c / **17**:1087a–g	**2**:698d–699a *passim* / **12**:460g–461d / **19**:555f–556a
c. Appellate court systems and courts in federal systems		**5**:223f–224d / **5**:90d–93a / **15**:13f–14c / **17**:314f–315c	**4**:1003c–d / **17**:316g–317b
d. The selection and qualifications of judges in civil law and common law systems		**5**:224d–225e / **9**:736b	**7**:606c–d / **9**:734e–h / **10**:782b–c
e. The structure and status of the judiciary in countries governed by the Soviet and socialist law system		**5**:225f–226c / **17**:314f–317b	**4**:293c–f / **17**:350f–351a
f. Diverse views of judicial function		**5**:90d–93a / **7**:3a–d / **10**:720f–722a / **10**:782g–783c	**10**:717e–g / **17**:316g–317b
2. Methods and procedures of the law			
a. Criminal procedure	CRIMINAL LAW **5**:279–281	**12**:195h–196d	**4**:1001g–h / **17**:320b–h
i. Procedures in the investigatory process: detention of suspects; accumulation of evidence		**5**:279b–e / **2**:537b–d / **5**:271g–272c / **14**:667g–669e / **14**:674b–f / **14**:675b–677c / **17**:777d–g / **18**:526c–d	**11**:851c
ii. Preparation of charges: roles of public prosecutor and defense counsel		**5**:279f–h	**10**:779b–d / **10**:782d–e

	articles	article sections	other references
iii. Trial procedure and rights of the defendant: jury and bench trials; public trial; rights of counsel and presentation of evidence; acquittal or conviction; sentencing		**5**:279h–280f / **7**:1g–6c / **10**:361b–c / **11**:813e–814f	**4**:666e–g / **4**:1002b–c / **5**:222g–223a
iv. Postconviction procedures: appeals from the verdict of the trial court		**5**:280g–281a / **5**:223f–224b / **12**:196d–f	
b. Civil procedure [see 553.E.]			
c. Administrative procedure	ADMINISTRATIVE LAW **1**:92–96		
i. The development of codes of administrative procedure		**1**:95b–e	
ii. Rules of justice and impartial and fair treatment		**1**:95e–g	
iii. The scope of judicial review in administrative courts and other courts [see also F.1.a., above]		**1**:92e–95a / **1**:95g–96a / **5**:95f–96b / **5**:221d–222b	
3. Methods of adjudicating litigious disputes *with special attention to*			
a. The jury system	JURY **10**:360–362	**15**:10f–11e	**5**:280a–c
i. Historical development of the jury system		**10**:360h–361c	**6**:1120f–g / **8**:765h–766c
ii. Jury procedure and organization: voir dire selection, size, limited authority to sentence, and judicial control over the jury		**10**:361c–g	**4**:666e–g / **15**:11a–d
iii. Controversy concerning the jury's impartiality, competence, and interpretive powers		**10**:361g–362d	**14**:123h–124b
b. Systems of arbitration	ARBITRATION **1**:1074–1077		
i. Commercial arbitration		**1**:1074h–1076c / **5**:127h–128a	
ii. Labour arbitration		**1**:1076c–1077a / **18**:569f	**2**:410h–411b / **10**:567d–e / **17**:346e–f
iii. Arbitration of international disputes [see also B.2.c., above]		**1**:1077a–h / **9**:733d–736a / **18**:896h–897f	**19**:971h–972a

Section 553. Branches of private law, substantive and procedural
[for Part Five headnote see page 283
for Division V headnote see page 352]

The articles and parts of articles referred to in Section 553 deal with five main subjects: A, laws governing the right to acquire, hold, and use economic goods; B, laws governing marriage, the family, and succession; C, laws governing the redress of injuries to persons and property, to which the state is not a party; D, laws governing economic transactions; and E, civil procedural law.

The outline of subject A first deals with the historical development of property rights; with the original and derivative methods of acquiring property rights; and with the types of property rights classified by the different types of ownership. Dealing with subdivisions of property law, the outline covers laws concerning tangible property, real and personal; laws protecting intangible or incorporeal property rights, such as copyright, patent, and trademark law; laws concerning the temporal division of property rights in common law and civil law traditions; laws concerning trusts; the law of mortgages; and laws concerning bankruptcy. Finally, the outline treats restrictions imposed upon property ownership in the interests of public welfare, and the political, social, and economic consequences of property rights.

The outline of subject B first deals with laws governing the institution of the family and the relationships among its members. It treats legal definitions of the family; laws concerning the marriage contract, the civil effects of marriage, and the status of married women; laws concerning children and parental obligations and rights; and laws concerning the termination of marriage. The outline then deals with laws concerning the devolution of property by means of inheritance. It treats criticisms and defenses of the right to devise and bequeath property; freedom of testation; the issue of the division of property; the development of laws governing intestate and testate succession; and laws governing the assumption of inherited property.

Subject C is laws governing the redress of injuries to persons and property, to which injuries the state is not a party. The outline first deals with the nature, scope, and historical development of tort law. It goes on to the doctrine of strict liability as compared with negligence liability, and to recent changes in tort liability burden. In a general survey of modern tort law, the outline treats intentional personal injuries, such as battery and assault; intentional injuries to property; injuries resulting from negligent acts, including employers' liability and the manufacturer's liability to the consumer; and injuries done to personality and personal relationships, such as libel and slander and other invasions of privacy, and including interference with economic relationships.

Subject D is laws governing economic transactions. The outline begins with laws governing the making and execution of promises. It treats the historical development of contract law; the rules governing the legal enforcement of contracts in various legal systems; current trends and issues in the law of contract; and the role of contract law in the sphere of economic activity. The outline goes on to the historical development and the principal elements of laws governing commercial transactions, and commercial relationships of agency. It next deals with laws regu-

lating business association, here covering the principal forms of business associations; laws governing the management and control of business entities; laws impinging upon the structure of corporate finance; recent trends in laws governing mergers and consolidations; and laws governing the liquidation of insolvent businesses. The outline next deals with the historical development, scope, and nature of laws regulating relationships between employers and employees. Finally, it deals with laws governing commercial transportation, covering laws regulating the carriage of goods, maritime law, and air law.

The outline of subject E begins with the historical growth of civil procedural law. It goes on to the elements of civil procedure, covering such things as problems of jurisdiction; definitions and limitations of parties to a suit; provisional remedies sought prior to trial; and the actions involved in the commencement of civil action. It next treats the conduct of civil trials, dealing with the law of evidence and the rules governing the determination of questions of fact as a basis of a judgment by the court. Finally, it treats the rendering of judgment in civil cases, and post-trial appeals and other methods of review.

	articles	article sections	other references
A. Laws governing the right to acquire, hold, and use economic goods	PROPERTY, LAW OF **15**:46–56		**4**:663f–664a
1. Historical development of property rights		**15**:46h–49b / **6**:502h–503a / **7**:170d–172c / **8**:400h–401b	**6**:280c–f / **8**:748a–b
a. In primitive and nomadic societies		**15**:47a–c	**1**:331h–332d / **8**:42a–e / **8**:1157c–g / **9**:587b–c / **9**:939g–h / **11**:867e–f / **12**:370c–e / **14**:780d–781a
b. In agricultural societies		**15**:47c–d / **4**:998e–g / **6**:1127c–e / **7**:650c–g / **12**:147d–g	**6**:1128f–1129e / **8**:1164d–1165h / **9**:587d–f / **10**:70h–71b / **12**:169e–g / **16**:320a–c / **16**:320g–321c / **17**:435c–d
c. In urban and commercial societies		**15**:47d–h / **12**:459h–461h	
2. Methods of acquiring property rights		**15**:47h–49b	**4**:664f–h / **10**:635h–636d / **10**:638a–641h *passim*
a. Original acquisition: occupancy, accession, adverse possession, and expropriation		**15**:48b–f	**8**:766b–c
b. Derivative possession: sale, judicial sale, and will and intestate succession [see also B.2., below]		**15**:48f–49b / **9**:587a–593f	**3**:290c–d / **5**:531d–g / **11**:501e–g
3. Types of property rights classified by ownership		**15**:49c–51a	**9**:586a–b
a. Ownership by individuals and families		**15**:49d–f / **15**:49h–50b	**17**:317g–318a
b. Ownership by tribes and clans		**15**:49f–g / **3**:286c–287d	**14**:780d–f
c. Ownership by collectives and cooperatives		**15**:50c–d / **1**:321c–322d	**17**:317c–g
d. Ownership by charitable (not-for-profit) organizations		**15**:50e	
e. Ownership by private corporations [see also 534.D.4.]		**15**:50f–g	
f. Ownership by state and municipal corporations [see also D.3.a.iv., below; 534.G.4.; and 535.B.5.b.ii.]		**15**:50h–51a	
4. Laws concerning tangible property: the distinctions between real and personal property		**15**:51b–52e	**15**:57c–e / **18**:526h–527b
a. Ancient divisions of property		**15**:51d–e	**8**:42a–e
b. Modern divisions of property		**15**:51e–52e	**4**:663f–g / **9**:588a–e / **9**:588h–589c
5. Laws protecting intangible or incorporeal property rights			
a. Easements and servitudes: profits and mineral rights		**15**:52e–53b / **1**:396e–g	
b. Rights to the exclusive exploitation of literary, dramatic, musical, and other artistic works	COPYRIGHT LAW **5**:152–156	**2**:89f–90b / **2**:91h–92g / **2**:113g–h / **5**:807d–e	**2**:112f–113d / **3**:1087f–1088b / **3**:314e–g / **6**:787e–f / **15**:226e–g / **15**:227g–228f *passim* / **15**:229g–230d / **15**:234b–h / **17**:319f–g
c. Rights to the exclusive exploitation of inventions and other discoveries of useful processes and materials	PATENT LAW **13**:1071–1075		**5**:152d–e / **17**:319d–e
d. Rights to the exclusive exploitation of symbols and other devices used to identify the origin or ownership of business products	TRADEMARK LAW **18**:557–563		
6. Laws concerning the temporal division of property rights		**15**:53b–54e / **6**:1119f–h	**6**:232g–233b / **6**:1127c–e

	articles	article sections	other references
a. Common law land ownership: freehold and leasehold estates		**15**:53c–h / **12**:459h–461h	**4**:998e–g / **5**:531d–e
b. Civil law land ownership: dominium (absolute ownership) and usufruct (life estate)		**15**:53h–54e / **15**:1057f–1058c	**4**:663f–g / **12**:459b–g
7. Laws concerning trusts: ownership for the benefit of others	TRUSTS, LAW OF **18**:726–729	**15**:54e–55c	**5**:531d–e
a. Historical development of the law of trusts		**18**:726c–f	**4**:1001c–d
b. The elements of a trust: settlor, trust property, trustee, beneficiary, and trust instrument		**15**:54e–55a / **18**:726g–727a	**2**:698g–699a / **9**:594d–595b *passim* / **10**:778c–e
c. Types of trusts: express, implied, constructive, statutory, and public and private trusts		**18**:727a–728a	**12**:461c–e
d. Trusts established for the benefit of families, social and philanthropic organizations, and business corporations		**18**:728a–h	
e. The status of the trust in civil law systems: a comparison of the trust and the fideicommissum		**15**:55a–b / **18**:728h–729g	**9**:589c–e
8. Laws concerning the use of property as security for a legal obligation	MORTGAGES, LAW OF **12**:459–462		
a. Historical development of mortgage law		**12**:459b–461h	
b. The social importance of mortgages		**12**:461h–462g	
9. Laws concerning the liquidation or rehabilitation of insolvent estates	BANKRUPTCY, LAWS CONCERNING **2**:694–699		
a. Historical development of bankruptcy law		**2**:695a–f	**15**:194c–d
b. Methods of liquidating insolvent estates		**2**:695g–699a	
c. Methods of rehabilitating insolvent estates		**2**:699b–d / **7**:301h–302a	
10. Restrictions imposed upon property ownership in the interests of public welfare: political, social, and economic consequences of property rights		**15**:55d–56e / **9**:650b–d / **18**:526f–527b	
B. Laws governing marriage, the family, and succession			
1. Laws governing the institution of the family and the relationships among its members	FAMILY LAW **7**:166–173	**6**:1119c–e / **9**:939h–940c / **17**:319g–320b	**4**:409d–g / **4**:522e–523e *passim* / **12**:817a–c / **16**:599a–601f *passim*
a. Legal definitions of the family: various types of family groups [see also 512.B.3.a. and 522.A.3.]		**7**:166f–167a / **7**:155b–156a / **10**:477f–478b	
b. Laws concerning the marriage contract: civil effects of marriage; the legal status of married women		**7**:167a–g / **7**:169a–172c / **7**:159g–h / **7**:165f–166a / **8**:791d–e / **10**:480d–481c	**4**:662h–663b / **4**:664d–f / **4**:1121g–1122c / **8**:1188c / **9**:941d–942c / **17**:128a–c / **19**:797g–h / **19**:908h–915f *passim*
c. Laws concerning children: legitimacy, adoption, and guardianship; parental obligations and rights		**7**:167g–169a / **8**:791f–793a / **10**:481f–g / **14**:969d–e	**9**:591a–b / **10**:478h–479c / **11**:851e–f / **12**:816g–817a
d. Laws concerning the termination of marriage: divorce and other forms of marital dissolution		**7**:172d–173a / **7**:163e–164e / **9**:591c–592f / **10**:481e–f	**4**:663c–d / **9**:940a–942e *passim*
2. Laws concerning the devolution of property by means of inheritance	INHERITANCE **9**:585–595	**4**:1003h–1004a / **10**:484b–h / **18**:726g–729g	**3**:234c–e / **5**:531d–g
a. The nature of inheritance rights: criticisms and defenses of the right to devise and bequeath property		**9**:585g–586h / **5**:529e–g / **9**:940c–f	**6**:1013g–1014a / **10**:484c–f
b. Freedom of testation: the property owner's right to name his beneficiaries; legal limitations on the power to devise property and to disinherit		**9**:586h–588g	**18**:631a–b
c. The issue of the division of property: undivided inheritance of property by one heir versus equal distribution among descendants		**9**:588g–589g / **6**:1119e–f	**1**:628h–629b / **4**:998f–g / **16**:309e–h

	articles	article sections	other references
d. Development of laws governing intestate succession: intestate rights of spouses		**9**:589g–592g	**4**:663d–f/**8**:400g–h/**15**:49a–b/**15**:1059a–b
e. Development of laws governing testate succession: requirements for valid wills; factors that invalidate wills		**9**:592g–593f	**4**:1001c–d
f. Laws governing the assumption of inherited property: methods of determining and administering the settlement of debts and assets		**9**:593f–595b	
C. Laws governing the redress of injuries to persons and property, to which the state is not a party: tort law	TORTS, LAW OF **18**:523–529		
1. The nature and scope of tort law: tort as distinct from criminal and contract laws		**18**:523c–524b/**4**:1004a–c	**15**:12g–h
2. Historical development of tort law		**18**:524b–f	**4**:410a–b/**8**:694g–695f *passim*/**15**:1058c–d/**18**:525d–g
3. The doctrine of strict liability as compared with negligence liability: recent changes in tort liability burden		**18**:524f–525g/**1**:398e–399c/**3**:961d–962a/**9**:647f–648e/**9**:656f–657a/**11**:502c–h	
4. General survey of modern tort law		**18**:525g–529a	
a. Intentional personal injuries: battery and assault; false imprisonment; mental anguish		**18**:525h–526f	
b. Intentional injuries to property: trespass to land and chattels; nuisance; unlawful appropriation and conversion of property		**18**:526f–527b/**1**:396g–397a	**8**:698c–d/**15**:55h
c. Injuries resulting from negligent acts		**18**:527b–528f/**9**:647f–648e/**9**:656f–657a	
i. Injuries resulting from failure to comply with required standards of care: the proximate cause doctrine; effects of contributory negligence and third-party intervention		**18**:527b–528d/**1**:399a–c	**8**:697b–d/**11**:851g–h/**17**:318h–319b
ii. The employer's liability and the master–servant relationship	AGENCY, LAW OF **1**:295	**8**:697a–d/**11**:502c–h/**19**:752h–753h	**8**:699b–c/**16**:137e–138b/**18**:524g–h/**9**:656f–h
iii. The manufacturer's liability to the consumer		**5**:199b–h	**18**:528d–f
d. Injuries to personality and personal relationships: physical, mental, and economic injuries		**18**:525d–526f	
i. Defamation: libel and slander; other invasions of privacy and interference with familial relationships		**18**:528f–529a	**3**:1088c–1089f *passim*/**13**:297f–h/**15**:238e–g
ii. Interference with economic relationships: deceptive practices; unfair competition; infringement		**5**:102g–103b/**5**:152f–153b/**13**:1073g–1074a/**18**:558g–559c/**18**:560c–g	**5**:153f–154c
D. Laws governing economic transactions			
1. Laws governing the making and execution of promises	CONTRACTS, LAW OF **5**:124–128	**18**:523f–g	
a. Historical development of contract law		**5**:124a–125a/**1**:291d–292g/**6**:502h–503a/**6**:1120a–c/**8**:401b–f	**3**:960c–g/**4**:409h–410a/**7**:169e–g/**15**:1058d–g
b. Modern rules governing the formation of a contract and the setting of standards of fairness and social utility		**5**:125b–f/**4**:988g–989f/**4**:1004c–d	**15**:234h–235b
c. Contracts as voluntary obligations enforceable at law: contract law in various legal systems		**5**:125g–127h/**7**:169a–g	**7**:167a–d
i. Rules governing offer and acceptance		**5**:125g–126c/**9**:656a–e	
ii. Contracts unenforceable at law: methods of curing legal defects to make a contract binding at law		**5**:126c–127b	

	articles	article sections	other references
iii. Regulations requiring the performance of a contract and sanctions for failure to perform		**5**:127b–f	**4**:664h–665a /**4**:989c–991d
iv. Multiparty contracts: the rights of third parties		**5**:127f–h / **1**:293d–295e	**18**:726c–729g *passim*
d. Current trends and issues in the law of contracts: arbitration and codification of contract law		**5**:127h–128c / **1**:1074h–1076c / **5**:102h–103b	
e. The role of contract law in the sphere of economic activity		**5**:124a–125a / **9**:656a–e / **11**:501g–502c	**5**:98f–100g *passim* / **18**:669h–670c
2. Laws regulating commercial transactions and practices	COMMERCIAL TRANSACTIONS, LAW OF **4**:987–994		
a. Historical development of the law governing commercial transactions		**4**:988a–f / **2**:695a–f / **16**:449c–452c	**8**:748c–e /**11**:460g–461a / **12**:459h–461e
b. Principal elements of commercial law: commercial transactions as contracts		**4**:998g–994d / **5**:98f–100b / **12**:358e–360h	**3**:960c–g
i. Sales of goods and requirements for delivery		**4**:989f–991g / **3**:962a–963b	
ii. Transfer of negotiable instruments; *e.g.*, promissory notes, checks, drafts or bills of exchange		**4**:991g–992c / **2**:700d–701b	**3**:963d–e /**7**:299f–h
iii. Issuance of documents of title; *e.g.*, bills of lading, warehouse receipts		**4**:992d–g / **3**:962b–d / **3**:962h–963e / **11**:501g–502c / **11**:502h–503a	**3**:965c–d
iv. Issuance of letters of credit		**4**:992g–993a	
v. The use of security interests (liens and pledges) as collateral for loans of money		**4**:993a–994d / **3**:801d–g / **3**:962f–h / **16**:447d–448e	**2**:697e–698a /**7**:299h–300a / **12**:461e–h
c. Laws governing the relationship between agent and principal in the transaction of commercial and other legal affairs	AGENCY, LAW OF **1**:291–295	**3**:963f–964a / **10**:571e–f	**15**:235b–d
3. Laws regulating business associations	BUSINESS ASSOCIATIONS, LAW OF **3**:529–536	**15**:217f–219c	
a. Principal forms of business associations		**3**:529h–531e	
i. Partnerships		**3**:530d–f / **3**:532g–533b	
ii. Corporate companies or corporations		**3**:532b–g / **3**:533b–f / **3**:530f–531a / **5**:182d–h	**5**:187g–188a /**6**:234g–235b / **8**:1118e–g
iii. Cooperative and mutual organizations		**3**:531b–e	**15**:50c–d
iv. State and municipal corporations; quasi-public enterprises and utilities [see also 534.G.4. and 535.B.5.b.ii.]		**3**:312a–313a / **4**:648c–649c / **14**:884g–886c / **15**:200b–202a	**3**:531d–e /**4**:646d–f / **13**:946g–947d /**15**:50h–51a
b. Historical development of business associations		**3**:531e–532b / **5**:182h–184e	**2**:701g–h /**6**:224h–225g / **15**:1057d–f
c. Laws governing the management and control of business entities		**3**:532b–534d / **5**:184e–185a	
i. The structure and regulation of management		**3**:532c–533f / **3**:491b–495g / **5**:185f–186d / **5**:187e–188h	
ii. Rights of shareholders to influence and control management		**3**:533f–534d / **5**:187g–188d	
d. The structure of corporate finance		**3**:534d–535d / **7**:300d–301c	
i. Common and preferred shares of stock: rights and interests of owners of equity capital		**3**:534d–535b / **16**:448a–e	**7**:300g–h /**7**:301b–c
ii. Borrowed capital: rights acquired by holders of bonds and debentures		**3**:535b–d / **16**:447e–h	

iii. Reinvestment of company earnings

e. Trends in laws governing mergers and consolidations: employee participation
[see also 534.H.2.c.]

f. Laws governing the liquidation of insolvent business and nonbusiness estates: the law of bankruptcy

4. Laws regulating relationships between employers and employees

a. Historical development of labour law

b. The scope and nature of labour law: the use and treatment of the labour force

i. Individual employer–employee and collective employment relationships: wages and other remuneration; hours and conditions of work

ii. Health, safety, and welfare of workers: workmen's compensation, unemployment insurance, and social security benefits

iii. Trade unions and labour–management relations: administration of labour contract provisions

c. Comparison of labour law in various legal systems

d. Effects of political factors on labour law

5. Laws governing commercial transportation

a. Laws regulating the carriage of goods

i. Historical development of laws of commercial transportation

ii. Contract and tort liabilities of common or contract carriers in various legal systems

iii. The carrier's duty to deliver; processes and agents of storage and forwarding; use of liens and bills of lading
[see also D.2.b., above]

b. Laws regulating the transportation of goods and passengers at sea: marine salvage and insurance doctrines

c. Laws regulating the transportation of goods and passengers by air: national and private air rights; nationality of aircraft; criminal and civil jurisdiction over illegal acts committed during flight

E. Civil procedural law

1. Historical growth of civil procedural law

a. Development of civil procedure in Roman and medieval European law

articles	article sections	other references
		5:185h–186a /**7**:300h–301b
	3:535d–536d / **7**:301d–h	
BANKRUPTCY, LAWS CONCERNING **2**:694–699	**7**:301h–302a	
LABOUR LAW **10**:570–574		
	10:570f–571c / **19**:935d–h	**10**:695a–696c / **18**:564d–570g *passim* / **18**:976f–977b
	10:571c–573h / **8**:1184f–g	
	10:571e–572d / **1**:1021b–e / **10**:564c–e / **17**:318d–g	
	10:572d–h / **9**:649b–h / **19**:746a–749c / **19**:751d–752b / **19**:752h–753h	**16**:137e–138b /**18**:524g–525a / **18**:528c–d
	10:572h–573d / **1**:1076c–1077a / **9**:510e–512b / **10**:564e–567g	**6**:773b–c /**18**:563f–570g *passim*
	10:573d–h / **18**:564d–570g	**2**:410h–411c
	10:574a–h / **1**:810c–g / **4**:671e–672e	
CARRIAGE OF GOODS, LAW OF **3**:960–965		
	3:960b–g	
	3:960g–962a / **1**:398e–399c / **11**:502c–h	
	3:962a–965h / **11**:501d–502c	**4**:989h–990e /**17**:708g–709f / **17**:710f–711d
MARITIME LAW **11**:500–503	**9**:646d–647f / **3**:965b–d / **5**:57e–g / **9**:748b–c / **18**:669h–671h	**4**:988a–c /**4**:992d–e / **9**:748h–749a /**19**:542a–d
AIR LAW **1**:395–399	**3**:965d–g / **1**:145d–g / **9**:648h–649b / **18**:576h–578a / **18**:639f–641b	**7**:400e–f /**9**:748f–h / **18**:634b–c /**18**:638a–e
PROCEDURAL LAW **15**:4–14		
	15:5b–6f / **4**:998h–999b / **4**:1036c–f / **17**:314f–316e / **18**:524b–f	**8**:765h–766d
	15:5b–g / **6**:1120e–g	**12**:159d–160a

	articles	article sections	other references
b. Development of equity law and equity courts in England and the United States		**15**:5g–6c / **4**:999e–g / **4**:1000b–d / **4**:1001b–d / **18**:726c–728f	**12**:460g–461d
c. 19th- and 20th-century civil procedural law codifications		**15**:6c–f / **4**:662c–665a / **4**:1036e–1037b / **4**:1038c–f / **5**:220f–221d / **18**:728h–729g	
2. Elements of civil procedure		**15**:6f–14c	
a. National or territorial jurisdiction and venue of courts: the competence of a court to handle a case		**15**:6f–7a	**2**:698e–f
b. Jurisdiction or venue in private international law: the source and nature of the conflict of laws; foreign judgments and choice of law	CONFLICT OF LAWS **4**:1085–1088	**1**:398a–e / **2**:699d–f / **3**:965b–d / **7**:172f–h	**3**:536c–d / **4**:991d–g / **15**:52b–e
c. Definitions and limitations of parties to a suit: class actions and amicus curiae		**15**:7a–g	**2**:696c–e
d. Provisional remedies sought prior to trial; *e.g.*, writs of attachment, injunctions, other restraining orders		**15**:7g–8b	
e. The commencement of civil action: summons, pleadings, appearance, pretrial motions, discovery procedures, and pretrial conference		**15**:8b–10e	
3. The conduct of civil trials: rules governing the determination of questions of fact as a basis of a judgment by the court	EVIDENCE, LAW OF **7**:1–6	**15**:10f–12c	**5**:280d–e / **10**:779b–d
a. Historical development of the law of evidence		**7**:1c–2e / **6**:1120e–g	
b. The establishment of the burden of proof		**7**:2e–f / **9**:940g–941a	
c. Problems of relevancy and admissibility of evidence		**7**:2f–3d / **14**:675d–677c	**15**:10h–11a
d. The privilege against self-incrimination and privileged professional communications		**7**:3h–4e	**11**:814a–b / **17**:1086b–1087a *passim*
e. Testimonial evidence: the cross-examination; methods of establishing the credibility of witnesses		**7**:4e–5c	
f. Other types of evidence: confessions; documentary, expert, and real evidence		**7**:5d–6c / **2**:537b–d / **11**:813e–814f	
4. The rendering of judgment in civil cases: assessment of damages; res judicata; collateral estoppel		**15**:12d–13e	**2**:696e–f / **4**:1086h–1087g / **5**:222e–f
5. Post-trial appeals and other methods of review [see also 552.F.2.a.iv.]		**15**:13f–14c	

Section 554. The profession and practice of law
[for Part Five headnote see page 283
for Division V headnote see page 352]

The articles and parts of articles referred to in Section 554 deal with three main subjects: A, the profession of law; B, legal ethics; and C, educational requirements for the legal profession.

The outline of subject A begins with the history, composition, and general characteristics of the legal profession. It goes on to the functions served by the legal profession in its private and public roles, and to its different roles in different systems of law. The outline further treats the effect of the political structure on the legal profession; the organization of the legal profession; and the future of the legal profession.

The outline of subject B, legal ethics, first deals with different conceptions, in various countries and legal systems, of the ethical requirements in the practice of law. It then treats the lawyer's moral responsibilities to his client (for example, to protect confidential communications), and his moral responsibility as either public prosecutor or defense attorney in criminal cases.

The outline of subject C treats the history, aims, and different methods of legal education; the examination and qualification of candidates for the bar; prelegal and postgraduate legal education; and current trends in legal education.

	articles	article sections	other references
A. The profession of law	LEGAL PROFESSION **10**:779–784		

	articles	article sections	other references
1. History of the legal profession		**10**:779f–781a / **4**:664a–b / **4**:999g–1000a / **4**:1001d–e / **6**:1115h–1117b / **8**:399b–g / **9**:938b–939e / **12**:146f–g	**4**:609b–e / **4**:1000g–h / **6**:326d–e / **6**:328e–g / **6**:337c–e / **8**:360g–h / **9**:745e–h / **15**:38d–f / **15**:1056a–b
2. Composition and characteristics of the legal profession		**10**:781a–e / **10**:775g–776g	
3. Functions served by the legal profession		**10**:781f–782f	**10**:779b–d
a. Its private roles		**10**:781f–782a	**9**:593a–b / **10**:777h–778c / **12**:196c–d
b. Its public roles		**10**:782b–g / **1**:94e–95a / **5**:220b–222f	
c. Its different roles in different systems of law		**5**:224f–225e / **10**:777g–778c / **10**:1037b–h	**10**:782b–784b *passim*
4. Effects of the political structure on the legal profession		**10**:782g–783c	
5. The organization of the legal profession		**10**:783c–g / **10**:776c–g / **10**:777e–778c	
6. The future of the legal profession		**10**:783g–784b	
B. Legal ethics	LEGAL ETHICS **10**:777–779		
1. Ethical requirements in the practice of law: conceptions of the role of the lawyer in various countries		**10**:777e–778c / **10**:778g–h	
2. The lawyer's moral responsibilities to his client; *e.g.*, to avoid conflicts of interests, to protect confidential communications, to charge reasonable fees		**10**:778c–779b	
3. The lawyer's moral responsibility as either public prosecutor or defense attorney in criminal cases		**10**:779b–d	**5**:279c–e / **10**:782d–e
C. Educational requirements for the legal profession	LEGAL EDUCATION **10**:773–777		
1. History of legal education		**10**:773h–774b / **4**:1036e–1037b / **10**:782f–g	**4**:999g–1000a / **6**:328e–g / **6**:1116c–1117b *passim*
2. Aims of legal education		**10**:774b–h	
3. Methods of legal education: the apprenticeship approach; the case method approach; lectures and seminars; moot courts		**10**:774h–775f	**9**:570h–571a / **9**:572h–573a / **17**:1087c–e
4. Examination and qualification of candidates for the bar		**10**:775g–776g	
5. Prelegal and postgraduate legal education		**10**:776g–777b / **4**:1038h–1039c	
6. Current trends in legal education		**10**:777b–c / **10**:720f–722a	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AUSTIN, JOHN **2**:380
BECCARIA, CESARE **2**:785
BENTHAM, JEREMY **2**:837
BLACKSTONE, SIR WILLIAM **2**:1098
CICERO **4**:607
COKE, SIR EDWARD **4**:825
ERSKINE, THOMAS ERSKINE, 1ST BARON **6**:957
GROTIUS, HUGO **8**:431
HALE, SIR MATTHEW **8**:554
HAMMURABI **8**:598
HOBBES, THOMAS **8**:970
HOLMES, OLIVER WENDELL **8**:996
JUSTINIAN I **10**:362
MANSFIELD, WILLIAM MURRAY, 1ST EARL OF **11**:460
MARSHALL, JOHN **11**:535
PUFENDORF, SAMUEL VON **15**:265
SAVIGNY, FRIEDRICH KARL VON **16**:288
TANEY, ROGER BROOKE **17**:1015
VITORIA, FRANCISCO DE **19**:493

Division VI. Education

[for Part Five headnote see page 283]

The outlines, and the articles and parts of articles referred to, in the three sections of Division VI treat the aims and methods of education; educational systems around the world; and the organization of education.

The articles referred to in Section 561 deal with diverse philosophies of education and with experimental findings and theories about the processes of learning and teaching.

Section 562 treats the major types of educational systems existing today; the history of educational practices and institutions around the world; and international educational activities.

Section 563, on the organization of education, treats the phases or levels of education; the preparation and performance of teachers; the economics of education; and the social and political aspects of education.

Section 561. The aims and methods of education 371
562. Education around the world 372
563. The organization of education 377

Section 561. The aims and methods of education

[for Part Five headnote see page 283]

The articles and parts of articles referred to in section 561 deal with two main subjects: A, philosophies of education; and B, the learning process and the teaching science or art.

The outline of subject A begins with the methods and scope of the philosophy of education and with assumptions about human learning common among theorists of education. Turning to various conceptions of the means and ends of education, it first sets forth eight different model theories of the educated person, the differences reflecting basic philosophical positions. It then treats areas of disagreement among educational theorists, covering diverse conceptions about what constitutes knowledge and how it is communicated; diverse conceptions about the purpose of education; and diverse conceptions about controlling student behaviour.

The outline of subject B begins with experimental findings and theories about the processes of learning and thinking. Going on to pedagogy, the outline deals with the components of the teaching situation, treating the elements that modify the learner's behaviour; the psychology of instructional objectives; and curricular strategies that enhance the teaching process. It next deals with traditional and contemporary general theories concerning the role of the teacher in the learning process. Finally, it treats issues about the organization of instruction and about the value of different instructional media.

articles	article sections	other references
EDUCATION, PHILOSOPHY OF **6**:408–412		
A. Philosophies of education		
1. The method and scope of the philosophy of education: its relationship to the history of education and other fields of study	**6**:408e–g / **8**:1170c–g / **8**:1180e–1183a / **18**:5f–6h	**6**:316d–405g *passim*
2. Assumptions about learning common to theories of education; *e.g.*, about variable motivation and capacity for learning; about the complex social context of learning; about the intellectual, emotional, and physical components of learning [see also 436.A.]	**6**:408g–409f / **2**:118h–120c / **6**:413a–b / **10**:758a–b / **13**:1098a–g	**10**:754f–g
3. Conceptions of the means and ends of education	**6**:409f–412g / **4**:514b–515a / **8**:1180a–d / **13**:1099g–1102e / **15**:665a–c	**1**:100h–101b *passim* / **11**:455d–e / **13**:801d–e
a. Model theories of the educated person	**6**:409f–411f / **13**:1099g–1101g	**17**:13g–h
i. The Platonic view	**6**:409g–410a	**6**:324c–d / **14**:535g–536b / **15**:800c–d
ii. The Thomist view	**6**:410a–c	**16**:356c–f
iii. The Lockean view	**6**:410c–e	**6**:352b–d / **13**:1100e–f
iv. The naturalist view	**6**:410e–f / **6**:353g–354g	**13**:1100c–e
v. The Marxist view	**6**:410g–411a / **6**:375f–h	
vi. The pragmatist view	**6**:411a–c	**18**:6c–f
vii. The behaviourist view	**6**:411c–e / **13**:1100g–1101g	
viii. The existentialist view	**6**:411e–f	
b. Areas of disagreement among educational theorists	**6**:411g–412g / **5**:268h–269b	

	articles	article sections	other references
i. Diverse conceptions about what constitutes knowledge and how knowledge is communicated		6:411g–412a	15:664d–g
ii. Diverse conceptions about the purpose of education		6:412a–c / 6:413a–414e / 13:1098g–1099b / 15:640a–d	6:313b–e / 6:699c–d / 16:355b–357e *passim*
iii. Diverse conceptions about disciplining students and encouraging student competitiveness		6:412c–f	13:1098e–f / 13:1101h–1102a
B. The learning process and the teaching art			
1. Processes of learning and thinking: experimental findings and theories [see 436]			
2. Pedagogy: the art and science of teaching	PEDAGOGY 13:1098–1103		
a. Components of the teaching situation		13:1098a–1099g	
i. Elements that modify the learner's behaviour; *e.g.*, the teacher, the subject matter, other learners, the physical environment of the school		13:1098a–g / 6:413a–b	6:414e–416h *passim* / 18:12g–14g *passim*
ii. The psychology of instructional objectives: development of cognitive, psychomotor, and emotional growth		13:1098g–1099b / 6:372f–373a / 6:413b–414d	
iii. Curricular strategies that enhance the teaching process; *e.g.*, diagnostic procedures, strategies designed to motivate the learner, evaluation techniques		13:1099b–g / 6:698e–700e / 8:864a–b	6:432h–433f / 18:5h–6h
b. General theories concerning the role of the teacher in the learning process		13:1099g–1101g / 6:372f–376e / 8:1178h–1179b	
i. Traditional views; *e.g.*, the teacher as a trainer of mental faculties, the teacher as a provider and promoter of experiences		13:1099g–1100f	6:373c–f
ii. Contemporary views: *e.g.*, the teacher as moderator of behavioral responses in the learner; the teacher as director of inquiry and thinking; the teacher as encourager, co-analyzer, and co-builder of mental structures originating in the learner		13:1100g–1101g	6:373g–376e / 6:699f–h
c. The organization of instruction: contemporary practices and techniques; *e.g.*, nongraded schools, general-purpose classrooms, open-plan and team teaching		13:1101g–1102e / 6:415e–416h / 6:698e–g	6:412c–d / 6:433f
d. Instructional media: speaking–listening facilities; visual and observational aids; programmed learning; computer-based instruction		13:1102e–1103c / 8:863h–864a	6:430d–g

Section 562. Education around the world

[for Part Five headnote see page 283
for Division VI headnote see page 371]

The articles and parts of articles referred to in Section 562 deal with three main subjects: A, the educational systems of the world; B, the history of education; and C, international educational activities.

The outline of subject A first deals with the factors governing the classification of educational systems. It then sets forth the characteristics of the major types of educational systems in various countries around the world. It treats centralized systems, decentralized systems, joint national and local systems, systems controlled by political parties, and sectarian systems. It also suggests emergent trends in educational systems.

The outline of subject B treats education in primitive and early civilized cultures; education in classical Eastern and Western cultures; education in the Persian, Byzantine, early Russian, and Islāmic civilizations; education in the European Middle Ages; education in Asian civilizations from about AD 700 to the eve of Western influence; European education during the Renaissance and Reformation; European education in the 17th and 18th centuries; Western education in the 19th century; and education in the 20th century—including traditional and experimental educational movements, contemporary Western patterns of education, revolutionary patterns, modernizing Afro-Asian patterns of education, and education in colonies and newly emerging nations.

The outline of subject C treats the nature of international educational relations, the history of such relations, and recent developments with regard to them.

	articles	article sections	other references
A. Educational systems of the world	EDUCATION, SYSTEMS OF 6:417–430		

	articles	article sections	other references
1. Factors in the formation and classification of educational systems		**6**:417e–418f / **6**:413h–415e	
a. Formation of educational policy		**6**:417g–418f / **6**:414e–415e / **8**:864c–d / **13**:1101g–1102e	
b. Administrative functions and procedures; *e.g.*, management of finances, faculty recruitment, student selection		**6**:417e–g / **6**:415e–g / **6**:416a–b / **8**:864d–865b / **18**:7a–8h	**6**:418g–429g *passim* / **6**:694c–696a *passim* / **6**:700b–e / **8**:857g–863c *passim* / **8**:865f–867d *passim*
2. Types of educational systems and their characteristics		**6**:418g–430g	
a. Centralized systems *with special attention to*		**6**:418g–420h	
i. France		**6**:418g–419e / **6**:694e–f / **8**:857g–858e / **8**:861h–862c	**6**:379h–380a / **7**:607c–f
ii. Italy		**6**:419e–h	**1**:1020e–f / **6**:380d–g / **9**:1109c–e
iii. The Scandinavian countries		**6**:419h–420e	**1**:98g–99c / **5**:586e / **7**:308d–e / **13**:269e–f / **17**:853b–d
iv. The Latin American countries		**6**:420e–g	**4**:254b–d / **4**:873c–d / **5**:354h–355a / **8**:457g / **13**:989b–c
b. Decentralized systems *with special attention to*		**6**:420h–424d	
i. The United States		**6**:421b–422c / **1**:1021b–d / **6**:695g–696a / **8**:860d–861b / **8**:862h–863a	**6**:381c–383a
ii. The Federal Republic of Germany		**6**:422c–h / **6**:694f–695a / **8**:858e–859b / **8**:862c–d	**8**:64b–f
iii. India		**6**:422h–423d	**6**:394b–f / **9**:299f–300b
iv. Canada		**6**:423e–424a	**1**:426e–f / **3**:730e–g / **6**:383c–384d / **12**:1087b–c
v. Australia		**6**:424a–d	**6**:384d–385a
c. Joint national and local systems *with special attention to*		**6**:424d–425h	**18**:887h–888c
i. England and Wales		**6**:424d–425c / **6**:376f–378f / **6**:695a–d / **8**:859c–860d / **8**:862e–h	**1**:1020g–1021a
ii. Japan		**6**:425c–h / **1**:1021d–e	**6**:392b–g / **10**:53d–g
d. Systems controlled by political parties *with special attention to*		**6**:426a–427h	**1**:421g–h / **5**:14d–f
i. The U.S.S.R.		**6**:426a–h / **6**:695d–g / **8**:861b–h / **8**:863a–b	**1**:99e–f / **6**:386g–387e / **17**:352f–353a
ii. The People's Republic of China		**6**:426h–427d	**4**:294g–295e / **6**:389c–390e / **8**:866e–g
iii. Spain		**6**:427e–h	**17**:395f–396c
e. Sectarian systems: national and regional sectarian systems; sectarian education as an alternative system to public education *with special attention to*		**6**:427h–429g / **15**:1000e–g	
i. Ireland		**6**:428a–c	**9**:887d–e / **13**:241f–g
ii. Canada: Quebec and Newfoundland		**6**:428c–e	**12**:1087b–c
iii. Pakistan		**6**:428e–h	
iv. The United States		**6**:428h–429g	
f. Emergent trends in educational systems		**6**:429h–430g / **6**:699a–700e	

B. History of education: philosophies, practices, and institutions	articles	article sections	other references
	EDUCATION, HISTORY OF 6:316–405	**13**:1099g–1101g	
1. Education in primitive and early civilized cultures		**6**:317f–319a	
a. Education in primitive cultures		**6**:317f–h	**15**:641d–g
b. Education in the earliest civilizations		**6**:317h–319a / **15**:641h–642c	
i. In the Old World civilization of Egypt, Mesopotamia, and North China		**6**:317h–318e	**6**:477g–h
ii. In the New World civilizations of the Mayas, Aztecs, and Incas		**6**:318e–319a	**15**:641h–642c
2. Education in classical cultures		**6**:319b–329e / **8**:1170g–1173c / **15**:800b–801b	
a. Ancient Indian education		**6**:319b–320d	**15**:642d–g
i. The Hindu tradition		**6**:319b–e	
ii. The introduction of Buddhist influences		**6**:319f–h	
iii. Classical India		**6**:319h–320c	
iv. Influences of Indian education in Asia		**6**:320c–d	
b. Ancient Chinese education		**6**:320d–322b	**15**:643f–g
i. The Chou period: feudalism and development of the classics		**6**:320g–321c	
ii. The Ch'in–Han period: schools of philosophical and educational thought		**6**:321d–322b	
c. Ancient Hebrew education		**6**:322b–f	**10**:229d–h / **10**:316h–317b / **15**:644b–g
d. Ancient Greek education		**6**:322f–326h / **8**:1170h–1172g	**6**:914g–915a / **10**:1092h–1093c / **10**:1098b–c
i. Minoan and Mycenaean education		**6**:322f–323a	
ii. Spartan education		**6**:323a–e	
iii. Athenian culture and education: the influence of the Sophists, Plato, Isocrates, and Aristotle		**6**:323e–324h / **17**:11b–f	**14**:532c–d
iv. Hellenistic education: the spread of Greek culture to the Near East and Central Asia		**6**:324h–326h	
e. Ancient Roman education		**6**:326h–329e / **8**:1172g–1173c	**8**:1180a
i. Early Roman education		**6**:326h–327d	
ii. Roman adoption of Hellenistic education		**6**:327d–328h	
iii. Education in the later Roman Empire		**6**:328h–329e	
3. Education in the Persian, Byzantine, early Russian and Islāmic civilizations		**6**:329f–333e	
a. Ancient Persian education: influences of Zoroastrian and Sāsānid cultures		**6**:329f–330b	**15**:644h–645a
b. Byzantine education: influences of Greek Christian and humanistic culture; development of primary, secondary, higher educational institutions		**6**:330b–331a	
c. Kiev and Muscovy: Russian education to the period of the early Romanovs		**6**:331b–332a	
d. Islāmic education		**6**:332a–333e / **3**:1085e–g / **9**:921h–922e	**15**:645g–646b
i. Aims and purposes of Muslim education		**6**:332c–d	
ii. Muslim schools and universities		**6**:332d–333c	
iii. Major periods of Muslim education and learning		**6**:333c–e	
iv. Influences of Muslim learning on medieval and modern Europe		**6**:333e	
4. Education in the European Middle Ages		**6**:333f–339d / **15**:801b–c	**4**:515a–c / **12**:163f–164a
a. Christian education to the 8th century: early schools; development of monastic schools in England, Ireland, Italy, and Spain		**6**:333f–334g / **8**:1174a–f	**15**:645a–c
b. The Carolingian renaissance and its aftermath		**6**:334h–335h / **1**:1018g–h	**8**:1174g–1175b

	articles	article sections	other references
i. The cultural revival under Charlemagne and his successors		**6**:334h–335c	**4**:46b–c
ii. Influences of the Carolingian renaissance in other countries		**6**:335d–f	
iii. Education of the laity in the 9th and 10th centuries		**6**:335f–h	
c. The 12th-century renaissance		**6**:335h–339d / **3**:1085g–1086b	**8**:1175b–f / **16**:355b–e
i. Reform of monastic schools and rise of secular urban schools		**6**:335h–336g	
ii. Development of universities		**6**:336g–338h	
iii. Development of grammar schools and courtly education		**6**:338h–339d	
5. Education in Asian civilizations from *c.* 700 to the eve of Western influence		**6**:339d–343c	
a. Indian education from *c.* 700 to 1707		**6**:339d–340c	
i. Foundations of Muslim education		**6**:339e–g	
ii. Muslim and Hindu education in the Mughal period		**6**:339g–340c	
b. Chinese education from 618 to 1911		**6**:340c–342b	**4**:323d–f
i. T'ang dynasty: cultural florescence and the shaping of the examination system		**6**:340c–h	
ii. Sung dynasty: reform and expansion of curricula		**6**:340h–341c	
iii. Mongol, Ming, and Manchu periods: growth of anti-foreign feeling and intellectual conservatism		**6**:341c–342b	
c. Japanese education from ancient times to 1867		**6**:342–343c	**15**:643g–644a
i. Chinese and Buddhist influences to the 12th century		**6**:342c–e	
ii. The feudal period: samurai and temple education		**6**:342e–343c	
6. European education during the Renaissance and Reformation		**6**:343c–348d	**1**:1018h–1019a / **15**:645d–e
a. Development of Renaissance education: Arabic and secular influences on Humanism		**6**:343c–g / **8**:1175f–1177c	**14**:262d–263a
b. The Humanistic tradition in Italy		**6**:343h–344g	
i. Humanistic academies and boarding schools		**6**:343h–344e	
ii. Nonscholastic education: family and courtly education		**6**:344f–g	
c. The humanistic tradition in northern and western Europe		**6**:344h–345h	
i. The influence of the Dutch Humanists: Brethren of the Common Life; Desiderius Erasmus		**6**:345a–d	
ii. The influence of Juan Luis Vives: the social functions of education		**6**:345d–f	
iii. The influence of early English Humanists: John Colet and Thomas More		**6**:345f–h	
d. Education in the Reformation and Counter-Reformation		**6**:345h–348d	
i. The German Reformation and the educational systems developed by Martin Luther, Philipp Melanchthon, Johannes Sturm, and Valentin Friedland (Trotzendorf)		**6**:346b–f	
ii. Developments during the English Reformation: the influence of Sir Thomas Elyot, Roger Ascham, Richard Mulcaster, and Sir Francis Bacon		**6**:346f–347b	
iii. Developments during the French Reformation: the influence of François Rabelais, Petrus Ramus, and Michel de Montaigne		**6**:347c–g	
iv. The Calvinist Reformation and John Calvin's influence on higher education		**6**:347g–348a	
v. The Roman Catholic Counter-Reformation: the development of Jesuit colleges		**6**:348a–d	
7. European education in the 17th and 18th centuries		**6**:348d–359b / **1**:1019d–h	
a. The social and historical setting		**6**:348d–349b	
i. The new scientism and rationalism		**6**:348g–h	
ii. The Protestant demand for universal elementary education		**6**:348h–349b	

	articles	article sections	other references
b. Education in 17th-century Europe		**6**:349b–352a	
i. Central European educational theorists: Wolfgang Ratke, John Amos Comenius, and Andreas Reyher		**6**:349b–350c	**4**:968b–h
ii. French educational theorists and practitioners: the Jesuits, Oratorians, and Jansenist teaching orders; the influence of Fénelon		**6**:350d–351c	
iii. English educational theories and practices: the influence of the Puritans and Royalists		**6**:351c–g	
iv. The growth of the academies		**6**:351g–352a	
c. Education in 18th-century Europe		**6**:352a–356a / **8**:1177c–1178h	**13**:1100c–f / **18**:4f–g
i. The ideas and schools of the Enlightenment		**6**:352a–f	
ii. The influence of Pietism: August Hermann Francke and Johann Julius Hecker		**6**:352g–353g	
iii. The influence of naturalism: Jean-Jacques Rousseau, Étienne Bonnot de Condillac, Claude-Adrien Helvétius, and Johann Bernhard Basedow		**6**:353g–354g	
iv. The influence of nationalism: government control of education		**6**:354h–356a	
d. European influences in New World educational development		**6**:356a–359b	
i. Spanish and Portuguese America: colonial elitist and Roman Catholic education		**6**:356a–e	
ii. Colonial French America: the Jesuit educational system in Quebec		**6**:356f–357b	
iii. Colonial British America: religious and secular education		**6**:357b–359b	
8. Western education in the 19th century		**6**:359b–371g / **18**:4g–6g	**1**:98d–h / **13**:801d–e / **16**:373d–g
a. The social and historical setting: nationalism, industrialism, urbanization, political revolution and reform		**6**:359b–e	
b. The early reform movements: the new pedagogy and psychology		**6**:359e–362f	**14**:990f–991d / **18**:5f–6a
i. Pestalozzianism: the pedagogy of Johann Heinrich Pestalozzi		**6**:359f–360e	**14**:138e–g
ii. Friedrich Froebel and the kindergarten movement		**6**:360e–361d	**7**:745g–746d
iii. Herbartianism: the psychology and pedagogy of Johann Friedrich Herbart		**6**:361d–h	
iv. Other German and French theorists: Johann Gottlieb Fichte, Friedrich Schleiermacher, Wilhelm von Humboldt, Jean-Joseph Jacotot, and Édouard Séguin		**6**:361h–362f	
c. Development of national systems of education; *e.g.*, in Germany, France, England, Russia, the United States, the British dominions		**6**:362g–368h	**4**:515c–d / **11**:455c–e
d. Spread of Western educational practices to Asian countries; *e.g.*, to India, to Japan		**6**:368h–371g	
9. Education in the 20th century		**6**:371g–405g / **1**:1019h–1021e / **6**:429h–430g / **6**:699a–700e / **18**:16c–d	**18**:15b–d
a. Political, social, economic, and intellectual trends		**6**:371g–373a / **8**:865f–867d / **13**:1100g–1101g	**6**:699c–d / **18**:6f–h
b. Traditional educational movements		**6**:373a–f / **8**:1182b–g	
i. Essentialist education: the influence of William Chandler Bagley		**6**:373a–c	
ii. Humanistic or liberal education: the influence of Robert M. Hutchins and Mortimer J. Adler		**6**:373c–e	
iii. Religious and classical education		**6**:373e–f / **15**:646c–g	
c. Experimental educational movements		**6**:373g–376e	**18**:6c–f

	articles	article sections	other references
i. Child-centred education: the influence of Francis W. Parker, Maria Montessori, and Ovide Decroly		**6**:373g–374c	
ii. Pragmatist and progressive education: the influence of Cecil Reddie and John Dewey		**6**:374c–375a	**5**:681b–682d
iii. Scientific-realist education: the influence of Édouard Claparède, Jean Piaget, and Alfred North Whitehead		**6**:375a–f	
iv. Social-reconstructionist education; *e.g.*, educational systems of the Soviet Union, Nazi Germany, Israeli kibbutzim		**6**:375f–376e	
d. Western patterns of education; *e.g.*, in the United Kingdom, Germany, France, Italy, The Netherlands, Switzerland, the U.S., Canada, Australia, New Zealand		**6**:376f–385f / **1**:1020c–1021d	**1**:98h–99h
e. Revolutionary patterns of education		**6**:385f–390e	**1**:99e–f / **14**:635b–d / **18**:838c–d
i. Russian educational development from 1905: modernization under the later Russian Empire and under Communism		**6**:385f–387e	
ii. Chinese educational development from *c.* 1850: modernization under the later Manchus, under the republic, under the nationalist government, and under Communism		**6**:387f–390e	**4**:368d–f
f. The modernization of education in Asia and Africa		**6**:390e–395h / **1**:1021d–e	
i. Pre- and post-World War II patterns of education in Japan		**6**:390e–392g	
ii. Pre- and post-independence patterns of education in India		**6**:392g–394f	
iii. Development of educational apartheid in South Africa		**6**:394g–395h	
g. Education in colonies and newly emerging nations in Africa, Asia, and Latin America		**6**:395h–405g	
i. Patterns of African education		**6**:395h–399a	**19**:783c–f
ii. Patterns of education in the Arab world and in Israel		**6**:399b–401b	**1**:570a–c / **6**:456g–457b / **9**:1065h–1066b
iii. Patterns of education in Latin America		**6**:401b–403c	**4**:259b–e / **12**:88d–f
iv. Patterns of education in Southeast Asia		**6**:403c–405g	**9**:473g–474b / **14**:242h–243a
C. International educational activities	INTERNATIONAL EDUCATIONAL RELATIONS **9**:736–741		
1. The nature of international educational relations: historical background; international educational activities		**9**:736f–738d	
2. Recent developments in international educational relations *with special attention to*		**9**:738d–741g	**1**:1023a–b
a. Activities of international educational agencies		**9**:738d–740h	**1**:101a–b / **18**:902c–f
b. Teacher and student exchanges		**9**:740h–741g	**6**:429h–430a

Section 563. The organization of education
[for Part Five headnote see page 283
for Division VI headnote see page 371]

The articles and parts of articles referred to in Section 563 deal with four main subjects: A, the phases or levels of education; B, the preparation and performance of teachers; C, the economics of education; and D, the social aspects of education.

The outline of subject A first covers the historical development, current influencing factors, and major patterns of education at each of the phases or levels of education—preschool, elementary and secondary, and higher education. It goes on to the education of exceptional children, treating the children who are classed as exceptional, the patterns of special education, and the problems of personal adjustment of gifted and mentally or physically handicapped children. It next deals with the historical background of modern adult education; the agencies and institutions involved in it; and the types of adult education. Finally, it deals with vocational training—apprenticeship and employee training.

The outline of subject B begins with the education of teachers, treating pre-service education, certification and appointment, and in-service education. It goes on to deal with the teaching profession. Here it treats the economic and social status of teachers; their functions and roles—for example, as scholar or as parent substitute; the development of professionalism in teaching; and the development of educational associations and teachers' unions.

Subject C is the economics of education. It begins with eco-

nomic analyses of the relationship between investment in education and economic returns to the student and the community. It goes on to the increasing demand for educational services and to the problems of supplying that demand. It next deals with the economic planning of education, treating various approaches to the determination of educational expenditures and to the determination of fees and revenue collection. Finally, it treats economic influences on the balance between different forms of education in developed and developing countries.

Subject D is the social aspects of education. The outline first deals with different conceptions of the social functions of education. It goes on to social, ethnic, political, and economic factors that affect schools in different locales. It next deals with internal factors affecting school practices—teacher–administrator relationships, parent–teacher and teacher–student relationships, and student peer-group relationships. Dealing with the state's interest in education, the outline treats education as a means of inculcating national values and as a means of training government personnel and providing advisers and consultants to those possessing political power. Finally, the outline treats the freedom of the university teacher to choose educational materials and courses of study, and his freedom of critical dissent.

	articles	article sections	other references
A. Phases or levels of education			
1. Preschool education	PRESCHOOL EDUCATION **14**:989–992		
a. The concept of early education: its origin and development		**14**:990b–991h / **6**:360e–361c	**6**:430c–d
b. Modern views of the aims and methods of early education: psychological theories; new areas of concern—*e.g.*, language development, nutrition		**14**:991h–992f	**6**:373h–375f
2. Elementary and secondary education	ELEMENTARY AND SECONDARY EDUCATION **6**:693–700		
a. Historical development of elementary and secondary education [see 562.B.]			
b. Major patterns of elementary and secondary education *with special attention to*		**6**:694c–696a	
i. France		**6**:694e–f	**6**:354h–355b / **6**:379h–380c / **7**:607d–e
ii. The Federal Republic of Germany		**6**:694f–695a	**6**:379d–f / **8**:64b–c
iii. England		**6**:695a–d / **6**:376f–378f	**6**:355f–356a / **18**:887h–888a
iv. The U.S.S.R.		**6**:695d–g	**6**:355c–f / **6**:387c–e
v. The United States		**6**:695g–696a	**6**:381c–g
c. Factors affecting contemporary elementary and secondary education		**6**:696a–697b	
i. Technological change		**6**:696b–e / **3**:313e–314b	**6**:312c–d / **6**:315d–f / **6**:430a–b / **13**:1102e–1103c *passim* / **18**:122b–c
ii. Population growth		**6**:696e–f	
iii. Concern for equality of educational opportunity		**6**:696g–h / **6**:409b–d / **19**:912h–913g	**6**:315b–d
iv. Long-range educational planning		**6**:696h–697b	
d. Educational objectives, curricula, and methodology		**6**:697c–699a / **6**:411g–412g / **13**:1098g–1099g	**6**:359g–362f *passim*
e. Current and emerging trends		**6**:699a–700e / **6**:372b–e / **6**:429h–430g	**13**:1101g–1102e *passim*
3. Higher education: colleges, universities, and professional schools	HIGHER EDUCATION **8**:857–867	**10**:776h–777b	**4**:515e–h
a. Major models of higher education *with special attention to*		**8**:857f–863c	**16**:355b–e
i. France		**8**:857g–858e / **8**:861h–862c	**7**:607e–f
ii. Germany		**8**:858e–859b / **8**:862c–d	**8**:64d–f
iii. England		**8**:859c–860d / **8**:862e–h	**18**:888b–c
iv. The United States		**8**:860d–861b / **8**:862h–863a	**6**:382e–383a / **13**:26g–27a / **18**:930d–f
v. The U.S.S.R.		**8**:861b–h / **8**:863a–b	

	articles	article sections	other references
b. Curricula in higher education; admission requirements; subject patterns; teaching methods; examinations		**8**:863d–864b / **10**:774b–777b	**18**:13d–f / **18**:235d–e
c. Social and administrative patterns of higher education: governmental and internal relations		**8**:864c–865b / **6**:415e–g / **8**:1178h–1179b	**4**:259b–d
d. Research and postgraduate studies		**8**:865b–f	
e. Recent trends		**8**:865f–867d / **10**:777b–c	**9**:517d–518f
4. Special education: education of exceptional children	EDUCATION OF THE EXCEPTIONAL **6**:431–434		
a. Children classed as exceptional: the gifted, the mentally retarded, the physically handicapped, and the socially and emotionally disturbed		**6**:431c–432d	**6**:381g–382a / **9**:673d–g / **9**:675c–e
b. Patterns of special education		**6**:432d–434a	
i. Historical development of special education		**6**:432d–g / **3**:110f–g	**3**:111b–c / **6**:362e–f
ii. Modern patterns of organizing special educational programs		**6**:432h–434a / **11**:912f–914a	**9**:674g–675a / **13**:1101h–1102e *passim*
c. Problems of personal adjustment of the exceptional child		**6**:434a–e	**9**:674h–675b / **9**:676a–c
5. Education of the adult population	ADULT EDUCATION **1**:97–101		
a. Historical background of modern adult education		**1**:98c–99h	
b. Agencies and institutions involved in adult education		**1**:99h–100h / **3**:313e–314b	**16**:926h
c. Types of adult education		**1**:97g–98b	**6**:315f–h
6. Vocational training: apprenticeship and employee training	APPRENTICESHIP AND EMPLOYEE TRAINING **1**:1018–1023	**19**:395d–h	
B. The preparation and performance of teachers			
1. The education of teachers	TEACHER EDUCATION **18**:4–9		
a. Historical development of teacher education		**18**:4e–7d	
b. Pre-service education of teachers		**18**:7d–8f	
i. General education		**18**:7f–8a	
ii. Study of educational principles		**18**:8b–c	
iii. Practical training: "practice teaching"		**18**:8d–f	
c. Certification, appointment, and probation of teachers: the diversity of requirements and procedures		**18**:8f–h	
d. In-service education of teachers		**18**:8h–9d	
2. The teaching profession	TEACHING PROFESSION **18**:9–16		
a. The economic and social status of teachers: salaries; geographical mobility; the teacher "stereotype"		**18**:10a–12g	
b. Functions and roles of teachers		**18**:12g–14g / **6**:416f–h	**13**:1098c–e / **13**:1099b–g *passim*
i. Roles as curriculum designer, educational consultant, and scholar		**18**:13a–g / **18**:14e–g	
ii. Role of parental substitute: the doctrine of *in loco parentis*		**18**:13g–14b	
c. The teacher as a professional		**18**:14g–16b	
i. Development of professionalism in teaching		**18**:14g–15d / **6**:415e–g	**18**:7d–9d *passim*
ii. Educational associations and teachers' unions		**18**:15d–16b	
C. The economics of education	EDUCATION, ECONOMICS OF **6**:310–316		
1. The relationship between investment in education and economic returns to the student and the community		**6**:310h–311g / **10**:563e–g	

	articles	article sections	other references
2. The increasing demand for educational services; problems of supplying these services		**6**:311h–312g	**18**:10c–d
3. Economic planning of education		**6**:312h–315a	
a. Various approaches to the determination of educational expenditure		**6**:312h–314d	
b. Various approaches to the determination of fees and revenue collection		**6**:314d–315a	
4. The balance between different forms of education		**6**:315b–316c	
a. In developed countries		**6**:315b–f	
b. In developing countries		**6**:315f–316c	**6**:205b–f
D. Social aspects of education	EDUCATION, SOCIAL ASPECTS OF **6**:413–416		
1. Social functions of education		**6**:413b–414d/ **13**:1098g–1099b/ **19**:1094b–d	**2**:119h–120c/**18**:258a–b
a. Transmission of culture		**6**:413b–c/ **6**:413d–f	**6**:316d–f/**13**:1099a–b
b. Transmission of skills; preparation for working		**6**:413c–d/ **6**:413f–414a	
c. Caretaking of youth; promotion of peer-group relations		**6**:414a–d	**6**:376b–e
2. Social, ethnic, political, and economic environmental factors affecting schools in various locales		**6**:414e–415e/ **6**:315b–316c/ **6**:417g–418f/ **6**:696a–697b	**6**:311h–312g
a. The village school		**6**:414e–g	
b. The town school		**6**:414g–h	
c. The suburban school		**6**:415a–c	**18**:168f–g
d. The depressed-neighbourhood school		**6**:415c–e	
3. Organization and social factors affecting school practices		**6**:415e–416h/ **13**:1101g–1102e/ **18**:12g–14g	
a. School organization and teacher–administration relationships		**6**:415e–416b	
b. Parent–teacher and student–teacher relationships		**6**:416b–c/ **6**:416f–h	**6**:411h–412a/**13**:1102b–d/ **18**:13g–14b
c. Student peer-group relationships		**6**:416d–f	
4. Education as a means of inculcating national values through indoctrination and the use of propaganda		**6**:413d–f/ **6**:354h–356a/ **6**:418c–d/ **15**:36g–h	**6**:359c–e/**8**:866g–867a/ **14**:723h–724a
5. Education in the service of the state: training of government personnel; the teacher as government adviser and consultant		**1**:1022d–1023e/ **2**:15g–17e/ **8**:865b–d/ **18**:14c–g	**6**:315h–316c/**16**:988d–f
6. The freedom of the university teacher to choose educational materials and courses of study: freedom of critical dissent		**8**:864c–d	**3**:1085h–1086b/**6**:418c–d/ **18**:13d–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ARISTOTLE **1**:1162
COMENIUS, JOHN AMOS **4**:967
DEWEY, JOHN **5**:680
FROEBEL, FRIEDRICH **7**:745
ISOCRATES **9**:1031
MANN, HORACE **11**:454
PESTALOZZI, JOHANN HEINRICH **14**:138
PLATO **14**:531
QUINTILIAN **15**:341

Introduction to Part Six:

The world of art

by Mark Van Doren

Let us imagine if we can a world entirely without art: without story, image, edifice, or significant sound. If we can, for perhaps it is impossible. Such a world might well be invisible, inaudible, ineffable, and intangible. Even if we could see it, hear it, feel it, we would not know we did, at least as men know things. Without the earliest of all arts, language, we would scarcely know of what we were deprived: the privilege, namely, of expressing our satisfaction or dissatisfaction with what had taken place before our eyes. Without the arts of speaking, listening, thinking, counting, and measuring—without the intellectual arts—we could not assess or repossess the experience we had undergone. Without the useful arts we could make nothing, build nothing worthy to contain and shelter our bodies, to be a home wherein our thought might rest. And then without the fine arts—the arts that serve only themselves, that are ends, not means, that justify themselves when they give us nothing but pleasure—we would be shallow and poor of mind, with little or no sense of the world's depth and colour, or of ourselves as creatures for whom the present moment is also past and future. We call these arts fine not because they are better than the others but because they are different, as beauty is different from use—beauty that is its own excuse for being.

None of them is more intimately ours than story. The art of literature is the art of story; there are songs and there are essays long and short, there are histories, there are biographies, there are treatises, sermons, and discussions of everything under the sun, but story is our first and last entertainment—when we are children and when we are too old to care any more what truth is unless it comes in the past tense, with persons reflecting in their lives the peculiar radiance that attends the accidents of time and character. Stories may vary in length from the anecdote to the epic, from the fairy tale to the novel, the imaginary biography, the romance. And they may reach us in many forms: in the theatre, for instance, where they may employ flesh-and-blood actors to convey their meaning or where they may be only flickers of light and shade upon a screen that has no depth save what we give it in our imaginations; where, in other words, they call themselves plays or motion pictures, or where, if music also sounds and dancers whirl and pose, they call themselves ballets.

Nature does not tell stories; only artists do, and in the process they work transformations that measure the distance between matter and mind. In nature, so far as we can know it, there are no beginnings and no ends in the sense familiar to both writers and readers of fiction and drama, or for that matter history, which likewise imposes form upon a welter of events. No matter how simple a tale is, or how complex, how few the words in it or how many, it is a human construction that no animal or plant, and of course no stone, would find in the least degree interesting; whereas human beings hold their breaths until an end is reached. Ends are intelligible as the raw materials of life seem not to be; if life itself does not become intelligible through story, it becomes in some mysterious way both beautiful and clear, and for the time being that suffices.

Each of the fine arts flourishes both in large and in little forms. Just as story has a choice between the brevity of folk tales and the elaboration of epics and romances, so statements about life may be as compendious as a proverb—the wisdom of many and the wit of one—or as bulky as the longest book in numberless volumes. So music—the sound of other worlds—reaches our ears either as simple song or as opera and symphony and other complex forms. There are those who say that the song, like the anonymous fable or tale, is more lasting and important than compositions of great complexity can ever be; and they also say that the lyric poem, at least when it is perfect, as in truth it seldom is, has more to tell us, or at least deeper ways of touching us, than the most tremendous tragedy in five acts or the subtlest comic novel in a thousand pages. When a memorable melody attaches itself to a lyric or a ballad, something indeed does come into existence and hang there as if for perpetuity. Music is the most ineffable of all the arts. It has its own language and it listens to itself; we do not so much hear it as overhear it, nor can we speak very sensibly about what we have overheard. Successful music, powerful music, has an effect upon us that many have tried in vain to describe; it takes us out of ourselves, they say, and perhaps they need to say no more than that. Even then they may be speaking only of the music that is native to them; Eastern music sounds like mere noise to untrained Western ears, and Western music has a monotony, say the Chinese, that Europeans of course deny is there. The same thing is true, though in lesser measure, of all the arts. East and West have different eyes as well as ears, and different thoughts.

The arts of drawing and painting, of etching and lithography, of engraving and decorative design, have covered many surfaces—canvas, plaster, parchment, paper—which no longer show where the artist's hand once worked; for the materials of these arts are perishable, as the marble of sculptors has been, as the bronze, as the wood. Much remains, but more does not. Even the cave paintings of prehistoric France and Africa, hailed by modern man when he discovered them as miracles of survival, may not survive the visits that living people rushed to pay them. Ancient Greek music has failed to survive for a further reason: we do not know how it was written or how it sounded; we are told that it had almost magical powers over those who heard it in its time, but that time is gone, along with the time when paintings adorned the walls and columns of Greek temples and houses. Painting has been for centuries the queen of the arts in Europe. Belgium, the Netherlands, France, Germany, Spain, Italy, and England—each of them in its turn, and sometimes in more than one turn, has enriched the world with shapes and colours that only genius could have foretold, only passion could have brought into being. And that is but half the story; in China long before, in India, in Persia, in Japan, in Russia, the brushes of painters, sometimes tipped with gold, beautified and glorified the palaces of emperors, the tombs of princes, and the dwelling places of great gods. In Egypt for millennia the order of the world was registered in stone and gold, and the written word itself was pictures.

Sculpture, that once was solid and now is full of spaces—or may be—left open by the ingenuity of workers in metal, has changed as architecture has changed. Both arts now cultivate openness: buildings are closed, but the exterior is glass, so that space plays games with itself inside, and the effect

is of a lightness that winds might blow away, except of course that the buildings look lean and strong enough to remain just where they are. It has always been true that architects desired the effect of lightness, as all art does, heaviness being a quality that no mind admires; any building weighs tons, but we are not supposed to think of that; rather indeed we are expected to imagine that brick and stone for once have learned to lie lightly on the earth, which they do not seem to press at all. So with Classical sculpture, from Greek days on; the charm of it was its poise, its grace, its management of idea in marble. So too with Classical architecture; the Parthenon is both massive and weightless, like a ship that might sail yet does not. And always in China and Japan there have been those curled and tapered roofs that still look as if at this very instant in time they are taking wing. The open revolution, then, was only a restatement of what had long been understood though some of its secrets were forgotten.

Abstraction in all the arts, for there is no art from which it is absent, is again a restatement of what has always been true, however feebly it was recognized by schools of artists who had lost contact with reality. Great painting, great music, great poetry, great architecture—great landscape architecture too—have never been strangers to abstraction, just as they have never been slaves to an incomplete understanding of what is meant when we say that art is imitation. It *is* imitation, but of what? Of essences, not accidents; of the truth that is hard to see; of beauty that is basic; of shapes that will not change; of colours that will not fade. And if, say, the great painters of the past, comprehending this, still "copied nature," they did not do so inanely. They did so, on the contrary, with huge effort aimed at the verities that underlie verisimilitude, so that in one sense they were not copying at all; they were extracting essences, they were reducing appearances to the ideas that informed them; they were, in a word, abstracting truth from vessels that contained it. But they did not say they were doing this. They said they were copying nature. And when later on they were taken at their word by painters with inadequate aspiration, the result was woeful insipidity, was mediocrity and flatness. The heroic remedy was warfare against representation as such, was a shortcut to abstraction that could have its weakness too, was a loss, in all but the great revolutionaries, of that contact with Earth which no art ever can be without. Abstract painting at its best—and the worst does not matter—imitates nature at nature's best; is "like" nature after all, for nature is brilliant and strong, and abstract painting convinces us of this even though it dispenses with the particulars with which we used to be fascinated and of which we were quite properly fond.

A world entirely without art would be worse than invisible, inaudible, ineffable, and intangible. It would be a world without temporal dimension, it would be a world that human minds could not remember. Human memory is unique in its capacity not only to recall but also to utilize the past, and to apply it; and better still, to re-create it so that it becomes a part of the present moment, which is more like eternity than anything else we shall ever experience. Human memory is nothing less than the origin of human art.

"The Greeks fabled not unwisely," said Sir Thomas Browne, "in making Memory the mother of the Muses." The memory of man is indeed a wonderful thing, and his richest possession. Not only is it the source of all our arts, it is their record too, stored in the mind of the beholder, the listener. Plato even asked us to conceive "in the mind of man a block of wax, the gift of Memory, and when we wish to remember anything which we have seen, or heard, or thought in our own minds, we hold the wax to the perceptions and thoughts, and in that material receive the impression of them as from the seal of a ring; and we remember and know what is imprinted as long as the image lasts." An artist whose poems or pictures or musical ideas have great power is certainly, we feel, the possessor of a memory that is always at his command, bringing to him at any moment whatever detail he needs, and reminding him too of the knowledge he has, and never forgets, of the way the world is put together, so that he does not misrepresent things as they are. The human race itself can be said to be such an artist, for it has its myths which it keeps alive, its stories that are "so true," someone has said, "that they couldn't have happened." There is such a thing as folk memory, the mother perhaps of all our thoughts and feelings, and the guardian of such wisdom as we have.

A story that cannot be remembered, a song that fades out of the mind, a hero whose name escapes us, a sentence we thought we would never forget but somehow do—such works of art must be defective at the core. But there are others that we could not forget if we tried, and it is those we live with in the company of friends who remember them too. Perhaps the final justification of art is the two-fold pleasure it gives: the pleasure of remembering great and beautiful things that we cannot lose, and the pleasure of sharing them with others who possess them in the same fashion.

There is a limited number of such things, of these greatest of human works of art; by definition there can be no superfluous masterpieces. The ones we have are numerous after all, and no single person can claim to have done justice to every one of them, or can claim to know what further ones are still unborn. Mnemosyne, goddess of Memory and Mother of the Muses, will have the deciding vote as to which ones, now or in the future, will survive the ravages of time.

Part Six. Art

The outlines, and the articles and parts of articles referred to, in the twelve sections of Part Six are concerned with man's creation, experience, and evaluation of works made primarily for aesthetic enjoyment and contemplation. The arts of making things primarily for practical use are treated in Part Seven, on technology.

The articles referred to in the three sections of Division I treat theories about the nature and classification of works of art; the apprehension, interpretation, appreciation, and criticism of works of art; and the nonaesthetic contexts of art—that is, the interaction of the arts with the major institutions of society. Many aspects of aesthetics are involved in the treatment of such subjects; the philosophical discipline of aesthetics, as itself an object of study, is dealt with in Section 10/51 of Part Ten.

The articles referred to in the nine sections of Division II present analytical and historical studies of the particular arts—literature; theatre; motion pictures; music; dance; architecture, garden and landscape design, and urban design; sculpture; drawing, painting, printmaking, and photography; and the arts of decoration and functional design.

Division I. Art in general 383
II. Particular arts 393

Division I. Art in general

The outlines, and the articles and parts of articles referred to, in the three sections of Division I treat the theory and classification of the arts; the experience and criticism of works of art; and nonaesthetic contexts of art.

The first articles referred to in Section 611 treat diverse theories concerning the definition of art and the nature, functions, and effects of works of art, and diverse theories concerning the creation of works of art. The treatment of classification involves such classifications of the kinds of art as those by reference to the intention of the maker or the recipient, to the media used, or to the use and need of performers, or interpreters. The articles referred to at the end of Section 611 treat two ways of characterizing and grouping works of art—by reference to the cultural or social circumstances of their production or the extent and character of their audience; and by reference to criteria of style.

The first articles referred to in Section 612 deal with the experience of works of art, differentiating the factors that affect apprehension, interpretation, and appreciation. The next subject treated is the diverse criteria for the evaluation of works of art, and diverse conceptions of the purposes and methods of criticism. The last subject is scholarship concerning the arts and its relation to other humanistic disciplines.

The first articles referred to in Section 613 treat sociological conceptions, social uses, and social control of art; the relation of the arts to religion and to science and technology; and the place of the arts in education. Further subjects treated are the economics of art, the training and work of the artist, and the preservation and dissemination of works of art.

Section 611. Theory and classification of the arts 383
612. Experience and criticism of works of art 386
613. Nonaesthetic contexts of art 389

Section 611. Theory and classification of the arts

The articles and parts of articles referred to in Section 611 deal with two main subjects: A, general theories and conceptions of art; and B, classification of the arts.

The outline of subject A begins with problems about the definition of art and with diverse conceptions about its scope. It goes on to treat diverse theories concerning the nature, functions, and effects of art, covering mimetic, expressive, and formalist theories of art and pragmatic theories that view art in terms of its effects on its audience or in terms of its being a means to various human ends. Finally, the outline treats theories of the motivation for the production of works of art and theories about factors that are influential in the creative process.

Subject B is the various ways of classifying the kinds of art or of characterizing and grouping particular works of art. The out-

line first deals with the classification of the kinds of art into useful art, fine art intended for enjoyment as an end in itself, and arts that are both useful and fine. It then deals with other ways of classifying kinds of art: by reference to physical differences in the artistic media and in the modes of existence of the work of art; by reference to differing relations to performance and interpretation; by reference to different uses of notational devices; by reference to differing spatial and temporal existence of the works of art; and by reference to the cultural circumstances of their production and to the extent and character of their audience. The outline next deals with the characterization and grouping of works of art by reference to criteria of style. It first treats issues concerning the legitimacy of stylistic criteria and diverse historical and contemporary conceptions of the nature and principal aspects of style in the arts. After covering twelve varieties of style, the outline deals with the dynamics of style, treating diverse theories of the origin, diffusion, change, and duration of styles.

articles	article sections	other references
ART, PHILOSOPHY OF **2**:40–56		
A. General theories and conceptions of art		
1. Attempts to define art: diverse conceptions of the scope of art	**2**:40g–41e / **1**:232g–233g / **2**:81f–82c / **2**:103b–f / **13**:448g–449b	
a. The inclusive conception of art: art defined as all forms of human skill and their products, all man-made objects without regard to their aesthetic value or function		**8**:1180a / **19**:284f–g / **19**:480d–f
b. The aesthetic conception of art: art defined as only those processes and products of human activity that can be distinguished wholly or in part by their aesthetic function	**2**:40h–41b / **1**:108d–e	
c. Other uses of the term art; *e.g.*, "art" used normatively to include only those works considered good art, "art" used popularly to include only the visual arts	**2**:41b–c	
2. Diverse theories concerning the nature, functions, and effects of art	**2**:44f–56d / **2**:103f–104b / **4**:958h–961g	**2**:85e–f / **2**:86d–f / **2**:125a–d / **7**:78c–d / **10**:1038b–1041d *passim*
a. Mimetic theories of art: art viewed as an imitation or representation of nature	**2**:44f–47e	**1**:156b–e / **10**:1038b–e / **12**:663b–d
b. Expressive theories of art: art viewed as a representation or manifestation of the inner state of the artist	**2**:47e–49g / **10**:1039d–f	**1**:156h–157d / **10**:1042c–e
c. Formalist theories of art: the work of art viewed as an organic unity; *i.e.*, a self-contained, self-justifying entity	**2**:49h–51c / **1**:155f–156a / **10**:1039h–1040g	
d. Pragmatic theories of art: art viewed in terms of its effects on its audience; *i.e.*, as a means to various ends	**2**:51d–56d / **2**:104b–f	
i. As a means to the enhancement of experience and thought	**2**:51h–53e / **2**:119c–e	
ii. As a means of escape from, or consolation for, reality	**13**:281b–d	
iii. As a means of perceiving a higher, more perfect, or ideal reality		**1**:156b–e
iv. As a source of pleasure or delight	**2**:51d–h	**1**:150h–152c
v. As a means of promoting cultural and historical community or continuity	**2**:97b–c	**2**:104b–e
vi. As instructive, didactic, or propagandistic	**2**:53e–56d / **2**:118h–119a / **13**:281d–282a / **15**:37e–38d	
vii. As therapeutic; *i.e.*, as healing or purgative	**1**:152d–f / **2**:55g–h / **2**:119a–c	
viii. As a means of communication		**4**:1008g–h / **15**:798f–802d *passim*
3. The making of works of art: theories of human motivation in producing works of art; the creative process	**2**:47f–49a / **2**:105b–e / **2**:128c–129a / **14**:602b–603g	**7**:78c–d / **8**:973e–f / **12**:719c–e
a. Psychological factors in artistic creativity; *e.g.*, imagination, memory, the unconscious	**10**:652h–654c / **18**:356f–357a	
b. The effects of materials and techniques on creativity	**2**:133a–b / **13**:875e–876g	
c. The therapeutic nature of the creative process		**2**:48a–b / **8**:980g–h

	articles	article sections	other references
B. Various ways of classifying the kinds of art or of characterizing and grouping particular works of art	ARTS, CLASSIFICATION OF THE **2**:81–85		**19**:246a–c
1. The philosophical, psychological, and aesthetic problems involved in classifying kinds of art		**2**:84e–85a / **2**:123f–127g	
2. Major distinctions among the kinds of art			**2**:43b–h
a. By reference to the intention of the maker or the recipient of the work of art		**2**:81b–82c	**2**:40h–41e
i. Useful art: the sphere of human productions intended for use as means or implements to be employed for some end; *e.g.*, ships, swords		**7**:471c–e	
ii. Fine art: the sphere of human productions intended for enjoyment as objects that serve as ends in themselves; *e.g.*, poems, sonatas		**2**:81f–g	
iii. Arts that are both useful and fine; *e.g.*, architecture, photography		**1**:1111b–1112a / **14**:306d–307b / **14**:324g–326f	
b. By reference to the manipulation of physical matter: the production of artistic works that are physical objects		**2**:82h–83b	
c. By reference to performers as interpreters or creators of works of art		**2**:83b–f	
d. By reference to the use of notational devices; *e.g.*, literature, music, dance		**2**:83f–84a	
3. Other distinctions among the kinds of art; *e.g.*, space and time arts, primary and auxiliary arts		**2**:83c–d / **2**:82f–h / **2**:84h–85a	
4. The characterization of works of art by reference to the cultural or social circumstances of their production or the extent and character of their audience: the primitive, folk, and popular arts	PRIMITIVE, FOLK, AND POPULAR ARTS **14**:1031–1037	**2**:82c–h / **2**:130a–c / **10**:1046a–1047c	
a. Primitive arts		**14**:1031d–1034a / **14**:1045a–f	
b. Folk arts		**14**:1034b–1035g / **7**:449a–e / **7**:455g–456e / **7**:463d–g / **7**:466h–467a / **7**:470f–476e	
c. Popular arts		**14**:1035h–1037b / **3**:314g–316g / **14**:804g–805e / **14**:812d–813f	
5. The characterization and grouping of works of art by reference to criteria of style	ARTS, STYLE IN THE **2**:123–134		**19**:245h–246a
a. The issue concerning the legitimacy of stylistic criteria		**2**:123a–d / **14**:1032g–1033a	**10**:1045c–e
b. The nature of style		**2**:123f–127g / **18**:260d–g	**10**:653e–654d
i. Diverse historical and contemporary conceptions of style in the arts		**2**:123g–125d / **19**:363d–g	**12**:719c–e
ii. Principal aspects of style: value aspects, creative aspects, formal aspects, metaphorical aspects, polar aspects, measurable aspects		**2**:125d–127g	
c. The varieties of style: single-culture styles and cross-cultural styles		**2**:127h–132c	
i. Personal styles: the styles of particular artists		**2**:128c–129a / **15**:72a–73a	
ii. School styles: styles of groups of artists sharing similar aesthetic principles		**2**:129a–g	**7**:74g–h
iii. Social styles: styles associated with a particular class or section of society; *e.g.*, court, bourgeois, proletarian styles		**2**:129g–130a / **7**:473h–474d	
iv. Ethnic styles		**2**:130a–c	
v. Regional and national styles		**2**:130c–d / **10**:1047a–c	**17**:172b–d

	articles	article sections	other references
vi. Ecological styles; *e.g.*, provincial, urban, rural styles		**2**:130d–f	
vii. Religious styles [for styles in particular religions, see Part Eight, Division II; for religious styles in particular arts and art forms, see Division II, below]		**2**:130f–131a	
viii. Period styles: styles of particular historic periods		**2**:131a–b/ **7**:638c–639c/ **15**:73b–d/ **19**:379b–380b/ **19**:444f–445f/ **19**:458h–459d	**10**:1180h–1181d/ **15**:663h–664d
ix. Outlook styles; *e.g.*, the classical, the romantic, the realistic, the fantastic		**2**:131c–e/ **12**:710d–e/ **12**:712e–f/ **13**:283a–285a/ **15**:1020h–1022b	**8**:799f–h
x. Contextual styles: styles involving contextual criteria; *e.g.*, the tragic, the comic, the satiric, the pastoral, the heroic, the melodramatic		**2**:131f–g/ **4**:958c–961g/ **18**:588d–592h	**9**:5d–11d *passim*/**13**:285a–d
xi. Procedural styles: styles involving formal criteria; *e.g.*, the mimetic, the representational, the naturalistic, the abstract		**2**:131g–132b/ **18**:588d–590e	
xii. Professional styles: styles derived from outside the arts; *e.g.*, the journalistic, the scientific, the technological		**2**:132b–c	
d. The dynamics of style: the historical development, diffusion, change, and duration of style in the arts		**2**:132c–134f/ **10**:205e–g/ **14**:1033a–h	**1**:156e–g/**6**:1068d–1071b *passim*/**6**:1075g–1076f *passim*
i. Factors involved in the origins of style: politico-economic factors, cultural factors, technical factors, artistic factors		**2**:132f–133d/ **15**:1020h–1022b/ **19**:458h–459d	**8**:99h–100c/**19**:397c–g
ii. The diffusion of style: stylistic correspondences in real space; stylistic correspondences in the arts		**2**:133d–h	
iii. Diverse theories concerning change and duration of style: cyclical theories, dialectical theories, sequential theories, satiation theories		**2**:133h–134f/ **15**:660e–662f/ **15**:1024e–g/ **19**:378h–379b	

Section 612. Experience and criticism of works of art

[for Part Six headnote see page 383
for Division I headnote see page 383]

The articles and parts of articles referred to in Section 612 deal with three main subjects: A, the aesthetic experience; B, criticism of works of art; and C, scholarship in the field of the arts.

The outline of subject A gives separate treatment to the apprehension, the interpretation, and the appreciation of works of art. It first presents diverse views in aesthetics of the psychological factors involved in the apprehension of art. It goes on to the kinds of influences on apprehension, such as individual temperament, social and cultural conditioning, and acquired attitudes and values. It then treats the levels and types of individual response to works of art. In dealing with interpretation, the outline covers diverse views in aesthetics of the nature and levels of meaning in works of art; the relevance to interpretation of knowledge of the materials, techniques, and conventions of the various arts; diverse views of the roles of symbol and myth in the arts; and the varying uses of symbol and myth in different arts and in particular styles in the history of the same art. In dealing with the appreciation of works of art, the outline treats the factors that affect an individual's appreciation of a work of art, and the relation of evaluation and criticism to appreciation.

Subject B is the criticism of works of art. The outline first deals with the roles of identification, description, interpretation, and evaluation in the criticism of a work of art. It goes on to deal with diverse criteria of evaluation. It covers such criteria as those implicit in the traditional concept of beauty; criteria that involve concepts of unity, complexity, and clarity; criteria related to the meanings and intelligibility of a work; criteria related to a work's social, moral, or religious significance; criteria related to the technical accomplishments of a work; and criteria related to the intention of the artist. The outline next deals with the application of such criteria in the criticism of works of art. It covers diverse views of the functions of critics in relation to the artist, his work, and its public reception; diverse critical methods, critical styles, and critical approaches to the arts; and the factors that affect the quality of criticism.

The outline of subject C first deals with the resources and methods of scholarship in the field of the arts. It next treats the relation of scholarship in the arts to other humanistic disciplines. At the end it deals with the tools and techniques for the conservation and restoration of works of art.

	articles	article sections	other references
A. The aesthetic experience: the apprehension, interpretation, and appreciation of works of art	AESTHETICS **1**:149–162		
1. The apprehension of works of art		**1**:152f–153b/ **1**:155f–156a	

	articles	article sections	other references
a. Diverse views of the psychological factors involved; *e.g.*, sensory acuity, concentration, empathy, emotion, knowledge, the unconscious		**1**:150h–151e	
b. Influences affecting the apprehension of works of art; *e.g.*, individual temperament, social and cultural conditioning, acquired attitudes and values		**1**:156b–h/ **14**:44b–h	
c. The levels and types of individual response to works of art		**14**:602b–603g	**2**:123b–127g *passim*
i. The role of study and analysis; *e.g.*, the discernment of artistic intention, the recognition of artistic form or style, the awareness of traditions and trends in the arts		**1**:151e–152c	
ii. The comparison and association of works of art: different responses to the familiar and the novel			**2**:41f–42a
iii. The interplay of personal involvement and detachment		**1**:152d–f	
2. The interpretation of works of art		**2**:41e–42g	**2**:86c–87b/**10**:1037g–1038a
a. Meaning in art		**1**:156b–h/ **1**:157h–159c/ **2**:47b–e	
i. Diverse views of the nature and levels of meaning in works of art		**1**:156h–157h/ **14**:1032e–g	**7**:78c–d/**7**:132g–135c *passim*
ii. Theories of meaning: meaning as a factor in the enjoyment of a work of art		**1**:158a–f/ **12**:664b–667d	
iii. Knowledge of the materials, techniques, and conventions of the various arts as affecting the interpretation of works of art			**2**:41f–42a
iv. Intelligibility and unintelligibility in the arts: the communication of meaning		**2**:43h–44c/ **2**:47b–e	
b. Symbol and myth in the arts		**1**:157d–h/ **2**:46f–47b/ **13**:280c–g	**1**:160c–g/**4**:550f–551a/ **8**:905c–d
i. Diverse approaches to the analysis and understanding of symbol and myth in the arts		**1**:911h–912c/ **5**:239b–f/ **7**:461d–462e/ **11**:1003d–f/ **12**:795g–796e/ **14**:1032e–g/ **17**:900f–904b	**4**:1007e–h
ii. Characteristics of symbol and myth in the arts; *e.g.*, sources, meanings, relation to aesthetics and judgment, kinds and workings		**8**:402f–406b/ **10**:191b–e/ **12**:790c–791d/ **12**:793f–795g/ **12**:799c–802e/ **13**:885b–g/ **14**:1045a–f/ **17**:904b–905g/ **17**:907f–908g/ **19**:175g–176c	**1**:912d–916b *passim*/ **7**:463h–464c/**15**:41b–g
iii. Characteristic usages of symbol and myth in the literary, musical, performing, and visual arts		**1**:237f–238a/ **6**:907g–908c/ **8**:406b–e/ **8**:928d–g/ **10**:1044d–h/ **12**:798d–799c/ **17**:905g–907e	**1**:916b–d/**3**:395c–397g *passim*/**7**:132h–135c *passim*/ **17**:1036e–f
iv. The varying uses of diverse kinds of symbolic and mythic types in particular arts [see Division II, below]			
v. The varying uses of diverse kinds of symbolic and mythic types in particular artistic styles [see 611.B.5.]			
3. The appreciation of works of art		**1**:153e–155e	
a. Factors affecting an individual's appreciation of a work of art; *e.g.*, awareness of artistic traditions and styles, individual tastes and attitudes			**1**:677e–g/**2**:41f–42a
b. The application of aesthetic standards: the relation of evaluation and criticism to appreciation			**2**:87b–88a/ **2**:118g–120c *passim*

	articles	article sections	other references
4. Special problems of appreciation and apprehension			
a. In the sphere of literature [see 621]			
b. In the sphere of the theatrical arts [see 622, 623, 625]			
c. In the sphere of music [see 624]			
d. In the sphere of the visual arts [see 626, 627, 628, 629]			
B. The criticism of works of art	ARTS, CRITICISM OF THE **2**:85–89		**2**:40d–f
1. The role of identification, of description, and of interpretation in the criticism of a work of art		**2**:85c–87b	
2. The role of evaluation in the criticism of a work of art		**2**:87b–88c	
3. Diverse criteria of evaluation			
a. Aesthetic criteria: beauty as the traditional criterion; other aesthetic criteria; *e.g.*, the sublime, the sensuous			**1**:153e–154b
b. Criteria related to the union of form and content; *e.g.*, unity, simplicity, complexity, clarity and coherence		**1**:155f–156a / **2**:50d–51c / **10**:1045c–1046a	
c. Criteria related to meaning; *e.g.*, intelligibility, ambiguity, multiplicity and levels of meanings		**1**:157h–159c / **2**:47b–e / **10**:1043a–b	**10**:1040e–f
d. Criteria related to social, moral, or religious significance			**1**:156b–e / **2**:53e–54b
e. Criteria related to technique; *e.g.*, mastery of the medium, sophistication, innovation, crudity and refinement		**10**:1043e–1044d	**15**:68h–73d *passim*
f. Criteria related to the intention of the artist			**2**:42c–g
4. The practice of criticism		**2**:88c–89d / **12**:722c–g	
a. Diverse views of the functions of the critic: in relation to the artist, to his work, and to its public reception		**10**:1037d–1038b / **10**:1049c–e / **12**:724b–d / **13**:297h–298e / **18**:215g–216b	**2**:101h–102b
b. Diverse critical methods: analytical, interpretative, and descriptive types of criticism		**2**:86b–d	
c. Diverse critical styles: journalistic criticism, scholarly criticism, annotative, and referential criticism		**10**:1080a–g	**13**:298a–d
d. Diverse critical approaches to the arts; *e.g.*, the biographical-historical approach, the psychological-anthropological approach, the moralist-idealist approach, the sociocultural approach		**2**:88h–89c / **2**:128c–129a / **2**:129c–130e / **2**:132g–133a	**2**:41f–42b / **2**:53e–54b / **10**:1038b–1041d *passim*
e. Factors affecting the excellence of criticism; *e.g.*, the relation between objective considerations and subjective attitudes or biases, the technical vocabulary and literary style of the critic, the varieties of interpretation		**10**:1080a–g / **12**:722f–h	**10**:1040c–1041d *passim*
C. Scholarship in the arts			
1. Resources and methods of scholarship in the field of the arts		**1**:1079h–1082e / **6**:923e–924h / **8**:1182b–g / **10**:1048h–1049c / **12**:795g–796e / **18**:189e–195b	**2**:978a–981a *passim* / **9**:568c–569b / **9**:569f–570e / **10**:996b–1012h *passim* / **13**:911g–914d *passim*
2. The relation of scholarship in the arts to other humanistic disciplines; *e.g.*, to linguistic studies, to history, to archaeology		**6**:915c–h / **8**:1180a–d	**1**:1078c–f / **8**:428b–429a / **8**:1170a–1179b *passim* / **10**:1010b–1012h *passim* / **10**:1039g–1040a
a. The records of the various arts		**18**:189e–190e	**6**:920d–923e *passim* / **11**:1007a–c
b. The tools and techniques of research		**6**:923e–924b / **7**:469h–470d / **18**:190e–192e	**2**:978a–981a *passim* / **12**:651d–g
c. The tools and techniques of authentication		**2**:90g–91a / **2**:91h–92f	**13**:914b–d

	articles	article sections	other references
d. The tools and techniques for conservation and restoration of works of art; *e.g.*, of buildings, of paintings, of sculpture, of objects of decorative art	ART CONSERVATION AND RESTORATION **2**:56–64	**12**:510d–g	**10**:856e–866e *passim* / **12**:651a–d

Section 613. Nonaesthetic contexts of art

[for Part Six headnote see page 383
for Division I headnote see page 383]

The articles and parts of articles referred to in Section 613 treat four main subjects: A, the interaction of the arts with social, economic, and cultural institutions; B, the economics of art; C, the training and work of the artist; and D, the preservation and dissemination of works of art.

The outline of subject A begins with the arts and society, taken generally, and covers sociological conceptions of the field of art; the psychological and cultural aspects of the aesthetic function; the social uses of art; the reflection of social forces in art; the social dynamics of artistic creativity; and the traditional and modern milieus in which art is produced. The outline goes on to social control of art, involving censorship and related forms of regulation. It next covers the interrelations of the arts and religion, and the interrelations of the arts with science and technology. Finally, it deals with aesthetic education, treating diverse theories about the role of the arts in education; particular uses of the arts in educational curricula; and the effects of diverse educational systems on the artist and his public.

Subject B is the economics of art. The outline first deals with diverse factors that affect the economic value of a work of art. It next treats the forms of economic support of the arts. Dealing with the art market, the outline covers conceptions of the "art industries"; the role of entrepreneurs in the art marketplace; and the role of critics and scholars in the art marketplace. The outline then treats the forms of remuneration of artists and the legal protection of property rights. It also deals with fraudulence in the arts, such as forgery, piracy, and plagiarism.

The outline of subject C begins with the methods of training artists, by systems of apprenticeship and in formal educational institutions. It next treats the social and intellectual status of artists; special environments for artistic work; and the functions and effects of various professional and honorary societies for the arts. Finally, it treats diverse conceptions of the distinction between the professional and the amateur artist and the influence of amateurs on the development of the arts.

In dealing with subject D, the preservation and dissemination of works of art, the outline covers the roles of libraries, museums, and producing and performing associations; the roles of systems of notation for literature, music, and dance; the roles of industry and commerce; the roles of mechanical and electronic media; the roles played by oral and imitative traditions; and the roles of fairs, festivals, exhibitions, and expositions.

	articles	article sections	other references
A. The interaction of the arts with social, economic, and cultural institutions	ARTS, SOCIAL AND ECONOMIC ASPECTS OF THE **2**:102–122		
1. The arts and society: general considerations		**2**:103b–105e	
a. Sociological conceptions of the field of art		**2**:103b–f	
b. Psychological and cultural aspects of the aesthetic function		**2**:103f–104b / **2**:54b–56d / **12**:798d–799c	
c. Social uses of art		**2**:104b–f	
i. Uses of the arts in the service of the sociopolitical order: to preserve the moral and philosophical values of an existing order; to teach or support the dogmas of a particular sociopolitical order		**12**:510a / **12**:649f–650a / **13**:281d–g / **15**:38c–39a / **15**:800b–802d / **16**:128a–b / **17**:1051a–e	**6**:906g–907c / **7**:464c–465a / **10**:1038a–b / **12**:493e–g / **19**:249b–c
ii. Uses of the arts to criticize the values of the sociopolitical order	SATIRE **16**:268–272	**13**:282a–d	**3**:909h–922b *passim* / **4**:979c–d / **16**:850b–853b *passim*
d. The cognitive character of art: its reflection of social forces		**2**:104f–105a / **2**:132f–133a / **7**:471c–472b / **10**:1046f–1047a	**1**:156e–g / **1**:233g–234e / **2**:63h–64b / **6**:1068d–1071b *passim* / **6**:1075g–1076f *passim*
e. Social dynamics of artistic creativity		**2**:105b–e / **7**:638c–639c / **10**:1047d–g / **13**:449d–450b	**10**:120c–g
2. Artists and artistic cultures		**2**:105e–109b	
a. The social role of the artist		**2**:105e–106f	
b. Artistic cultures: traditional and modern situations in which art is produced [for the training and work of the artist, see C., below]		**2**:106f–109b	
3. Economic support of the arts [see B., below]			

	articles	article sections	other references
4. Social control of art: censorship and related forms of regulation		**2**:114a–115g / **16**:87b–f / **16**:271h–272e	**3**:1083c–1090b *passim* / **13**:297f–h / **15**:226d–g / **15**:229b–c / **16**:75h / **16**:77d–e
a. Types of regulation: censorship, criticism, the imposition of moral or aesthetic codes		**2**:114a–e	**2**:94b–f / **12**:493g–494b
b. Sources of regulation; *e.g.*, the state, religious bodies, social and patriotic groups		**2**:114c–e / **4**:352e–f	**4**:1009c–e
c. Targets of regulation		**2**:114e–115b	
d. Conditions for social control of art		**2**:115b–c	
e. Implications of social control of art		**2**:115d–g	
5. The arts and religion		**2**:115h–117c	
a. Social relationships		**2**:115h–116e / **10**:202e–h	**9**:952d–953f
i. The interaction of the arts and religion		**2**:115h–116b / **12**:797g–798d / **17**:900d–f	**1**:234e–f / **17**:172f–g
ii. The separation of art from religion		**2**:116c–e	**3**:559d–560d *passim* / **9**:923e–g / **10**:298e–g / **17**:907d–e
b. Aesthetic influences		**2**:116f–117c	**1**:157d–h / **1**:159f–160a
i. The role of religion in defining and organizing artistic styles, forms and content		**2**:116f–117a / **2**:130g–131a / **2**:880c–881g / **4**:501h–504a / **4**:519b–520b / **10**:533g–534b / **13**:885b–g / **17**:908f–g / **17**:1044a–c / **17**:1054e–1055b / **18**:218f–219b / **19**:318g–319a	**2**:881g–975e *passim* / **3**:395c–397g *passim* / **4**:1098g–1099a / **7**:474e–475d / **10**:1099d–f / **11**:1007a–e / **13**:1044g–1052a *passim* / **17**:904c–907e *passim* / **18**:212h–213b
ii. The role of art in defining and organizing religious beliefs [for the role of art in specific religions, see Part Eight]		**2**:117a–c	
iii. The use of art in ritual and liturgy [for the specific uses of art in the rituals and liturgies of particular religions, see Part Eight]		**11**:578g–585c / **16**:126d–128a / **17**:904f–905g	**3**:1174f–1182c *passim*
6. Technology, science, and the arts		**2**:117c–118f	**8**:1181a–1182b
a. The influences of science and technology on art: their effects on content, on style, and on creativity		**2**:117c–118d / **2**:133a–b / **9**:513e–518h	
i. Influences on the development of new arts; *e.g.*, motion pictures, photography, printmaking		**12**:540b–544b / **18**:123d–124f	**12**:511g–513e *passim* / **14**:309c–318e *passim* / **14**:1085c–1096b *passim*
ii. Influences on the presentation of a particular art in new forms and styles, through new techniques or with new materials		**3**:314g–316g / **13**:879h–880b / **16**:430c–d	**1**:108f–g / **3**:917h–922b *passim* / **4**:25g–h / **6**:673b–677g *passim* / **12**:667d–668a / **12**:691f–695f *passim* / **12**:730d–g / **12**:743d–e / **13**:880g–h / **14**:805e–g / **15**:221f–222b / **17**:51g–57d *passim* / **18**:124f–126h
iii. Influences on the social, psychological, and intellectual environment of art		**2**:99f–g / **4**:1009b–h	**2**:108g–h / **6**:888a–894e *passim* / **10**:1040e–1041a / **18**:21h–23a *passim* / **18**:940e–941e
b. The influences of art on science and technology		**2**:118d–f	
7. The arts in education: aesthetic education		**2**:118g–120c	
a. Diverse theories about the role of the arts in education; *e.g.*, didactic theories, therapeutic theories, developmental theories, culture-critical theories		**2**:118h–119f / **8**:1178h–1179b	**6**:906g–907c / **19**:380a–b
i. In the general education of the human being		**8**:1180a–d	**2**:54d–56d *passim* / **18**:588d–f

	articles	article sections	other references
ii. In particular formal educational curricula		**2**:95e–f / **8**:1182b–g / **15**:798f–800a	**15**:664d–g
b. Particular uses of the arts in educational curricula		**2**:119g–120c / **15**:800b–802d / **18**:258a–c	
c. The effects of diverse educational systems on the artist and his public		**2**:93e–95f	
8. The preservation and dissemination of art [see D., below]			
B. The economics of art	ARTS, SOCIAL AND ECONOMIC ASPECTS OF THE **2**:109–113		
1. Economic evaluation of the arts: diverse factors affecting the economic value of a work of art		**2**:109b–g / **2**:92f–g	**14**:1074d–h
2. Systems of financing artistic activities: forms of economic support of the arts		**2**:109g–110h / **2**:57c–58f / **2**:100b–h / **3**:312a–313e / **10**:859a–h / **10**:860e–861f / **18**:225h–226a	**12**:742c–743b *passim*
a. The subsidization or patronage of the arts and the artist		**2**:110c–d / **2**:100b–d / **2**:100f–g / **4**:352e–f / **7**:638c–639c / **14**:1032c–d / **18**:216e–f	**12**:652c–f / **13**:296h–297b / **17**:172h–173a
b. The purchase and collecting of works of art		**2**:110d–h / **2**:100d–f / **2**:113d–g / **2**:120d–121b / **8**:976a–c / **10**:860e–863d / **10**:867f–868f / **12**:653b–e / **14**:326g–h	**12**:650d–e
3. The art market: the organization of artistic activities for economic profit		**2**:110h–112d	**18**:943a–d
a. Conceptions of the "art industries" and their functions: selling entertainment in a popular market; selling reputation in an elite market; the interactions of popular and elite markets		**2**:111a–112b / **3**:922c–e / **12**:493c–496b / **18**:258f–259g	**3**:312a–313c *passim*
b. The role of entrepreneurs in the art marketplace; *e.g.*, publishers, recording companies, producers, dealers		**12**:692c–695f / **15**:233g–235g	**10**:868d–e / **13**:296g–h / **14**:804d–g / **15**:230f–h / **18**:214e–f
c. The role of critics and scholars in the art marketplace		**2**:90g–91a / **2**:91h–92f / **12**:724b–d	**2**:56g–64b *passim* / **10**:1037d–f
4. Remuneration of artists and protection of their rights		**2**:112d–113d / **3**:316h–317a	
a. Forms of remuneration; *e.g.*, direct payment, commissions, subsidies, royalties, residuals		**2**:100b–h / **13**:449d–f	**2**:113b–c
b. Protection of the rights of the artist			
i. The role of contracts and copyrights		**5**:152e–156g	**2**:112g–113c / **15**:230c–d / **15**:234b–h / **15**:228d–e
ii. The role of labour unions		**2**:101f–h	**2**:112a–b
5. Fraudulence in the arts	ARTS, FRAUDULENCE IN THE **2**:89–92	**2**:113g–h	**13**:914b–d
a. Kinds and instances of forgery and their effects in the visual arts, in literature, in music		**2**:89f–90g / **2**:91a–h	
b. Methods of detecting forgery		**2**:90g–91a / **2**:91h–92f	
c. Piracy and plagiarism in the arts: forms, occurrence, and effects			**3**:314e–g / **5**:153d–g / **6**:787e–f / **15**:229g–230a

C. The training and work of the artist

1. The preparation of the artist: methods of training
   a. Training by systems of apprenticeship
   b. Training in formal educational institutions: development, curricula, and teaching methods
      i. Specialized academies, schools, institutes, or studios
      ii. General schools and colleges: the arts in higher education
   c. Training by the study of other artists and of life: the self-taught artist
2. Art as a vocation: conditions of work in the arts
   a. The economic rewards of the arts [see B., above]
   b. The social and intellectual status of the artist
   c. The working environment of the artist; *e.g.*, the solitary artist, the artist in the art colony or group, the artist in the academic setting, the artist in the urban setting, the artist in "bohemia"
   d. Functions and effects of societies and institutions for the arts; *e.g.*, guilds and unions, honorary societies
3. Professionalism and amateurism in the arts
   a. Diverse conceptions of the distinctions between the professional and the amateur artist
   b. The economic and social limitations on professionalism or on full-time participation in the arts
   c. The range of amateur activity in the arts
   d. The influences of the amateur on the development, the preservation, and the dissemination of the arts

D. The preservation and dissemination of works of art

1. The role of institutions
   a. Libraries and archives
   b. Museums and galleries
   c. Producing associations: the preservation of works of art by performance
2. The role of writing and notation
3. The role of industry and commerce
4. The role of mechanical and electronic media
   a. Printing, photography, motion pictures, and recording
   b. Television and radio

articles	article sections	other references
ARTS, PRACTICE AND PROFESSION OF THE **2**:93–102	**2**:105e–109b	
	2:93e–97a	
	2:93g–94b / **2**:96b–c	**1**:1018c–1019h *passim*
	2:94b–96e / **15**:800b–802d	
	2:94b–95e / **2**:95g–96e / **6**:351g–352a	
	2:95e–f / **2**:96a–b / **18**:216g–217a	
	2:96f–g	**7**:470f–472b *passim*
	2:97a–102e / **2**:106f–109b / **13**:296g–297h	**1**:108h–109a
	2:97b–100b / **2**:105e–106f / **10**:1047d–g	**12**:719c–e / **12**:742h–743a / **14**:807f–h / **19**:175d–f / **19**:380a–b
	2:100h–101e / **2**:106f–109b	
	2:101f–h / **2**:102a–b / **6**:351g–352a	
	2:102c–e / **14**:1032c–d	**12**:652h–653a
	2:93b–c	**1**:232g–h / **2**:107g–108a / **19**:175d–f
		2:100b–h *passim* / **2**:106e–f
	2:102c–e / **8**:974e–976c / **14**:315h–316c	**7**:471c–476e *passim*
	2:102e / **8**:973h–974b / **14**:316d–318e	**12**:553h–555a *passim*
	2:120c–122b / **2**:133d–134f	
	1:691g–692f	**2**:56g–64b *passim* / **2**:145e–f / **7**:609e–610c / **8**:67f–h / **18**:943d–944a
LIBRARY **10**:856–866	**12**:510d–g	**2**:978b–980b *passim* / **10**:867c–875f *passim* / **15**:229a
MUSEUM **12**:649–661	**14**:326g–h	**2**:120e–121b / **9**:1112e–g
	13:593c–f / **18**:258d–259g	**12**:742h–743b
	4:455e–456f / **12**:742a–b / **18**:189e–190c	**2**:120d–e / **12**:732h–738b *passim*
	12:494g–496b	**13**:296g–h / **18**:943a–d
	12:510b–h	**10**:872f–874a *passim* / **14**:802d–803h *passim* / **18**:944a–f **12**:691f–695f *passim* / **14**:306d–326h *passim* / **14**:1051h–1052d / **15**:224d–235g *passim*
TELEVISION AND RADIO, ARTS OF **18**:123–127	**3**:313c–316g / **5**:832d–833f	

	articles	article sections	other references
i. As media using and disseminating diverse forms of the arts		**18**:125g–126h/ **12**:699a–c	
ii. As media with their own aesthetic character and standards		**18**:123d–124f	
5. The role of oral tradition		**2**:642a–b/ **6**:906g–907g/ **7**:465h–466e/ **7**:467a–e/ **16**:126f–g/ **18**:190c–e/ **19**:31b–c	**7**:454f–460b *passim*/ **8**:1017g–1021d *passim*
6. The role of imitative tradition		**2**:96f–g	**13**:884h–885a
7. The role of fairs, festivals, exhibitions, expositions, and related phenomena		**12**:496f–497a/ **12**:653e–654a/ **13**:861c–862c/ **16**:271d–f	**7**:475e–g/ **7**:197h–202e *passim*

Division II. Particular arts

[for Part Six headnote see page 383]

Division I dealt generally with the theory and classification of the arts, the experience and criticism of works of art, and the interaction of the arts with social, cultural, and economic institutions.

The outlines, and the articles and parts of articles referred to, in the nine sections of Division II treat the particular arts: literature; theatre; motion pictures; music; dance; architecture, garden and landscape design, and urban design; sculpture; drawing, painting, printmaking, and photography; and the arts of decoration and functional design.

In each of the nine sections, articles are referred to that treat such subjects as the nature and scope of the art and its various forms; its media, tools, and techniques; aesthetic problems special to the art; its relations to its audience; and the manner in which its work is presented.

In each section, articles are referred to that treat the primitive, folk, and popular forms of the particular art. Articles are also referred to in each section that treat the characteristics and historical development of the particular art among Western; East, South, Southeast, and Central Asian; African; Eskimo and American Indian; and Oceanian peoples.

Section 621. Literature 393
622. Theatre 400
623. Motion pictures 404
624. Music 407
625. Dance 414
626. Architecture, garden and landscape design, and urban design 417
627. Sculpture 421
628. Drawing, painting, printmaking, and photography 423
629. Arts of decoration and functional design 428

Section 621. Literature

[for Part Six headnote see page 383]

The articles and parts of articles referred to in Section 621 deal with six main subjects: A, the art of literature; B, the techniques of literature; C, kinds of literary composition; D, primitive, folk, and popular literature; E, children's literature; and F, the characteristics and historical developments of literature in particular cultures.

The outline of subject A begins with the nature and scope of literature. It goes on to diverse theories about the composition of literary works, to conceptions of poetry, and to the characteristics of language as the medium of literary composition. It next deals with the nature, elements, and sources of literary themes and with the relation of content to literary form. Dealing with literature and its audience, the outline treats the relation between kinds of literature and the extent or social circumstances of their audiences, and the differing relations of literary works to their audiences according to the manner of presentation. It further deals with the integration of literature with other arts; diverse systems of classifying literary works; and the various kinds of writings on literature.

The outline of subject B first deals with the art of rhetoric, treating the elements of rhetoric; diverse historical and contemporary conceptions of the nature of rhetoric; the uses of rhetoric in different kinds of literature; and the relation of rhetoric to grammar and syntax, to literary diction and style, and to prosody. It next deals directly with prosody, the systematic study of versification and the manipulation of the elements of language that contribute toward acoustic and rhythmic effects in literature. It treats the relation of prosody to other elements of literature, theories of prosody, the elements of prosody, and its uses in verse, prose, drama, and oratory.

Subject C is kinds of literary composition. The outline first treats the characteristics of various kinds of narrative imaginative literature—the epic, the saga, the romance, the novel, the short story, the fable, the parable and allegory, and the ballad; kinds of dramatic or theatrical literature; kinds of lyric literature; and forms of satirical literature. It next treats the major forms of nonfictional prose literature: forms of factual-narrative literature, such as histories and biographies; forms of expository writing, such as the essay and travel literature; forms of argumentative writing, such as the oration and some types of scientific and philosophical writing; and various kinds of journalistic writing.

The outline of subject D begins with the characteristics of

primitive literature. It goes on to the characteristics, the oral transmission, the influence, and the major techniques and forms of folk literature. Finally, it deals with popular literature—relatively simple writings of widespread appeal—treating its relation to other forms of literature and its effects, forms, and techniques.

The outline of subject E treats attempts at definition of children's literature; types of children's literature; and the development of children's literature.

The articles referred to in connection with subject F treat the literature of Western peoples, including the literature of Jewish and Islāmic peoples; the literature of East, South, Southeast, and Central Asia; and the literatures of African, Eskimo and American Indian, and Oceanian peoples.

	articles	article sections	other references
A. The art of literature	LITERATURE, ART OF **10**:1041–1049		**2**:43h–44c
1. The nature and scope of literature: the distinction between literature and other forms of writing		**10**:1041f–1042c / **2**:1007f–g / **10**:1074a–d / **13**:280g–281b / **19**:1042g	**8**:975f–h / **10**:654b–c
a. Literary form or structure: the poet as "maker"		**13**:277f–280c / **14**:601d–602a / **15**:72a–73d	
b. The role of imagination in literary creation		**10**:1075f–1076b	
2. Literary composition		**10**:1042c–1044d	
a. Diverse theories about the composition of literary works		**10**:1042c–f	**6**:907c–g
b. Poetry as "making": poetry as a mode of thought; the broad and narrow conceptions of poetry	POETRY **14**:599–603	**10**:1042g–h / **15**:71g–73d	**10**:1051d–f / **10**:1066h–1067c
i. Problems in defining poetry		**14**:599h–600b	
ii. Distinctions between poetry and prose		**14**:600b–601c	
iii. The idea of poetic form		**14**:601d–602a	
c. Language as the medium of literary composition		**10**:1043a–e / **10**:650c–654e	
i. Its aesthetic and intellectual powers		**10**:1043a / **10**:650c–651d / **10**:1050g–1051g / **15**:68h–71f / **17**:905c–e	**4**:1008d–f / **15**:798f–800a *passim* / **16**:850b–853b *passim*
ii. Its imprecision and ambiguity: the problems of semantics		**10**:1043b / **10**:651d–652g / **10**:1000a–h / **10**:1007g–h / **16**:507f–512b	**10**:1065b–e / **19**:926a–928f *passim*
iii. The problems of translating literary works from one language to another		**10**:1043c–e / **10**:656f–657d	**2**:44c–e
d. Craftsmanship: the techniques of literary composition [see also B., below]		**10**:1043f–1044d / **9**:957b–d / **15**:799e–800a	
3. The content of literature: its subject matter		**10**:1044d–1046a / **2**:46b–f / **13**:277f–280g	
a. The nature, elements, and sources of literary themes		**10**:1044d–1045b / **8**:402f–403e / **13**:280c–g	**15**:1022c–1023f
b. The relation of content to literary form		**10**:1045c–1046a	
4. Literature and its audience		**10**:1046a–f	**16**:631d–e / **16**:711g–h
a. The relation between kinds of literature and the extent or social circumstances of their audiences: conceptions of popular, folk, and elite literatures		**10**:1046a–c / **7**:456f–457a / **14**:804g–805e	**10**:654c–d
b. The differing relations of literary works to their audiences according to the manner of presentation		**10**:1046c–f	**10**:1051a–c
i. Written or printed literature		**10**:1046e–f	**13**:280g–283a *passim*
ii. Literature transmitted or interpreted orally		**16**:126f–g	**1**:659a–c / **1**:237d–239a *passim* / **6**:906g–907c / **7**:455g–456a / **12**:798d–e
iii. Literature produced or performed		**5**:987e–988b / **18**:214h–215b	**18**:212e–g
5. The integration of literature with other arts		**10**:1047f–g	

	articles	article sections	other references
a. Literature and the theatre		**5**:980h–988f / **17**:530d–552b / **18**:255c–f	**18**:212e–g / **18**:580d–592h *passim*
b. Literature and the motion picture		**12**:504h–505c	
c. Literature and music			**12**:666d–e / **13**:579c–f
d. Literature and dance		**5**:454g–455a	
e. Literature and the visual arts; *e.g.*, the visual representation of literary motifs, references, allusions, characters, episodes		**8**:928f–g / **17**:1054h–1055b	**8**:406b–c / **13**:883d–g
6. Literary genres: diverse systems of classifying literary works		**10**:1047h–1048h / **9**:956a–g / **10**:1075a–e / **13**:285d–290a / **14**:599h–601c	**10**:1051d–g
7. Writings on literature		**10**:1048h–1049e / **18**:588d–592h	
a. Theoretical treatises about literature		**10**:1042c–f / **4**:959e–961g / **5**:985g–986g / **15**:73e–75f	**1**:1170d–e
b. Scholarly research and writing on literature		**10**:1048h–1049c / **7**:60g–63a / **18**:189e–195b	**16**:629h–631c *passim*
c. Critical writing on literature	LITERARY CRITICISM **10**:1037–1041	**10**:1049c–e / **9**:972c–973a / **10**:1080a–g / **10**:1165c–f / **13**:297h–298e	**10**:1099a–b / **16**:631d–632f
B. Techniques of literature			
1. Rhetoric: the art of discourse	RHETORIC **15**:798–805		**8**:1173a–b / **10**:650c–654e *passim*
a. Nature and scope of rhetoric		**15**:798f–800a / **10**:1077d–f	
i. Traditional and modern rhetoric: diverse historical and contemporary conceptions of the nature of rhetoric		**15**:798f–799e	**15**:38d–f / **15**:341d–h
ii. Elements of rhetoric: figures of speech; *e.g.*, metaphor, simile, personification, hyperbole, allegory, parallelism		**15**:799e–h / **16**:269g–270a	**16**:850b–853b *passim*
iii. The rhetoric of a discourse: the strategies whereby the rhetorician communicates with his audience		**15**:799h–800a	
b. Rhetorical traditions: diverse historical and contemporary uses of rhetoric; *e.g.*, in prose, in verse, in drama, in oratory		**15**:800b–803b / **10**:1076b–e / **13**:642a–643f	**4**:609b–f / **10**:1092h–1093c / **10**:1098b–c / **15**:1021b–d
c. The relation of rhetoric to grammar and syntax, to literary diction and style, and to prosody			**10**:1043a–b / **15**:68e–f / **15**:275b–f
2. Prosody: the manipulation of the elements of language that contribute to acoustic and rhythmic effects in literature	PROSODY **15**:68–75		**10**:1043e–h
a. The nature of prosody and its relation to other elements of literature		**15**:68e–g	**15**:798f–800a *passim*
b. Theories of prosody		**15**:73e–75f	
c. Elements of prosody		**15**:68h–71f	
i. Rhythmic elements; *e.g.*, accent, beat, cadence, the foot, the stanza, metre		**15**:70a–71f	
ii. Acoustic elements; *e.g.*, rhyme, assonance, alliteration		**15**:69g–70a	
d. Prosodic style: the uses of prosody in verse, prose, drama, and oratory		**15**:71g–73d	**14**:600b–603g *passim*
C. Kinds of literary composition		**10**:1047h–1048h	
1. Narrative imaginative literature		**8**:822c–g / **13**:277f–280g	**10**:1060b–c
a. Epic; *e.g.*, the "literary" epic, the beast epic, the mock epic, the romantic epic	EPIC **6**:906–910		**9**:962f–963a / **10**:1048a–b / **10**:1090f–1091b / **10**:1096g–1097c / **11**:1011h–1012d
b. Saga: the king's sagas, legendary sagas, the sagas of Icelanders, and related forms	SAGA **16**:145–147		**8**:35g–36a / **10**:1118f–1119c / **12**:794g–h

	articles	article sections	other references
c. Romance: the romance of love, chivalry, and adventure; *e.g.*, Arthurian romance, the pastoral romance, the Gothic romance, the historical romance	ROMANCE (LITERATURE) **15**:1020–1024	**10**:1102d–1103b / **13**:283a–d / **13**:286c–d	**4**:959a–e / **6**:910b–c
d. The novel	NOVEL **13**:276–299	**10**:1165h–1166e / **18**:585g–586g	**10**:1048d–f / **15**:829g–830d
e. The short story and its antecedents; *e.g.*, the tale, the sketch	SHORT STORY **16**:711–716		
f. Fable, parable, allegory, and related forms	FABLE, PARABLE, AND ALLEGORY **7**:132–139	**4**:553g–554e / **10**:1103h–1104b	**1**:916c–d / **10**:587a–f
g. Ballad, lay, and idyll	BALLAD **2**:641–645		
2. Dramatic or theatrical literature	DRAMATIC LITERATURE **5**:980–988	**10**:1140f–1142f / **10**:1167c–d / **18**:219h–220b	
a. Tragedy	TRAGEDY **18**:580–592	**5**:983d–f	**1**:147h–149e / **10**:1091h–1092c / **10**:1096f–g / **16**:624h–626f / **17**:15a–17a / **18**:213b–c
b. Comedy	COMEDY **4**:958–967	**4**:979a–f / **12**:212f–213b	**10**:1092c–e / **10**:1096c–f / **16**:623g–624g
c. Tragicomedy		**4**:964d–965a	**4**:963b–h
d. Farce and related forms		**12**:211b–d	
e. Melodrama		**5**:984e–f	
f. Religious drama and ritual		**5**:983g–984a / **12**:781d–782g / **18**:221g–222e	
g. Radio, motion-picture, and television scripts		**12**:504h–505c	
3. Lyric literature		**14**:600b–603g / **10**:1059f–1060a / **15**:69c–73d	
a. Music-based lyrics; *e.g.*, ballad, hymn, madrigal		**10**:1103b–e	**10**:1091c–h
b. Language-based lyrics; *e.g.*, sonnet, ode, elegy, pastoral		**10**:1133b–f / **10**:1164b–e / **10**:1166e–h	**10**:1097h–1098b / **10**:1139e–1140f / **16**:619d–620h
4. Satiric literature	SATIRE **16**:268–271	**4**:958h–959e	**9**:8e–f / **10**:1048c–d
a. Diverse attempts at definition, characterization, and classification of satiric literature		**16**:268g–270d	
b. Forms of satiric literature; *e.g.*, satire, parody, lampoon, hoax, burlesque		**16**:270e–271a	
c. History of satiric literature		**10**:1165a–c	**10**:1097d–f / **10**:365h–366e / **16**:268h–270d *passim* / **17**:856g–859a *passim*
5. Nonfictional prose literature	LITERATURE, NONFICTIONAL PROSE **10**:1074–1086		
a. Diverse attempts at definition, characterization, and classification of nonfictional prose literature		**10**:1074a–1076b / **2**:1006f–1007b	
b. Characteristic styles of and approaches to nonfictional prose literature: author presence; descriptive, narrative, expository, and argumentative modes		**10**:1076b–1077f	**2**:1007g–1010g *passim*
c. Major forms of nonfictional prose literature		**10**:1077f–1086d	
i. The essay		**10**:1077g–1079e / **10**:1164f–1165e	**12**:395a–396g *passim*
ii. History as literature		**10**:1079e–1080a	**8**:946b–947h *passim* / **10**:1092f–h / **17**:983f–985a
iii. Criticism as literature		**10**:1080a–g / **10**:1038b–1040c / **10**:1049c–e	
iv. Doctrinal and religious literature		**10**:1081h–1082d / **2**:880c–881g / **10**:12f–13a / **13**:1077f–1078e / **16**:126f–128b / **17**:1051e–1054h	**2**:881g–975e *passim* / **3**:431h–441b

	articles	article sections	other references
v. Philosophical literature		**10**:1080g–1081h	**10**:1093d–f / **14**:249c–250a *passim*
vi. Political literature		**10**:1082d–1083c	
vii. Polemical literature		**10**:1083c–d	
viii. Scientific literature		**10**:1083d–e	
ix. Reportage: journalism		**10**:1083e–h	
x. Aphorism, epigram, adage, maxim, and related short forms		**10**:1083h–1084f	**10**:682g–683e
xi. The dialogue: philosophical and literary dialogues		**10**:1084g–1085b	**14**:532g–538d
xii. Travel literature		**10**:1085b–f	
xiii. Epistolary literature: the letter as literature		**10**:1085f–1086a	
xiv. The oration, the speech, and related forms	ORATORY **13**:641–643	**10**:1077d–f / **15**:800b–802d	**4**:609b–f / **5**:578a–580c *passim*
xv. Biographical and autobiographical literature; *e.g.*, character sketch, critical biography, popular biography, interpretive biography, letter, diary, journal, memoir	BIOGRAPHICAL LITERATURE **2**:1006–1014	**10**:1086a–d	**10**:1098f–h / **10**:1151e–f
d. Development of nonfictional prose literature		**10**:1074f–1075a / **2**:1010h–1014b / **10**:1166h–1167c	
D. Primitive, folk, and popular literature			
1. Primitive literature [see 611.B.4.]			
2. Folk literature	FOLK LITERATURE **7**:454–460		
a. General considerations about folk literature; *e.g.*, its differentiation from and relation to belles lettres and popular literature; its transmission through oral tradition; its relation to folklore and mythology; its relation to the cultural milieu		**7**:455g–456e / **1**:911h–912c / **10**:1046a–d	**1**:659a–g / **8**:404b–c / **14**:1034b–1035f *passim*
b. Techniques of folk literature: the uses of descriptive realism, of the supernatural, of repetition, and of formulistic expression		**7**:456f–457a / **2**:643h–645a	
c. Forms of folk literature: folk songs, ballads, folk dramas, fables, folktales, proverbs, riddles, and charms		**7**:457e–460b / **1**:238d–h / **2**:641g–643h / **7**:463d–f / **19**:926f–h	
d. Development of folk literature		**7**:454h–455g / **2**:642c–d / **2**:645a–c / **10**:195b–g / **10**:1060d–g	**10**:194b–c
3. Popular literature	POPULAR LITERATURE **14**:804–807	**10**:1046c–f	
a. General considerations about popular literature; *e.g.*, its differentiation from and relation to belles lettres and folk literature; its widespread appeal and availability; its functions and effects		**14**:804g–805e / **14**:806f–807a / **13**:281b–d / **14**:1035h–1037b	
b. Forms and techniques of popular literature		**14**:805e–806e / **9**:966e–967b	**13**:285d–290a *passim* / **16**:850b–853b *passim*
c. Development of popular literature		**14**:804c–g	
E. Children's literature	CHILDREN'S LITERATURE **4**:227–242		
1. General considerations about children's literature; *e.g.*, attempts at definition; its special nature, subject matter, and audience; its features and forces		**4**:228c–230b	
2. Genres and types of children's literature; *e.g.*, fairy tales, nursery rhymes		**4**:228c–g	**3**:966g–967h
3. Development of children's literature		**4**:230b–242b	

	articles	article sections	other references
F. Characteristics of literature in particular cultures: historical developments of literature			
1. The literature of Western peoples	LITERATURE, WESTERN **10**:1086–1260	**2**:1010h–1013f / **10**:1077f–1086d	**2**:880c–975e *passim*
a. In antiquity		**10**:1087f–1099c / **10**:1038b–e	**2**:1010h–1011b / **5**:983d–g
i. Ancient Egyptian and Near Eastern literature		**10**:1088b–1089d / **6**:504e–g / **6**:920f–921g	**6**:908c–f / **11**:970c–d / **11**:976h–977a / **11**:979b–e / **11**:1007a–1012h *passim* / **16**:712b–c
ii. Ancient Greek and Hellenistic literature		**10**:1089d–1094g / **6**:908g–909f / **8**:372b–e / **18**:580f–582e	**1**:147h–149e / **1**:1154a–1155d *passim* / **4**:962b–d / **6**:1031g–1032g / **8**:402e–406f *passim* / **8**:830c–831b *passim* / **8**:1017g–1021d *passim* / **8**:1170h–1171f / **16**:712f–h / **17**:15a–17a
iii. Ancient Roman and early Christian literature		**10**:1094g–1099c / **6**:909f–g / **13**:1078f–1081h / **15**:1122b–e / **18**:582f–g	**2**:948h–974a *passim* / **3**:1009h–1010f / **8**:1071h–1073g / **10**:365h–366e / **13**:797d–798h / **15**:1098g–h / **15**:1118f–1119a / **18**:160d–161d *passim* / **19**:152b–153e *passim*
b. Medieval literature		**10**:1099c–1130g / **6**:909h–910c / **10**:1038f–g / **13**:1081h–1086f / **15**:1022c–1023h / **16**:145e–147d / **16**:713a–f	**2**:1011b–e / **4**:62d–65b *passim* / **5**:482b–485f *passim* / **5**:983g–984a / **11**:933h–934b / **19**:146h–148d *passim*
c. From the Renaissance to the present in Europe and the Americas		**10**:1130g–1260e / **4**:230b–242b / **4**:962d–965e / **10**:1038g–1040c / **13**:290b–295d / **13**:296c–f / **14**.804c–g / **15**:1023h–1024h / **16**:713f–716h / **18**:582h–587f	**2**:1011e–1013f / **5**:984a–h / **6**:882a–883a *passim*
i. Renaissance literature: 15th- and 16th-century literature		**10**:1130g–1147b / **15**:661e–h / **15**:666d–667a	**11**:517b–518a / **15**:346b–347g / **17**:495g–496c
ii. Seventeenth-century literature		**10**:1147c–1163f / **4**:962e–963b	**12**:205d–208h *passim* / **16**:617g–629g
iii. Eighteenth-century literature		**10**:1163f–1180h / **4**:963b–964c	**5**:1063d–1065d *passim* / **7**:291c–293b *passim* / **16**:342d–344g
iv. Nineteenth-century literature		**10**:1180h–1216a / **16**:714d–716c	**3**:544b–546g / **4**:837g–840e / **5**:966c–969c *passim* / **6**:1069d–1070a / **6**:1075g–1076a / **8**:679d–680f *passim* / **8**:744b–745c / **18**:483f–486e / **19**:930a–931g
v. Twentieth-century literature		**10**:1216a–1260f / **4**:964d–965e / **16**:716c–h	**3**:731b–c / **6**:724c–725f / **7**:608h–609b / **8**:66f–h / **9**:1111c–e / **15**:131f–133e *passim* / **16**:256f–257e / **16**:656c–658c *passim* / **17**:353d–354a / **18**:941f–h
d. The literature of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:196–199	**2**:881g–883c / **10**:1088h–1089d / **10**:1125f–1126d / **10**:1259g–1260f / **13**:295d–e	**2**:898c–938g *passim* / **9**:145g–146f / **10**:184a–190e *passim* / **10**:191a–195g *passim* / **10**:282h–283h *passim* / **10**:299d–e / **10**:312h–313g / **10**:314b–f / **10**:319g–321c / **15**:63g–65e *passim* / **17**:1006a–1012a *passim*

	articles	article sections	other references
e. The literature of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:954–973	**9**:952c–954a / **9**:924b–c / **9**:944e–945a / **9**:949c–g / **15**:341h–343c / **17**:144d–146f / **17**:419h–420e	**3**:633f–634c / **3**:644g–645a / **9**:820a–h *passim*
2. The literature of Eastern peoples			
a. The literature of East Asian peoples	LITERATURE, EAST ASIAN **10**:1050–1073	**13**:295f–h	**3**:439f–440e / **5**:985a–c
i. Chinese		**10**:1050g–1059d / **4**:353c–354a / **17**:1051a–1055b	**4**:344g–345c / **4**:1104a–1107h *passim* / **17**:1036g–1039a *passim*
ii. Korean		**10**:1059e–1064g / **10**:532c–e	
iii. Japanese		**10**:1064g–1073c / **6**:910c–g / **10**:98b–100d	
b. The literature of South Asian peoples: literature of India, Sri Lanka, Kashmir, Pakistan, and Bangladesh	SOUTH ASIAN PEOPLES, ARTS OF **17**:132–150	**17**:131c–132c / **3**:419c–420c / **3**:421a–422b / **3**:432d–439e / **8**:909g–911d / **8**:927a–928d / **9**:967f–968f / **10**:12f–13b / **13**:295h–296b	**3**:417g–418c / **5**:984h–985a / **8**:923h–926h *passim* / **8**:932g–940h *passim* / **9**:356h–357a / **9**:360f–g / **9**:364g–365a / **10**:375d–376b *passim* / **16**:712d–e
c. The literature of Southeast Asian peoples: literature of Burma, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, and the Philippines	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:230–237		
d. The literature of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1122–1124		
3. The literature of African peoples: African literature in European languages; African literature in African languages (*e.g.*, Swahili, Yoruba)	AFRICAN PEOPLES, ARTS OF **1**:237–242	**1**:232c–237a / **13**:296b–c	
4. The literature of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:659–663	**1**:658d–f	
a. Of Eskimos and North American Indian peoples		**1**:659g–661g	
b. Of Meso-American Indian peoples		**1**:661h–662c / **1**:662f–663c	**2**:548f–g / **11**:719f–g
c. Of South American Indian peoples		**1**:662c–f	
5. The literature of Oceanian peoples: Melanesian, Micronesian, and Polynesian	OCEANIAN PEOPLES, ARTS OF **13**:454–456	**13**:449d–454b	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ADDISON, JOSEPH **1**:83
ALBERTI, LEON BATTISTA **1**:427
ARIOSTO, LUDOVICO **1**:1151
ARNOLD, MATTHEW **2**:36
AUDEN, W.H. **2**:363
AUSTEN, JANE **2**:377
BALZAC, HONORÉ DE **2**:679
BAUDELAIRE, CHARLES **2**:770
BECKETT, SAMUEL **2**:788
BLAKE, WILLIAM **2**:1100
BOCCACCIO, GIOVANNI **2**:1173
BORGES, JORGE LUIS **3**:40
BOSWELL, JAMES **3**:61
BRECHT, BERTOLT **3**:152
BRONTË FAMILY **3**:327
BROWNING, ROBERT **3**:333
BUNYAN, JOHN **3**:480
BURNS, ROBERT **3**:516
BUTLER, SAMUEL **3**:540
BYRON, LORD **3**:544
CAMÕES, LUÍS DE **3**:701
CAMUS, ALBERT **3**:711
CARLYLE, THOMAS **3**:923
CARROLL, LEWIS **3**:966
CATULLUS **3**:1009
CERVANTES, MIGUEL DE **3**:1182
CHAUCER, GEOFFREY **4**:62
CHEKHOV, ANTON **4**:65
CICERO **4**:607
COBBETT, WILLIAM **4**:809
COLERIDGE, SAMUEL TAYLOR **4**:837
CONGREVE, WILLIAM **4**:1131
CONRAD, JOSEPH **5**:28
COOPER, JAMES FENIMORE **5**:132
CRANE, STEPHEN **5**:234
DANTE **5**:481
DAUDET, ALPHONSE **5**:513
DEFOE, DANIEL **5**:550
DEMOSTHENES **5**:578
DICKENS, CHARLES **5**:706
DICKINSON, EMILY **5**:712
DIDEROT, DENIS **5**:723
DONNE, JOHN **5**:954
DOSTOYEVSKY, FYODOR **5**:966
DREISER, THEODORE **5**:1014
DRYDEN, JOHN **5**:1062
ELIOT, GEORGE **6**:721
ELIOT, T.S. **6**:723
EMERSON, RALPH WALDO **6**:753
EURIPIDES **6**:1030
FAULKNER, WILLIAM **7**:195
FERDOWSĪ **7**:232
FIELDING, HENRY **7**:291
FITZGERALD, F. SCOTT **7**:377
FLAUBERT, GUSTAVE **7**:379
FORSTER, E.M. **7**:547
FROST, ROBERT **7**:747
GARCÍA LORCA, FEDERICO **7**:882
GIDE, ANDRÉ **8**:158
GOETHE, JOHANN WOLFGANG VON **8**:224
GOGOL, NIKOLAY **8**:234
GOLDSMITH, OLIVER **8**:240
GORKY, MAKSIM **8**:255
GRIMM BROTHERS **8**:427
HARDY, THOMAS **8**:645
HAUPTMANN, GERHART **8**:666
HAWTHORNE, NATHANIEL **8**:678
HEINE, HEINRICH **8**:743
HEMINGWAY, ERNEST **8**:757

(*continued*)

HERZEN, ALEKSANDR IVANOVICH 8:827
HESIOD 8:830
HÖLDERLIN, FRIEDRICH 8:992
HOMER 8:1017
HOPKINS, GERARD MANLEY 8:1070
HORACE 8:1071
HUGO, VICTOR 8:1132
JALĀL AD-DĪN AR-RŪMĪ 10:14
JAMES, HENRY 10:24
JOHNSON, SAMUEL 10:244
JONSON, BEN 10:266
JOYCE, JAMES 10:279
JUVENAL 10:365
KAFKA, FRANZ 10:370
KĀLIDĀSA 10:375
KEATS, JOHN 10:412
KIPLING, RUDYARD 10:485
LA FONTAINE, JEAN DE 10:586
LAMARTINE, ALPHONSE DE 10:618
LA ROCHEFOUCAULD 10:682
LAWRENCE, D.H. 10:722
LAWRENCE, T.E. 10:725
LERMONTOV, MIKHAIL 10:832
LESSING, GOTTHOLD EPHRAIM 10:838
LUCIAN 11:172
LUCRETIUS 11:173
MALLARMÉ, STÉPHANE 11:387
MALRAUX, ANDRÉ 11:389
MANN, THOMAS 11:455
MARLOWE, CHRISTOPHER 11:516
MARTIAL 11:546
MAUPASSANT, GUY DE 11:707
MELVILLE, HERMAN 11:873
MEREDITH, GEORGE 11:923
MILTON, JOHN 12:204
MOLIÈRE 12:322
MONTAIGNE, MICHEL DE 12:394
NABOKOV, VLADIMIR 12:804
NERUDA, PABLO 12:967
O'NEILL, EUGENE 13:571
ORWELL, GEORGE 13:750
OVID 13:797
PEPYS, SAMUEL 14:36
PETRARCH 14:161
PETRONIUS ARBITER 14:189
PINDAR 14:465
PLUTARCH 14:578
POE, EDGAR ALLAN 14:597
POPE, ALEXANDER 14:796
POUND, EZRA 14:931
PROPERTIUS, SEXTUS 15:45
PROUST, MARCEL 15:131
PUSHKIN, ALEKSANDR 15:308
QUINTILIAN 15:341
RABELAIS, FRANÇOIS 15:345
RACINE, JEAN 15:357
RICHARDSON, SAMUEL 15:829
RILKE, RAINER MARIA 15:846
RIMBAUD, ARTHUR 15:848
RONSARD, PIERRE DE 15:1135
ROSSETTI FAMILY 15:1155
RUSKIN, JOHN 16:32
SADE, MARQUIS DE 16:135
SAINTE-BEUVE, CHARLES-AUGUSTIN 16:168
SARTRE, JEAN-PAUL 16:256
SCHILLER, FRIEDRICH 16:342
SCOTT, SIR WALTER 16:411
SENECA 16:530
SHAKESPEARE, WILLIAM 16:615
SHAW, GEORGE BERNARD 16:655
SHELLEY, PERCY BYSSHE 16:659
SIDNEY, SIR PHILIP 16:730
SMOLLETT, TOBIAS 16:908
SPENSER, EDMUND 17:493
STAËL, MADAME DE 17:528
STEELE, SIR RICHARD 17:635
STENDHAL 17:669
STERNE, LAURENCE 17:676
STEVENSON, ROBERT LOUIS 17:688
SWIFT, JONATHAN 17:856
TASSO, TORQUATO 17:1075
TENNYSON, ALFRED, LORD 18:140
THACKERAY, WILLIAM MAKEPEACE 18:195
THOMAS, DYLAN 18:344
THOREAU, HENRY DAVID 18:350
TOLSTOY, LEO 18:483
TURGENEV, IVAN 18:778
TWAIN, MARK 18:805
VALÉRY, PAUL 19:17
VERLAINE, PAUL 19:84
VIGNY, ALFRED DE 19:145
VILLON, FRANÇOIS 19:146
VIRGIL 19:151
VOLTAIRE 19:512
WELLS, H.G. 19:757
WHITMAN, WALT 19:819
WILDE, OSCAR 19:824
WORDSWORTH, WILLIAM 19:928
YEATS, WILLIAM BUTLER 19:1075
ZOLA, ÉMILE 19:1156

Section 622. Theatre

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 622 deal with four main subjects: A, the theatrical arts; B, the kinds and methods of theatrical production; C, the elements of theatrical production; and D, the characteristics and historical developments of the theatre in particular cultures.

The outline of subject A first treats the nature and origins of the theatre as an art; the special functions and problems of theatrical production; and the special interrelation of theatrical performance and audience. It next deals with directing, covering diverse views of the role of directors; their relation to playwrights, producers, actors, and designers; special problems and techniques of directing; and the history of directing. The outline of the art of acting covers such topics as diverse views of the actor as an artist; the physical, emotional, and intellectual resources of the actor; major problems and styles of acting; the interaction of actor and audience; the training of actors; and the history of acting. After dealing with the roles of other arts in the theatre, the outline concludes by treating theoretical, critical, and descriptive writing about the theatre.

The outline of subject B begins with the diverse kinds of theatrical production, treating kinds defined by the nature of the production itself; kinds defined by their special purpose or audience; kinds defined by the system of production; kinds defined by the controlling artist; kinds defined by their style; and kinds defined by the lack of a unified dramatic structure, such as circuses, pageants, parades, and popular entertainments. The outline then deals with diverse methods of theatrical production, treating procedures for preparation of the production, and the composite aspects and collective methods of theatrical production.

The outline of subject C first deals with the kinds and uses of theatre buildings, stages, and auditoriums, and with the historical development of theatres in Western and non-Western cultures. It goes on to the subject of staging and stage design. It first deals with the elements and principles of composition in staging and with various styles and types of staging in theatrical and other performing arts. It then treats the materials and methods of scenic design, of stage lighting, of stage machinery, of stage sound, of costume design, and of theatrical makeup. Finally, it treats the coordination and interaction of the diverse elements of theatrical production and design and the history of staging and stage design.

The articles referred to in connection with subject D treat the theatre of Western peoples, including Jewish and Islāmic peoples; the theatre of East, South, Southeast, and Central Asian peoples; the theatre of African peoples; the theatre of Eskimo and American Indian peoples; and the theatre of Oceanian peoples.

articles	article sections	other references
THEATRE, ART OF **18**:212–217		
A. Theatrical arts		
1. The nature and origins of theatre as an art	**18**:212d–213e/ **5**:468h–470g/ **14**:812d–f/ **17**:243c–g/ **17**:530d–f/ **18**:218f–219b	**12**:798h–799b/**18**:236d–e
2. Special functions of theatre and theatrical production; *e.g.*, theatre as social, moral, or religious expression, theatre as entertainment	**18**:213e–214e/ **3**:1127g–1128g/ **15**:289f–291a/ **18**:216b–e	**5**:981b–d/**7**:134c–e/ **16**:640g–h/**17**:531h–532c/ **17**:533c–d
3. Special problems of theatre and theatrical production		
a. Problems involving illusion and reality: the special character of mimesis, or imitation, in the theatre	**18**:213e–214a/ **18**:253d–g	**5**:981d–g

	articles	article sections	other references
b. The theatrical hierarchy: problems deriving from the composite and collective nature of theatrical production		**18**:214e–h / **5**:826d–g / **18**:256c–f	**16**:618d–g
c. Problems involving the space-time aspects of theatrical art; *e.g.*, theatre structure, conventions of time and space		**18**:215c–g / **5**:987a–e / **18**:253g–254f	**17**:530d–552b *passim*
d. The aesthetic consequences of diverse nonaesthetic factors; *e.g.*, the necessity for subsidies		**18**:216e–f	**5**:828f–g / **18**:258c–259g *passim*
4. The special interrelation of theatrical performance and audience		**18**:214h–215b / **5**:987e–988b / **18**:236d–f / **18**:252d–g	**15**:289h–290c
5. The arts of design in the theatre: staging and the design of stages, sets, lights, costumes, and makeup [see C.2., below]			
6. Directing	DIRECTING **5**:826–833	**12**:507c–h	
a. Diverse views of the role of the director		**5**:826e–g	
b. The work of the director: his relations with the playwright, the producer, the actors, the designers, and subsidiary directors		**5**:826d–e / **18**:256c–f	**1**:61e–62a *passim*
c. Special problems and techniques of directing		**5**:826h–827a	
d. History of directing		**5**:826h–829c	**18**:230a–233h *passim*
7. Acting	ACTING **1**:58–64	**12**:505c–d / **18**:252c–253g	**12**:210g–213g *passim*
a. Diverse views of the actor as an artist		**1**:59b–f	
b. The physical resources of the actor		**1**:62a–63b / **18**:252g–253b	**4**:980d–982h *passim*
c. The emotional and intellectual resources of the actor		**1**:62a–63b / **18**:253b–g	
d. The elements, problems, and processes of character creation and exposition		**1**:60c–f / **1**:63b–64c / **4**:980d–982h / **18**:253d–g	
e. Styles of acting		**1**:60f–62a / **1**:63d–h / **4**:979g–980b	
f. The interaction of actor and audience		**18**:252d–g	
g. The nature of nondramatic performance: the role of the entertainer		**14**:812f–813f / **18**:253b–d	**3**:314g–315b / **4**:636h–637f
h. The training of the actor and entertainer [see 613.C.]			
i. History of acting		**1**:59f–60b	**2**:862g–863c / **7**:911c–912b
8. The roles of other arts in the theatre			
a. Literature in the theatre: special resources for writing for the theatre		**5**:980h–988f / **4**:962b–965e / **16**:271a–b / **18**:255c–f	**18**:212e–g / **18**:580d–592h *passim*
b. Music in the theatre		**5**:986g–987a	
i. In opera [see 624.G.2.a.]			
ii. In ballet, in musical comedy and related forms, and as background or incidental music in nonmusical theatre	MUSIC, THEATRICAL **12**:695–703	**2**:646f–h / **14**:808g–809a / **14**:813g–814c	**12**:667d–668a / **14**:810b–d
c. Dance in the theatre		**2**:645d–f / **12**:212c–e / **17**:158c–159d	**18**:257d–e
i. Ballet, modern dance, dance in musical comedy, and related forms of dance production [see 625]			
ii. The relation of dance and choreography to staging and stage design		**5**:454c–f	
d. Painting and architecture in the theatre [see C., below]			
9. The integration of theatrical production with other arts [see C., below]			

	articles	article sections	other references
10. Theoretical, critical, and descriptive writing about the theatre		**18**:215g–216b / **1**:60c–61d / **4**:959e–962b / **5**:985g–986g / **18**:588d–592h	**18**:222f–223a
B. Kinds and methods of theatrical production	THEATRICAL PRODUCTION **18**:251–260		
1. Diverse kinds of theatrical production		**18**:256f–260g	
a. Kinds defined by the nature of the production itself		**18**:256g–257f	
i. The traditional dramatic forms or genres; *e.g.*, tragedy, comedy [for these forms as literature, see 621.C.2.]		**18**:257c–e / **18**:219h–220b	
ii. Dramatic improvisation: commedia dell'arte and related forms	COMMEDIA DELL'ARTE **4**:979–987	**12**:212f–213b	**18**:223d–e
iii. The Kabuki theatre	KABUKI THEATRE **10**:366–370	**12**:687f–689b	
iv. The Nō theatre	NŌ THEATRE **13**:270–273	**12**:684a–685g	**5**:986f–g
v. Mime and pantomime	MIME AND PANTOMIME **12**:210–213		**9**:978f–g
vi. Puppet, marionette, and shadow plays and related forms	PUPPETRY **15**:289–297		**9**:979e–980c / **18**:260c–d
vii. Nondramatic theatrical production [see B.1.f., below]			
b. Kinds defined by their special purpose or audience; *e.g.*, religious theatre, civic theatre, educational theatre, court theatre		**18**:257f–258c / **18**:221g–222e / **18**:223h–224c / **18**:242e–g / **18**:243b–d	
c. Kinds defined by their system of production; *e.g.*, single-performance productions, repertory systems, stock companies, touring companies		**18**:258c–259g / **18**:216g–217a	**18**:233h–234c
d. Kinds defined by the controlling artist; *e.g.*, actor-dominated productions, dramatist-controlled productions, productions controlled by a nonperforming director		**18**:259g–260d / **18**:227e–f	
e. Kinds defined by their style: general aesthetic style; styles of particular countries, historical periods, and playwrights		**18**:260d–g / **1**:63d–h / **8**:906d–f / **10**:114a–b / **17**:164h–168a	
f. Kinds defined by the lack of a unified dramatic structure		**18**:256g–257b	**3**:476a–478g *passim*
i. Circuses and carnivals	CIRCUS **4**:634–640	**18**:256g–257a / **7**:202b–c	
ii. Pageants, parades, and related forms	PAGEANT AND PARADE **13**:861–865	**4**:638g–639f / **7**:201g–202b / **18**:242g–243b	**18**:257a–b
iii. Popular entertainments: music hall, variety, and burlesque productions; nightclub shows; cabaret; musical comedy and revue	POPULAR THEATRE **14**:812–814	**1**:253c–f / **12**:697d–698c / **18**:221d–g	**12**:212a–b / **12**:212e–f / **12**:212h–213b / **14**:808g / **14**:809d–e
2. Diverse methods of theatrical production		**18**:255c–256f	
a. Procedures for preparation of the production: obtaining, rehearsing, and performing the piece; arranging the performance area		**18**:255c–256b / **1**:63c–d	
b. Collaboration of the participants: the composite aspects and collective methods of theatrical production		**18**:256c–f / **4**:979g–980d	
C. Elements of theatrical production		**18**:252b–255b	
1. The production area: theatre buildings, stages, and auditoriums	THEATRES AND STAGES **18**:236–251		

	articles	article sections	other references
a. Theatre as place: kinds and uses of theatre buildings, stages, and auditoriums		**18**:236d–238h / **5**:987a–e / **18**:253g–254d	**1**:1092e–f / **4**:634g–635a / **10**:368b–g
b. The historical development of theatres in Western and non-Western cultures		**18**:238h–251b / **18**:220b–d / **18**:224h–225b	**19**:303h–304g
2. Staging and stage design: the arrangement of words, dance, music, costume, makeup, lighting, sound, and properties for theatrical effect	STAGING AND STAGE DESIGN **17**:529–565		
a. Staging: the elements and principles of composition in staging; styles and special types of staging in theatre and other performing arts		**17**:530d–552b / **2**:647c–d / **4**:979g–980d / **4**:982h–983e / **10**:369b–e / **13**:272h–273c	**15**:295g–296b
b. The materials and methods of scenic design		**17**:552b–553g	
c. The materials and methods of stage lighting		**17**:553g–558h	**18**:249c–d
d. The materials and methods of stage machinery		**17**:559a–f	**18**:249d–e
e. The materials and methods of stage sound [for music, see A.8.b., above]		**1**:56b–57h / **18**:237h–238d	**18**:248b–249a
f. The materials and methods of theatrical costume design		**17**:559f–564g	**4**:980d–982h *passim* / **10**:368g–369a / **11**:585d–586f
g. The materials and methods of theatrical makeup		**17**:564h–565g	
h. The coordination and interaction of the diverse elements of theatrical production and design		**5**:826d–829c / **18**:254g–255b	
i. The history of staging and stage design		**17**:530d–565g	
3. Directing [see A.6., above]			
4. Acting [see A.7., above]			
D. Characteristics of theatre in particular cultures: historical developments of theatre			
1. Theatre of Western peoples	THEATRE, WESTERN **18**:218–235	**18**:239f–251b	
a. Theatre in antiquity		**18**:218f–221d	
i. In nonclassical antiquity; *e.g.*, Egypt, the Near East		**18**:218f–219g	
ii. In Classical antiquity; *e.g.*, Greece, Rome		**18**:219g–221d / **4**:634g–635b / **12**:211b–212c / **17**:530g–533b / **18**:240c–242d / **18**:580f–582f	**4**:962b–d / **5**:983d–g
b. Theatre in the Middle Ages		**18**:221d–222e / **17**:535b–536f / **18**:242d–243d	**4**:635c / **5**:983g–984a / **12**:212e–f
c. Theatre from the Renaissance to the end of the 19th century in Europe and the Americas		**18**:222e–229c / **4**:962d–964d / **4**:979a–986e / **12**:212f–213b / **17**:536f–550f / **18**:243d–249a / **18**:582h–585g	**4**:635d–636a / **5**:178f–180d *passim* / **5**:984a–h / **10**:266g–269h *passim* / **12**:322a–325e *passim* / **15**:358d–359a / **16**:617g–629g
d. Theatre in the 20th century in Europe and the Americas		**18**:229d–235e / **4**:964d–965e / **4**:986e–987c / **12**:213b–g / **17**:550f–552b / **18**:249b–251b / **18**:586g–587f	**3**:731g–732a / **9**:1111h–1112b / **8**:66f–h / **13**:572b–573a / **17**:354e–355b / **18**:942c–e
e. Theatre of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:200–202		
f. Theatre of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:977–982	**9**:952c–954a	

	articles	article sections	other references
2. Theatre of Eastern peoples			
a. Theatre of East Asian peoples: Chinese, Japanese, and Korean	DANCE AND THEATRE, EAST ASIAN 5:468–480	10:114a–b / 17:533h–535a / 18:238h–239e	5:985a–c / 10:336g–370d *passim* / 13:270h–273h *passim*
b. Theatre of South Asian peoples: theatre of India, Sri Lanka, Kashmir, Pakistan, and Bangladesh	SOUTH ASIAN PEOPLES, ARTS OF 17:158–171	17:131c–132c / 8:906d–f / 17:533d–h	5:984h–985a / 12:212c–d
c. Theatre of Southeast Asian peoples: Burmese, Cambodian, Indonesian, Laotian, Malayan, Filipino, Thai, and Vietnamese	SOUTHEAST ASIAN PEOPLES, ARTS OF 17:241–250	17:230g–233g / 17:535a–b	9:475f–h
d. Theatre of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF 3:1127–1130	3:1122f–h	
3. Theatre of African peoples	AFRICAN PEOPLES, ARTS OF 1:250–253	1:232c–237a	
4. Theatre of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF 1:669–676	1:658d–f	
5. Theatre of Oceanian peoples: Melanesian, Micronesian, and Polynesian	OCEANIAN PEOPLES, ARTS OF 13:456–461	13:449d–454b	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AESCHYLUS 1:147
ARISTOPHANES 1:1154
BARNUM, P.T. 2:724
BEAUMONT AND FLETCHER 2:782
BECKETT, SAMUEL 2:788
BERNHARDT, SARAH 2:862
BOOTH, EDWIN 3:39
BRECHT, BERTOLT 3:152
CALDERÓN DE LA BARCA, PEDRO 3:593
CHEKHOV, ANTON 4:65
CONGREVE, WILLIAM 4:1131
CORNEILLE, PIERRE 5:178
CRAIG, EDWARD GORDON 5:231
DUSE, ELEONORA 5:1095
EURIPIDES 6:1030
GARRICK, DAVID 7:910
GOLDSMITH, OLIVER 8:240
IBSEN, HENRIK 9:151
IRVING FAMILY 9:904
JONSON, BEN 10:266
KEAN, EDMUND 10:411
MARLOWE, CHRISTOPHER 11:516
MOLIÈRE 12:322
O'NEILL, EUGENE 13:571
PIRANDELLO, LUIGI 14:469
PLAUTUS 14:551
RACINE, JEAN 15:357
REINHARDT, MAX 15:580
SHAKESPEARE, WILLIAM 16:615
SHAW, GEORGE BERNARD 16:655
SHERIDAN, RICHARD BRINSLEY 16:668
SOPHOCLES 17:14
STANISLAVSKY, KONSTANTIN 17:580
STRINDBERG, AUGUST 17:737
TERENCE 18:142
TERRY, ELLEN 18:150
VEGA CARPIO, LOPE FÉLIX DE 19:40
WILDE, OSCAR 19:824

Section 623. Motion pictures

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 623 deal with three main subjects: A, the art of motion pictures; B, the motion-picture industry; and C, the history of motion pictures.

The outline of subject A first treats the essential characteristics of the motion picture; the particular forms and characteristics of motion pictures considered popular; and the problems arising from the distinction between the "art film" and other motion pictures. The treatment of the component arts of the motion picture covers the art of the camera; film editing; the arrangement of cinematic images in time; the use of sound; motion-picture acting; motion-picture design; the techniques and uses of animation; and the styles, techniques, and history of motion-picture directing. The outline goes on to the types of motion pictures, dealing with such classifications as those based on intention, on stylistic or technical considerations, on special audiences, and on genre. Further topics dealt with are special social functions of motion pictures; the special problems of production cost, distribution, and exhibition; the interrelation of motion-picture art and technology; the roles of other arts in motion pictures; and the study and appreciation of motion pictures.

The article referred to on subject B, the motion-picture industry, first treats the types of motion-picture industry. It further treats the economics of the motion-picture industry; the interaction of the motion-picture industry with its social, political, and economic milieu, and with other industries such as the music and publishing industries; and the effects on the motion-picture industry of film festivals and awards.

The article referred to on subject C treats the background, from 1815 to 1895, of the origins of the motion picture; the age of the filmstrip and the one-reeler; the age of the silent feature; and developments in the sound era, from 1928 to the present, including the vicissitudes of the sound film in the age of television.

	articles	article sections	other references
A. The art of motion pictures	MOTION PICTURES, ART OF 12:497–510		

	articles	article sections	other references
1. The nature of motion-picture art: the question of the legitimacy of motion pictures as art		**12**:497c–e	**12**:529f–h / **18**:255a–b
a. Essential characteristics of the motion picture		**12**:497f–500d	**18**:124a–f / **18**:125e–f
i. Qualities of the film image: intensity, intimacy, ubiquity, particularity, and neutrality		**12**:498a–e	
ii. Characteristics of the medium: luminosity, realism, movement, and montage		**12**:498e–499h	
iii. The motion-picture experience: special relationship of motion pictures to the audience		**12**:499h–500d	
b. The motion picture as a popular art: forms and characteristics of motion pictures considered popular		**12**:508d–h / **14**:1035h–1036c	**4**:967b–c
c. Problems arising from the distinction between the "art film" and other motion pictures		**12**:508c–d	
2. The component arts of motion pictures: expressive elements of motion pictures		**12**:500d–507b	
a. The art of the camera: materials, techniques, and history of cinematographic expression		**12**:500f–503a / **12**:511g–513e / **12**:544c–546a	
b. Film editing: its materials and techniques; the aesthetic contribution of the film editor		**12**:503a–e	
c. The arrangement of cinematic images in time: slow motion or accelerated motion effects, time conventions, and tempo		**12**:503e–504b	
d. Sound in motion pictures [for music, see A.8.b., below]		**12**:504b–h / **12**:548h–549h / **17**:57d–e	**12**:526g–527g
e. The script or screenplay [see A.8.a., below]			
f. Motion-picture acting: characteristics that distinguish it from acting in the theatre; *e.g.*, nonconsecutive filming	ACTING **1**:63–64	**12**:505c–d	
g. Motion-picture design		**12**:505d–507b	
i. Lighting		**12**:506f–h / **12**:547c–h	
ii. Setting: scenic design		**12**:506h–507a	
iii. Costume and makeup design		**12**:507a–b	
iv. Special-effects design		**12**:505d–506f / **12**:549h–550c	
h. Motion-picture directing [see A.3.a., below]			
i. Animation	ANIMATION **1**:918–922		
i. Techniques of animation		**1**:919d–920e / **12**:551g–552a	
ii. Forms of animated motion pictures		**1**:920e–921c	
iii. Special uses of animation in motion pictures: in abstract motion pictures; in television and in industrial, educational, and scientific motion pictures		**1**:921c–922a	**1**:109c–d
iv. History of animation in motion pictures		**1**:920e–922a	**5**:896f–897d
3. Style in motion pictures: the merging of component arts into a unified whole		**12**:507c–508b	
a. The role of the director	DIRECTING **5**:829–832	**12**:507c–h	
i. Diverse views of the art of motion-picture directing; *e.g.*, the *auteur* theory		**12**:507c–e	**18**:723e–g
ii. Special characteristics and problems of motion-picture directing		**5**:829d–e	
iii. Techniques of motion-picture directing		**12**:507e–h	
iv. History of motion-picture directing		**5**:829e–832d / **12**:515g–518c / **12**:534d–538b	**2**:841g–842g *passim* / **4**:681g–682d *passim* / **6**:516g–517g / **7**:223d–h / **8**:221c–222c *passim* / **15**:673d–674c *passim*
b. National styles and schools		**12**:507h–508b	
4. Types of motion pictures: the classification of motion pictures		**12**:508c–510a	

	articles	article sections	other references
a. The overlapping of motion-picture classifications		**12**:508c–d	
b. Types of motion picture classified by intention; *e.g.*, storytelling films, documentary films, news films, propaganda films, promotional films, educational films, short subject or filler films		**12**:509b–510a	**12**:523a–533a *passim*
c. Types of motion picture classified by stylistic or technical considerations; *e.g.*, animated films, abstract films, experimental and avant-garde films		**1**:920e–922a	**12**:536a–h
d. Types of motion picture classified by special audience or medium; *e.g.*, children's films, films for teen-age audiences, "family" films, "adult" films, films for television		**12**:509a–b / **12**:552a–e	**12**:538e–539c
e. Types of motion picture classified by genre; *e.g.*, westerns, gangster films, musicals, romantic films		**12**:508d–h	**12**:529f–533a *passim*
5. Special functions of motion pictures; *e.g.*, their use as media of education and propaganda		**12**:510a / **12**:552e–553h	**16**:271b–d / **12**:493e–g
6. Special problems of motion pictures; *e.g.*, problems of production cost, distribution, and exhibition		**12**:494b–496c	
7. The interrelation of motion-picture art and technology		**12**:540a–555a	**12**:511g–513e *passim*
8. The roles of other arts in motion pictures			
a. Literature in the motion picture: film writing		**12**:504h–505c	
i. The particular requirements of original and adapted screenplays		**12**:505b–c	
ii. The special relation of the script, or scenario, to the production process		**12**:504h–505a	
b. Music in the motion picture	MUSIC, THEATRICAL **12**:698–699	**12**:504e–f	**12**:667f–668a
c. Dance in the motion picture			**5**:456c–d
d. Painting and drawing in the motion picture		**1**:919d–922a	
e. Sculpture and architecture in the motion picture		**12**:505d–506e	
9. The study and appreciation of motion pictures		**12**:510b–h	
a. Writings about motion pictures; *e.g.*, theoretical, critical, descriptive		**12**:510b–d	
b. The preservation of film: film collections		**12**:510d–f	
c. The study of film: film societies		**12**:510g–h	
B. The motion-picture industry	MOTION-PICTURE INDUSTRY **12**:493–497	**12**:519g–521b	**12**:514h–515d
1. Types of motion-picture industry; *e.g.*, theatrical, industrial, educational, "underground"		**12**:493c–e	**9**:301g–302b
2. The economics of the motion-picture industry: types, methods, and effects of motion-picture production, distribution, and exhibition		**12**:494b–496c	
3. The motion-picture industry and society: the interaction of the motion-picture industry with its social, political, and economic milieu		**12**:493e–494b	
4. The interaction of the motion-picture industry with other industries; *e.g.*, music, publishing		**12**:496d–e	
5. Film festivals and awards: their effects on the motion-picture industry; *e.g.*, the economics of box office success		**12**:496f–497a	
C. History of motion pictures	MOTION PICTURES, HISTORY OF **12**:511–539		
1. The background for the origins of the motion picture: developments from 1815 to 1895		**12**:511g–513e	**12**:540b–541b
2. The age of the filmstrip and the one-reeler: developments from 1896 to 1907		**12**:513f–515g	**12**:541b–d
3. The age of the silent feature: developments from 1908 to 1928		**12**:515g–526g	**8**:426a–427b *passim*

	articles	article sections	other references
4. The sound era: developments from 1928 to the present		**12**:526g–539d/ **12**:541d–543f	
a. The early years: 1928 to 1945		**12**:526g–533a	
b. The sound film in the age of television: 1945 to 1965		**12**:533b–538b	
c. Recent trends		**12**:538b–539d	**3**:732a–b/**7**:609d–e/ **17**:355c–e/**18**:942g–943a

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ANTONIONI, MICHELANGELO **1**:998
BERGMAN, INGMAR **2**:841
BUÑUEL, LUIS **3**:479
CHAPLIN, CHARLIE **4**:32
CLAIR, RENÉ **4**:681
COCTEAU, JEAN **4**:815
DISNEY, WALT **5**:896
EISENSTEIN, SERGEY **6**:516
FELLINI, FEDERICO **7**:223
GODARD, JEAN-LUC **8**:221
GRIFFITH, D.W. **8**:426
KUROSAWA AKIRA **10**:546
RAY, SATYAJIT **15**:537
RENOIR, JEAN **15**:673
RESNAIS, ALAIN **15**:744
TRUFFAUT, FRANÇOIS **18**:723

Section 624. Music

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 624 deal with eleven main subjects: A, the art of music; B, the sources of musical sound; C, the elements of music; D, musical notation; E, forms of musical composition; F, musical performance; G, music for the theatre; H, primitive, folk, and popular music; I, jazz; J, the recording and reproduction of music; and K, the characteristics of music in particular cultures.

The outline of subject A begins with diverse conceptions of music as an art and with speculations on the nature of music. It goes on to problems of musical meaning and of musical interpretation. It next deals with the use of music as an adjunct to other human activities and with the integration of music with other arts. Finally, it treats writings about music—theories of music, scholarly writings about music, and music criticism.

The outline of subject B begins with the physical aspects of musical sound. It next treats the human voice as a source of musical sound and historical developments of the art of singing in Western and non-Western cultures. It then deals with the history, technology, and techniques of different classes of musical instruments. Articles are referred to that separately treat percussion instruments, wind instruments, the organ, stringed instruments, keyboard instruments, and electronic instruments.

Subject C is the elements of music, their patterning and modes of organization in compositions. The outline first covers pitch, duration, timbre, harmony, counterpoint, texture, and orchestration and instrumentation. It then treats principles of musical form, types of musical form, and the historical development of characteristic Western and non-Western musical forms.

The outline of subject D treats the history and the methods of Western staff notation; other systems of notation; and the relation of notation to musical performance.

Articles referred to in connection with subject E separately treat the major instrumental forms of music—the sonata, the symphony, and the like—and solo and choral vocal forms.

The outline of subject F begins with general considerations about musical performance, treating diverse conceptions of the role of the performer, the relation of performance to the medium, and the relation of individual temperament and national traditions to performance. It then deals with the historical development of musical performance practice.

The outline of subject G, after general considerations about theatrical music, treats opera, music for theatrical dance, and such forms of musical theatre as musical comedy, operetta, and zarzuela. It then treats incidental music for the theatre, motion pictures, and television. Finally, it treats the history of theatrical music.

The outline of subject H, first dealing with folk music, treats its differentiation from and relation to popular and to "art" music; the formal characteristics and instruments of folk music; and regional and individual styles and varieties of folk music. Dealing with popular music, the outline treats its differentiation from and relation to folk music, "art" music, and jazz; the forms of popular music; and the development of popular music.

The outline of subject I, jazz, treats its differentiation from and relation to folk music, popular music, and "art" music; its emphasis on the performer as creator; its reflection of social and cultural forces; and the development of jazz styles.

The outline of subject J treats the types of music reproduction; the techniques of music recording; the effects of music recording on composition, teaching, criticism, and performance; and the development of music recording.

Subject K is the characteristics and historical development of music in particular cultures. The articles referred to treat the music of Western peoples, including Jewish and Islāmic peoples; of East, South, Southeast, and Central Asian peoples; and of African, Eskimo and American Indian, and Oceanian peoples.

	articles	article sections	other references
A. The art of music	MUSIC, ART OF **12**:662–669		
1. Diverse conceptions of music as an art: speculations on the nature of music		**12**:662f–664b/ **10**:119g–121c/ **12**:704a–b/ **12**:715f–716a/ **17**:905e–f	
2. Problems of musical meaning; *e.g.*, the question of mimesis, or imitation, in music; the question of extrinsic versus intrinsic meaning in music; the question of music as an autonomous communication		**12**:664b–667d/ **12**:722d–f	**2**:45d–h/**6**:674d–e
3. Problems of musical interpretation: the question of the relation of a work to its performance		**12**:666d–667d/ **12**:724b–d/ **12**:738c–g	**2**:85g–h

	articles	article sections	other references
4. Music and its environment: the relation of music to other human activities			
a. The use of music as an adjunct to other human activities; *e.g.*, ritual, social activities		**12**:662d–664b / **1**:243a–d / **12**:729e–h / **17**:150c–g / **17**:237a–c / **19**:851d–852g	**3**:1125f–1126a / **7**:467c / **8**:975a–b / **10**:120c–g / **14**:800d–803h *passim*
b. The integration of music with other arts; *e.g.*, dance, theatre, literature, film		**9**:973d–f / **12**:695g–696b / **13**:578f–579b / **17**:237d–e	**12**:720c–d / **19**:498h–499g / **19**:519f–520b
5. Writings about music			
a. Theories of music: their relation to criticism, to composition, and to the history of music; their relation to philosophical, scientific, and mathematical theories	MUSIC THEORY **12**:746–748	**12**:664b–667d / **8**:647d–648b / **12**:295g–296e / **12**:670g–671c / **12**:672b–673b / **12**:722h–724a / **12**:739h–740c / **18**:741f–742h	**4**:443a–b / **12**:681a–d / **12**:715h–716a / **15**:324f–g / **17**:150g–151a
b. Scholarly writings about music		**1**:669b–e / **7**:469h–470d / **13**:460g–h	**9**:974a–b
c. Criticism of music: conceptions of the nature and functions of musical criticism; the question of objectivity versus subjectivity in criticism; the question of criticism of a work versus criticism of a performance	MUSICAL CRITICISM **12**:722–724		
B. The sources of musical sound			
1. The physical aspects of musical sound: tone, movement, pitch, and timbre	SOUND, MUSICAL **17**:34–39	**8**:647d–e / **18**:741a–f / **19**:848c–849b	**15**:324f–g / **17**:739d–740f *passim*
2. The human voice: techniques, styles, and historical developments of the art of singing in Western and non-Western cultures	SINGING **16**:789–793		**7**:469d–e / **17**:479g–484a *passim*
3. Musical instruments: the history, technology, and technique of classes and specific types of instruments	MUSICAL INSTRUMENTS **12**:729–732	**1**:248f–250e / **7**:469a–c / **9**:974f–975a / **12**:673b–d / **13**:457h–458c / **13**:643h–644d	
a. Idiophonic and membranophonic instruments	PERCUSSION INSTRUMENTS **14**:58–66	**17**:38h–39a / **13**:644g–645a	
i. Idiophones: instruments whose substance vibrates to produce sound; *e.g.*, xylophones, rattles, cymbals, bells		**14**:58g–63e / **1**:249g–250b / **1**:664g–665f	
ii. Membranophones: instruments that emit sound by the vibration of a stretched membrane; *e.g.*, drums, mirlitons		**14**:63f–66e / **1**:250c–e / **1**:664e–f	
b. Aerophonic instruments: instruments that produce sound by the vibration of a column of air	WIND INSTRUMENTS **19**:847–860	**12**:732d–f / **1**:249d–f / **1**:665f–g / **17**:38e–h	
i. Brass instruments; *e.g.*, trumpets, horns		**19**:849b–850c	**17**:38e–f
ii. Woodwind instruments; *e.g.*, flutes, clarinets, oboes, bassoons		**19**:850d–851d	**17**:38f–g
iii. Aerophonic instruments with keyboards: the organ	ORGAN **13**:676–682		
c. Chordophonic instruments: instruments that produce sound by the vibration of struck, plucked, or bowed strings	STRINGED INSTRUMENTS **17**:738–746	**12**:732a–b / **1**:248g–249d / **1**:665h–666a / **17**:38c–e	
i. The lute family; *e.g.*, lutes, fiddles, violins, guitars		**17**:740f–741d / **17**:745h–746f	
ii. The zither family		**17**:741d–f / **17**:745e–h	
iii. The lyre family		**17**:741f–h / **17**:745c–e	

	articles	article sections	other references
iv. The harp family		**17**:741h–742b / **17**:745a–c	
v. Stringed keyboard instruments; *e.g.*, the clavichord, the harpsichord, the piano	KEYBOARD INSTRUMENTS **10**:436–446	**12**:732b–c / **13**:645a–b	
d. Electrophonic instruments: instruments that produce sound by electrical, electromechanical, or electronic means; *e.g.*, electric organs, tape recorders, synthesizers, computers	ELECTRONIC MUSIC AND INSTRUMENTS **6**:672–677	**13**:645b–c	**4**:25g–h
C. The elements of music: their patterning and modes of organization in composition	MUSICAL COMPOSITION **12**:715–721	**12**:722h–724a / **12**:725b–726d / **12**:747b–h	
1. Pitch			**17**:36h–38b
a. Interval: the difference in pitch between two tones		**8**:651g–654g / **18**:741b–f	**12**:672f–g / **17**:37d–h
b. Scale: a pattern of pitch relationships expressed as a series of intervals dividing an octave	SCALES, MUSICAL **16**:302–304	**1**:244b–d / **7**:468h–469a / **8**:647d–651b / **18**:741c–f	**4**:25f–g / **9**:974b–d / **12**:672h–673a / **12**:682h–683b / **17**:37h–38b / **17**:152f–153d / **17**:238a–b
c. Tuning and temperament: the organization and modification of systems of pitch relationships	TUNING AND TEMPERAMENT, MUSICAL **18**:741–743	**12**:747h–748g	**17**:37b–c / **17**:739d–f
d. Motive and theme		**12**:716d–e / **1**:244e–f / **4**:24a–c	**1**:663h–664a
e. Mode, melody type, tune family	MODES, MUSICAL **12**:295–298	**8**:654g–655a	**16**:303e–f / **17**:153d–g
2. Duration (time)		**12**:746b–e / **12**:745b–e	
a. Pulse and metre		**12**:745f–746a	
b. Rhythm	MUSICAL RHYTHM **12**:744–746	**12**:716a–d / **1**:244g–245h	**1**:664a–c / **9**:974d–e
c. Tempo		**12**:744h–745a	
3. Timbre			**17**:36g–h
4. Harmony	HARMONY **8**:647–656	**12**:717g–721d	**1**:245h–246c
a. Basic concepts of harmony; *e.g.*, consonance and dissonance, functional harmony, keys, modulation, tonality		**8**:647a–c / **8**:651g–654g / **18**:743b–f	
b. The development and disintegration of harmony as a means of organization in Western music		**8**:647d–651g / **8**:655d–656b / **4**:24c–d / **12**:747h–748e	**12**:708g–715a *passim* / **16**:350f–351d
c. The relationship of harmony to other elements of music; *e.g.*, to melody, to musical form		**8**:654g–655b / **17**:5a–6h	**16**:303g–304b
5. Counterpoint	COUNTERPOINT **5**:213–216	**7**:769b–770a	
6. Texture: monophonic, homophonic, heterophonic, and polyphonic		**4**:24d–f / **7**:769b–770a / **12**:704g–705d	**1**:246c–247h / **5**:214a–215d / **7**:468d–f / **8**:647a–656b *passim* / **12**:716e–717h *passim*
7. Orchestration and instrumentation	ORCHESTRATION AND INSTRUMENTATION **13**:643–647		
a. The nature of orchestration and instrumentation: the art of combining the resources of different instruments in musical composition		**13**:643h–644d	
b. Types of instrumentation: approaches to composition for diverse instruments and combinations of instruments; the development of Western and non-Western instrumentation		**13**:644d–647e	
c. Arrangement and transcription: the adaptation of a composition for instruments other than those for which it was originally written		**13**:647e–h	

	articles	article sections	other references
8. Form in music	MUSICAL FORM **12**:725–729		**7**:468c–d
a. Principles of musical form: the organization and patterning in time of the structural elements of music		**12**:725b–726d / **8**:655b–d	**12**:718c–e
b. Types of musical form		**12**:726d–727c / **12**:718e–719b	
i. Iterative and reverting types; *e.g.*, period (one-part) form, binary (two-part) form, ternary (three-part) form		**12**:726e–h / **17**:5a–6h	**4**:1064g–1065a / **12**:711a–c
ii. Strophic types; *e.g.*, ballad forms, variation form	VARIATIONS, MUSICAL **19**:27–31	**12**:726h–727a	
iii. Progressive or through-composed types; *e.g.*, the motet, the tone poem		**12**:727b–c	
c. The development of musical form: characteristic Western and non-Western forms; 20th-century modifications of traditional forms		**12**:727c–729a / **4**:23d–24a / **8**:655b–656b	**9**:974e–f / **12**:716e–721d *passim*
D. Notation: the encoding of music	MUSICAL NOTATION **12**:732–738		**2**:83g–h
1. Western staff notation: general principles; *e.g.*, the recording of pitch and duration, harmony and rhythm; the use of auxiliary signs for timbre, volume, ornamentation		**12**:733b–736c	
2. Other systems of notation: verbal and syllabic notations, alphabetical notations, numerical notations, graphic notations, and tablatures		**12**:736c–738b / **12**:682e–g	
3. The relation of notation to musical performance		**12**:732h–733a / **12**:738f–h	**4**:443a–b
E. Forms of musical composition *with special attention to*			
1. Instrumental forms		**12**:707b–h / **12**:709g–710b / **12**:711c–h / **13**:644d–647e / **17**:742b–743e / **19**:858g–860f	**16**:237g–h
a. Sonata	SONATA **17**:4–10	**12**:727e–f	**12**:711a–c
b. Symphony	SYMPHONY **17**:909–918		**12**:711c–e
c. Chamber music: music for small ensemble; *e.g.*, duet, trio, quartet, quintet	CHAMBER MUSIC **4**:22–29		
d. Concerto	CONCERTO **4**:1064–1074		
e. Variation forms; *e.g.*, chaconne, passacaglia, variation set	VARIATIONS, MUSICAL **19**:27–31		
f. Fugue	FUGUE **7**:769–770		
g. Forms for electrophonic instruments; *e.g.*, tape music, computer music	ELECTRONIC MUSIC AND INSTRUMENTS **6**:672–677	**12**:714h–715a / **13**:645b–c	
2. Vocal forms	VOCAL MUSIC **19**:497–502	**13**:645c–d	**17**:237e–g
a. Solo vocal forms		**1**:244d–f	**16**:791f–792h
i. Liturgical chant		**19**:497g–498a / **12**:296e–297h / **12**:704g–705a / **17**:151e–152d	**10**:206c–f / **12**:741b–c
ii. Secular song; *e.g.*, chanson, canzone		**19**:498a–g / **12**:705g–706a	**12**:741c–e
iii. "Art song"; *e.g.*, lied, concert aria		**19**:498h–502b	
b. Choral forms	CHORAL MUSIC **4**:442–449		

	articles	article sections	other references
i. Sacred choral forms; *e.g.*, mass, motet, anthem, cantata, oratorio		**4**:443c–445d / **12**:709e–g / **12**:728b–c	
ii. Secular choral forms; *e.g.*, secular cantata, symphonic choral music		**4**:446f–447g	
iii. Occasional choral music: choral forms composed to commemorate an occasion of state; *e.g.*, a royal marriage		**4**:445d–446e	
c. Vocal forms for solo or choral performance		**4**:447g–449h	
i. Madrigal		**4**:447g–449b	
ii. Lied, chanson, and glee		**4**:449b–h	
F. Musical performance	MUSICAL PERFORMANCE **12**:738–744	**12**:724b–d	
1. General considerations about musical performance; *e.g.*, diverse conceptions of the role of the performer; the relation of performance to medium; the relation of individual temperament and national traditions to performance		**12**:738c–740c / **17**:743e–744d / **19**:30e–h	**3**:316f–g / **4**:442f–443a
2. Historical development of musical performance practice		**12**:740c–744e	**4**:447g–448a
G. Music for the theatre	MUSIC, THEATRICAL **12**:695–703		**12**:667d–668a
1. General considerations about theatrical music; *e.g.*, its nature and elements; its role as distinct from the role of concert music; its relation to other elements of theatre		**12**:695g–696b / **5**:986g–987a / **12**:727h–728b / **13**:578f–579b / **13**:593c–f	**4**:966e–g
2. Types of theatrical music		**12**:696b–700g	
a. Opera	OPERA **13**:578–593		**18**:223b–d
b. Music for theatrical dance; *e.g.*, ballet, modern dance		**12**:696b–697c / **2**:646f–h / **5**:454b–c	
c. Musical theatre; *e.g.*, musical comedy, operetta, zarzuela, Nō theatre		**12**:697d–698c / **12**:684a–685g / **12**:687f–689b / **12**:699h–700g / **14**:813g–814c	
d. Incidental and background music; *e.g.*, for the theatre, for motion pictures and television		**12**:698c–699h / **12**:504e–f	**3**:316f–g
3. History of theatrical music		**12**:700h–703g / **12**:709a–e / **12**:713c–e / **13**:579c–593c	**5**:953g–954g *passim* / **12**:403c–405g *passim* / **12**:711h–712c / **15**:258h–259b / **15**:1160a–1161a / **19**:82d–84d *passim* / **19**:517e–520b
H. Primitive, folk, and popular music			
1. Primitive music [see 611.B.4.]			
2. Folk music	FOLK MUSIC **7**:466–470		
a. General considerations about folk music; *e.g.*, its differentiation from and relation to popular music and "art" music; its characteristic methods of composition and transmission; its relation to communal activities		**7**:467a–468b / **12**:668d–669e / **16**:790h–791f	**12**:715f–g / **14**:1034b–1035f *passim* / **19**:31b–c
b. Formal characteristics of folk music: melodic form, rhythm and metre, and scales		**7**:468c–469a	
c. Instruments of folk music		**7**:469a–c / **19**:860e–f	
d. Regional and individual styles and varieties of folk music		**7**:469c–e / **3**:1124f–1125b	**16**:792h–793e

	articles	article sections	other references
3. Popular music	POPULAR MUSIC **14**:807–811	**12**:715a–d	
a. General considerations about popular music; *e.g.*, its differentiation from and relation to folk music, "art" music, and jazz; its origin in urban cultures and composition by professional musicians; its characteristic methods of transmission		**14**:807d–e / **14**:1035h–1037b	**7**:467h–468a / **12**:668g–h
b. Forms of popular music; *e.g.*, popular songs, popular instrumental forms, popular theatrical forms, popular dance forms		**14**:802d–803e	**3**:906b–c / **5**:465e–h / **14**:807f–811g *passim*
c. Development of popular music		**14**:807f–811g	**18**:942e–g
I. Jazz	JAZZ **10**:119–126	**12**:715a–d	**12**:668h–669c / **14**:802f–h / **14**:810d–811a
1. General considerations about jazz: its differentiation from and relation to folk music, popular music, and "art" music; its emphasis on the performer as creator; the importance of improvisation; its reflection of social and cultural forces		**10**:119g–121c / **10**:126d–h	**13**:647g–h
2. Development of jazz styles		**10**:121c–126d	
J. Recording and reproduction of music	MUSIC, RECORDING OF **12**:691–695		
1. Types of music reproduction: mechanical, acoustical, and electrical		**12**:691g–692c	
2. Techniques of music recording: the role of the producer		**12**:693a–e	
3. Effects of music recording; *e.g.*, on composition, on teaching, on criticism, on performance, on musicology		**12**:692c–h / **12**:715a–d / **14**:802d–803h	**3**:316f–g / **12**:667d–668a *passim*
4. Development of music recording		**12**:693e–695f	**17**:51h–60b *passim*
K. Characteristics of music in particular cultures: the historical development of music			
1. The music of Western peoples	MUSIC, WESTERN **12**:704–715	**12**:716e–721d / **12**:740c–744a / **13**:579c–593c	
a. In antiquity		**12**:704c–g / **8**:647d–h / **12**:740c–h	
b. In the Middle Ages		**12**:704g–706a / **12**:716e–717e / **12**:740h–742a	**5**:213g–214c / **8**:648a–e / **14**:807f–808b / **19**:497g–498f
c. From the Renaissance to the present in Europe and the Americas		**12**:706b–715d / **4**:22d–23d / **4**:26a–29b / **4**:443c–449h / **4**:1065c–1074g / **5**:214c–216g / **8**:648e–656b / **14**:808b–811g / **17**:6h–10g / **19**:27h–30e / **19**:500c–502b	
i. In the Renaissance		**12**:706b–708f / **4**:1065d–f / **12**:717e–h / **12**:742a–b / **14**:808b–e	**3**:543a–g *passim* / **5**:214c–f / **8**:648e–649e / **13**:932b–g / **19**:27h–29a
ii. In the Baroque period		**12**:708g–710c / **4**:26a–c / **4**:1065g–1070a / **12**:717h–718g / **13**:580b–583e / **13**:645e–646a / **14**:808f–809a / **17**:8c–h / **17**:909g–911a	**2**:557b–560f / **5**:214g–215c / **7**:770b–d / **8**:649f–650d / **12**:742c–f / **16**:338c–339a / **19**:29b–e

	articles	article sections	other references
iii. In the Classical period		**12**:710d–712d / **4**:26c–h / **4**:1070b–1072d / **7**:770d–e / **12**:718g–719b / **13**:583e–584g / **13**:646a–c / **17**:911a–914f	**5**:215c–h / **8**:650d–e / **8**:680h–684a *passim* / **12**:742g–h / **17**:8h–9e / **19**:29e–30a
iv. In the Romantic period		**12**:712e–714d / **4**:27a–f / **4**:1072d–1074b / **7**:770e–g / **12**:719c–720d / **12**:742h–743d / **13**:584h–591a / **13**:646d–f / **14**:809d–810a / **17**:914g–917e	**2**:799f–800h / **3**:106f–109h *passim* / **5**:215h–216c / **6**:1070d–g / **6**:1076e–f / **8**:650f–651a / **11**:350c–351f / **17**:9e–10a / **19**:30a–b / **19**:517e–520d
v. In the 20th century		**12**:714d–715d / **4**:27f–29b / **4**:1074b–g / **7**:770g–h / **8**:655d–656b / **12**:720d–721d / **12**:743d–g / **13**:591b–593c / **13**:646f–647b / **14**:810b–811g / **17**:10a–g / **17**:917e–918d / **19**:30c–e	**3**:731e–f / **5**:216c–g / **8**:66h–67a / **16**:717c–718c / **17**:354c–e
d. Music of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:205–207		
e. Music of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:973–977	**9**:952c–954a / **9**:923h–924a	
2. The music of Eastern peoples			
a. Music of East Asian peoples	MUSIC, EAST ASIAN **12**:669–691	**12**:744d–e	
i. Of Chinese peoples		**12**:671g–678a	
ii. Of Korean peoples		**12**:678a–680a	
iii. Of Japanese peoples		**12**:680b–691d	**16**:675f–h
b. Music of South Asian peoples	SOUTH ASIAN PEOPLES, ARTS OF **17**:150–158	**17**:131c–132c / **12**:744a–b	**19**:31d–e
c. Music of Southeast Asian peoples: Burmese, Cambodian, Indonesian, Laotian, Malayan, Filipino, Thai, and Vietnamese	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:237–241	**17**:230g–233g / **12**:744b–c	**17**:241h–250a *passim*
d. Music of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1124–1127	**3**:1122f–h	
3. The music of African peoples	AFRICAN PEOPLES, ARTS OF **1**:242–250	**1**:232c–237a	**16**:791f–g / **16**:792e–h
4. The music of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:663–669	**1**:658d–f	**16**:791g–792b
a. Of Eskimo and North American Indian peoples		**1**:666a–667f	
b. Of Meso-American Indian peoples		**1**:667g–668e	
c. Of South American Indian peoples		**1**:668e–669b	
5. The music of Oceanian peoples: Melanesian, Micronesian, and Polynesian	OCEANIAN PEOPLES, ARTS OF **13**:456–461	**13**:449d–454b	**16**:792b–e

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BACH, JOHANN SEBASTIAN 2:556
BARTÓK, BÉLA 2:727
BEETHOVEN, LUDWIG VAN 2:795
BERG, ALBAN 2:840
BERLIOZ, HECTOR 2:854
BIZET, GEORGES 2:1092
BOCCHERINI, LUIGI 2:1177
BRAHMS, JOHANNES 3:106
BRUCKNER, ANTON 3:337
BYRD, WILLIAM 3:541
CHOPIN, FRÉDÉRIC 4:439
COPLAND, AARON 5:147
CORELLI, ARCANGELO 5:172
COUPERIN FAMILY 5:217
DEBUSSY, CLAUDE 5:540
DONIZETTI, GAETANO 5:953
DVOŘÁK, ANTONÍN 5:1097
FRANCK, CÉSAR 7:688
GABRIELI FAMILY 7:822
GLUCK, CHRISTOPH 8:212
GOUNOD, CHARLES 8:258
HANDEL, GEORGE FRIDERIC 8:602
HAYDN, JOSEPH 8:680
LISZT, FRANZ 10:1034
MAHLER, GUSTAV 11:349
MENDELSSOHN, FELIX 11:901
MONTEVERDI, CLAUDIO 12:403
MOZART, WOLFGANG AMADEUS 12:600
MUSSORGSKY, MODEST 12:752
PALESTRINA 13:931
PROKOFIEV, SERGEY 15:33
PUCCINI, GIACOMO 15:257
PURCELL, HENRY 15:297
RACHMANINOFF, SERGEY 15:356
RAMEAU, JEAN-PHILIPPE 15:500
RAVEL, MAURICE 15:532
RIMSKY-KORSAKOV, NIKOLAY 15:851
ROSSINI, GIOACCHINO 15:1159
SCARLATTI, DOMENICO 16:337
SCHOENBERG, ARNOLD 16:349
SCHUBERT, FRANZ 16:361
SCHUMANN, ROBERT 16:364
SHOSTAKOVICH, DMITRY 16:717
SIBELIUS, JEAN 16:723
STRAUSS, RICHARD 17:726
STRAVINSKY, IGOR 17:729
TCHAIKOVSKY, PETER ILICH 18:1
TELEMANN, GEORG PHILIPP 18:78
VERDI, GIUSEPPE 19:82
VIVALDI, ANTONIO 19:494
WAGNER, RICHARD 19:517
WEBER, CARL MARIA VON 19:713
WEBERN, ANTON VON 19:717

Section 625. Dance

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 625 deal with five main subjects. Subject A is the art of dance. A group of three subjects covers major kinds of dance: B, ballet; C, modern dance; and D, primitive, folk, and popular dance. Subject E is the characteristics and historical development of dance in particular cultures.

The outline of subject A begins with the origins, nature, and functions of dance as an art and with questions of meaning and communication in dance. Dealing with the components of dance, the outline covers the special skills and functions of the dancer in diverse kinds of dance; diverse views of the role of the choreographer and the elements and principles of choreographic composition; the arts of costume design, scenic design, and lighting design for dance productions; and the various kinds of musical and verbal accompaniments to dance. The outline goes on to diverse classifications of kinds of dance—classifications based on the training of the dancer, on the number of dancers, on the social or cultural circumstances of the dancer, and on the function of the dance. It further treats systems of dance notation; theoretical, critical, and descriptive writings about dance; and the integration of dance with other arts in the theatre and in motion pictures.

The outline of subject B treats the nature of ballet as an art; certain special problems of ballet; the integration of ballet with other arts in opera, drama, and motion pictures; the major kinds of ballet—traditional, classical, modern, abstract, and expressive ballet; diverse national traditions in ballet; the materials and methods of ballet; and the history of ballet.

The outline of subject C, modern dance, treats the principles underlying modern dance; the kinds, theories, techniques, and methods of modern dance; the integration of modern dance with other arts; and the influence of modern dance on ballet and theatrical dance.

The outline of subject D begins with folk dance. It first deals with general considerations about folk dance, such as its differentiation from and relation to popular dance, ballet, and modern dance; its relation to regional environment and ethnic milieu; and its relation to folklore and folk literature, to daily and seasonal labour, and to sexual interests. It then treats the techniques, forms, and history of folk dance. The outline of popular dance presents similar general considerations and then treats the kinds and techniques, the development, and the dissemination of popular dance.

The outline of subject E deals with the characteristics and with the historical development of dance in particular cultures. It treats the dance of Western peoples, including Jewish and Islāmic peoples; of East, South, Southeast, and Central Asian peoples; and of African, Eskimo and American Indian, and Oceanian peoples.

articles	article sections	other references
A. The art of dance		
DANCE, ART OF 5:451–456		
1. The nature of dance as an art: its origins and functions	5:451e–452f/ 1:669e–671f/ 17:242f–243b	1:250f–251b
2. Questions of meaning and communication in dance: conjectured mimetic bases of all dance forms; conventions and iconography of dance	5:451h–452b/ 1:252a–e/ 12:290g–291g	12:798h–799b
3. Components of dance	5:452g–455a	
a. The dancer: his special skills and functions in various kinds of dance	5:452g–453e/ 2:646d–f	12:213b–e
b. The choreographer		
CHOREOGRAPHY AND DANCE NOTATION 4:452–455	5:453e–454b	
i. Diverse views of the role of the choreographer: his work with dancers, musicians, and composers	4:452d–e/ 4:456e–f/ 2:647d–g	
ii. Elements and principles of composition in choreography	4:452b–f	
iii. Historical development of the choreographer's role	4:452g–455d	
c. Theatrical effects in dance: costume, scenic design, and lighting	5:454c–f/ 2:646f–h	

	articles	article sections	other references
d. Accompaniments to dance: rhythm, music, the spoken word; narrative methods and materials		**5**:454b–c / **5**:454f–455a / **2**:646f–647c / **7**:452g–453e / **12**:696b–697c	**13**:456g–457g
4. Diverse classifications of kinds of dance		**5**:455a–456d	
a. Classifications based on the training of the dancer; *e.g.*, natural or untutored dance, professional dance		**5**:455b–c	
b. Classifications based on the number of dancers; *e.g.*, solo dance, group dance, couple dance		**5**:455c–e	
c. Classifications based on the social or cultural circumstances of the dancer; *e.g.*, ethnic and folk dance, court dance, ballroom dance		**5**:455e–456b / **1**:670c–671a / **7**:449a–e	
d. Classifications based on the function of the dance; *e.g.*, magic and therapeutic dance, religious dance, social dance, theatrical dance		**5**:456b–d / **7**:449e–450c	**14**:800d–e / **16**:640g–h
5. The preservation of dances and dance styles: dance notation	CHOREOGRAPHY AND DANCE NOTATION **4**:455–456		**2**:83h–84a / **5**:453g–h
6. Theoretical, critical, and descriptive writing about dance		**5**:461d–g / **5**:464g–465b / **13**:460h–461a	**1**:676d–f
7. The integration of dance with other arts: dance in the theatre, in motion pictures		**5**:468c–f / **17**:158c–159d	**12**:210g–213g *passim*
B. Ballet	BALLET **2**:645–654		
1. The nature of ballet as an art		**2**:645d–646d	
2. The special problems of ballet: aesthetic problems deriving from its composite and ensemble nature; economic problems (*e.g.*, the problem of cost of production)		**2**:646d–647g	
3. The integration of ballet with other arts; *e.g.*, with opera, drama, motion pictures		**2**:654b–c / **2**:646g–647b	
4. Major kinds of ballet: traditional, classical, modern, abstract, and expressive		**2**:645h–646d	
5. Diverse national traditions in ballet and their influences		**2**:651b–652e	
6. The materials and methods of ballet			
a. Ballet "positions" and movements		**2**:646d–f	
b. The resources of the other arts; *e.g.*, the musical score, the libretto, the techniques of theatrical production		**2**:646g–647d / **12**:696b–697c	
c. The choreographic program		**2**:647d–g	**4**:453b–455a
7. History of ballet		**2**:647h–654c / **4**:452g–455a	
a. In the 15th and 16th centuries: the origins of ballet in the Renaissance		**2**:647h–648e / **5**:461a–c	**4**:452g–453a
b. In the 17th and 18th centuries: court ballet; *ballet d'action*		**2**:648f–649f / **5**:461d–462b	**4**:453a–c
c. In the 19th century: the ballet of the romantic tradition		**2**:649g–651a / **5**:465b–d	**4**:453d–454a
d. In the 20th century: modern ballet		**2**:651b–654c / **5**:466c–h	**4**:454a–455a / **5**:683e–h / **7**:448a–h *passim* / **13**:1097b–g / **17**:354e–355b *passim*
C. Modern dance	MODERN DANCE **12**:290–295		
1. Principles underlying modern dance: expression and communication of feeling		**12**:290h–291g	
a. Reactions against older forms		**12**:290h–291b	
b. Intellectual and artistic influences on modern dance		**12**:291c–g	
2. Development of modern dance: kinds, theories, techniques, and methods of modern dance		**12**:291h–295c / **5**:466h–467c	**4**:455a–d / **12**:213b–e

	articles	article sections	other references
3. The relation of modern dance to other arts			
a. The integration of modern dance with other arts; *e.g.*, with musical theatre, drama, motion pictures			**4**:454e–f/**4**:455c–d/ **12**:213b–e
b. The influence of modern dance on ballet and theatrical dance		**12**:294g–h	
D. Primitive, folk, and popular dance			
1. Primitive dance [see 611.B.4.]			
2. Folk dance	FOLK DANCE **7**:449–454	**5**:455e–f	
a. General considerations about folk dance; *e.g.*, attempts at definition; its differentiation from and relation to popular dance, ballet, and modern dance; its relation to regional environment and ethnic milieu; its relation to folklore and folk literature, to daily and seasonal labour, and to sexual interests		**7**:449a–450h/ **1**:669e–670c	**14**:800d–e
b. Techniques of folk dance; *e.g.*, methods of organization of participants, styles of movement		**7**:450h–453e	**1**:670c–672b
c. Forms of folk dance: the Virginia reel, the Highland fling, the Morris dance, the *Schuhplattler*, the tarantella, and the Mexican hat dance; other regional and ethnic dances		**7**:451d–452f/ **3**:1130f/ **17**:162h–164c	**1**:672e–676d
d. History of folk dance		**7**:453e–454d	
3. Popular dance	POPULAR DANCE **14**:800–803	**5**:455h–456b	
a. General considerations about popular dance; *e.g.*, attempts at definition; its differentiation from and relation to folk dance, ballet, and modern dance; its relation to social activities, to sexual interests, and to fashion and fad; the importance of improvisation		**14**:800d–g/ **5**:459c–f	
b. Kinds and techniques of popular dance		**5**:462d–463c/ **5**:464a–g/ **5**:467c–468b	**14**:800g–803e *passim*
c. Development of popular dance		**14**:800g–803e	**7**:453e–454a
d. The dissemination of popular dance: effects of exploration and colonization; effects of the mass media		**14**:803e–h	
E. Characteristics of dance in particular cultures: historical development of dance			
1. Dance of Western peoples	DANCE, WESTERN **5**:457–468		
a. Dance in antiquity		**5**:457c–458g	**14**:800g–h
b. Dance in the Middle Ages		**5**:458g–459f/ **14**:800h–801c	
c. Dance from the Renaissance to the end of the 19th century		**5**:459f–466a/ **2**:647h–651a/ **14**:801c–802d	**4**:452g–454a
d. Dance in the 20th century		**5**:466a–468f/ **2**:651b–654c/ **12**:291h–295c/ **14**:802d–803e	**4**:454a–455d
e. Dance of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:199–200		
f. Dance of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:977–982	**9**:952c–954a	
2. Dance of Eastern peoples			
a. Dance of East Asian peoples: Chinese, Japanese, and Korean	DANCE AND THEATRE, EAST ASIAN **5**:468–480		
b. Dance of South Asian peoples: dance of India, Sri Lanka, Kashmir, Pakistan, and Bangladesh	SOUTH ASIAN PEOPLES, ARTS OF **17**:158–171	**17**:131c–132c	

	articles	article sections	other references
c. Dance of Southeast Asian peoples: Burmese, Cambodian, Indonesian, Laotian, Malayan, Filipino, Thai, and Vietnamese	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:241–250	**17**:230g–233g	**9**:475g–h
d. Dance of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1127–1130	**3**:1122f–h	
3. Dance of African peoples	AFRICAN PEOPLES, ARTS OF **1**:250–253	**1**:232c–237a	
4. Dance of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:669–676	**1**:658d–f	
a. Dance of Eskimo and North American peoples		**1**:672e–675a	
b. Dance of Meso-American Indian peoples		**1**:675a–h	
c. Dance of South American Indian peoples		**1**:675h–676d	
5. Dance of Oceanian peoples: Melanesian, Micronesian, and Polynesian	OCEANIAN PEOPLES, ARTS OF **13**:456–461	**13**:449d–454b	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BALANCHINE, GEORGE **2**:608
DIAGHILEV, SERGEY **5**:682
DUNCAN, ISADORA **5**:1082
FOKINE, MICHEL **7**:448
GRAHAM, MARTHA **8**:264
NIJINSKY, VASLAV **13**:100
PAVLOVA, ANNA **13**:1097

Section 626. Architecture, garden and landscape design, and urban design

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 626 deal with three main subjects: A, the art of architecture; B, garden and landscape design; and C, urban design.

The outline of subject A first treats the elements of design and the principles of composition in architecture; problems special to architecture as an art; the iconography of architecture; and the influence of theoretical, descriptive, scholarly, and critical writings on architecture. It goes on to deal with the aesthetic aspects of the building materials and constructional systems used in architecture; the diverse structural elements and details of buildings; and the several kinds of architectural ornamentation. It next treats the diverse kinds of architecture and building types as determined by different functions. After dealing with the general characteristics of primitive, folk, and popular architecture, the outline concludes with the historical developments of architecture in particular cultures, covering the architecture of Stone Age peoples; of Western, including Jewish and Islāmic, peoples; of East, South, Southeast, and Central Asian peoples; and of African, Eskimo and American Indian, and Oceanian peoples.

Subject B is garden and landscape design. The outline begins with the elements of garden and landscape design, the principles of composition, and the design process. It goes on to the physical components—the materials, methods, and techniques of garden and landscape design. It next treats the kinds of garden and landscape design as determined by diverse formal and contextual criteria and as determined by diverse functions. After dealing with the relation of garden and landscape design to other components of landscape architecture, the outline concludes with the historical developments and general characteristics of garden and landscape design in particular cultures.

The outline of subject C, urban design, similarly treats the elements of urban design and the principles of composition; problems for urban design arising from functional and environmental demands and from economic, social, and political forces; the diverse kinds of urban design; the relation of urban design to other components of landscape architecture; and the development and general characteristics of urban design in particular cultures.

	articles	article sections	other references
A. Architecture	ARCHITECTURE, ART OF **1**:1088–1114		
1. Architecture as an art		**1**:1088h–1089a	**19**:246f–g/**19**:380c–h
a. Elements of design and principles of composition		**1**:1102c–1108g	
b. Problems of architecture: the relation of aesthetic to functional considerations; the economic and social forces acting upon the architect; the relation of architecture to its external environment and to the spectator; the relation of architectural design to technological capabilities		**1**:1093h–1095e/ **2**:56h–58f/ **12**:658d–f	**3**:456a–457c *passim*/ **12**:171h–173a/ **19**:1029h–1030b
c. The iconography of architecture		**1**:1102e–1104h	**12**:798e–h/**17**:905h–906c

	articles	article sections	other references
d. Theoretical, descriptive, scholarly, and critical writings on architecture		**1**:1110b–1114h / **19**:380c–g	**13**:933a–935b *passim* / **18**:242a–b
2. Aesthetic aspects of building materials and constructional systems used in architecture [for technological aspects, see 733]		**1**:1095e–1102c / **2**:58g–59f	**19**:301f–302d
a. Building materials; *e.g.*, stone, brick, wood, iron and steel, concrete		**1**:1095h–1097c / **3**:452e–456a	**11**:487d–e
b. Constructional systems; *e.g.*, load-bearing wall and non-load-bearing wall, post and lintel, arch, vault, dome, truss, framed structures		**1**:1097c–1102c / **3**:454b–456a	**19**:363g–h
3. Diverse structural elements and details of buildings; *e.g.*, floors, walls, ceilings, roofs, windows, doors, stairways			**1**:1097c–1102c *passim* / **3**:458e–464f *passim*
4. Architectural ornamentation: mimetic ornament, applied ornament, and organic ornament		**1**:1108h–1110b	
5. Diverse kinds of architecture and building types determined by their functions		**1**:1089d–1093h	
a. Domestic, or residential, architecture; *e.g.*, houses, apartments, castles, hotels		**1**:1089e–1090d	**19**:305b–g / **19**:396b–c / **19**:465c–f
b. Religious and commemorative architecture; *e.g.*, temples, churches, synagogues, mosques, tombs, shrines, memorials, monuments		**1**:1090d–1091g / **3**:396a–e / **3**:1175f–1176b / **5**:537d–538b / **8**:906c–d / **12**:783f–784a / **16**:675a–b / **19**:250d–251a / **19**:354e–360b	**10**:202h–205g *passim* / **17**:173d–183g *passim* / **17**:905h–906c / **16**:675d–f / **19**:302h–303f
c. Governmental architecture; *e.g.*, town halls, capitols, courthouses, post offices		**1**:1091g–1092b	**19**:302h–305b
d. Recreational architecture; *e.g.*, theatres, auditoriums, athletic facilities, museums, libraries		**1**:1092b–h / **10**:863d–865e / **10**:871h–872c / **12**:657a–659a / **18**:236d–238h / **19**:1161h–1162g	**8**:250a–b / **17**:526f–528a *passim* / **19**:303h–304g
e. Educational and public welfare architecture; *e.g.*, schools and universities, hospitals, prisons, aqueducts		**1**:1092h–1093e	**1**:1035f–1042g *passim* / **19**:473c–e
f. Commercial and industrial architecture; *e.g.*, office buildings, banks, stores, factories, refineries		**1**:1093e–h	**19**:463b–464e / **19**:470b–471b
g. Agricultural architecture; *e.g.*, barns, stables, silos		**7**:175a–177b	
h. Military architecture; *e.g.*, forts, castles, armouries [see also 736]		**7**:548f–555f	
6. Primitive architecture [see 611.B.4.]			
7. Folk architecture	FOLK VISUAL ARTS **7**:470–480		**14**:1034b–1035g *passim*
8. Popular architecture		**14**:1035h–1037b	
9. The architecture of Stone Age peoples: Paleolithic, Mesolithic, and Neolithic	STONE AGE EUROPEAN PEOPLES, ARTS OF **17**:702–708		**18**:1074g–1075b
10. Characteristics of architecture in Western cultures: historical developments of Western architecture	VISUAL ARTS, WESTERN **19**:245–484		
a. The architecture of Western peoples in antiquity		**19**:248h–324e / **12**:783f–784a	
i. Ancient Egyptian		**19**:248h–257h / **18**:261g–264h	**6**:466c–467c / **11**:895b–897d *passim*
ii. Ancient Near Eastern: Mesopotamian, Syro-Palestinian, pre-Islāmic Arabian, Anatolian, and Iranian		**19**:257h–273c / **11**:1005f–1006b / **18**:1021g–1022b	**13**:117a–e
iii. European Metal Age: Aegean and eastern Mediterranean, western Mediterranean, and northern European		**19**:273d–284f	**9**:1080c–f / **1**:118a–e / **1**:113g–114a
iv. Ancient Greek and Hellenistic		**19**:284f–300c / **5**:173g–174f / **6**:905g–906d	**2**:262g–265c / **8**:333f–334a *passim* / **8**:371h–372a / **13**:564h–566e *passim*

	articles	article sections	other references
v. Ancient Roman and early Christian		**19**:300d–324e / **1**:1036c–1038e / **3**:175b–f	**14**:791c–h / **15**:1075e–1083c *passim* / **17**:526f–h / **18**:1075d–e
b. The architecture of Western peoples in the Middle Ages		**19**:324e–379b	
i. Eastern Christian: Byzantine, Armenian, Georgian, Syriac and Palestinian, Coptic, and Ethiopian		**19**:324e–345d	
ii. Western Christian: early medieval, Romanesque, and Gothic		**19**:345d–379b	**3**:176b–177a / **11**:934c–d / **12**:162g–h / **18**:1076b–c
c. The architecture of Western peoples from the Renaissance to the end of the 19th century		**19**:379b–458g	
i. Renaissance		**19**:379b–412e	**3**:111g–114a *passim* / **3**:177a–c / **10**:809h–817c *passim* / **13**:933a–935b / **17**:428d–f
ii. Baroque		**19**:412e–432e	**3**:51g–52h *passim* / **19**:1021c–1024d
iii. Neoclassical, Romantic, and Realistic		**19**:432e–458g	
d. The architecture of Western peoples in the 20th century		**19**:458h–484c	**5**:167h–171a *passim* / **8**:67b–c / **8**:429f–431b *passim* / **16**:112c–113b / **17**:527b–528a / **17**:794h–796h / **19**:1029f–1031f
e. The architecture of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:202–205		**10**:298h–299b
f. The architecture of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:982–1010	**9**:952c–954a / **9**:924c–e	**1**:826h–827a / **3**:634e–635a / **17**:181d–183g
11. Characteristics of architecture in Eastern cultures: historical developments of Eastern architecture			
a. The architecture of East Asian peoples	VISUAL ARTS, EAST ASIAN **19**:174–244		
i. Of Chinese peoples		**19**:175b–207c	
ii. Of Korean peoples		**19**:207d–215d	
iii. Of Japanese peoples		**19**:215d–244b	**16**:675d–f
b. The architecture of South Asian peoples	SOUTH ASIAN PEOPLES, ARTS OF **17**:171–206	**17**:131c–132c / **8**:906c–d	**8**:901g–h
i. Of the peoples of the Indian subcontinent		**17**:173b–183h / **9**:339g–340c	**8**:913b–c / **8**:915b–916a / **17**:1083d–e
ii. Of the peoples of Sri Lanka		**17**:205f–206c	
c. The architecture of Southeast Asian peoples	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:250–273	**17**:230g–233g	
i. Of Burmese peoples		**17**:253c–255h	**13**:860b–d
ii. Of Thai and Laotian peoples		**17**:255h–259a	
iii. Of Cambodian and Vietnamese peoples		**17**:259a–264e	**1**:885g–886d
iv. Of Indonesian peoples		**17**:264f–270f	**9**:475c–e
v. Of Filipino peoples		**17**:270g–271c	
d. The architecture of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1130–1143	**3**:1122f–h	
12. The architecture of African peoples: in Sudanic cultures, in West African cultures, in Central African cultures, in East African cultures, and in southern African cultures	AFRICAN PEOPLES, ARTS OF **1**:253–276	**1**:232c–237a	
13. The architecture of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:676–692	**1**:658d–f	
a. Of Eskimo and North American Indian peoples		**1**:679b–684h	**6**:170c–e
b. Of Meso-American Indian peoples		**1**:684h–687f / **11**:940d–941b / **11**:944d–945d	**11**:940a–b

	articles	article sections	other references
c. Of South American Indian peoples		**1**:688b–691f	**1**:841d–847a *passim*/ **9**:260c–g/**17**:123a–b
14. The architecture of Oceanian peoples: Melanesian, Micronesian, Polynesian, and Australian Aboriginal peoples	OCEANIAN PEOPLES, ARTS OF **13**:461–467	**13**:449d–454b/ **11**:865d–f/ **12**:124c–e	**14**:778h–779d
B. Garden and landscape design	GARDEN AND LANDSCAPE DESIGN **7**:884–901		
1. Garden and landscape design as an art		**7**:884c–888d/ **7**:903b–904b	
a. Elements of design		**7**:885e–887e	
b. Principles of composition		**7**:887e–888c	
c. The design process		**7**:888c–d	
2. Physical components of garden and landscape design: materials, methods, and techniques		**7**:888e–889h	
a. Natural components; *e.g.*, earth, rock, water, plants		**7**:888e–889c	
b. Structural components; *e.g.*, earth-related structures, shelter structures, engineering		**7**:889c–h	
3. Kinds of garden and landscape design		**7**:890b–891g/ **7**:904b–905c	
a. Kinds determined by diverse formal and contextual criteria; *e.g.*, the picturesque, the exotic, the organic, the ornamental		**7**:884g–h	
b. Kinds determined by function; *e.g.*, gardens, parks, botanical gardens, arboretums, cemeteries		**19**:1161h–1162g	**3**:63h–65f *passim*
4. The relation of garden and landscape design to other components of landscape architecture (site planning, land planning, master planning, urban design, and environmental planning) and to landscape architecture as a whole		**7**:884c–885c/ **7**:891c–g/ **1**:1093h–1095e/ **18**:1053h–1054g	
5. Characteristics of garden and landscape design in particular cultures: historical developments of garden and landscape design		**7**:891h–901b/ **7**:902a–903b	
C. Urban design: the artistic aspects of city planning	URBAN DESIGN **18**:1053–1073		
1. Urban design as an art			**2**:57c–58a
a. Elements of design and principles of composition		**18**:1054g–1059b	**12**:798e–h/ **18**:1074g–1079c *passim*
b. Problems of urban design; *e.g.*, the relation of aesthetic response to functional and environmental demand; problems of economic and social forces and governmental requirements [for the sociological, political, economic, and psychological aspects of urban design, see 525.B.; for the technological aspects of urban design, see 737.C.2.]		**18**:1059b–1064c	
2. Diverse kinds of urban design		**18**:1053f–g/ **18**:1064c–1065d	
3. The relation of urban design to other components of landscape architecture (garden and landscape design, site planning, land planning, master planning, and environmental planning) and to landscape architecture as a whole		**18**:1053h–1054g/ **1**:1093h–1095e/ **7**:884c–885c	**7**:891c–g
4. Characteristics of the aesthetic aspects of urban design in particular cultures: historical developments of urban design		**18**:1065d–1073a/ **18**:1081c–1082e/ **19**:421e–h	**2**:268e–h/ **5**:167h–171a *passim*/ **18**:1074g–1079c *passim*/ **19**:305g–306d

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AALTO, ALVAR **1**:1
ADAM, ROBERT **1**:71
ALBERTI, LEON BATTISTA **1**:427
BERNINI, GIAN LORENZO **2**:863
BORROMINI, FRANCESCO **3**:50
BRAMANTE, DONATO **3**:111
BRUNELLESCHI, FILIPPO **3**:343
CORBUSIER, LE **5**:167
FISCHER VON ERLACH, JOHANN BERNHARD **7**:328
GAUDÍ, ANTONIO **7**:957
GROPIUS, WALTER **8**:429
JONES, INIGO **10**:265
LEONARDO DA VINCI **10**:809
MANSART, FRANÇOIS **11**:459
MICHELANGELO **12**:97
MIES VAN DER ROHE, LUDWIG **12**:171
NERVI, PIER LUIGI **12**:993
PALLADIO, ANDREA **13**:933
RAPHAEL **15**:512
RICHARDSON, HENRY HOBSON **15**:828
SAARINEN, EERO **16**:112
SULLIVAN, LOUIS **17**:794
WREN, SIR CHRISTOPHER **19**:1020
WRIGHT, FRANK LLOYD **19**:1029

Section 627. Sculpture

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 627 deal with two main subjects: A, the art of sculpture; and B, the historical development and the characteristics of sculpture in particular cultures.

The outline of subject A begins with the elements of design and principles of composition in sculpture; with problems special to sculpture, such as issues about what it imitates or expresses, its ways of imitating movement, and the special relation of a work of sculpture to the spectator; and with the iconography of sculpture. It goes on to the materials of sculpture and to the tools, methods, and techniques of sculpture. It next treats the diverse kinds of sculpture, distinguished by their spatial context, by subject matter, or by special uses or functions. Finally, it treats the characteristics of folk and of popular sculpture.

The articles dealing with subject B treat the historical development and characteristics of the sculpture of Stone Age peoples; of Western peoples, including Jewish and Islāmic peoples; of East, South, Southeast, and Central Asian peoples; of African peoples; of Eskimo and American Indian peoples; and of Oceanian peoples.

articles	article sections	other references
A. The art of sculpture		
SCULPTURE, ART OF **16**:421–437		
1. Sculpture as an art	**16**:421a–424e / **16**:427c–f	**19**:247d–e
a. Elements of design and principles of composition	**16**:421g–424e / **19**:251c–252g	
b. Problems of sculpture; *e.g.*, the problem of mimesis, the problem of virtual or kinetic movement, the problem of the relation of the work to the spectator	**16**:421a–f	
c. The iconography of sculpture	**16**:436h–437d / **12**:784b–e	**12**:798e–h / **17**:906f–907d
2. Materials of sculpture; *e.g.*, stone, wood, metal, clay, ivory, plaster, concrete, glass fibre, wax, paper	**16**:424e–426h	**11**:486c–487g *passim*
3. Tools, methods, and techniques of sculpture; *e.g.*, carving, modelling, casting and molding, surface finishing	**16**:426h–431h	
4. The diverse kinds of sculpture	**16**:431h–436g	
a. Kinds of sculpture distinguished by their spatial context; *e.g.*, sculpture in the round, relief sculpture, kinetic sculpture, environmental sculpture	**16**:431h–434e	
b. Kinds of sculpture distinguished by subject matter	**16**:434f–436g / **3**:420c–h	
i. Representational sculpture; *e.g.*, human figures, devotional images and objects, portraits, still lifes, animal figures	**16**:434f–436b / **3**:1174h–1175b	**3**:1178a–c
ii. Nonrepresentational sculpture	**16**:436b–d	
iii. Decorative sculpture	**16**:436d–g	
c. Kinds of sculpture distinguished by their special uses or functions	**16**:437d–g	
i. Ceremonial and ritualistic objects [see 812.D.4.e.vi.]		
ii. Coins and medals [see 725.B.4.g.]		
iii. Commemorative sculpture; *e.g.*, monuments, tombs, tombstones, stelae [see 626.A.5.b.]		
iv. Masks	MASK **11**:578–586	
d. Primitive sculpture [see 611.B.4.]		
e. Folk sculpture	FOLK VISUAL ARTS **7**:470–480	**14**:1034b–1035g *passim*
f. Popular sculpture	**14**:1035h–1037b / **8**:974f–975a	
B. Characteristics of sculpture in particular cultures: historical development		
1. The sculpture of Stone Age peoples: Paleolithic, Mesolithic, and Neolithic	STONE AGE EUROPEAN PEOPLES, ARTS OF **17**:702–708	
2. The sculpture of Western peoples	VISUAL ARTS, WESTERN **19**:245–484	

	articles	article sections	other references
a. The sculpture of Western peoples in antiquity		**19**:248h–324e / **12**:784b–e	
i. Ancient Egyptian		**19**:248h–257h	
ii. Ancient Near Eastern: Mesopotamian, Syro-Palestinian, pre-Islāmic Arabian, Anatolian, and Iranian		**19**:257h–273c	
iii. European Metal Age: Aegean and eastern Mediterranean, western Mediterranean, and northern European		**19**:273d–284f	
iv. Ancient Greek and Hellenistic		**19**:284f–300c	**8**:333f–334a / **8**:371f–h / **13**:565b–566d *passim*
v. Ancient Roman and early Christian		**19**:300d–324e	
b. The sculpture of Western peoples in the Middle Ages		**19**:324e–379b	
i. Eastern Christian: Byzantine, Armenian, Georgian, Syriac and Palestinian, Coptic, and Ethiopian		**19**:324e–345d	
ii. Western Christian: early medieval, Romanesque, and Gothic		**19**:345d–379b	
c. The sculpture of Western peoples from the Renaissance to the end of the 19th century		**19**:379b–458g	
i. Renaissance		**19**:379b–412e	**5**:951e–953e / **10**:809h–817c *passim* / **12**:97d–101b / **19**:93e–94b
ii. Baroque		**19**:412e–432e	
iii. Neoclassical, Romantic, and Realistic		**19**:432e–458g	**3**:780e–781a
d. The sculpture of Western peoples in the 20th century		**19**:458h–484c	**3**:116d–118a *passim* / **3**:592b–593a *passim* / **12**:432f–435c *passim* / **18**:942a–c
e. The sculpture of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:202–205		
f. The sculpture of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:952c–954a		
3. The sculpture of Eastern peoples			
a. The sculpture of East Asian peoples	VISUAL ARTS, EAST ASIAN **19**:174–244		
i. Of Chinese peoples		**19**:175b–207c	
ii. Of Korean peoples		**19**:207d–215d	
iii. Of Japanese peoples		**19**:215d–244b	
b. The sculpture of South Asian peoples	SOUTH ASIAN PEOPLES, ARTS OF **17**:171–206	**17**:131c–132c / **8**:905h–906a	
i. Of the peoples of the Indian subcontinent		**17**:184b–197e	
ii. Of the peoples of Sri Lanka		**17**:206c–e	
c. The sculpture of Southeast Asian peoples	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:250–273	**17**:230g–233g	
i. Of Burmese peoples		**17**:253c–255h	
ii. Of Thai and Laotian peoples		**17**:255h–259a	
iii. Of Cambodian and Vietnamese peoples		**17**:259a–264e	
iv. Of Indonesian peoples		**17**:264f–270f	
v. Of Filipino peoples		**17**:270g–271c	
d. The sculpture of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1130–1143	**3**:1122f–h	
4. The sculpture of African peoples: in Sudanic cultures, in West African cultures, in Central African cultures, in East African cultures, and in southern African cultures	AFRICAN PEOPLES, ARTS OF **1**:253–276	**1**:232c–237a	

	articles	article sections	other references
5. The sculpture of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:676–692	**1**:658d–f	
a. Of Eskimo and North American Indian peoples		**1**:679b–684h	
b. Of Meso-American Indian peoples		**1**:684h–687f	**11**:937c–e
c. Of South American Indian peoples		**1**:688b–691f	
6. The sculpture of Oceanian peoples: Melanesian, Micronesian, Polynesian, and Australian Aboriginal peoples	OCEANIAN PEOPLES, ARTS OF **13**:461–467	**13**:449d–454b	**6**:131f–132b

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BERNINI, GIAN LORENZO **2**:863
BRANCUSI, CONSTANTIN **3**:116
CALDER, ALEXANDER **3**:592
CANOVA, ANTONIO **3**:780
CELLINI, BENVENUTO **3**:1057
DONATELLO **5**:951
GHIBERTI, LORENZO **8**:148
GIACOMETTI, ALBERTO **8**:151
LEONARDO DA VINCI **10**:809
MICHELANGELO **12**:97
MIRÓ, JOAN **12**:274
MOORE, HENRY **12**:432
PICASSO, PABLO **14**:440
PISANO, NICOLA AND GIOVANNI **14**:472
RODIN, AUGUSTE **15**:981
SLUTER, CLAUS **16**:893
VERROCCHIO, ANDREA DEL **19**:92

Section 628. Drawing, painting, printmaking, and photography

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 628 deal with four main subjects: A, drawing; B, painting; C, printmaking; and D, photography.

The outline of subject A first deals with the elements of design and principles of composition in drawing and with the surfaces, media, and techniques of drawing. It goes on to the diverse kinds of drawing, determined on the one hand by subject matter and on the other by special uses, such as those involved in animation, caricaturing, cartoon and comic-strip drawing, cartography, and drafting. Finally, it treats the historical developments and the characteristics of drawing in particular cultures.

The outline of subject B first treats the elements of design and principles of composition in painting; special problems, such as that of the representational and the nonrepresentational aspects of painting; the iconography of painting; and the surfaces, media, and techniques of painting. It goes on to related media and techniques, articles being referred to that give separate treatments of mosaic, stained glass, and tapestry. It next treats various classifications of kinds of painting and the characteristics of primitive, folk, and popular painting. Finally, it covers the painting of Stone Age peoples; Western painting, including that of Jewish and Islāmic peoples; the painting of East, South, Southeast, and Central Asian peoples; and the painting of African, of Eskimo and American Indian, and of Oceanian peoples.

The outline of subject C first deals with the characteristics and special problems of printmaking as an art and with the surfaces, media, and techniques of printmaking. It then treats the characteristics of folk and of popular prints and the characteristics of printmaking in particular cultures.

The outline of subject D treats the nature and problems of photography as an art; the aesthetic effects obtained through the equipment, materials, and techniques of photography; the diverse kinds of photography; and the historical development and characteristics of photography in particular cultures.

	articles	article sections	other references
A. Drawing	DRAWING **5**:992–1010		
1. Elements of design and principles of composition		**5**:993e–995f/ **5**:973f–977a	
2. Surfaces, media, and techniques of drawing		**5**:995f–1003d	
a. Drawing surfaces; *e.g.*, paper, plaster, stone		**5**:995b–c/ **5**:995f–996a	
b. Drawing media; *e.g.*, chalk, charcoal, crayon, ink, pastel, pencil, scratchboard, silverpoint, wash		**5**:996a–1003d	
c. Drawing techniques		**5**:995a–b	**5**:973f–977h *passim*
3. Diverse kinds of drawing		**5**:1003h–1007b	
a. Kinds of drawing determined by subject matter; *e.g.*, portraits, landscapes, figure compositions, still lifes		**5**:1003d–h	
b. Kinds of drawing determined by special uses [for aspects of drawing related to writing, see 629.C.4.]			
i. Animation	ANIMATION **1**:918–922		**5**:896f–897d
ii. Caricature, cartoon, and comic strip	CARICATURE, CARTOON, AND COMIC STRIP **3**:909–922	**5**:1003g–h/ **16**:271f–g	**4**:965h–966a

	articles	article sections	other references
iii. Cartography and mapping		**17**:832f–833a	**11**:475c–478e *passim* / **11**:480c–481b *passim*
iv. Drafting	DRAFTING **5**:973–977		
4. Characteristics of drawing in particular cultures: historical developments of drawing		**5**:1007b–1010d	
B. Painting	PAINTING, ART OF **13**:869–885		
1. Painting as an art		**13**:869d–875e	**19**:246g–h
a. Elements of design and principles of composition		**13**:869h–875e	
b. Problems of painting; *e.g.*, the problem of the representational and the nonrepresentational		**13**:882h–883a / **13**:885a–b / **4**:965e–966d	
c. The iconography of painting		**13**:883b–d / **13**:885b–g	**17**:906f–907d
2. Surfaces, media, and techniques of painting		**13**:875e–881a	
a. Painting surfaces; *e.g.*, canvas and other textiles, glass, leather, metal, plaster, stone, wood		**13**:881a–f / **13**:882c–f	
b. Painting media; *e.g.*, acrylic, casein, encaustic, fresco, gouache, ink, oil, tempera, watercolour		**13**:876g–881a	
c. Painting techniques		**13**:875e–876g	
3. Related media and techniques		**19**:247a–c	
a. Calligraphy [see 629.C.4.a.i.]			
b. Drawing [see A., above]			
c. Mosaic	MOSAIC **12**:462–474		
i. Elements of design and principles of composition		**12**:463b–d	
ii. Materials and techniques		**12**:463d–465h	
iii. Periods and centres of activity		**12**:465h–474b / **19**:315g–316d / **19**:323a–g	**19**:327f–328d
d. Photography [see D., below]			
e. Printmaking [see C., below]			
f. Stained glass	STAINED GLASS **17**:566–576		
i. Elements of design and principles of composition		**17**:567b–f	
ii. Materials and techniques		**17**:567g–570g / **2**:63f–g	
iii. Periods and centres of activity		**17**:570h–576d	
g. Tapestry	TAPESTRY **17**:1055–1067		
i. Elements of design and principles of composition		**17**:1055d–f	
ii. Materials and techniques		**17**:1055f–1057h	
iii. Periods and centres of activity		**17**:1057h–1067a	
4. The kinds of painting		**13**:881a–885b	**2**:83a–b
a. Kinds of painting determined by the type or form of the physical object on which the picture is painted		**13**:881a–883a	
i. Fixed objects; *e.g.*, cave painting, mural painting		**13**:881a–e / **17**:704d–706c	**19**:314e–315e
ii. Movable objects: easel painting, fan painting, manuscript illumination, miniature painting, screen painting, and scroll painting		**13**:881e–882f	
b. Kinds of painting determined by subject matter		**13**:883a–885b / **4**:965e–966d	
i. Representational painting; *e.g.*, devotional painting, genre painting, landscape painting, narrative painting, portrait painting		**13**:883d–885a	**3**:1174h–1175b / **19**:315e–f

	articles	article sections	other references
ii. Nonrepresentational painting		**13**:882h–883a / **13**:885a–b	
c. Primitive painting [see 611.B.4.]			
d. Folk painting	FOLK VISUAL ARTS **7**:470–480		**14**:1034b–1035g *passim*
e. Popular painting		**14**:1035h–1037b / **8**:974f–975a	
5. The painting of Stone Age peoples: Paleolithic, Mesolithic, and Neolithic	STONE AGE EUROPEAN PEOPLES, ARTS OF **17**:702–708		
6. Characteristics of painting in Western cultures: historical developments of Western painting	VISUAL ARTS, WESTERN **19**:245–484		
a. The painting of Western peoples in antiquity		**19**:248h–324e / **12**:784f–g	
i. Ancient Egyptian		**19**:248h–257h	
ii. Ancient Near Eastern: Mesopotamian, Syro-Palestinian, pre-Islāmic Arabian, Anatolian, and Iranian		**19**:257h–273c	
iii. European Metal Age: Aegean and eastern Mediterranean, western Mediterranean, and northern European		**19**:273d–284f	**1**:118c–e
iv. Ancient Greek and Hellenistic		**19**:284f–300c	**8**:333f–334a
v. Ancient Roman and early Christian		**19**:300d–324e	**15**:1119b–d
b. The painting of Western peoples in the Middle Ages		**19**:324e–379b	
i. Eastern Christian: Byzantine, Armenian, Georgian, Syriac and Palestinian, Coptic, and Ethiopian		**19**:324e–345d	
ii. Western Christian: early medieval, Romanesque, and Gothic		**19**:345d–379b	**4**:616c–617b *passim* / **5**:1076f–1078c *passim*
c. The painting of Western peoples from the Renaissance to the end of the 19th century		**19**:379b–458g	
i. Renaissance		**19**:379b–412e	**2**:1022f–1023f *passim* / **3**:75h–78f *passim* / **3**:338f–341d *passim* / **5**:190e–h / **5**:1085a–1088e *passim* / **8**:161f–163f *passim* / **8**:306b–308h *passim* / **10**:809h–817c *passim* / **11**:462a–464a *passim* / **14**:454b–455c *passim* / **15**:512b–514f *passim* / **17**:428d–f / **18**:434c–436d / **18**:457g–461b *passim*
ii. Baroque		**19**:412e–432e	**15**:652g–658e / **16**:4b–e
iii. Neoclassical, Romantic, and Realistic		**19**:432e–458g	**4**:10b–12d *passim* / **5**:70b–71a / **6**:1070b–c / **6**:1076b–d / **8**:232d–233f / **11**:439f–442c *passim* / **12**:347f–349d
d. The painting of Western peoples in the 20th century		**19**:458h–484c	**3**:731c–e / **8**:67a–b / **10**:376e–379b *passim* / **11**:699e–701f *passim* / **12**:274f–275g *passim* / **12**:344e–346c *passim* / **14**:440g–444h *passim* / **18**:941h–942c
e. The painting of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:202–205		
f. The painting of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:982–1010	**9**:952c–954a / **9**:923e–h / **9**:951g–h	

	articles	article sections	other references
7. Characteristics of painting in Eastern cultures: historical developments of Eastern painting			
a. The painting of East Asian peoples	VISUAL ARTS, EAST ASIAN **19**:174–244		
i. Of Chinese peoples		**19**:175b–207c	
ii. Of Korean peoples		**19**:207d–215d	
iii. Of Japanese peoples		**19**:215d–244b	**16**:567f–569a *passim*
b. The painting of South Asian peoples	SOUTH ASIAN PEOPLES, ARTS OF **17**:171–206	**17**:131c–132c / **8**:906a–b	
i. Of the peoples of the Indian subcontinent		**17**:197e–203h	
ii. Of the peoples of Sri Lanka		**17**:206f–h	
c. The painting of Southeast Asian peoples	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:250–273	**17**:230g–233g	
i. Of Burmese peoples		**17**:253c–255h	
ii. Of Thai and Laotian peoples		**17**:255h–259a	
iii. Of Cambodian and Vietnamese peoples		**17**:259a–264e	
iv. Of Indonesian peoples		**17**:264f–270f	
v. Of Filipino peoples		**17**:270g–271c	
d. The painting of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1130–1143	**3**:1122f–h	
8. The painting of African peoples: in Sudanic cultures, in West African cultures, in Central African cultures, in East African cultures, and in southern African cultures	AFRICAN PEOPLES, ARTS OF **1**:253–276	**1**:232c–237a	
9. The painting of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:676–692	**1**:658d–f	
a. Of Eskimo and North American Indian peoples		**1**:679b–684h	
b. Of Meso-American Indian peoples		**1**:684h–687f	**11**:938b–d
c. Of South American Indian peoples		**1**:688b–691f	
10. The painting of Oceanian peoples: painting of Melanesian, Micronesian, Polynesian, and Australian Aboriginal peoples	OCEANIAN PEOPLES, ARTS OF **13**:461–467	**13**:449d–454b	
C. Printmaking	PRINTMAKING **14**:1074–1096		
1. Printmaking as an art: its characteristics and problems; *e.g.*, the problem of originality versus reproduction		**14**:1074b–h	
2. Surfaces, media, and techniques of printmaking		**14**:1075a–1085c	
a. Printmaking surfaces: the diverse kinds of paper and fabrics		**14**:1084g–h	
b. Printmaking media			
i. Relief or cameo media; *e.g.*, woodcuts and linoleum cuts, wood engraving		**14**:1075b–1077a	**14**:300g–h
ii. Intaglio media; *e.g.*, aquatint, drypoint, etching, lift-ground prints, line engraving, mezzotint, soft-ground print, stipple, engraving		**14**:1077b–1081b	**14**:300h–301c
iii. Surface media: lithography, monoprint, serigraphy		**14**:1081c–1084b	
c. Printmaking tools and techniques [see 735.E.4.b.]			
3. Folk prints	FOLK VISUAL ARTS **7**:472–473		
4. Popular prints		**3**:911c–922b	

	articles	article sections	other references
5. Characteristics of printmaking in particular cultures: their historical developments		**14**:1085c–1096b / **14**:300g–306c / **19**:406f–h	**14**:1052g–1059c *passim* / **15**:655d–f
D. Photography as an art	PHOTOGRAPHY, ART OF **14**:306–326		
1. The nature and problems of photography as an art		**14**:306d–307b	**12**:498a–499h *passim*
a. Elements of design and principles of composition		**14**:306h–307b / **14**:312d–313c	
b. Characteristics of photography: the unique reproductive capacity of the photograph; the dual nature of the photograph as both an aesthetic and a documentary object		**14**:306e–h	
c. Problems of photography; *e.g.*, the problem of environment and movement, the problem of optical and chemical limitations of the medium		**14**:316d–318e	
d. Theoretical, scholarly, descriptive, and critical writings on photography		**14**:309h–310b / **14**:316f–317c	
2. Aesthetic effects obtained through the equipment, materials, and techniques of photography [for technological aspects, see 735.G.]		**14**:307c–309b	**12**:500d–504b *passim*
a. Lenses		**14**:307c–f	
b. Cameras		**14**:307f–308b	
c. Exposure, processing, and printing		**14**:308c–309b	
3. The kinds of photography			
a. Major kinds of photography determined by subject matter; *e.g.*, portraits, landscapes		**14**:311g–312c / **14**:320f–321f	
b. Kinds of functional photography; *e.g.*, photojournalism and photo reportage, holography, astronomical photography, aerial photography, radiography		**14**:313f–315c / **14**:322d–324c / **14**:342h–345g	**8**:1007e–1011b *passim*
c. Popular or amateur photography		**14**:315h–316c / **8**:975d–f	
4. Characteristics of photography in particular cultures: historical developments of photography		**14**:309c–326f	**14**:328d–329d / **17**:690d–691e *passim*
a. Developments to World War I		**14**:309c–318e	
b. Developments since World War I		**14**:318e–326f	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ANDREA DEL SARTO **1**:865
ANGELICO, FRA **1**:869
BELLINI, GIOVANNI **2**:828
BERNINI, GIAN LORENZO **2**:863
BLAKE, WILLIAM **2**:1100
BONNARD, PIERRE **3**:36
BOTTICELLI, SANDRO **3**:75
BRAQUE, GEORGES **3**:118
BRUEGEL, PIETER, THE ELDER **3**:338
CALDER, ALEXANDER **3**:592
CANALETTO **3**:751
CARAVAGGIO **3**:815
CARRACCI **3**:957
CARTIER-BRESSON, HENRI **3**:971
CÉZANNE, PAUL **4**:10
CHAGALL, MARC **4**:19
CHARDIN, JEAN-BAPTISTE-SIMÉON **4**:42
CIMABUE **4**:616
CLAUDE LORRAIN **4**:694
CONSTABLE, JOHN **5**:69
COROT, JEAN-BAPTISTE-CAMILLE **5**:180
CORREGGIO **5**:190
COURBET, GUSTAVE **5**:228
CRANACH, LUCAS, THE ELDER **5**:232
DAUMIER, HONORÉ **5**:515
DAVID, JACQUES-LOUIS **5**:519
DEGAS, EDGAR **5**:558
DE KOONING, WILLEM **5**:563
DELACROIX, EUGÉNE **5**:565
DUCCIO DI BUONINSEGNA **5**:1076
DUCHAMP, MARCEL **5**:1078
DÜRER, ALBRECHT **5**:1025
EAKINS, THOMAS **5**:1118
EYCK, JAN AND HUBERT VAN **7**:89
FRAGONARD, JEAN-HONORÉ **7**:580
GAINSBOROUGH, THOMAS **7**:823
GAUGUIN, PAUL **7**:958
GHIRLANDAJO, DOMENICO **8**:150
GIORGIONE **8**:160
GIOTTO **8**:161
GOGH, VINCENT VAN **8**:231
GOYA, FRANCISCO DE **8**:258
GRECO, EL **8**:308
GRÜNEWALD, MATTHIAS **8**:449
HALS, FRANS **8**:576
HIROSHIGE **8**:943
HOGARTH, WILLIAM **8**:985
HOKUSAI **8**:989
HOLBEIN, HANS, THE YOUNGER **8**:990
HOMER, WINSLOW **8**:1021
HSIA KUEI **8**:1122
INGRES, JEAN-AUGUSTE-DOMINIQUE **9**:582
KANDINSKY, WASSILY **10**:376
KLEE, PAUL **10**:492
KOKOSCHKA, OSKAR **10**:499
LÉGER, FERNAND **10**:784
LEONARDO DA VINCI **10**:809
LIPPI, FRA FILIPPO **10**:1022
MANET, ÉDOUARD **11**:439
MANTEGNA, ANDREA **11**:462
MASACCIO **11**:570
MATISSE, HENRI **11**:698
MA YÜAN **11**:723
MEMLING, HANS **11**:884
MICHELANGELO **12**:97
MI FEI **12**:173
MIRÓ, JOAN **12**:274
MODIGLIANI, AMEDEO **12**:298
MONDRIAN, PIET **12**:343
MONET, CLAUDE **12**:347
MORRIS, WILLIAM **12**:456
MUNCH, EDVARD **12**:616
OGATA KŌRIN **13**:515
OROZCO, JOSÉ CLEMENTE **13**:741
PERUGINO **14**:136
PICASSO, PABLO **14**:440
PIERO DELLA FRANCESCA **14**:454
PISSARRO, CAMILLE **14**:474
POLLOCK, JACKSON **14**:747
POUSSIN, NICOLAS **14**:933
RAPHAEL **15**:512
REMBRANDT **15**:652
RENOIR, PIERRE-AUGUSTE **15**:673
REYNOLDS, SIR JOSHUA **15**:791
ROSSETTI FAMILY **15**:1155
ROUAULT, GEORGES **15**:1166
ROUSSEAU, HENRI **15**:1170
RUBENS, PETER PAUL **16**:1
SESSHŪ **16**:567
SEURAT, GEORGES **16**:575
SŌTATSU **17**:17
STEICHEN, EDWARD **17**:665
STIEGLITZ, ALFRED **17**:690
TIEPOLO, GIOVANNI BATTISTA **18**:399
TINTORETTO **18**:433
TITIAN **18**:457
TOULOUSE-LAUTREC, HENRI DE **18**:533
TURNER, J.M.W. **18**:802
UCCELLO, PAOLO **18**:824
VAN DYCK, SIR ANTHONY **19**:23
VELÁZQUEZ, DIEGO **19**:53
VERMEER, JAN **19**:86
VERONESE, PAOLO **19**:87
WATTEAU, ANTOINE **19**:663
WEYDEN, ROGIER VAN DER **19**:803
WHISTLER, JAMES MCNEILL **19**:814

Section 629. Arts of decoration and functional design

[for Part Six headnote see page 383
for Division II headnote see page 393]

The articles and parts of articles referred to in Section 629 deal with five main subjects: A, the nature and scope of the arts of decoration and functional design; B, the arts of decoration; C, the arts of functional design; D, primitive, folk, and popular arts of decoration and functional design; and E, the characteristics of the arts of decoration and functional design in particular cultures and their historical developments.

The outline of subject A treats the general aesthetic characteristics of the arts of decoration and functional design and the materials, processes, and techniques of these arts.

The outline of subject B treats the kinds of decorative art and the types of decorative objects classified by the materials and the methods used to produce or decorate them. Articles referred to give separate treatment to such arts as pottery, glasswork, metalwork, floral decoration, basketry, enamelwork, and lacquerwork.

The outline of subject C, the arts of functional design, involves a classification of kinds and types of decorative objects according to differences of function. The outline begins with diverse conceptions of the functions of dress design and body decoration and with the historical development and characteristics of dress design and body decoration in particular cultures. It goes on to the characteristics of industrial design as an art; the influence of modern materials and technological processes on industrial design; the diverse kinds of industrial design classified by function; and the historical development of industrial design.

Dealing next with interior design, the outline covers its special aesthetic problems; the integration of interior design and decoration with architecture; the furniture and accessory furnishings used for interior decoration; the diverse kinds of interior design and decoration determined by function; and the characteristics of interior design and decoration in particular cultures. The outline next deals with the design of materials and objects for communication and identification, treating handwriting systems and styles; the several printing arts; advertising art and design; the design of signs and symbols used primarily for identification, such as heraldic design; and the design of various kinds of exhibitions and displays, such as museum and gallery display. Finally, the outline deals with the design and decoration of diverse kinds of specialized functional objects—the design of coins, currency, and medals; of play materials; of decorative mechanical objects, such as automata; and of objects for the military, such as arms and armour.

The outline of subject D covers primitive, folk, and popular arts of decoration and functional design.

Subject E is the historical development and characteristics of the arts of decoration and functional design in particular cultures. The outline covers the arts of decoration and functional design of Stone Age peoples; of Western, including Jewish and Islāmic, peoples; of East, South, Southeast, and Central Asian peoples; and of African, Eskimo and American Indian, and Oceanian peoples.

articles	article sections	other references
A. The nature and scope of the arts of decoration and functional design		
1. General aesthetic characteristics of the arts of decoration and functional design [for the general aesthetic characteristics of the arts of decoration and of functional design as visual arts, see 611.B.; for the specific aesthetic characteristics of particular decorative arts and arts of functional design, see B. and C., below]		
2. The materials, processes, and techniques of the arts of decoration and functional design [for technological aspects, see Part Seven; for painting and drawing, see 628; for sculpture, see 627; for the various crafts, see B., below]		
B. The arts of decoration: the kinds of decorative arts and types of decorative objects classified by the materials and methods used to produce or decorate them, or both		
1. Clay		
POTTERY **14**:892–930	**8**:980c–e/ **16**:425f–h	
2. Fabrics	**2**:63g–h/ **8**:979h–980b/ **9**:698c–h/ **16**:11a–24b/ **18**:176a–184c/ **18**:186e–187f	**18**:171a–172g *passim*
3. Gems	**7**:978b–979a/ **10**:164g–165c/ **10**:166b–e	**7**:969c–976e *passim*/ **19**:180g–181c/ **19**:317h–318a
GLASS, HISTORY OF **8**:181–196	**12**:463h–464h	**17**:566h–576d *passim*/ **19**:318b–c
4. Glass		
METALWORK **11**:1092–1118	**7**:782f–783a/ **10**:164e–g/ **10**:165e–h/ **16**:425c–e	**11**:1061b–1063e/ **19**:317a–f
5. Metals		
6. Paper; *e.g.*, papier-mâché, wallpaper		**9**:695h–696c/**16**:426g
7. Stone	**12**:463f–g/ **16**:424f–425a	**11**:487d–e
8. Wood	**7**:781h–782f/ **8**:980e–g/ **16**:425b–c	

	articles	article sections	other references
9. Other kinds of inorganic materials *with special attention to*			
a. Plaster, cement, and concrete		**16**:426d–f	
b. Plastics and other synthetic materials		**14**:510f–511b	**16**:426f
10. Other kinds of organic materials *with special attention to*			
a. Flowers, foliage, and related botanical materials; *e.g.*, bouquets, garlands, wreaths [for garden and landscape design, see 626.B.]	FLORAL DECORATION **7**:411–419	**9**:698h–699b	
b. Plant fibres, reeds, branches, and related materials; *e.g.*, baskets, mats	BASKETRY **2**:757–762		
c. Skins, furs, and related materials		**7**:815c–816c	**10**:759g–761b *passim*
d. Shell, horn, bone, ivory, and related materials		**7**:976f–977d / **16**:425h–426a	
e. Wax			**13**:523b–c / **16**:426g
11. Special decorative finishing materials, processes, and techniques			
a. Enamelwork; *e.g.*, cloisonné, champlevé, painted enamels	ENAMELWORK **6**:773–779	**10**:165h–166b	
b. Lacquerwork; *e.g.*, carved lacquer, inlaid lacquer, laque burgautée	LACQUERWORK **10**:575–580		**19**:184b–d / **19**:240c–d
c. Inlay work; *e.g.*, veneering, intarsia, marquetry			**7**:784g–785a
C. The arts of functional design: kinds and types of artistic object classified by their function			
1. Dress design and body decoration		**10**:166e–h / **11**:578g–579g	
a. Dress and dress accessories	DRESS **5**:1015–1039		
i. Diverse conceptions of the functions of dress; *e.g.*, as a form of individual and collective human expression; as a symbol of status or membership; as a symbol of religious, military, or magical power		**5**:1015h–1016d / **3**:1175b–d / **15**:634f–635a	**4**:752e–g / **4**:846d–e / **5**:1024h–1025e / **8**:782h–798e *passim* / **11**:580d–585c *passim* / **16**:121c–f
ii. Materials, methods, and techniques used in the making of dress and dress accessories [for the technological aspects of garment making, see 732.B.3]		**2**:761b–d / **4**:752b–d	**18**:171a–187f *passim*
iii. Jewelry	JEWELRY **10**:164–182		
b. Body decoration			**10**:166f–h
i. Diverse conceptions of the functions of body decoration		**3**:1175b–d / **15**:634f–635a	
ii. Major types of body decoration: cosmetics; hairdressing and hair adornment; physical modification; perfumes, scents, and fragrances		**5**:196a–198h	
c. Characteristics of dress design and body decoration in particular cultures: historical developments of dress design and body decoration		**5**:1016e–1039f / **1**:121g–122a / **5**:196c–e / **10**:166e–182h / **15**:635b–639g	**6**:170e–f / **19**:240f–h
2. Industrial design	INDUSTRIAL DESIGN **9**:512–519		
a. Industrial design as an art		**9**:512d–513d	
i. Elements of composition and principles of design: the essence of good design		**9**:512g–513d	
ii. The special nature and problems of industrial design; *e.g.*, the relation of appearance to function, the relation of design to public taste, the problems of mass production		**9**:518h–519h	
b. The influence of modern materials and technological processes on industrial design		**9**:516f–518h	
c. Diverse kinds of industrial design classified by function; *e.g.*, design of commercial equipment, design of communications equipment, design of household appliances, design of transportation equipment		**7**:785h–794a / **11**:598e–599b	**2**:519h–527f *passim* / **4**:743c–750d *passim*

	articles	article sections	other references
d. Historical development of industrial design		**9**:513e–518h	
3. Interior design	INTERIOR DESIGN **9**:687–730		
a. Interior design as an art		**9**:687a–694f	
i. The special elements and principles of composition in interior design		**9**:687g–693e	
ii. The special problems of interior design; *e.g.*, the problem of relating aesthetic response to functional, social, and economic demands; the problem of relating aesthetic response to natural environment and pre-existing architectural environment; the problem of appropriateness		**9**:687b–g	
iii. The iconography of interior design		**9**:693e–694f	
b. The integration of interior design and decoration with architecture: the design and decoration of interior architectural elements		**9**:694f–697d	
i. Ceilings		**9**:694g–h	
ii. Floors		**9**:694h–695g	**12**:466b–468a *passim*
iii. Floor coverings; *e.g.*, rugs, carpets, mats	RUGS AND CARPETS **16**:10–24	**7**:406d–409h	
iv. Walls; *e.g.*, moldings, panelling, wallpaper		**9**:695g–696d	**17**:1055d–1067a *passim*
v. Windows and doors		**9**:696d–g	**17**:566h–576d *passim*
vi. Other interior architectural elements; *e.g.*, heating units, stairs and staircases		**9**:696g–697d	
c. Objects used for interior decoration: furniture and accessory furnishings	FURNITURE AND ACCESSORY FURNISHINGS **7**:781–807	**9**:697d–699b	
i. General aesthetic characteristics of furniture design and decoration		**7**:781e–f	
ii. Materials, processes, and techniques of the construction and decoration of furniture and accessory furnishings [for the industrial aspects of furniture production, see 732.B.4.]		**7**:781h–785h / **2**:63d–f / **7**:808b–811c	**3**:1181b–d
iii. Kinds and types of furniture: chairs, tables, beds, storage furniture, kitchen furniture, bathroom furniture, multiple-use furniture, and furniture for special functions or occasions		**7**:785h–793a / **2**:761a–b	
iv. Kinds and types of accessory furnishings: clocks, mirrors, fabrics, lamps, screens, accessory furnishings for special functions or occasions		**7**:793b–794a	**2**:990f–h / **17**:1055d–1067a *passim*
v. Characteristics of furniture and accessory furnishings in particular cultures: history of furniture design and decoration		**7**:794a–807b	
d. Diverse kinds of interior design and decoration determined by function; *e.g.*, domestic, governmental, institutional, public and commercial, religious [for analogous kinds of architecture, see 626.A.5.]		**9**:700f–702b / **3**:1176b–g	
e. Characteristics of interior design and decoration in particular cultures: their historical developments		**9**:702c–730c	
4. The design of materials and objects for communication and identification			
a. Handwriting systems and styles [for forms of writing, see 442.C.]			
i. Calligraphy: writing as an art	CALLIGRAPHY **3**:645–669		**13**:912e–914b *passim* / **19**:175f–g / **19**:187h–188b / **19**:228b–c / **19**:1042g
ii. Lettering and illuminating		**1**:109d–g / **13**:881h–882b	**10**:203h–204c / **10**:204d–e / **19**:352f–353h / **19**:361a–362e / **19**:367g–h / **19**:371a–c
b. Printing arts: typography and printing design; illustration; bookbinding [for printmaking, see 628.C.]	TYPOGRAPHY **18**:810–824		**14**:1052g–1059c *passim*

	articles	article sections	other references
c. Advertising art and design	ADVERTISING DESIGN **1**:108–111		
i. General considerations about advertising design; *e.g.*, its relation to other arts and to technology; the role of the advertising designer or commercial artist		**1**:108d–109a	
ii Media, materials, and techniques of advertising design		**1**:109b–g	**1**:106c–d
iii. Historical development of advertising design		**1**:109h–111e	
d. The design of signs and symbols used primarily for identification; *e.g.*, heraldic design	HERALDRY **8**:782–798	**1**:109d–g	
i. General considerations about the design of identification devices: its nature, scope, and relation to other kinds of design		**8**:782h–786h	
ii. Elements, principles, materials, and techniques		**8**:786h–793e	
iii. Historical development		**8**:793e–798d / **16**:741f–743f	
e. The design of exhibitions and displays; *e.g.*, museum and gallery display		**12**:653e–654a	
5. The design and decoration of diverse kinds of specialized functional objects			
a. The design of coins and currency and of medals		**3**:1075e–f / **4**:821h–823a	
b. The design and decoration of play materials [for game boards and implements and playing cards, see 452.C.]		**4**:203e–h	**2**:990c–h
c. Automata: the design of decorative mechanical objects	AUTOMATA **2**:494–496		**15**:910d–e
d. The design and decoration of arms [for the technological aspects of arms, see 736]	ARMS DESIGN AND DECORATION **2**:30e–35b	**2**:28c–30d	**8**:782h–798e *passim* / **19**:240b–c
i. Elements of arms design and decoration: ornamental motifs and devices		**2**:31e–32c	
ii. Materials and techniques of arms design and decoration		**2**:32c–33a	
D. Primitive, folk, and popular arts of decoration and functional design			
1. Primitive arts of decoration and functional design [see 611.B.4.]			
2. Folk arts of decoration and functional design	FOLK VISUAL ARTS **7**:470–480	**17**:271d–273a	**14**:1034b–1035g *passim*
3. Popular arts of decoration and functional design		**8**:979c–980g / **14**:1035h–1037b	
E. Characteristics of the arts of decoration and functional design in particular cultures: their historical developments			
1. The arts of decoration and functional design of Stone Age peoples: Paleolithic, Mesolithic, and Neolithic	STONE AGE EUROPEAN PEOPLES, ARTS OF **17**:702–708		**2**:761g–h / **5**:291a–c / **6**:1060a–1061b *passim*
2. Characteristics of the arts of decoration and functional design in Western cultures: their historical developments	VISUAL ARTS, WESTERN **19**:245–484	**6**:775e–777e / **7**:414g–417c / **10**:166h–178c	
a. Arts of decoration and functional design of Western peoples in antiquity		**19**:248h–324e / **6**:775e–776a / **8**:181d–183b / **10**:166h–171c / **11**:1094e–f / **11**:1096b–1097c / **11**:1101g–1104b / **11**:1108b–c / **11**:1110f–h	**2**:33b–c / **7**:414g–415c
i. Ancient Egyptian		**19**:248h–257h / **5**:1016e–1017h / **14**:897f	**10**:167e–168d

	articles	article sections	other references
ii. Ancient Near Eastern: Mesopotamian, Syro-Palestinian, pre-Islāmic Arabian, Anatolian, and Iranian		**19**:257h–273c / **5**:1017h–1019d / **14**:897d–e / **17**:929d–931b	**1**:993a–b / **17**:938b–f / **18**:1021e–f
iii. European Metal Age: Aegean and eastern Mediterranean, western Mediterranean, and northern European		**19**:273d–284f / **5**:1020f–1021b / **14**:897g–899c / **14**:900d–f / **10**:250d–251b / **17**:403b–404a	**1**:114d–h / **1**:115c–117e *passim* / **1**:118e–119b / **3**:1072d–1073h *passim* / **6**:1061c–1063a *passim* / **9**:1080d–f / **16**:439f–442a *passim*
iv. Ancient Greek and Hellenistic		**19**:284f–300c / **5**:1021c–1023a / **14**:899a–900d	**8**:333f–334a / **10**:169c–170d
v. Ancient Roman and early Christian		**19**:300d–324e / **5**:1023b–1024d / **14**:900f–901b	**10**:170d–171c
b. Arts of decoration and functional design of Western peoples in the Middle Ages		**19**:324e–379b / **6**:776a–f / **8**:183b–f / **10**:171c–173d / **11**:1094h–1095b / **11**:1104b–1105b / **11**:1108c–f / **11**:1114h–1115a	**2**:495c–d / **7**:415c–d / **11**:1097d–1101f *passim*
i. Eastern Christian: Byzantine, Armenian, Georgian, Syriac and Palestinian, Coptic, and Ethiopian		**19**:324e–345d	**10**:171c–e
ii. Western Christian: early medieval, Romanesque, and Gothic		**19**:345d–379b / **3**:653e–656f / **5**:1024d–1026b	**10**:172h–173d
c. Arts of decoration and functional design of Western peoples from the Renaissance to the end of the 19th century		**19**:379b–458g / **5**:1026c–1032b / **6**:776f–777e / **8**:184e–191f / **10**:173d–177f / **10**:579b–580e / **11**:1095c–g / **11**:1105c–1107b / **11**:1108g–1109h / **11**:1110h–1114g / **11**:1115a–c / **14**:904d–917c	**2**:33e–34a / **2**:495d–496c / **7**:415d–416g
i. Renaissance		**19**:379b–412e / **3**:656g–657g	
ii. Baroque		**19**:412e–432e	
iii. Neoclassical, Romantic, and Realistic		**19**:432e–458g	
d. Arts of decoration and functional design of Western peoples in the 20th century		**19**:458h–484c / **5**:1032b–1035b / **6**:660e–661f / **8**:191g–195f / **10**:177f–178c / **14**:917d–918e	**7**:416g–417c / **11**:1107b–e
e. Arts of decoration and functional design of Jewish peoples	JEWISH PEOPLES, ARTS OF **10**:202–205		
f. Arts of decoration and functional design of Islāmic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:982–1010	**9**:952c–954a / **5**:1019d–1020e / **8**:183f–184e / **11**:1097e–h / **14**:901b–904d	**10**:171e–g
3. Characteristics of the arts of decoration and functional design in Eastern cultures: their historical developments			
a. The arts of decoration and functional design of East Asian peoples	VISUAL ARTS, EAST ASIAN **19**:174–244	**6**:665d–669g / **11**:1116b–1117e	**2**:34a–c / **7**:417g–419a
i. Of Chinese peoples		**19**:175b–207c / **4**:353a–b / **5**:1035d–1036f / **6**:665f–668c / **6**:777f–779a / **8**:195f–196a / **10**:576f–577e / **11**:1116b–1117b / **14**:918e–925c	**2**:496c–g / **4**:299d–301e *passim* / **10**:178c–179a

	articles	article sections	other references
ii. Of Korean peoples		**19**:207d–215d / **5**:1038c–g / **6**:668c–h / **14**:925c–926b	
iii. Of Japanese peoples		**19**:215d–244b / **5**:1036f–1038c / **6**:668h–669g / **6**:779b–e / **10**:577e–579b / **11**:1117b–e / **14**:926b–928c	**10**:179a–b
b. The arts of decoration and functional design of South Asian peoples	SOUTH ASIAN PEOPLES, ARTS OF **17**:171–206	**17**:131c–132c / **5**:1038h–1039f / **10**:179b–180a / **11**:1115d–h	
i. Of the peoples of the Indian subcontinent		**17**:203h–205c / **9**:342d–g / **9**:343e–g	
ii. Of the peoples of Sri Lanka		**17**:206c–e	
c. The arts of decoration and functional design of Southeast Asian peoples	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:250–273	**17**:230g–233g / **10**:180a–b / **11**:1116a–b	
i. Of Burmese peoples		**17**:253c–255h	
ii. Of Thai and Laotian peoples		**17**:255h–259a / **14**:928d–e	
iii. Of Cambodian and Vietnamese peoples		**17**:259a–264e	
iv. Of Indonesian peoples		**17**:264f–270f	**9**:475h–476c
v. Of Filipino peoples		**17**:270g–271c	
d. The arts of decoration and functional design of Central Asian peoples	CENTRAL ASIAN PEOPLES, ARTS OF **3**:1130–1143	**3**:1122f–h	
4. The arts of decoration and functional design of African peoples: in Sudanic cultures, in West African cultures, in Central African cultures, in East African cultures, and in southern African cultures	AFRICAN PEOPLES, ARTS OF **1**:253–271	**1**:232c–237a / **10**:180d–181b / **11**:1118d–g	
5. The arts of decoration and functional design of Eskimo and American Indian peoples	AMERICAN INDIAN PEOPLES, ARTS OF **1**:676–692	**1**:658d–f / **10**:181b–182h / **11**:1117e–1118c / **14**:928f–930a	**2**:761h–762a
a. Of Eskimo and North American Indian peoples		**1**:679b–684h / **14**:928g–929a	
b. Of Meso-American Indian peoples		**1**:684h–687f / **11**:945d–g / **14**:929b–e	
c. Of South American Indian peoples		**1**:688b–691f / **14**:929f–930a	**1**:841h–847a *passim* / **17**:124f–h
6. The arts of decoration and functional design of Oceanian peoples: Melanesian, Micronesian, Polynesian, and Australian Aboriginal peoples	OCEANIAN PEOPLES, ARTS OF **13**:461–467	**13**:449d–454b	**2**:762a–d / **11**:866g–867c / **14**:780a–d / **14**:783c–d

Introduction to Part Seven:
Knowing how and knowing why

by Lord Ritchie-Calder

Benjamin Franklin defined man as "the tool-making animal." If he had added the phrase "with foresight," he would have adequately described *Homo faber*, man the technologist.

Inventiveness was the indispensable condition for the survival of the human species. Without fur or feather, carapace or scale, ancestral man stood naked to the elements; and without fang or claw or tusk to fight his predators, without speed to elude them, without camouflage to deceive them or the ability to take to the trees like his cousin, the ape, he was physically at a hopeless disadvantage. What he developed to deal with his deficiencies was the capacity to invent. He possessed not only sensory perceptions (though these were less acute than those of many of his fellow creatures), he also possessed imagination and finger-skills. He did not just improvise to meet an emergency as an ape might in using a broken branch as a weapon; he also saw the need for keeping a club handy—he planned ahead. Other creatures had their inherited instincts, their built-in experience. Some, like the beaver or the weaverbird, with their biological tools, could contrive quite elaborate structures; others, like the bees or the ants, could evolve efficient organizations; others, like the squirrel, were provident in the sense of laying in stores. With nimbleness of brain and hand, a combination of gray matter and motor-cells, man could scheme to outreach, with club, or spear or sling, his natural enemies; he could manage nature and escape from the restraints of his environment. He clothed himself in pelts and moved to inhospitable climes, he mastered fire and dared to bring it into his dwelling for heating and cooking, he learned to cultivate and plant the soil, he domesticated animals, and he devised specialized tools like the hoe and the ax to improve the efficiency of his labour.

From earliest time and beginning with the simplest contrivances, every discovery and invention has depended on the fact that the human being is not only a perceptual but also a conceptual creature capable of observing, memorizing, and juxtaposing images. He can make a mental design, a techno-poetic fantasy, even when the means of actually producing it are not available. Seven hundred years ago Roger Bacon could imagine a power-driven ship, a horseless carriage, an airplane, the miniaturized servo-motor, "but one finger in length and one in width," and the bathysphere. The vision cannot materialize, however, unless man has the method. This is the process by which he makes an observation (perceptual); forms a hypothesis (conceptual); experiments to test this "hunch"; formulates a theory to justify his insights; and by further proofs produces "laws" according to which anyone can go on repeating the results. With spoken language, he can transfer experience, father to son, master to apprentice, generation to generation. With written language, he can produce the textbooks that are the ready-reckoners for other innovators who thereby do not have to rediscover Newton's laws or the laws of thermodynamics every few years. This systematic treatment of the arts and crafts is the simplest expression of the meaning of "technology," from the Greek roots *techne*, arts, and *logia*, words. The ancient Greeks had no such combined term because their philosophers divorced manual skills from intellectual pursuits. Plato berated Eudoxus and Archytas when by experiments and recourse to instruments they solved problems that the theorists considered insoluble. He accused them of "making use of matter which requires manual labour and is the object of servile trades."

This intellectual condescension still persists, although individual technologists have won recognition from scientific societies and learned academies. The prejudice is suggested by the acceptance of the term "science *and* technology." Yet both science and technology use the scientific method. Was Leonardo da Vinci, apart from being an artist, a scientist or a technologist? In terms of discovering and testing new knowledge he was a man of science, but his designs for practical innovations outnumbered those of Thomas Alva Edison. Edison, 400 years later, patented over 1,000 inventions. They included major ones, for which he is remembered, but also hundreds of bits of useful hardware, important in their way. He made only one scientific discovery, the Edison effect, which he patented but did not pursue. The rest were derived from scientific knowledge and developments. He saw the profitable relevancies that lesser men missed; he fitted the mental nut to the mental bolt and created things.

Customarily, science, or the scientific hierarchy, is divided into four categories:

Pure, or academic, research is the pursuit of knowledge for its own sake. It is mainly the work of an individual, or the group he leads. The pure scientist has to justify himself only before a jury of his peers. He is judged not by the usefulness but by the integrity of his work. He is the Maker Possible.

Oriented fundamental research is still basic science, that is to say the scientist is still questioning nature, seeking to extend knowledge and understanding, but he is not a free agent indulging his curiosity. He is restrained within a frame of reference. For instance, in studying chemical reactions at high pressures he is not assuming that he is going to discover polyethylene, or if he is studying gases at high temperatures he is not necessarily thinking of jet engines or rockets; but he is compiling data that will be important in a general field and likely to have some foreseen applications. In the big corporations, this is called "speculative research." Such a scientist is likely to have adequate research facilities, endowments, or contracts. He is the Maker Probable.

Applied research is programmed research. The target is specified, and results are expected. The predicted yield is the measure of the support. The scientist is held accountable in the annual report. He is the Maker to Happen.

Development is really technology, but coupling it with research (R and D) keeps it in the scientific hierarchy and away from the "rude mechanicals." It is the transfer of laboratory results, through the pilot plant, to the production line. R and D is far and away the most expensive scientific bracket because large-scale trial and error ("back to the drawing board") involves multimillions of dollars. The R and D scientist is the Maker to Work.

Through the craft guilds and their "mysteries" and their conversion to factory methods, technology had an evolutionary history in many cultures and many lands. Alfred North Whitehead claimed that "the greatest invention of the nineteenth century was the invention of the method of invention." Nowhere was this better demonstrated than at Edison's "invention factory" at Menlo Park, New Jersey, where, starting in 1876, Edison organized the first industrial

research laboratory. In folklore, he is regarded as a "loner," who invented by intuition. In fact, he systematized the process of invention, coordinating and applying relevant knowledge through a hard-worked team that included mathematicians, physicists, chemists, and skilled mechanics. Invention was no longer the private indulgence of the gifted amateur or the rare professional; a techno-methodology had been created to guarantee commercial success. In Edison's case the result was often a "package deal"—not just the incandescent lamp, but the generating plant and the transmission system. In the case of Henry Ford, it was not just the Model T, but the assembly line, which he enlarged to a factory that was one-fifth of a mile long, with a conveyor-belt system that synchronized each stage of construction with the delivery of each part to the operator. He embodied scientific management, with its time-and-motion studies and production engineering.

The feedback system between the know-why (academic science) and the know-how (technology) is recalibrating the time-function of change. A new scientific discovery (explanation of a phenomenon) is seized by the technologists and put to work. In turn the technologists provide the instruments that, with greater refinements and speed, enable the scientists to make further discoveries. An outstanding example is cybernetics. The pencil-and-paper mathematicians had long known the principles of the computer, but they had to wait for the post-World War II electronic engineers to produce the "hardware." Now with instant responses, or nearly so, and vast computer capacities and prodigious "memories," with means not only for numerical calculation but for logical simulation, with feedback (like a burned finger signalling to the brain and the brain withdrawing the finger from the hot plate), scientists are not only able to do calculations so complex that they would not previously have attempted them, but they are also learning, from the engineers, about the nature of systems, including the systems of nature itself. Cybernetics deals with the information-processing aspects, as distinguished from the energy-transforming aspects, of all systems regardless of their physical nature. This has facilitated the development of automatic control, telecommunications, and computing; it is applicable also to systems engineering, economics, and neurophysiology.

Though we acknowledge the truth of Whitehead's aphorism, his essentially engineering approach to technology is too restrictive. Every advance in the practical arts from hunting to food-gathering to cultivation, to animal husbandry, to irrigation, to mining, and on through construction, transportation, food-processing, heating, power generation, lighting, communications, military engineering, and clinical medicine has produced social and cultural changes. The Neolithic Revolution was as climacteric as the Industrial Revolution. Moreover, the preoccupation with Western technology ignores the cultural origins of many major innovations and forgets that, historically, the European Dark Ages (not so dark as is often supposed) coincided with Golden Ages of material advances in China, India, and pre-Columbian America. Only in recent years have historians (Singer, Crombie, Lynn White, Hall, Needham, Forbes, and others) given serious attention to these facts. The anthropologists, looking at cultural influences, have been similarly remiss. Economists have been preoccupied with the "production function" and sociologists with the social effects of innovation (from television to freeways) and with work-force redundancy. The present distortions, produced by rapid technological change, obscure the fact that civilization itself derived from excess production and redundancy. When agriculture surpassed subsistence, fewer tillers were required to support the cities, with their artisans (specializing in other forms of production), their priesthoods, their scholars, their soldiery and warrior-kings, their tithe-gatherers, their merchants, and their money-changers. Technological displacement today, whether it is called unemployment, underemployment, leisure, or nonwork, similarly calls for social readjustments to find nonmanufacturing expressions of human capacities.

No explanation of the intrinsic or historic attributes of technology can convey the love-hate overtones that the term has acquired. In the ogre sense of the word, it has become a threat to lives and livelihoods and to the total environment. In the efficiency sense, it is hailed as the methodological solution of all our problems from government administration to the production of miracle grains to abolish hunger. Some, like Jacques Ellul and B.F. Skinner, claim that we are already the hostages of our man-made environment: the first maintaining that technology has taken over all of man's activities and not just his productive activities; the second, that autonomous man, with free will and freedom and dignity, is now an anachronism and has to be intentionally controlled by the "technology of behaviour."

Obviously this usage is stretching the meaning of "technology" beyond the foregoing derivations and descriptions—the etymology; the cultural origins; the scientific precedents; the nuts-and-bolts and something popularly promoted to capital letters as "The Machine." This usage expands even Harold Lasswell's accommodating version: "The ensemble of practices by which one uses available resources to achieve values." It is more consistent with the French *la technique,* which refers to any complex of standardized means for attaining predetermined ends. Thus it would apply to organization, government institutions, systems of politics or religions, or anything which reduces spontaneous or impulsive behaviour to a rationale. As was said of *la technique* of wartime operational research, "it ran the war by numerical thinking instead of gusts of emotion."

In adventurously exploring the three divisions and fifteen sections of the encyclopaedia's treatment of technology of which this introduction is, hopefully, the appetizer, the reader will find other interpretations and probably produce his own. In common usage, however, the preoccupation is with "The Machine" and the effects of its products on our lives.

Resentment against the replacement of men by machines goes back beyond Ned Ludd and the machine-wreckers of the Industrial Revolution, but present-day attitudes are of a different order of magnitude. They derive from the speed and scale of change. Hahn and Strassmann's laboratory discovery of uranium fission in 1938 was transformed into a nuclear bomb in 1945. If there is no nuclear war, history will consider the Manhattan Project, which produced the bomb, as important as the bomb it produced. It is the archetype of the crash program in which men, materials, and methods are mobilized to attain an objective in a given time. Man on the Moon by 1970 was another example, with

the time-target beaten by six months. The time-lapse between a fundamental scientific discovery and its practical application has been reduced from centuries to decades to years to months. Since World War II, we have had the Atomic Age, the Cybernetic Age, the Space Age, and now the Bioengineering Age, in which not only by organ transplants but also by the deliberate manipulation of genes it may be possible to engineer the nature of man himself. Thus in the growing up of the postwar generation there have been four major epochs nearly as significant as the Stone Age, the Iron Age, the Renaissance, and the Industrial Revolution. At the same time there has come the shocked awareness of the effects on the environment of the wastes of technology. Again this is a matter of scale and lack of prescience. (The ore miners and metal workers of Cyprus and Asia Minor were polluting the Mediterranean with heavy metals 5,000 years ago, but the effects were insignificant compared with volcanic debris). When people complain, however, of "interference with the environment" they should be mindful that such interference has been the *sine qua non* of the survival of *Homo sapiens*. Moreover, when we try to get rid of our guilt-sense about the effects of misused technology and reject the gadgeting we ashamedly enjoy, we should not go too far and "throw out the baby with the bathwater." We cannot go back to the apes nor even to Arcadia.

The great problem is how to force ebullient technology and its transnational expansion to produce human well-being, not just in the quantity of artifacts but in improving the quality of life, including redressing of the mischief in the environment. This requires an enlightened and informed society that knows what it wants and is not cult-ridden or crash-programmed into accepting what it does not want or need. This cannot be achieved through programmed learning nor the technology of behaviour nor systems engineering. We are back with the know-why as the initiator and the monitor of the know-how.

Part Seven. Technology

The outlines, and the articles and parts of articles referred to, in the three divisions and fifteen sections of Part Seven treat the nature and development, the elements, and the major fields of technology.

Several points should be noted about the relations of this part to other parts.

Technology involves applications of the knowledge of nature dealt with in Parts One, Two, and Three, and in turn has an influence on the development of that knowledge. It has a major role in relation to human communication and man's daily life, treated in Divisions IV and V of Part Four. It has structuring impact on the cultural, social, economic, political, legal, and educational life of man, dealt with in Part Five; and a conditioning effect on the development of the fine arts, dealt with in Part Six. To a degree, technological developments affect developments in the religious life of man, dealt with in Part Eight. Technology is a major dimension in the history of mankind, the subject of Part Nine.

The branches of technology and of engineering have themselves become the subject of historical and analytical studies. Those studies are presented in Section 10/37 of Part Ten.

In the present part, the outlines and the articles referred to in the two sections of Division I treat the nature, scope, and history of technology, and the organization of human work.

Division II deals with technical processes not specific to any of the major fields of technology. The outlines and the articles referred to in the five sections of Division II treat the technology of energy conversion and utilization; the technology of tools and machines; the technology of measurement, observation, and control; the technology involved in the extraction and conversion of industrial raw materials; and the technology of industrial production processes.

Division III deals with the major fields of technology, differentiated by the various human needs, purposes, products, and services that have elicited technological development. The outlines and the articles referred to in the eight sections of this division treat the technology of agriculture; the technology of the major industries; construction technology; transportation technology; the technology of information processing and of communication; military technology; the technology of the urban community; and the technology of Earth and space exploration.

Division I. The nature and development of technology 437
II. Elements of technology 444
III. Major fields of technology 462

Division I. The nature and development of technology

The outlines, and the articles and parts of articles referred to, in the two sections of Division I treat the scope and history of technology, and the organization of human work.

The outline and the articles referred to in Section 711 treat the origins and the nature of technology; the mutual dependence of science and technology; diverse evaluations of the broad effects of technology on human life; the impact of technology on the various spheres of contemporary life in both developed and developing countries; and the history of technology.

Section 712 treats the stages in the development and organization of human labour; applications of scientific method to managerial functions; and the relations between man and machine in industrial production.

Section 711. Technology: its scope and history 438
712. The organization of human work 441

Section 711. Technology: its scope and history

[for Part Seven headnote see page 437
for Division I headnote see page 437]

The articles and parts of articles referred to in Section 711 deal with two main subjects: A, general conceptions or definitions of technology; and B, the history of technology.

The outline of subject A begins with the origins and nature of technology, and with its relationships to science. It goes on to diverse evaluations of the effects of technology, covering views that technology is morally neutral, broadly detrimental, or broadly beneficial. It next treats the relations between contemporary technology and the institutions of the underdeveloped regions, in the context of the high probability of technology's continuing presence and growth. Finally, it treats the impact of technology on the economic, political, military, educational, artistic, and social spheres of contemporary life.

The article referred to on subject B, the history of technology, begins with technology in the ancient world, covering Stone Age technology, the technology of the first urban revolution, and the technological achievements of Greece and Rome. It then deals with the development of technology from the Middle Ages to 1750, covering medieval advances and the emergence of Western technology, and with advances in power technology and the subsequent development of industries during the Industrial Revolution. It concludes with 20th-century technology, covering early developments, Space Age technology, and the environmental problems of technological society.

	articles	article sections	other references
A. General conceptions or definitions of technology	TECHNOLOGY, CONCEPTIONS OF **18**:21-24		
1. The origins and nature of technology		**18**:21c-e/ **18**:24f-25e	
2. The mutual dependence of science and technology: the inseparability of certain aspects of science and technology		**18**:21e-h/ **2**:329g-330b/ **13**:887b-d/ **14**:428g-h	**16**:373h-374b
3. Diverse evaluations of the effects of technology: the anti-technology trend		**18**:22b-23c/ **18**:53f-54d	**2**:535b-e
4. Technology and the underdeveloped regions: the export of Western technology [see also 511.A.3.]		**18**:23d-f	**18**:37g-38c
5. The inevitability of technology's continuing presence and growth		**18**:24a-e	
6. Relations between technology and other spheres of contemporary life			
a. Technology and wealth		**6**:229e-242a/ **6**:243d-h/ **9**:523g-524b/ **15**:29g-30f	**6**:216c-d
b. Technology and war [see also 544.B.6.d.]		**2**:530b-e/ **8**:493a-495b/ **11**:78h-79e/ **19**:597b-f/ **19**:598h-602f/ **19**:693e-696g	**19**:588a-590e *passim*/ **19**:594e-595a
c. Technology and education		**1**:1019d-h/ **1**:1021e-1022d/ **6**:696b-e	**6**:312c-d/**6**:430d-g
d. Technology and art [see also 613.A.6.]		**1**:108f-g/ **1**:1096f-1097c/ **2**:117c-118f/ **12**:497c-500d/ **12**:692c-695f/ **18**:123d-124f	**9**:514c-h/**12**:730d-h
e. Technology and social institutions [see also 511.A.3.]		**2**:534c-535e/ **6**:235h-236h/ **7**:165d-e	**15**:480d-f/**4**:1005c-g/ **4**:1009e-h
B. History of technology: sociocultural consequences of technological changes [see also 511.A.]	TECHNOLOGY, HISTORY OF **18**:24-54	**3**:174c-191e/ **3**:452e-456a/ **3**:753b-756e/ **6**:863b-866a/ **14**:300g-303b/ **14**:1052g-1059c	

	articles	article sections	other references
1. Technology in the ancient world		**18**:26e–32a/ **1**:1035g–1038e/ **3**:174c–176b/ **3**:452e–454e/ **3**:753b–e/ **4**:743d–744c/ **4**:821h–822d/ **5**:148b–f/ **5**:441a–f/ **6**:863b–d/ **7**:406d–e/ **7**:549b–550a/ **11**:587a–f/ **11**:1061b–1062g/ **18**:648f–650e/ **18**:651c–f/ **18**:750c–e/ **19**:520h–522b/ **19**:728b–729a	**1**:326b–327g *passim*/ **4**:298a–301e *passim*/ **5**:385f–h/**5**:1099d–e/ **8**:198g–199c/**8**:433d–f/ **8**:657d–658a/**11**:232f–233c/ **12**:246b–c/ **13**:216e–218g *passim*/ **14**:165a–c/**15**:1145c–f/ **18**:1074g–1075e/ **19**:648g–649b/ **19**:932b–934g *passim*
a. The beginnings of technology (to *c.* 3000 BC): emergence of the earliest communities; use of stone tools and weapons; beginnings of mining and agriculture		**18**:26e–28b/ **1**:288b–289c/ **2**:203g–204e/ **8**:606c–610h/ **8**:1050e–1051b/ **19**:932h–933e	**8**:1033d–1034a/**10**:727g–h/ **11**:967c–968g *passim*
b. The urban revolution (*c.* 3000–500 BC): early civilization in the valleys of the Nile and Tigris–Euphrates; waterworks for irrigation; urban manufacturing		**18**:28c–29h/ **7**:794a–g/ **8**:610h–613c/ **9**:342c–g/ **9**:899g–900e/ **12**:885b–e/ **15**:892b–893g/ **19**:520h–521d	**3**:163b–d/**13**:523b–c/ **16**:157a–d/**17**:828b–e/ **19**:273d–283b *passim*/ **19**:728b–f/**19**:934e–g
c. Technological achievements of Greece and Rome (500 BC–AD 500): mastery of iron, invention of mechanical contrivances, architectural and constructional works		**18**:30e–32a/ **1**:1036a–1038e/ **3**:175b–f/ **6**:863c–d/ **7**:794g–796b/ **11**:587c–f/ **12**:885f–887a/ **15**:893g–894b/ **16**:677f–h/ **19**:521d–e	**1**:330g–331g *passim*/ **1**:1087d–1088b/ **8**:198h–199c/**8**:710b–e/ **11**:10c–d/**16**:157e–f/ **17**:828e–g/**18**:750d–e/ **19**:648h–649b/**19**:728g–h
2. Technology from the Middle Ages to 1750		**18**:32a–37h/ **1**:853d–854a/ **3**:176b–177e/ **3**:753e–754g/ **4**:744b–745g/ **4**:747b–g/ **4**:1039f–1040h/ **6**:863d–864a/ **7**:550a–551e/ **11**:1062h–1063c/ **15**:670d–e/ **15**:894c–g/ **15**:924e–925c/ **18**:177a–179a/ **19**:522b–524c/ **19**:729b–f/ **19**:861a–f	**4**:773a–d/**4**:822d–823a/ **8**:199c–200a/**16**:369c–f/ **18**:171c–h/**19**:934g–936h *passim*
a. Medieval advances (AD 500–1500): harnessing of wind power and waterpower; construction of canals, tunnels, and bridges; construction of full-rigged ships; invention of printing		**18**:32a–35b/ **1**:1038f–1039b/ **3**:753e–h/ **12**:887h–888d/ **14**:1052g–1054e/ **19**:522b–523a	**1**:110a–b/**1**:332d–e/ **3**:176b–177a/**10**:952d–f/ **13**:533b–e/**16**:157f–158d/ **16**:678e–679a/ **18**:1075h–1076c/**19**:861a–d

	articles	article sections	other references
b. The emergence of Western technology (1500–1750): invention of early scientific instruments and tools; birth of steam power; development of agricultural and constructional techniques		**18**:35b–37h/ **6**:231c–232g/ **12**:127g–128b/ **12**:888d–890e/ **16**:679e–680c/ **18**:97b–98h/ **18**:321e–322b/ **18**:651g–652g/ **19**:523a–524c	**1**:314h–315b/**3**:177a–e/ **4**:1046c–e/**12**:55b–f/ **17**:828g–h/**18**:178a–179a
3. The Industrial Revolution (1750–1900)		**18**:38a–45c/ **3**:177e–180b/ **3**:754g–756e/ **4**:1075b–d/ **5**:441g–h/ **6**:229e–233d/ **6**:864b–h/ **7**:382f–385g/ **9**:631e–632d/ **11**:260b–e/ **15**:925d–926f/ **15**:1147h–1148c/ **16**:489b–g/ **18**:1076e–1077g/ **19**:524d–525b/ **19**:729g–730h/ **19**:861f–862d/ **19**:937d–938b/ **19**:938e–h	**1**:334d–f/**1**:335g–336f/ **3**:454e–h/**3**:455c–e/ **6**:716a–c/**11**:10h–11e/ **11**:251c–h/**11**:595h–596d/ **12**:128c–f/**12**:246d–f/ **15**:564a–g/**15**:739f–740a/ **18**:809b–810a/ **19**:460f–464b *passim*/ **19**:1045b–1047c *passim*
a. Advances in power technology: development of steam power, internal-combustion engine, electric power; exploitation of mineral and fossil fuels		**18**:38c–41e/ **2**:514d–518d/ **2**:764h–765g/ **5**:726f–727e/ **7**:84e–85d/ **6**:610c–e/ **6**:616h–617f/ **7**:929f–930b/ **10**:957h–958h/ **16**:680c–681a/ **17**:624d–625f	**2**:505f–506a/**4**:773d–f/ **4**:782h–783a/**5**:726b–c/ **6**:542a–e/**6**:854f–g/ **6**:1131d–1132b/ **8**:710e–711d/**14**:165d–e/ **14**:177a–b/**18**:161b–162b/ **18**:692b–g/**18**:766d–767b/ **19**:661e–662a/**19**:662e–663a
b. Development of industries: iron and steel, textiles, chemicals, transportation, communications		**18**:41e–45c/ **4**:750f–751b/ **5**:1099h–1100a/ **8**:200a–e/ **14**:328d–329d/ **14**:1054g–1057b/ **15**:426c–427e/ **15**:478c–481d/ **15**:894g–895g/ **17**:639d–640f/ **18**:83a–85g/ **18**:171h–172g/ **18**:653c–655b/ **18**:665d–666e/ **18**:750f–751g/ **19**:937h–938b	**1**:641b–g/**2**:870g–871c/ **4**:1046d–1047b/ **6**:308e–310e/**7**:257g–258b/ **7**:406h–407c/**10**:952f–h/ **11**:226e–h/**11**:490c–e/ **11**:1063d–e/**12**:540b–541b/ **13**:966e–967d/ **14**:301a–302b/**15**:1174b–f/ **16**:731g–732g/**17**:51h–52c/ **18**:67d–72c/**18**:105g–106b
4. Technology in the 20th century		**18**:45d–54d/ **1**:23h–24d/ **1**:132g–133h/ **3**:180b–191e/ **4**:751d–752a/ **7**:385g–405g/ **9**:632d–633a/ **15**:481e–482d/ **18**:655b–658b/ **19**:730h–735c	**3**:454h–455b/**4**:783a–g/ **15**:740a–e

	articles	article sections	other references
a. Early developments: exploitation of hydroelectric power; synthesizing of fibres, plastics, rubber, dyes, and drugs; rationalization of production		**18**:45d–50c/ **1**:337h–339a/ **1**:343g–344e/ **2**:528b–530e/ **3**:309e–312a/ **4**:1075d–e/ **5**:1106h–1107h/ **6**:617f–618f/ **6**:865c–866a/ **7**:385g–403a/ **12**:541b–544b/ **14**:1057b–1059c/ **15**:369d–371e/ **15**:899h–900e/ **15**:926f–928b/ **17**:55f–g/ **18**:85h–86h/ **18**:106c–107c/ **18**:633d–634a/ **19**:938h–940c	**1**:132g–133d/**2**:35e–36d/ **5**:553c–f/**7**:258c–f/ **7**:520g–521c/**10**:958h–959g/ **11**:490f–491b/**12**:693e–694h/ **13**:594c–595a/**14**:302c–303b/ **14**:511c–g/**15**:1174g–h/ **15**:1177f–h/**17**:52d–53b/ **18**:72d–73d/**18**:767e–h
b. Space Age technology: atomic power; automation and the computer; rocketry and space exploration; advances in agricultural technology; advances in transportation and communication		**18**:50c–53f/ **1**:392c–393f/ **3**:455e–456a/ **4**:1047c–f/ **7**:403a–405g/ **9**:658h–659b/ **12**:896e–897g/ **14**:341b–c/ **15**:371f–372e/ **15**:912f–913d/ **15**:928b–936e/ **16**:261f–263c/ **17**:1a–e/ **17**:362g–373c/ **17**:640h–642e/ **17**:970f–971g/ **18**:80a–c/ **18**:107c–108a/ **18**:634b–637b/ **19**:940d–941f	**1**:133d–h/**3**:122d–123c/ **7**:775b–f/**10**:156b–c/ **12**:694h–695f/ **13**:324b–328a *passim*/ **13**:595a–c
c. Effects of technology on the environment [see 355.D.5.d.]			

Section 712. The organization of human work
[for Part Seven headnote see page 437
for Division I headnote see page 437]

The articles and parts of articles referred to in Section 712 deal with three main subjects: A, the stages in the development of human labour; B, applications of scientific method to managerial functions; and C, the relation between man and machine in industrial production.

The outline of subject A begins with the organization of work in the prehistoric world, in the ancient world, and in the medieval world. It goes on to the changes in production techniques from the 16th to the 18th century that laid the foundations of modern industrial production. Finally, it deals with mass production—the organization of labour by product rather than by process. It treats the early stages of mass production; the general principles of mass production; planning for mass production; major examples of it; increased mechanization and automation; recent uses of robot devices; and the psychological, social, and economic effects of mass-production techniques.

The outline of subject B first deals with operations research—the application of scientific method to the management of organized systems. It treats first the origin of operations research in World War II and the essential characteristics of operations research. It goes on to the phases of operations research—formulating the problem, constructing models, deriving solutions from models, testing the model and the solution, and implementing and controlling the solution. It then treats the techniques associated with such prototype problems as allocation, inventory, replacement and maintenance, and queuing. The outline of subject B next deals with systems engineering—the effective utilization of scientific and technological knowledge in planning and designing new systems. It treats the development of systems engineering and its relation to operations research; systems-design techniques, tools, and procedures; and possible future applications of systems engineering.

The outline of subject C treats the effects, on the individual and on society, of the rationalization of work, and the efforts to design machines, tools, and work environments with consideration for the capabilities and limitations of man.

A. Stages in the development of human labour	articles	article sections	other references
	WORK, ORGANIZATION OF **19**:932–941	**2**:513b–c	
1. The organization of work in the prehistoric world [see also 511.A.1.]		**19**:932f–933e	
a. Origin of division of labour based on age and sex differences; initial absence of class divisions		**19**:932g–h	
b. Communal organization: specialization required by the development of pottery, textiles, agriculture, and metallurgy		**19**:932h–933e	
2. The organization of work in the ancient world		**19**:933e–934g	
a. Theories of civilization's development: explanations of the origin of hierarchical organization		**19**:933e–g/ **9**:521f–523b	**4**:658h–660c *passim*
b. Impact of social classes on the organization of labour		**19**:933g–h/ **16**:855g–858g	
c. Organization of agricultural labour		**19**:934a–c	**15**:1098b–c
d. Organization of industrial labour by craft		**19**:934c–e	
e. Organization of labour for large-scale construction		**19**:934e–g	**6**:466d–g
3. The organization of work in the medieval world		**19**:934g–936h	**9**:523b–f
a. Class divisions		**19**:934h–935b/ **12**:150h–152d/ **16**:858g–860e	
b. Agricultural production: the manor system		**19**:935b–d/ **12**:147d–g/ **12**:148e–149c	
c. Industrial production: the craft guilds; the putting-out system; effects of advances in technology		**19**:935d–936f/ **6**:231a–b	**1**:1018g–1019a/**12**:149c–g
d. Organization of free labour for large-scale construction projects such as castles, cathedrals, town walls, and other large works		**19**:936f–h	
4. Changes in production techniques from the 16th to the 18th century: foundations of modern industrial production		**19**:937a–938e/ **6**:221g–223h	**1**:1019d–f
a. Impact of the new technology: the rationalization of job functions		**19**:937d–h	
b. Development of new industries: influence of new power sources and population growth		**19**:937h–938b	
c. Discovery of the New World: the origin of an international division of labour		**19**:938b–e/ **16**:860f–862b	
5. Mass production: the organization of labour by product rather than by process	MASS PRODUCTION **11**:595–600		
a. The coming of mass production: the introduction of machine tools, interchangeable parts, and the assembly line; the new division of labour; the mass production farm		**11**:595h–596d/ **19**:938e–939e	**6**:229e–233d *passim*/ **7**:520g–521c/**19**:822g–823a
b. General principles of mass production: subdivision of the production process into specialized tasks; standardization of component parts; use of specialized machines; systematic organization of the total production process		**11**:596d–597c	
c. Planning for mass production: determining the details of the production sequence		**11**:597c–598e	**15**:25c–27a *passim*
d. Examples of mass production; *e.g.*, automobile industry, telephone industry [see also 732.B.2.]		**11**:598e–599b/ **2**:528e–529b/ **2**:532h–533c/ **7**:809d–g	
e. Sophistication of mass production		**19**:939e–941a	
i. Refinement of assembly-line techniques		**19**:939e–940c/ **3**:491c–493a	**11**:615c–e
ii. Increased mechanization and automation	AUTOMATION **2**:505–513	**19**:940d–941a/ **11**:264c–g/ **12**:910b–c/ **15**:490h–491d	**8**:201g–203f/**17**:712e–713a
iii. Robot devices: instrumented mechanisms used in science and industry to take the place of human beings	ROBOT DEVICES **15**:910–913		

	articles	article sections	other references
f. Mass production and society: psychological, social, and economic effects of the application of mass-production techniques [see C., below]			
6. Future trends in the organization of human labour		**19**:941b–f	
B. The application of scientific methods to managerial functions			
1. Operations research: the application of scientific method to the management of organized systems	OPERATIONS RESEARCH **13**:594–601		**7**:498a–b/**17**:970h–971a
a. History of operations research: its origin in relation to the development of radar and weapons systems during World War II; postwar trends		**13**:594c–595c	
b. Characteristics of operations research: the systems approach to problems; use of interdisciplinary teams; use of models of the system under investigation		**13**:595d–596d/ **11**:84d–g	
c. Phases of operations research		**13**:596d–599b	
i. Formulating the problem		**13**:596d–h	
ii. Constructing the model		**13**:596h–598b	**6**:201b–e/**17**:971g–h
iii. Deriving solutions from the model		**13**:598c–e	**6**:201e–g
iv. Testing the model and the solution		**13**:598e–g	
v. Implementing and controlling the solution		**13**:598h–599b	
d. Prototype problems and associated techniques; *e.g.*, allocation, inventory, replacement and maintenance, queuing		**13**:599b–601a/ **15**:25h–27f	
2. Systems engineering: the utilization of scientific and technological knowledge in planning and designing complex systems	SYSTEMS ENGINEERING **17**:970–976	**19**:595e–h	
a. Development of systems engineering: major sources of systems engineering; the relation between systems engineering and operations research		**17**:970f–971g	
b. Systems-design techniques, tools, and procedures		**17**:971g–974d/ **16**:140e–h	
i. Techniques; *e.g.*, use of flow charts and other symbolic models, precise formulation of suitable objectives		**17**:971g–973b	
ii. Tools; *e.g.*, optimization theory, communication theory, queuing theory, game theory [see also 10/23.E. and F.]		**17**:973b–e	
iii. Procedures; *e.g.*, exploratory planning, development planning		**17**:973d–974d	
c. Applications of systems engineering		**17**:974f–976d	
i. Development of radically new systems; *e.g.*, the Nike-Ajax missile system		**17**:974f–975b	
ii. Long-term systems development; *e.g.*, telephone communication systems		**17**:975b–f	
iii. Future applications: systems analysis of problems in waste management, urban development, civil government, and other areas		**17**:975g–976d	
C. The relation between man and machine in industrial production			
1. The effects on man of the rationalization of work: psychological and social aspects of mass production and automation		**2**:513b–h/ **11**:599c–600d	
a. Effects on the individual; *e.g.*, production-line fatigue, loss of employee identification with his job		**2**:513d–e/ **3**:491h–493a/ **9**:504c–g/ **11**:599c–h	**19**:939h–940c
b. Effects on society; *e.g.*, corporate ownership and management of industry		**1**:1021e–1022d/ **2**:513f–h/ **11**:599h–600d/ **19**:940g–941f	**6**:312d–e/**6**:315d–f
2. The human-factors approach: the design of machines, tools, and work environments with consideration for the capabilities and limitations of man	HUMAN-FACTORS ENGINEERING **8**:1168–1169	**15**:158b/ **16**:140h–141g	

Division II. Elements of technology

[for Part Seven headnote see page 437]

Division I was concerned with the nature and effects of technology as a whole. The outlines, and the articles and parts of articles referred to, in the five sections of Division II deal with technical processes not specific to any of the major fields of technology. The technologies of the major fields are dealt with in Division III.

The outline and articles referred to in Section 721 deal with the technology of energy conversion and utilization.

Section 722 treats hand tools, machines and machine components, and machine tools.

Section 723 deals with the technology of measurement, observation, and control, covering the technical dimension of observational and experimental work in the empirical sciences. The articles referred to treat the theory of measurement; the units and standards of measurement; the principles and processes by which instruments of measurement operate; the most common types of measuring instruments; instruments used for observing and recording; special instruments and apparatus used in scientific research; major systems of measurement and observation; and instrumentation and control systems.

Section 724 is concerned with the extraction and conversion of industrial raw materials. As a broad context for the many articles referred to in this section, which treat man's uses of the world's physical and biological resources, the outline first deals with the identification, distribution, and management of natural resources. It goes on to the technology of the extraction industries and then to many products of the primary conversion of raw materials.

Section 725, on the technology of industrial processes, treats the techniques of materials processing; metallurgy; the technology of materials handling in the production process; and the technology of packaging.

Section 721. Technology of energy conversion and utilization 444
722. Technology of tools and machines 448
723. Technology of measurement, observation, and control 449
724. Extraction and conversion of industrial raw materials 454
725. Technology of industrial production processes 458

Section 721. Technology of energy conversion and utilization

[for Part Seven headnote see page 437
for Division II headnote see page 444]

The articles and parts of articles referred to in Section 721 deal with five main subjects: A, the major types of energy useful to man; B, devices and techniques for the utilization of energy; C, devices for the conversion of energy; D, devices for energy concentration and control; and E, devices for the unlimited production of free energy.

The outline of subject A covers thermonuclear reaction, nuclear fission, and radioactivity as primary energy sources; solar, geothermal, and wind and water energy as recurring energy sources; and such non-recurring energy sources as coal, gas, and petroleum.

The outline of subject B covers devices for utilizing muscle energy, such as levers and pulleys; devices for utilizing wind and water energy, such as windmills and turbines; devices for utilizing gravitational energy, such as pendulums; devices for utilizing strain and compression energy, such as steam engines and pumps; devices for utilizing magnetic and electrical energy, such as magnets and electric motors; devices for utilizing rotational energy, such as centrifuges and gyroscopes; devices for utilizing heat energy, such as heat exchangers and refrigeration equipment; devices for utilizing chemical energy, such as gasoline engines, rocket engines, and chemical explosives; and devices for utilizing nuclear energy, such as nuclear reactors and radioactive isotopes.

The articles referred to in connection with subject C, devices for energy conversion, treat thermoelectric devices, thermionic devices, magnetohydrodynamic and electrogasdynamic devices, batteries and fuel cells, lamps and other lighting devices, X-ray tubes, and dynamos and generators.

Subject D is devices for energy concentration and control. The articles referred to treat electron tubes, semiconductor devices, and other solid-state devices.

The article referred to on subject E concerns the history of attempts to design so-called perpetual motion machines, devices that would theoretically provide for the unlimited production of free energy.

articles	article sections	other references
A. Major types of energy useful to man		
ENERGY SOURCES **6**:854–858		
1. History of man's exploitation of energy sources	**6**:854c–g/ **4**:782g–783g/ **18**:32h–33f	
2. Primary energy sources	**6**:857a–e	**18**:50e–h/**18**:288c–e

	articles	article sections	other references
a. Thermonuclear reaction		**6**:857a–b/ **13**:309e–310g	**14**:508f–h
b. Nuclear fission		**13**:301d–302c	**1**:65e–g/**6**:857b–c/ **13**:314a–324a *passim*/ **18**:1034e
c. Radioactivity		**6**:857b–e/ **5**:46a–b/ **6**:24g–25a/ **15**:456g–457a	
3. Recurring energy sources		**6**:857e–858b/ **5**:45c–f	
a. Solar energy		**1**:358d–e/ **2**:1039a–c/ **8**:715g	**6**:857f
b. Natural thermal energy; *e.g.*, geothermal energy		**6**:26e–f/ **8**:133g–134c/ **13**:502c–f	**6**:857h–858a
c. Wind and water energy		**6**:976a–b/ **18**:771b–c	**18**:767h–768b/**19**:661b–e/ **19**:861a–862g *passim*
4. Expendable energy sources: coal, gas, and petroleum		**6**:858c–e/ **5**:45g–46a/ **7**:923d–924e/ **13**:502g/ **14**:185f–186d/ **17**:627f–628c	**4**:773f–g/**4**:782f–790a *passim*/ **10**:957h–958d/**14**:165f–166d
B. Devices and techniques for the utilization of energy			
1. Devices for utilizing muscle energy; *e.g.*, pulley, lever, block and tackle, treadmill [see 722.B.2.]			
2. Devices for utilizing wind and water energy *with special attention to*			
a. Sails and sailboats		**19**:861f–h	**16**:157a–162e *passim*
b. Windmills	WINDMILL **19**:861–862	**18**:38d–f	
c. Waterwheels	WATERWHEEL **19**:660–662		**11**:233c/**18**:766b–c
d. Turbines	TURBINE **18**:766–776	**19**:661g–662a	
i. Water turbines		**18**:768c–771c/ **6**:623h–624d	**19**:661g–h
ii. Steam turbines		**18**:771c–773h/ **6**:620a–e	**8**:705d–f/**16**:680f–g/ **17**:628h–629e
iii. Gas turbines		**18**:774a–776f/ **6**:621h–622c/ **16**:687g–h	**7**:933a–b/ **10**:156d–159a *passim*
3. Devices for utilizing gravitational energy; *e.g.*, pendulums, counterweight mechanisms		**4**:744g–746d/ **11**:771d–g	**3**:180h–181c/**11**:774a–d
4. Devices for utilizing strain and compression energy *with special attention to*			
a. Steam engines and steam power plants	STEAM POWER **17**:624–633	**18**:35g–36b/ **18**:38g–40a	**3**:946a–d/**6**:855f–856a/ **8**:705c–d/**11**:331h–332a/ **16**:696c–d
b. Steam turbines [see B.2.d.ii., above]			
c. Compressed-air and compressed-gas tools and machines	PNEUMATIC DEVICES **14**:582–584		**15**:565a–c
d. Hydraulic devices	HYDRAULICS, APPLICATIONS OF **9**:77–79		
i. Pumps	PUMP **15**:270–274	**9**:77g–78b	**17**:632e–f
ii. Motors: cylinder-operated hydraulic devices and rotational motors		**9**:78b–h	**2**:523g–524c
iii. Hydraulic control circuits		**9**:79b–e	

	articles	article sections	other references
5. Devices for utilizing magnetic and electrical energy *with special attention to*			
a. Magnets and electromagnets	MAGNETS AND ELECTROMAGNETS **11**:332–339		**7**:174b–f
i. Magnetic materials: powder magnets, alloys, ferrites, permeable materials		**11**:334f–337a	**11**:312c–e
ii. Design and operation of electromagnets		**11**:337a–338e	**17**:58b–c
iii. Applications in communication systems, research, the electrical industry, and magnetic recording		**11**:338f–339h/ **17**:55f–57d	**4**:1050g–1051d/**6**:681d–g/ **11**:331g–h
b. Electric motors	ELECTRIC MOTOR **6**:610–616	**11**:339c–d	
i. Induction motors		**6**:610h–613f	
ii. Synchronous motors		**6**:613g–614g	
iii. Commutator motors utilizing ac and dc		**6**:614h–616d	
6. Devices for utilizing rotational energy *with special attention to*			
a. Centrifuges	CENTRIFUGE **3**:1143–1147		
b. Gyroscopes	GYROSCOPE **8**:525–529	**12**:905g–906f	
7. Devices for utilizing heat energy *with special attention to*			
a. Heat exchangers	HEAT EXCHANGER **8**:706–709		
i. Basic operation of heat exchangers		**8**:706d–707b	
ii. Types of heat exchangers: regenerative heat exchangers and heat pipes		**8**:708b–709f	**3**:465f–466a
b. Refrigeration equipment	REFRIGERATION EQUIPMENT **15**:563–567		
i. Types of refrigeration systems: mechanical, air-cycle, absorption, and thermoelectric		**15**:564g–567a/ **18**:320c–g	7:936e–f/**8**:724d–g/ **15**:938f–h
ii. Applications of refrigeration; *e.g.*, air conditioning, cold storage, refrigeration transport, freeze-drying		**15**:567b–g/ **5**:320a–322b/ 7:490b–491d	**3**:466a–b
8. Devices for utilizing chemical energy			
a. Internal-combustion engines *with special attention to*			
i. Gasoline and gas turbine engines	GASOLINE ENGINE 7:929–937		**1**:375b–e/**2**:520e–h/**18**:40e–f
ii. Diesel engines	DIESEL ENGINE **5**:726–728		**8**:705f–h/**15**:485c–f/ **16**:696f–g
iii. Jet, turbojet, fan-jet, and turboprop engines	JET ENGINE **10**:155–160		**1**:375e–g/**18**:775b–f
iv. Rocket engines	ROCKETS AND MISSILE SYSTEMS **15**:937–939		**1**:134h–135a/**8**:222h–223a
b. Chemical explosives	EXPLOSIVES 7:82–89		**2**:656a–c/**15**:937h–938d
i. Black powder		**7**:83b–84e/ **1**:698h–699a	
ii. Detonating explosives; *e.g.*, nitroglycerin, dynamites		**7**:84e–85h/ **12**:249f–250b	
iii. Other explosives: modern high explosives, nitrocellulosic explosives, and military explosives		**7**:86a–89c	**1**:700g–h
9. Devices and materials for utilizing nuclear energy *with special attention to*			
a. Nuclear reactors	NUCLEAR REACTOR **13**:314–324	**13**:310f–311e/ **17**:632a–c	**17**:752g/**18**:1036e–g

	articles	article sections	other references
i. Nuclear reactor principles [see 111.F.]			
ii. Development of nuclear reactors		**13**:315b–317a/ **13**:324e–326g	**6**:622e–f
iii. Development of nuclear power		**13**:317b–321f/ **13**:326b–327f	**7**:236e–237b/**16**:442c–f
iv. Safety problems of nuclear reactors		**13**:321f–h	**6**:622g–623a
v. Applications of nuclear reactors in research, nuclear-powered ships, rocket propulsion, desalinization plants		**13**:322a–c/ **12**:896f–897c/ **16**:680c–e/ **16**:697b–d	**13**:302b–c/**15**:939h–940b
vi. Nuclear fuel and its production, reprocessing, and management		**13**:322d–324a	**18**:1034e–1037b *passim*
b. Radioactive isotopes [see also 111.B.]		**15**:456g–457a/ **18**:684f–h	**1**:68a–b/**18**:319d–320a
C. Devices for energy conversion *with special attention to*			
1. Thermoelectric devices	THERMOELECTRIC DEVICES **18**:315–321	**15**:566h–567a/ **18**:325h–326b	**6**:856c–d
2. Thermionic devices	THERMIONIC DEVICES **18**:287–290		**6**:671h–672a/**6**:687h–688a
3. Magnetohydrodynamic and electrogasdynamic devices	MAGNETOHYDRODYNAMIC DEVICES **11**:329–332		
4. Batteries and fuel cells	BATTERIES AND FUEL CELLS **2**:764–770		**6**:643f–g/**6**:856e–g
a. Primary or voltaic batteries: dry cells and wet cells; standard cell		**2**:765g–766e	
b. Secondary or storage batteries; *e.g.*, lead-acid cell, nickel-cadmium cell		**2**:766f–767d/ **10**:729b–d	
c. Fuel cells; *e.g.*, acidic or alkaline electrolyte type, fused-salt electrolyte type, redox type		**2**:767d–769c	**6**:856f–g
5. Lamps and other lighting devices	LIGHTING AND LIGHTING DEVICES **10**:957–960	**12**:547b–e/ **14**:332h–333c	**10**:953g–h/**12**:550d–g/ **14**:295c–d
6. X-ray tubes [see also 112.D.1.]		**17**:473h–474b	**15**:459b–f
7. Devices for electric power generation: turbine-driven generators, engine-driven generators, nuclear-powered generators, hydraulic-turbine-driven generators, thermoelectric generators, and dynamos	ELECTRIC POWER **6**:616–625	**14**:508f–509c/ **18**:318h–320c	**11**:309g–310a/**18**:770f–771c/ **18**:775f–h
D. Devices for energy concentration and control *with special attention to*			
1. Electron tubes	ELECTRON TUBE **6**:687–691	**18**:111b–113d/ **18**:115d–116b	**15**:427f–g/**18**:118c–h
2. Semiconductor devices	SEMICONDUCTOR DEVICES **16**:512–521	**9**:658d–659b	**16**:264b–d
a. Preparation of semiconductor materials: doping, masking, and etching		**16**:513h–516f/ **9**:662c–664b	
b. Design, manufacture, and applications of semiconductor devices		**16**:516g–521g/ **6**:680c–e/ **9**:659b–662c/ **14**:300a–d	**6**:691c–f/**15**:427g–428a/ **18**:325g–h
3. Other solid-state devices		**6**:681h–682e	**6**:691e–f
E. Devices for unlimited production of free energy: attempts to design perpetual motion machines	PERPETUAL MOTION **14**:102–105	**6**:850f–g	

Section 722. Technology of tools and machines

[for Part Seven headnote see page 437
for Division II headnote see page 444]

The articles and parts of articles referred to in Section 722 deal with three main subjects: A, hand tools; B, machines and machine components; and C, machine tools.

The outline of subject A, after dealing with the early history of hand tools, goes on to the basic types of hand tools—percussive tools; cutting, drilling, and abrading tools; tool auxiliaries; screw-based tools; and measuring and defining tools. It then deals with such power-driven hand tools as electric drills and circular saws, and pneumatic hammers and riveters.

The outline of subject B begins with the basic characteristics and the mechanics of machines, and with the concepts of work, power, and efficiency. It goes on to deal with simple machines, and with machine mechanisms—devices that transmit motion by means of flexible connectors, rigid connecting links, or direct contact. It next treats machine components, such as gears, cams, linkages, belt drives, shafts, and springs. Finally, it deals with devices for friction accommodation and reduction.

Subject C is machine tools—stationary power-driven machines for shaping and forming parts made of metal or other materials. The outline begins with the history, basic characteristics, and principles of operation of machine tools. It then treats basic machine tools, such as shapers and planers, milling machines, and presses; modifications of basic machines, such as turret lathes; special purpose machines, such as gear-cutting machines; and such recent innovations as automatic control of machine tools, and chipless methods of removing metal.

articles	article sections	other references
A. Hand tools		
HAND TOOLS **8**:605–624		
1. Early history of hand tools: Paleolithic and Neolithic stone tools; development of metal tools	**8**:606c–613c/ **2**:203g–204b/ **8**:1050e–1051b	**1**:287h–289c *passim*/ **8**:1033g–1034a
2. Basic types of hand tools	**8**:613d–624e/ **3**:952c–e	
a. Percussive tools; *e.g.*, hammers, axes	**8**:613f–616e	
b. Cutting, drilling, and abrading tools; *e.g.*, knives, saws, files	**8**:616f–621c	
c. Tool auxiliaries; *e.g.*, workbench, vise	**8**:621c–622f	
d. Screw-based tools; *e.g.*, screwdrivers, wrenches	**8**:622f–623d	
e. Measuring and defining tools; *e.g.*, levels, dividers, rules	**8**:623e–624e	
3. Power-driven hand tools; *e.g.*, electric drills and circular saws; pneumatic hammers and riveters	**8**:624e–g/ **3**:952e–f/ **14**:583e–584c	
B. Machines and machine components		
MACHINES AND MACHINE COMPONENTS **11**:230–259		
1. General considerations: basic characteristics and operation of machines as motion-modifying devices; the mechanics of machines; the concepts of work, power, and efficiency	**11**:230h–232e	
2. Simple machines: lever, wedge, wheel and axle, pulley, and screw	**11**:232f–234h	**7**:543c–544c *passim*/ **18**:30e–31a/**18**:33a–f
3. Machine mechanisms: devices that transmit motion by means of flexible connectors, rigid connecting links, or direct contact	**11**:234h–236c	
4. Machine components	**11**:236d–259f	**2**:522d–525d
a. Gears	**11**:236d–240b	**11**:263g–h
b. Cams	**11**:240c–h	
c. Linkages	**11**:240h–243b	
d. Flywheels	**11**:243c–g/ **7**:935c	
e. Belt and chain drives	**11**:243g–245h	
f. Couplings	**11**:245h–247d	
g. Clutches	**11**:247d–248c	
h. Brakes	**11**:248c–249c	**18**:723a–d
i. Bearings	**11**:249d–253g	
j. Shafts and shaft accessories	**11**:253g–256d/ **7**:934a–b	
k. Screws	**11**:256e–258c	
l. Springs	**11**:258c–259f	
5. Friction accommodation and reduction		
a. Bearings [see B.4.i., above]		

b. Lubricants: their functions, types, and properties

articles	article sections	other references
LUBRICATION **11**:169–172	**14**:186e–g	**2**:521b–d/**7**:936f–h/ **11**:251b–253d *passim*/ **18**:708f–709a

C. Machine tools: stationary power-driven machines for shaping and forming parts made of metal or other materials

MACHINE TOOLS **11**:259–265	**11**:621c–e	
1. History and characteristics of machine tools	**11**:260b–f	
2. Operation of metal-cutting tools	**11**:260g–261f	
3. Basic machine tools: turning machines, shapers and planers, drilling machines, milling machines, grinding machines, power saws, and presses	**11**:261f–262h/ **3**:952f–953a	
4. Modifications of basic machines; *e.g.*, turret lathes, production millers	**11**:262h–263f	
5. Special-purpose machines; *e.g.*, gear-cutting machines, broaching machines	**11**:263g–264b	**1**:16b–f/**11**:239e–h
6. Recent innovations	**11**:264c–265c	
a. Automatic control of machine tools: application of tracer techniques and numerical control	**11**:264c–g/ **1**:140a–b	**2**:508g–509a
b. Chipless methods of removing metal; *e.g.*, plasma arc machining, laser-beam machining	**11**:264g–265c	

Section 723. Technology of measurement, observation, and control

[for Part Seven headnote see page 437
for Division II headnote see page 444]

The articles and parts of articles referred to in Section 723 deal with eight main subjects: A, the theory of measurement; B, units and standards of measurement; C, the principles and processes by which instruments of measurement operate; D, the most common types of measuring instruments; E, instruments used for observing and recording; F, special instruments and apparatus used in scientific research; G, major systems of measurement and observation; and H, instrumentation and control systems.

At A, indication is made of the section in Part Ten that deals with the theory of measurement, with theories and philosophic problems concerning the determination of quantitative relationships.

The outline of subject B begins with systems of weights and measures, setting standards for the measurement of mass and length. It then treats standards and techniques for the measurement of time.

The outline of subject C first deals with the measurement process, involving conceptual and operational definitions of measurable quantities, and a comparison of such quantities with a reference quantity. It then treats the functional elements of measurement systems; the performance characteristics and sources of error of instruments; and the phases in the evolution of instrument systems.

The outline of subject D begins with the instruments for measuring basic dimensions—length, mass and weight, time, temperature, electric current and other electrical properties, and light intensity. It then deals with instruments for measuring relationships derived from basic dimensions, covering instruments for measuring pressure; for measuring rate of flow; for measuring position by angulation and direction finding; for measuring gravity; for making optical measurements; for measuring nuclear radiation; and for measuring volumetric and mechanical properties of materials, including density, viscosity, and mechanical strength.

The outline of subject E treats optical and electron microscopes, optical and radio telescopes, spectroscopes, and interferometers.

The outline of subject F treats general laboratory equipment, such as filters, mixers, and centrifuges; and research reactors, particle accelerators, mass spectrometers, chromatographs, seismographs, and particle detectors.

Subject G is the major systems of measurement and observation. The outline treats surveying, mapping and cartography, hydrographic charting, oceanographic measurement, meteorological measurement, astronomical observations, navigational techniques and devices, and radiological techniques and devices.

The outline of subject H first deals with instrumentation systems—systems that operate or actuate control devices or record measurements automatically. It treats applications of instrumentation in industry and manufacturing, and also such nonmanufacturing applications as biomedical instrumentation; instrumentation for monitoring air purity and for the detecting and monitoring of pollutants; and automated chemical analysis systems. The outline of subject H then goes on to control systems. It treats the operational characteristics of closed-cycle control systems, or servomechanisms; the major types of control; and the application of control systems in process industries and manufacturing. Finally, it treats telemetry systems—systems for remote monitoring and control.

articles	article sections	other references
A. Theory of measurement [see 10/31.B.3.b.i.]		
B. Units and standards of measurement		
1. Systems of weights and measures: standards for the measurement of mass and length		
WEIGHTS AND MEASURES **19**:728–735		

	articles	article sections	other references
a. Early weights and measures: ancient Mediterranean and Chinese systems; medieval European weights and measures		**19**:728b–729c	
b. National systems: the English system; the U.S. customary system		**19**:729d–730b	
c. The metric system and the International System of Units (SI)		**19**:730c–735c	**5**:79e-g/**6**:563g–564d/ **6**:657e-g/**11**:733f-h/ **11**:742h–743a
2. Standards and techniques for measurement of time	TIME **18**:413–417		
a. General concepts of time measurement: the determination of epoch and of time interval		**18**:413e–414c	
b. Rotational time: time units; Universal Time (UT) or Greenwich Mean Time (GMT)		**18**:414c–415c	
c. Ephemeris Time (ET)		**18**:415c–e	
d. Principles and devices of time measurement and time reckoning		**18**:415e–417b	
i. Chronometers: time-measuring instruments [see D.1.c., below]			
ii. Calendars: early calendar systems and their astronomical basis; the Western calendar and calendar reforms; calendars of Middle Eastern, Far Eastern, and ancient American civilizations	CALENDAR **3**:595–612	**2**:551b–c/ **4**:302f-g/ **10**:218b-h	**4**:499b-g/ **4**:573b–582e *passim*/ **11**:721f-h
iii. Precision in time measurements: definition of the atomic second		**18**:416d–417b	
C. Principles and processes by which instruments of measurement operate	MEASUREMENT, PRINCIPLES AND INSTRUMENTS OF **11**:728–734		
1. The measurement process: conceptual and operational definitions of measurable quantities; comparison of such quantities with a reference quantity		**11**:728e–729b	
2. Functional elements of measurement systems; *e.g.*, amplification, digitalization, display, recording elements		**11**:729b–732g	
3. Performance characteristics and sources of error of instruments; *e.g.*, noise, interference, dynamic response, resolution, precision		**11**:732g–734a	
4. Development of measuring instruments: phases in the evolution of instrument systems		**11**:734a–d	
D. Common types of measuring instruments			
1. Instruments for measuring basic dimensions			
a. Devices for measuring length; *e.g.*, rules, calipers, micrometers		**8**:623h–624e/ **17**:829g–830d	**9**:637g–638d
b. Devices for measuring mass and weight; *e.g.*, scales, balances			**9**:638d-g
c. Devices for measuring time; *e.g.*, mechanical, electric, and atomic clocks	CLOCKS, WATCHES, AND SUNDIALS **4**:743–750	**18**:415e–416d	**2**:494c–e
d. Devices for measuring temperature; *e.g.*, gas, liquid, and electrical resistance thermometers	THERMOMETRY **18**:321–327	**8**:702c–f/ **18**:318f-h	**9**:636g-h/**12**:56e-g/ **18**:849b-d
e. Devices for measuring electric current and other electrical properties; *e.g.*, galvanometers, ammeters, voltmeters		**6**:566e–567c/ **6**:567g–568e	
f. Devices for measuring light intensity; *e.g.*, photometers, light meters, exposure meters		**12**:547f-h/ **18**:104c–e	**14**:300a-d/**14**:332f-h/ **14**:348c-h/**18**:850b-c
2. Instruments for measuring physical properties and relationships derived from basic dimensions			
a. Instruments for measuring pressure; *e.g.*, barometers, manometers		**11**:784f–785b/ **19**:16h–17g	**9**:636h–637b/**12**:56d-e/ **17**:831f-h
b. Instruments for measuring rate of flow; *e.g.*, flowmeters, water meters, gas meters		**9**:636d-g	**11**:788a-c

	articles	article sections	other references
c. Instruments for measuring position by angulation and direction finding			
i. Compasses; *e.g.*, magnetic compasses, gyrocompasses [see also 212.B.]	COMPASS **4**:1039–1042	**12**:906f–h	**8**:528d–f/**17**:831a
ii. Surveying instruments; *e.g.*, levels, transits, sextants	SURVEYING **17**:829–831	**6**:21c–e/ **8**:623e–h	**11**:674d–h
d. Instruments for measuring gravity; *e.g.*, gravimeters		**6**:21a–c/ **14**:177f	**6**:4g–5a/**8**:291e–292c
e. Instruments for making optical measurements; *e.g.*, polarimeters, refractometers		**9**:633e–634h/ **9**:638g–639a	
f. Instruments for measuring ionizing radiation; *e.g.*, Geiger counters, scintillation counters	RADIATION DETECTION AND CHARACTERIZATION **15**:393–398	**5**:201b–202a/ **17**:461d–462a/ **19**:1063c–h	**19**:1068e–g
g. Instruments for measuring volumetric and mechanical properties of materials, including density, viscosity, and mechanical strength		**7**:937d–f/ **9**:635e–636d	**7**:487d–f/ **11**:627a–630f *passim*
E. Instruments used for observing and recording			
1. Instruments for observing phenomena			
a. Microscopes	MICROSCOPE **12**:127–138	**12**:455g–456a	**12**:112a–b
i. Optical microscopes: simple, compound, and specialized types		**12**:128h–135b	
ii. Electron microscopes		**12**:135b–137g	**6**:672a–b
b. Telescopes	TELESCOPE **18**:97–105		**19**:1068g–1069a
i. Optical telescopes: refracting and reflecting telescopes and their relative advantages; the Schmidt telescope and special types of optical telescopes		**18**:97f–101e	**2**:237h–238a
ii. Radio telescopes: dish antennas and antenna arrays		**15**:467g–h/ **18**:101e–103g	
iii. Use of auxiliary instruments and balloons, rockets, and satellites in making telescopic observations [see G.6., below]			
c. Spectroscopes and spectrographs		**2**:235h–237g/ **17**:459g–462a/ **17**:475g–476g/ **18**:103h–104c	
d. Interferometers		**10**:936f–937f	**2**:237a–c/**8**:1009a–e/ **10**:688e–f/**18**:103b–f
2. Instruments for recording phenomena: cameras [see 735 G.1.b.]			
F. Special instruments and apparatus used in scientific research		**2**:996f–997b/ **8**:870h–871h/ **11**:338h–339b	
1. General laboratory equipment; *e.g.*, filters, mixers, centrifuges		**3**:1144d–1147e/ **12**:137g–138d	
2. Research reactors			**13**:302c–d/**13**:322a–b
3. Particle accelerators; *e.g.*, betatrons, cyclotrons, linear resonance accelerators, synchrotrons	ACCELERATORS, PARTICLE **1**:23–31	**11**:319c–h/ **15**:587f–g	**11**:322d–e/**11**:704e–f
4. Mass spectrometers	MASS SPECTROMETRY **11**:604–610		**2**:344h–345d/**9**:643g–h
5. Chromatographs		**9**:634h–635c	**2**:997a–b/**4**:159a–c/ **4**:565h–568b *passim*/ **9**:643d–g
6. Seismographs [see also 213.B.]	SEISMOGRAPH **16**:489–492		**19**:601d–e
7. Particle detectors; *e.g.*, bubble chambers, scintillation counters	RADIATION DETECTION AND CHARACTERIZATION **15**:393–398	**5**:201b–202a	**9**:789g–780a/**12**:1075g–h

	articles	article sections	other references
G. Major systems of measurement and observation			
1. Surveying	SURVEYING **17**:828–835		
a. Fundamentals of surveying: types of measurements and units of measure		**17**:829b–g	
b. Surveying instruments and their uses [see D.2.c.ii., above]			
c. Modern surveying practices		**17**:831h–835b	
i. Survey control: techniques assuring survey accuracy		**17**:831h–832f	
ii. Use of maps and charts in surveying		**17**:832f–833a/ **9**:99a–f/ **11**:481c–482a	
iii. Photogrammetry: measurements utilizing aerial photographs		**17**:833a–e	
iv. Procedures for conducting a survey		**17**:833e–834b	
v. Techniques of property boundary surveys		**17**:834b–e	
vi. Special types of surveys; *e.g.*, mine surveys		**17**:834f–835b	
2. Mapping and cartography	MAPS AND MAPPING **11**:470–484	**16**:461d–463e/ **17**:832f–833e	
a. History of cartography: maps and geography in the ancient and medieval worlds; in the age of discovery and exploration; from the 18th century to the present		**11**:470e–475b/ **2**:230g–232d/ **4**:880d–881a/ **9**:98a–d	**2**:227e–228d/**6**:75c–d/ **7**:1040e–f/**11**:520e–521d/ **11**:914f–915f *passim*
b. Elements of maps and charts: map scales, projections, and coordinate systems; map and chart symbolization		**11**:475c–478e/ **9**:100d–102a/ **11**:675c–f/ **12**:902f–h	
c. Types of maps and charts and their uses		**11**:478e–480b	
d. Modern map-making techniques		**11**:480c–484c	
i. Compilation from existing materials		**11**:480c–481b	
ii. Map production from original surveys		**11**:481c–e	
iii. Basic control surveys: geodetic surveys, satellite triangulation, and control extension surveys		**11**:481e–482a	**17**:372e–f
iv. Production of maps from aerial photographs: techniques and equipment of aerial photography; photogrammetric mapping procedures; final map editing and printing		**11**:482a–483h/ **17**:833a–e	
v. Automation in mapping: application of digital computers, automatic plotters, and modern information storage and retrieval techniques to map production		**11**:483h–484c	
3. Hydrographic charting	HYDROGRAPHIC CHARTING **9**:98–102		
a. Charting agencies: the work of national hydrographic offices and international hydrographic organizations		**9**:98d–h	
b. Modern survey techniques; *e.g.*, position fixing by means of Shoran and other electronic devices; echo sounding		**9**:98h–100d	
c. Chart construction: compilation of survey data; choice of scale, size, projection, and other chart characteristics		**9**:100d–102a	
d. Chart correction and distribution		**9**:102b	
e. Charting the world's waters: standardized series of charts of the oceans and seas		**9**:102c–d	
4. Oceanographic measurement [see also 222.B., 223, 738.B.]	UNDERSEA EXPLORATION **18**:848–852		
a. Basic methods and equipment of oceanographic measurment: water sampling bottles and bathythermographs		**18**:848d–h	
b. Techniques and equipment of physical oceanography: measuring waves, currents, and the physical properties of seawater		**18**:848h–850c/ **13**:441g–442g/ **18**:384f–385c	**9**:123h–124b

	articles	article sections	other references
c. Techniques and equipment of chemical oceanography: measuring chlorinity, salinity, and other chemical properties of seawater		**18**:850c–g	
d. Techniques and equipment of marine geology: sampling and analyzing marine sediments and other bottom deposits		**18**:850g–851e	**5**:116f–117a
e. Techniques and equipment of biological oceanography: determining the occurrence, distribution, and characteristics of marine organisms		**18**:851e–852f	
5. Meteorological measurement [see also 221, 224]	METEOROLOGICAL MEASUREMENT **12**:54–59	**2**:329g–330b/ **18**:365d–h	**19**:863c–f
a. Surface measurements; *e.g.*, pressure, temperature, humidity		**12**:55h–57f/ **9**:641c–d	
b. Upper-air measurement: observations by radar, radiosonde, and satellite		**12**:57f–59a/ **15**:941a–h/ **19**:698a–h	**1**:370g–h/**2**:329g–330a/ **17**:372b–e/**18**:365d–h
c. Measurement techniques of micrometeorology and mesometeorology		**12**:59a–c/ **12**:121f–h	**18**:517f–518c
d. Weather-station networks and communications systems		**12**:59c–e/ **18**:643f–h/ **19**:697d–h	**2**:330a–b/**9**:64a–b
e. Trends in meteorological measurement		**12**:59e–g	
6. Astronomical observations		**2**:245f–246c/ **9**:789c–790a/ **19**:1068d–1069b	
a. Use of optical and radio telescopes, spectroscopes, cameras, and related equipment		**2**:235h–237g/ **2**:253h–254c/ **6**:192d–194a/ **9**:581e–582a/ **14**:345c–d/ **14**:348c–350h/ **18**:99b–104e	**5**:202b–d/**15**:467f–468c/ **19**:1068e–1069a
b. Use of rockets, satellites, and space probes		**17**:373g–374f/ **18**:104e–105a	**5**:202d–g/**17**:366e–367g/ **19**:1068d
7. Navigational techniques and devices	NAVIGATION **12**:902–910		
a. Development of navigation		**12**:902c–905d	
i. Animal instinct		**12**:902c–e/ **12**:182e–183g	**10**:741g–743e
ii. Navigation as a human art		**12**:902f–905a	
iii. Navigation as a science		**12**:905b–d/ **11**:674d–675c	**11**:676d–677a
b. Modern navigation techniques		**12**:905e–910c/ **18**:641c–642d	**18**:579b–h *passim*
i. Driving: the use of stabilizers, autopilots, and inertial navigators		**12**:905e–906f/ **17**:361g–362b	**8**:527c–528a
ii. Staying on course: the use of modern compasses and Doppler radio		**12**:906f–907f	**4**:1041c–1042g *passim*
iii. Position finding: the use of sound, radio, and light waves in modern systems		**12**:907g–909f/ **17**:373b–c	**10**:955e–g/**15**:431b–g
iv. Radar: its use in navigation		**12**:909f–910c	**12**:157g/**15**:376g–377b
8. Radiological techniques and devices	RADIOISOTOPES, APPLICATIONS OF **15**:452–457	**15**:398d–h/ **15**:447c–448c	
a. The use of isotopic tracers in agriculture, medicine, industry, and science		**15**:453g–454g/ **9**:120f–h	**1**:606b–607b/**14**:295h–296d/ **14**:368b–d/**15**:447c–e/ **15**:464c–d
b. The use of direct radiation in thickness and density gauging, chemical analysis, and other processes		**15**:454g–456b/ **14**:522g–h/ **19**:1063h–1064b	**11**:629h–630a/**15**:416d–g/ **15**:447c–448b *passim*
c. Absolute age dating of archaeological, geological, and other materials [see also 242.C.2.]		**15**:456c–d/ **5**:502c–510f/ **7**:1068e–1069b/ **14**:954h–955c	**1**:1082d/**3**:848d–f/ **7**:1058h–1059c/**8**:998f–h/ **12**:241d–h

	articles	article sections	other references
d. The application of radioisotopes as sources of heat and power [see 721.B.9.b.]			
H. Instrumentation and control systems			
1. Instrumentation systems: systems that operate or actuate control devices or record measurements automatically	INSTRUMENTATION **9**:630–644		
a. Applications in industry and manufacturing		**9**:633b–639g	
i. Monitoring chemical properties; *e.g.*, use of refractometers and infrared analyzers		**9**:633d–635e	
ii. Monitoring physical properties; *e.g.*, determination of density and viscosity		**9**:635e–636g	
iii. Monitoring environmental properties; *e.g.*, measuring temperature and pressure		**9**:636g–637g	
iv. Monitoring production lines; *e.g.*, measurement and control of dimensions and physical properties of industrial parts or products		**9**:637g–639g	
b. Nonmanufacturing applications		**9**:639g–644g	
i. Biomedical instrumentation [see 10/35.A.3.d.iv.]			
ii. Atmospheric measurement; *e.g.*, monitoring air purity		**9**:641b–f	
iii. Pollution control: detection and monitoring of pollutants		**9**:641g–642h	
iv. Laboratory instrumentation; *e.g.*, automated chemical analysis systems		**9**:642h–644g	
2. Control systems	CONTROL SYSTEMS **5**:128–130		
a. Basic principles: the operational characteristics of closed-cycle control systems, or servomechanisms		**5**:128g–129e	
b. Current practice: major types of control and their application		**5**:129f–130e	
i. Conventional control		**5**:129f–g	
ii. Computer control		**5**:129h–130b/ **4**:1058b–f	
iii. Fluidic control	FLUIDICS **7**:433–437	**9**:79b–e	
iv. Control in process industries and manufacturing		**5**:130b–e/ **11**:264c–g	
3. Telemetry systems: remote monitoring and control	TELEMETRY **18**:79–81		**15**:433e–f

Section 724. Extraction and conversion of industrial raw materials

[for Part Seven headnote see page 437
for Division II headnote see page 444]

The articles and parts of articles referred to in Section 724 deal with three main subjects: A, the world's physical and biological resources; B, the technology of the extraction industries; C, the primary conversion of raw materials.

As a broad context for the many articles referred to in this section, which treat man's uses of the world's physical and biological resources, the outline of subject A treats the identification, distribution, and management of natural resources.

The outline of subject B deals first with the processes of underground mining and of surface mining and quarrying. The articles next referred to deal separately with the techniques for obtaining coal, salt, stone, metal ores, sulfur, and phosphates. Special treatment is given to the exploration, drilling, and recovery techniques involved in petroleum and gas extraction.

Subject C is the primary conversion of raw materials. The outline deals first with petroleum refining and with coal processing. It goes on to the production of metal ores and metals, articles being referred to that give separate treatment to twenty metals. It next deals with the production of synthetic gemstones and industrial crystals. Dealing with the processing of stone, sand, clay, and gravel, articles are referred to that separately treat glass production and products, and the manufacture of cement, of industrial ceramics, and of bricks and tiles. The outline next deals with the processing of water to obtain such materials as salt, magnesium, oxygen, and hydrogen, and with the processing of air to obtain oxygen, nitrogen, noble gases, and other gases. Finally, it deals with the processing of plant and animal products, articles being referred to that separately treat paper and paper production; wood and wood products; tobacco and other non-food products; leather and hides; furs; natural fibres; pharmaceuticals; oils, fats, and waxes; and the many kinds of plastics and resins.

	articles	article sections	other references
A. The world's physical and biological resources			
1. The identification and distribution of natural resources	CONSERVATION OF NATURAL RESOURCES **5**:44–46		**1**:198d–204d/**2**:171d–174a/ **2**:303a–e/**2**:395g–398c/ **6**:1050a–1051b/**9**:312d–f/ **13**:192d–193h/ **13**:843h–844b/**17**:91b–94b
a. Renewable resources: plants and animals, soil ecosystems, solar energy, air, water		**5**:44f–45f	**1**:201d–204d/**2**:172h–174a/ **2**:303a–b/**2**:397h–398c/ **6**:1050g–1051b/**9**:312e–f/ **13**:193c–h/**17**:92g–94b
b. Nonrenewable resources: fossil fuels, nuclear fuels, minerals		**5**:45g–46f/ **6**:858c–e/ **12**:246f–247h/ **14**:175a–g	**1**:198d–201d/**2**:171d–172h/ **2**:303c–d/**2**:395g–397h/ **6**:634b–d/**6**:1050a–g/ **13**:192e–193c/ **13**:843h–844b/**17**:91b–92g
2. The management of resources			
a. Conservation of natural resources	CONSERVATION OF NATURAL RESOURCES **5**:46–61	**12**:256e–g	
b. Salvage operations	MATERIALS SALVAGE **11**:623–626		**5**:46d–f
B. Technology of the extraction industries			
1. Mining and quarrying [see also 214.A.4.c.]	MINING AND QUARRYING **12**:245–256		**13**:661g–663a *passim*
a. History and current status		**12**:246b–247h/ **4**:773a–f/ **18**:760g–761h	
b. Processes		**12**:247h–256d/ **4**:773h–779c/ **18**:1035b–d	**13**:816g–817b
i. Underground mining: prospecting and exploration; operations and methods		**12**:247h–254f/ **4**:773h–777c/ **6**:22g–h/ **18**:427f–h	**13**:816g–h/**17**:791h–792d/ **17**:834g–835b/**18**:1035c–d
ii. Surface mining and quarrying		**12**:254f–256d/ **4**:777d–779c/ **8**:237g–238d	**14**:431a–c/**18**:1035b–c
c. Products *with special attention to*			
i. Coal	COAL MINING **4**:773–782		
ii. Salt	SALT AND SALT PRODUCTION **16**:192–195		
iii. Stone		**11**:587h–588b	**16**:216f–g
iv. Metal ores		**5**:148f–h/ **9**:894f–895c/ **13**:661g–663a	**11**:1063f–h
v. Sulfur	SULFUR PRODUCTS AND PRODUCTION **17**:791–793	**13**:816f–817c	**4**:128b–d
vi. Phosphates			**4**:133f–134a/**14**:284a–d
2. Techniques of extracting petroleum and gas [see also 214.C.4.]	PETROLEUM AND GAS EXTRACTION **14**:175–180	**12**:860h–862b	
a. Prospecting and exploration methods; *e.g.*, surface methods, seismographic observations, gravity meter surveys		**14**:177c–f	**7**:80f–81g *passim*/ **16**:461f–462c
b. Drilling and completing wells		**14**:177g–179b	
c. Recovery of oil and gas		**14**:179c–g	**12**:861f–862b
C. Primary conversion of raw materials			

	articles	article sections	other references
1. Petroleum refining	PETROLEUM REFINING **14**:180–187		
a. Separation of crude oil into its components		**14**:181c–182f	
b. Conversion processes: alterations of molecular structure		**14**:182g–184e	**3**:1001h–1002b
c. Purification processes; *e.g.*, sulfuric acid treatment, sweetening, hydrogen treatment		**14**:184f–185f	
d. Petroleum products and their uses		**14**:185f–187h/ **5**:728c–e/ **7**:937b–c/ **10**:159d–e	**2**:520h–521b/**4**:163b–c/ **14**:518a–c
2. Coal processing: production of coke, coal tar, light oil, gas, and chemicals [see also 214.C.4.a.]	COAL PROCESSING **4**:782–790		
a. Preparation of coal: classification, evaluation, cleaning		**4**:783g–784d	
b. Pyrolysis: low-temperature carbonization; high-temperature carbonization		**4**:784d–786f	
c. Coal products and their uses		**4**:786f–787f/ **5**:1100a–d	**14**:517h–518a
d. General processing techniques: briquetting, gasification, hydrogenation, and desulfurization		**4**:787g–789f	
3. Production and processing of metal ores and metals *with special attention to*			
a. Aluminum	ALUMINUM PRODUCTS AND PRODUCTION **1**:641–649	**1**:15a–d	**11**:1071b
b. Calcium	CALCIUM PRODUCTS AND PRODUCTION **3**:585–586		
c. Chromium	CHROMIUM PRODUCTS AND PRODUCTION **4**:570–572		
d. Cobalt	COBALT PRODUCTS AND PRODUCTION **4**:808–809		
e. Copper	COPPER PRODUCTS AND PRODUCTION **5**:148–152		**11**:1068c–f/**11**:1071d–e
f. Gold	GOLD PRODUCTS AND PRODUCTION **8**:237–240		
g. Iron	IRON MINING AND PROCESSING **9**:894–898		**11**:1066d–1067a
h. Lead	LEAD PRODUCTS AND PRODUCTION **10**:727–730		**11**:1068g–1069a
i. Magnesium	MAGNESIUM PRODUCTS AND PRODUCTION **11**:302–304		
j. Mercury	MERCURY PRODUCTS AND PRODUCTION **11**:921–923		**19**:1146b–c/**19**:1146f–g
k. Nickel	NICKEL PRODUCTS AND PRODUCTION **13**:71–73		

	articles	article sections	other references
l. Platinum	PLATINUM METALS, PRODUCTS AND PRODUCTION OF **14**:529–531		
m. Silver	SILVER PRODUCTS AND PRODUCTION **16**:776–778		**5**:386h–387a
n. Sodium and potassium	SODIUM AND POTASSIUM PRODUCTS AND PRODUCTION **16**:1005–1007	**4**:133e–f	
o. Steel and steel alloys	STEEL PRODUCTION **17**:637–663	**11**:1067b–1068b	**2**:870g–871c/**5**:386e–h
p. Tin	TIN PRODUCTS AND PRODUCTION **18**:426–433		
q. Titanium	TITANIUM PRODUCTS AND PRODUCTION **18**:455–457		**18**:612b
r. Tungsten	TUNGSTEN PRODUCTS AND PRODUCTION **18**:736–738		
s. Uranium	URANIUM PRODUCTS AND PRODUCTION **18**:1034–1037		**13**:322d–h
t. Zinc	ZINC PRODUCTS AND PRODUCTION **19**:1146–1150		**11**:1066b/**11**:1069b–c/ **19**:1146c–e
u. Rare-earth metals		**15**:521b–526h	
v. Metal alloys		**1**:644e–646c/ **4**:570g–571b/ **5**:150g–151d/ **9**:897f–898c/ **11**:334g–335d/ **18**:430b–432a/ **19**:1149a–1150b	**11**:1069h–1070a/**18**:737d–h
4. Production of synthetic gemstones and industrial crystals	GEMSTONES **7**:979–980	**1**:14f–15f/ **5**:337d–339f	**7**:250e–f/**12**:244g–245a/ **16**:514d–515a
5. Processing of stone, sand, clay, and gravel *with special attention to*			
a. Manufacture of conventional and special types of glass and glass products	GLASS PRODUCTS AND PRODUCTION **8**:196–207	**7**:268a–f	**8**:211c–f/**13**:604g–605a/ **13**:855g–h/**15**:525h–526a
b. Manufacture of cement, gypsum plasters, and plastic cements	CEMENT **3**:1075–1078		**11**:588c–d
c. Manufacture of industrial ceramics	CERAMICS, INDUSTRIAL **3**:1154–1156		
d. Manufacture of bricks and tiles	BRICK AND TILE PRODUCTION **3**:162–165		**11**:588d–e
6. Processing of water to obtain salt, magnesium, oxygen, hydrogen, and other elements	SALT AND SALT PRODUCTION **16**:192–195		**4**:137a–b/**8**:570f–g/**8**:572f–g
7. Processing of air to obtain oxygen, nitrogen, noble gases, and other gases	GASES, INDUSTRIAL AND DOMESTIC **7**:924–926	**13**:814b–c	

	articles	article sections	other references
8. Processing of plant and animal products			
a. To obtain paper and pulp	PAPER AND PAPER PRODUCTION **13**:966–976		
b. To obtain roundwood, sawnwood, veneer, plywood and laminated constructions, particle board, and fibreboard	WOOD AND WOOD PRODUCTS **19**:921–924	**7**:781h–782f	
c. To obtain tobacco and other nonfood products	TOBACCO PRODUCTION **18**:464–466		
d. To obtain leather and hides	LEATHER AND HIDES **10**:759–764		
e. To obtain furs	FURS **7**:811–816		**3**:932h–933b
f. To obtain natural fibres	FIBRES, NATURAL **7**:271–289	**5**:1102d–g/ **15**:1145g–1146a	
g. To obtain pharmaceuticals	PHARMACEUTICALS, PRODUCTION OF **14**:192–194		**1**:595b–598g *passim*
h. To obtain oils, fats, and waxes	OILS, FATS, AND WAXES **13**:527–535		**14**:192f–g/**16**:916e–f
i. To obtain resins and other products		**13**:889f–h/ **14**:513c–f/ **14**:517b–d/ **15**:1175a–h	**1**:487h–489f *passim*

Section 725. Technology of industrial production processes

[for Part Seven headnote see page 437
for Division II headnote see page 444]

The articles referred to in a subsequent section, 732, give separate treatment to the technologies of the major industries. The articles and parts of articles referred to here in Section 725 deal with the technologies common to many different industrial processes. They treat four main subjects: A, materials processing; B, metallurgy; C, materials handling in the production process; and D, the technology of packaging.

The outline of subject A begins with the preliminary mechanical and chemical processing of raw materials. It goes on to the processes for forming liquid and solid materials into parts or products, and to the kinds of joining and bonding processes. It then deals with the alteration or improvement of the properties of materials, covering the several kinds of thermal processing, the processing of materials in a vacuum, the use of ultrasonic and infrasonic waves, mechanical processing, and chemical processing. Finally, it treats the mechanical, chemical, and electrochemical finishing processes that modify the surfaces of materials.

The major article referred to on subject B, metallurgy, begins with the history of metallurgy. It next deals with the two phases of extractive metallurgy: mineral dressing, consisting of the mechanical operations necessary to separate minerals from worthless material; and process metallurgy, a series of processes, using heat, electricity, or water, by which the impure minerals isolated by mineral dressing are reduced to metal, refined, alloyed, and made available according to specifications. It further treats the principal areas of physical metallurgy: metallography, the study of the constitution and structure of metals and alloys; investigation of the types of corrosion and their prevention; and the methods of inspecting and testing metals and alloys. Metal joining is dealt with separately in an article referred to on welding, brazing, and soldering.

The article referred to on subject C treats the types of materials handling systems; the equipment for materials handling, such as carts, trucks, and conveyors; the modes of transporting materials; and the handling of materials by transfer machines. The technology of storage and warehousing is dealt with in a separate article.

The outline of subject D, the technology of packaging, covers the kinds of packaging materials; the design of retail packages; and the machinery and techniques for packaging and for package testing.

	articles	article sections	other references
A. Materials processing: the operations that are used to transform industrial materials from a raw-material state into finished parts or products	MATERIALS PROCESSING **11**:619–623		
1. Preliminary processing of raw materials		**3**:1155b–f	**11**:624c–g
a. Mechanical processing; *e.g.*, crushing, mixing, blending, separating, grading		**9**:895c–g/ **11**:1063h–1065c	**15**:1181e–g
b. Chemical processing; *e.g.*, leaching, smelting, coagulation, polymerization		**7**:248f–g/ **8**:238d–239c/ **11**:302g–303e/ **11**:1065f–1069e/ **15**:1180d–1181e/ **16**:777a–e	**3**:1155d–f

	articles	article sections	other references
2. Forming: processes in which parts are produced by casting or molding liquid materials or by applying pressure to solid materials		**11**:619f–621c	
a. Processing liquid materials		**11**:619f–620c	
i. Casting metals; *e.g.*, sand casting, die-casting		**11**:619f–620a/ **11**:1070b–e	**17**:650h–652d *passim*
ii. Casting and molding nonmetals; *e.g.*, slip casting, injection molding		**11**:620a–c/ **3**:1155g–1156c/ **14**:519d–521h/ **18**:488g–489a	**3**:163g–h/**8**:202c–203f/ **15**:1181g–h
b. Processing solid materials; *e.g.*, rolling, forging, stamping, pressing		**11**:620d–621c/ **11**:1072b–1073d/ **17**:653a–655e/ **18**:487g–488f	**5**:387b–388h *passim*/ **8**:201d–202c *passim*/ **15**:1181h–1182b
3. Material removal: processes for shaping parts by removing portions of a solid piece of material		**11**:621c–e/ **14**:522a–b	**11**:261f–265c *passim*
4. Joining: processes for bonding materials to each other		**11**:621f–622c/ **14**:522e–g	
a. Thermal joining: welding, brazing, and soldering [see B.6., below]			
b. Adhesive bonding: natural and synthetic adhesives and their uses	ADHESIVES **1**:88–90	**11**:622a–c/ **19**:923a–e	
5. Property modification: alteration or improvement of the properties of materials		**11**:622c–f	
a. Thermal processing			**15**:1182b–d
i. Basic heat-treating operations: annealing, stress relieving, and hardening		**3**:1156c–f/ **11**:1075c–g/ **17**:656d–e	**3**:163h–164b/**8**:203f–h/ **11**:622d–e/**15**:1182b–d/ **19**:922b–e
ii. Radio-frequency heating: induction and dielectric heating	RADIO-FREQUENCY HEATING **15**:448–452		
iii. Zone melting: zone refining and other techniques	ZONE MELTING **19**:1058–1060		**4**:159g–160a/**16**:514b–515a
iv. Exposure to cryogenic temperatures	CRYOGENICS, APPLICATIONS OF **5**:319–322	**11**:163c–f	
b. Processing of materials by exposure to physical conditions other than heat or cold			
i. Processing of materials in a vacuum	VACUUM TECHNOLOGY **19**:14–17	**5**:321d–e/ **14**:522h–523a	**17**:650f–h
ii. Use of ultrasonic and infrasonic waves	ULTRASONICS AND INFRASONICS **18**:840–843	**17**:34b–e	
iii. Other processes; *e.g.*, exposure to radiation		**14**:522g–h	
c. Mechanical and chemical processing		**16**:515g–516f/ **11**:1069g–1070a/ **11**:1072b–d/ **17**:653a–e/ **17**:657c–e/ **19**:922e–g	**8**:205e–206b/**19**:923c–e
6. Finishing processes: modification of the surfaces of materials		**11**:622g–623c	
a. Mechanical and chemical processes; *e.g.*, cleaning, polishing, embossing, coating		**11**:622g–623c/ **11**:1073h–1074c/ **14**:522c–d	**5**:388e–g
b. Electrochemical processes: electroplating	ELECTRO-PLATING **6**:691–693	**1**:648f–g/ **14**:523a–b	**17**:53h–54b/**18**:429f–h
B. Metallurgy	METALLURGY **11**:1061–1077		

	articles	article sections	other references
1. History of metallurgy		**11**:1061b–1063e/ **5**:148b–f/ **9**:894b–f/ **10**:727g–728a/ **13**:71d–e/ **16**:776f–g/ **17**:637g–642e/ **19**:738a–d/ **19**:1147a–c	**18**:426g–427b
a. Innovation of bronze, iron, and brass		**11**:1061e–1062c/ **8**:610h–613c/ **19**:933c–e	**5**:148b–e/**9**:342c–d/**9**:894b–c/ **17**:637g–638a/**18**:28c–h/ **19**:273d–283b *passim*
b. Developments from 500 BC to AD 1500: advances in metal refining and alloying; development of large-scale iron making		**11**:1062d–1063a	**17**:638a–f/**18**:30e–g/ **18**:34b–d
c. Developments after 1500: the metallurgical treatises of Biringuccio and Agricola; development of the steelmaking industry		**11**:1063b–e/ **1**:641b–g/ **11**:302e–f/ **18**:36c–e/ **18**:41e–42c/ **18**:46h–47a/ **18**:1034f–h	**1**:314h–315b/**2**:870g–871c/ **9**:894c–f/**17**:638d–642e/ **18**:736c–d/**19**:738b–d
2. Mineral dressing		**11**:1063f–1065e/ **18**:1035e–1036b	**10**:728c–e/**13**:72b–c
a. Crushing and grinding		**11**:1063h–1064b	
b. Concentration or mineral preparation		**11**:1064b–1065e/ **5**:148h–149c/ **9**:895c–g/ **18**:427h–428b/ **19**:1147e–f	**1**:642d–643b/**17**:643a–b
3. Process metallurgy		**11**:1065f–1072a/ **4**:571h–572g/ **5**:149c–150c/ **8**:238d–239c/ **11**:302g–303e/ **11**:623h–624g/ **13**:428b–h/ **14**:530b–d/ **15**:523f–525g/ **16**:777a–e	**4**:808d–g/**16**:1006c–e/ **19**:1147f–1148h
a. Pyrometallurgy: metallurgical processes that involve the use of heat		**11**:1056g–1070h	
i. Gas–solid reactions; *e.g.*, roasting		**11**:1056g–1066a/ **19**:1147f–g	**10**:728e–f
ii. Distillation: processes for refining metals by condensing metal vapours		**11**:1066a–1066d	**11**:922c–e
iii. Ferrous metallurgical processes: techniques for making iron and steel [see also 732.C.2.]		**11**:1066d–1068b/ **9**:895g–897f/ **17**:643e–652h	
iv. Nonferrous metallurgical processes: techniques for producing copper, lead, zinc, and other metals		**11**:1068c–1069e	**4**:571h–572a/**5**:149c–f/ **5**:150a–b/**10**:728e–729b/ **11**:303d–e/**11**:922c–e/ **13**:72a–e/**15**:524d–525g/ **18**:428b–e/**19**:1147g–1148e
v. Melting, alloying, casting, and ingot solidification		**11**:1069e–1070h/ **17**:650h–652h	
b. Electrometallurgy: metallurgical processes that involve electrochemical reactions		**11**:1070h–1071f	
i. Electrowinning (recovery of metals from solutions by electrolysis) and electrorefining		**11**:1071a–e/ **1**:643c–h	**1**:582g–583a/**4**:572c–g/ **11**:302h–303c/**15**:524b–d/ **19**:1148f–g
ii. Electroplating [see A.6.b., above]			
c. Hydrometallurgy: metallurgical processes that involve aqueous solutions		**11**:1071f–1072a/ **18**:455h–456d	**18**:736f–g
4. Metal processing		**11**:1072b–1075g/ **1**:139e–f/ **18**:428h–432a	

	articles	article sections	other references
a. Cold and hot working; *e.g.*, forging, rolling, drawing		**11**:1072b–1073d/ **1**:647b–g/ **15**:1149a–e/ **17**:653a–655e	**1**:645g–646a/ **5**:150c–151d *passim*/ **11**:620d–h/**18**:429a–d
b. Foundry processes; *e.g.*, sand casting, die-casting		**11**:1073d–g/ **9**:896d–g/ **11**:619f–620a	
c. Surface treatments; *e.g.*, hot dipping, metal cladding		**11**:1073h–1074c/ **1**:648b–h/ **17**:661f–662a	**15**:449b–450e/**18**:429h–430b
d. Powder metallurgy: powder manufacture, processes, and products		**11**:1074d–1075a/ **1**:646c–e/ **11**:334f–g	**18**:736h–737a
e. Nuclear engineering metallurgy: production, fabrication, and application of uranium and other metals of importance in nuclear engineering		**11**:1075a–c/ **18**:1035e–1036h	
f. Heat treatment: precipitation, allotropic transformation, and decomposition reactions		**11**:1075c–g	**1**:647g–648b/**15**:449b–451a
g. Special products; *e.g.*, coins, medals, tokens	COINS AND COINAGE **4**:821–825	**5**:387a–388h/ **7**:269a–h/ **10**:165e–h	
5. Physical metallurgy		**11**:1075h–1077g	
a. Metallography: the study of the constitution and structure of metals and alloys [see also 125.D.1.]		**11**:1075h–1076e/ **17**:656e–g	
b. Corrosion: types of corrosion and their prevention		**11**:1076e–1077d/ **10**:159f–h	**11**:629e–f/**8**:636g–637b
c. Inspection and testing: mechanical and nondestructive testing		**11**:1077d–g	**11**:626h–630f *passim*
6. Welding, brazing, and soldering	WELDING, BRAZING, AND SOLDERING **19**:738–743		**1**:139f–140a *passim*
a. Basic principles: the metallurgy of metal joining		**19**:738d–739a	
b. Welding processes; *e.g.*, forge welding, arc welding, resistance welding, brazing, soldering		**19**:739b–740c/ **11**:621f–622a	**15**:451a–b
c. Types of joints; *e.g.*, fillet welds, brazed joints		**19**:740d–741a	
d. Weldability of metals		**19**:741b–d	
e. Testing and inspection of welds: nondestructive and destructive methods		**19**:741d–h	
f. Applications; *e.g.*, construction of bridges, storage tanks, ships		**19**:741h–742d/ **16**:694f–695a	**15**:488f–g/**16**:681d–f
g. Recent developments; *e.g.*, plasma welding, laser welding, ultrasonic welding		**19**:742d–743a	
C. Materials handling in the production process	MATERIALS HANDLING **11**:615–619	**4**:756c–d	
1. Types of materials-handling systems by process		**11**:615f–616f	
a. Raw materials and parts supply		**11**:615f–616e/ **8**:638b–639a	
b. Continuous processing systems		**11**:616e–f	
2. Materials-handling equipment; *e.g.*, wheeled carts, power trucks, trailer trains, racks, bins, conveyors		**11**:616g–617g/ **8**:637f–639a/ **15**:486c–h/ **17**:711h–713a	**12**:862d–863a
3. Transportation of materials		**11**:617g–619b	
a. Evaluating transportation alternatives: factors that determine the most efficient mode of transport		**11**:617g–618a	**15**:493a–d
b. Modes of transport; *e.g.*, highway motor truck, rail, ocean transport [see also 734]		**11**:618b–619b/ **4**:779c–781h/ **14**:188g–189e/ **15**:477g–478a/ **15**:494c–495b	**14**:179h–180c/**18**:668b–g

4. Technology of storage and warehousing

D. Technology of packaging

1. Packaging materials: their characteristics and major applications
2. Retail package design
3. Packing machinery and techniques
4. Package testing

articles	article sections	other references
STORAGE AND WAREHOUSING 17:711–713	12:863c–d/ 14:188d–g	
PACKAGING 13:854–860		5:904b–c/7:495d–f
	13:854d–857c	
	13:857c–858e	
	13:858e–859h	
	13:859h–860a	

Division III. Major fields of technology

[for Part Seven headnote see page 437]

Division I of Part Seven was concerned with the nature and effects of technology as a whole. Division II dealt with technical processes not specific to any of the major fields of technology. The outlines, and the articles and parts of articles referred to, in the eight sections of Division III deal with the major fields of technology, differentiated by the various needs, purposes, products, and services that have elicited technological development.

The outline and the articles referred to in Section 731, on agriculture and food production, first treat common elements in the technology of agriculture and then treat crop farming, flock and stock farming, hunting and fishing, food processing, food preservation, the quality control of food, food sources and new product development, and the history of agriculture.

Section 732, on the technology of the major industries, first treats the technology of the manufacturing, fabrication, processing, service, and utilities industries. It then deals with industrial research and development, and with the technology of industrial safety.

The subject in Section 733 is construction technology. The outline first deals with the principles, materials, and machinery involved in building construction. It goes on to the technology of such works of civil engineering as dams, bridges, and tunnels. The last subject in the section is prefabrication and shop fabrication.

The subject in Section 734 is transportation technology. The outline first deals with the supporting systems, devices, and vehicles for transportation on roads, on rails, on water, and in the air. It then treats air-cushion machines; traffic control for all the forms of transportation; and the history of transportation.

The subject of Section 735 is the technology of information processing and dissemination. The outline first deals with calculating devices, office machines, and computers. The next group of subjects dealt with includes general information-recording devices; sound recording and reproduction; the technology of photography; and information processing. It further treats the major systems of communication, the major systems of detection and remote sensing, and the electronic components and circuits that make these systems possible.

Section 736, on military technology, treats offensive and defensive delivery and payload systems; military logistics systems; and purely defensive equipment and systems.

Section 731. Agriculture and food production 463
732. Technology of the major industries 469
733. Construction technology 474
734. Transportation technology 477
735. Technology of information processing and of communication systems 482
736. Military technology 489
737. Technology of the urban community 492
738. Technology of Earth and space exploration 495

Section 737, on the technology of the urban community, treats the basic engineering services of the city; the technology of the basic social services of the city; the technological response to new urban problems; and the history of city engineering.

Section 738 deals with the techniques and equipment for land and underground exploration, for undersea exploration, and for space exploration.

Section 731. Agriculture and food production

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 731 deal with nine main subjects. Subject A is the technology of agriculture. The other subjects fall into four groups. In the first there are three subjects: B, crop farming; C, flock and stock farming; and D, the technology of hunting and fishing. The next group also has three subjects: E, food processing; F, food preservation; and G, quality control of food. Subject H is food sources and new product development; and subject I is the history of agriculture.

The outline of subject A begins with farm management, treating the nature and scope of farm management; basic management problems; and management practices on large farms, on small and middle-sized farms, and on farms in developing countries. It goes on to the kinds of farm machinery and means of traction, to the utilization of draft animals, and to the kinds of farm buildings. The outline next deals with soil preparation, management, and irrigation, and with disease and pest control. It goes on to animal and plant nutrition, and to animal and plant breeding. Finally, after covering farming techniques, it treats agricultural technology in relation to weather and to pollution.

The outline of subject B, crop farming, first treats the kinds of horticultural crops and the kinds of cereal crops. It goes on to the history, purposes, and techniques of forest management, and to the major types of forest trees and forest products. Covering the production of other major field crops, articles referred to deal separately with coffee, tea, cocoa, sugar, and tobacco.

The articles referred to in connection with subject C, flock and stock farming, treat cattle, swine, sheep and goat, horse, and other livestock farming; poultry farming; animal feed; and beekeeping.

The outline of subject D treats hunting weapons and methods, the nature, development, and techniques of commercial fishing, and sport fishing equipment and methods.

Subject E is food processing. The outline treats modern practices in processing and producing fruits and vegetables; cereals; bakery products; confectioneries and candies; meat and fish; dairy products; beverages, alcoholic and nonalcoholic; spices, herbs, and flavourings; sugars; oils, fats, and waxes; eggs; and cocoa and chocolate products.

Subject F is food preservation. The article referred to first treats the different methods of preservation—low-temperature preservation, preservation by drying, high-temperature preservation, fermentation and pickling, chemical preservation, and preservation by radiation. It then treats food storage and packaging.

The outline of subject G covers the methods for the evaluation of food quality; the techniques for the control of food quality; and the regulation of food quality by legislation, grading, and inspection.

The outline of subject H covers the history and development of new foods and new food products; the utilization of new food sources; and the development of new market forms of foods and of the food developed for space exploration.

The article referred to at I, on the history of agriculture, extends from the origins of agriculture and the early agricultural societies to the 19th-century power revolution on the farm, and to the scientific agriculture of the 20th century.

articles	article sections	other references
AGRICULTURE, TECHNOLOGY OF **1**:347–366		
A. Technology of agriculture		
FARM MANAGEMENT **7**:177–181	**1**:316b–317b	**1**:323f–g *passim*
1. Farm management		
a. The nature and scope of farm management: the kinds of decisions involved in the management of human, capital, and land resource combinations; the manner in which technological possibilities and sociopolitical arrangements affect farm management	**7**:177d–178a/ **19**:939b–e	
b. Basic management problems: land, livestock, and labour; financial management and the question of large-scale operation; market risks and their reduction through specialization, diversification, or the use of future markets	**7**:178b–179e	
c. Management practices	**7**:179e–181b	
i. On large farms; *e.g.*, in the U.S., the U.S.S.R., Israel, and Australia	**7**:179e–180e	**17**:342g–343e
ii. On small and middle-sized farms; *e.g.*, in Canada, the United Kingdom, and Denmark	**7**:180e–h	
iii. In developing countries; *e.g.*, in India and Zaire	**7**:180h–181b	
2. Farm machinery and means of traction		
a. Tillage, planting, and harvesting machinery	**1**:348e–350c/ **1**:357a–c/ **3**:1161f–h	

	articles	article sections	other references
b. Draft animals	DRAFT ANIMALS **5**:970–973		
i. Types of draft animals and their principal tasks		**5**:970c–971h	**15**:2a–b
ii. Utilization of draft animals in agriculture and in transport		**5**:971h–972e/ **10**:1285a–f	**18**:648h–649a/**19**:521a–522b *passim*
iii. Draft harness and accessories		**5**:972e–973a	**8**:657d–659c *passim*
3. Farm buildings	FARM BUILDINGS **7**:175–177		
4. Soil preparation, management, and irrigation		**1**:348c–352e/ **7**:763b–f/ **8**:1110a–f	
a. Soil composition and structure		**1**:348c–e/ **16**:1017e–1018a	**8**:1110d–e/**16**:1018b–1028b *passim*
b. Fertilizing and conditioning soil		**1**:350c–352e/ **7**:763e–f	**8**:1110b–d/**16**:1014h–1018a *passim*
c. Cropping systems; *e.g.*, crop rotation, monoculture, cover crops, legume planting		**1**:352e–353c	
d. Weed control: mechanical, chemical, and biological practices	WEED CONTROL **19**:722–727	**1**:354e–h/ **7**:763b–d	
e. Irrigation and drainage systems: their planning, construction, and uses	IRRIGATION AND DRAINAGE **9**:899–904	**1**:355h–356a/ **8**:1110f–g	**1**:340c–g
5. Control of animal pests and disease organisms	PEST CONTROL **14**:139–148	**1**:344f–345h/ **1**:353d–354h/ **9**:611b–d	
a. Pest and disease organisms: extent of damage; control programs		**14**:139d–140d/ **1**:344f–345b/ **4**:829e–830a/ **15**:970b–971b	**7**:273e–h
b. Chemical pest control		**14**:140d–143e/ **1**:345b–e/ **1**:353e–g	**13**:692f–693a
c. Biological pest control		**14**:143f–147d/ **1**:353g–354c	**1**:345f–g
d. Integrated pest control		**14**:147d–148e	**1**:345f–h
e. Control of plant diseases and nematodes		**1**:354c–e/ **5**:882c–895f/ **8**:1110h–1111c	**19**:50g–51a
f. Control of animal diseases		**5**:877d–879g	**10**:1281d–1287e *passim*
6. Cultivation of plants and animals		**7**:812f–815a/ **7**:854e–855a/ **8**:818b–e/ **18**:43d–e/ **19**:46h–51b	**10**:1280b–1287a *passim*
a. Animal and plant nutrition		**1**:908e–910a/ **5**:425h–426a/ **8**:1089h–1090a/ **8**:1110a–g/ **13**:404a–406h	**1**:350d–352e/**7**:273c–e
b. Management and propagation techniques		**1**:339a–341a/ **1**:352e–353c	
c. Breeding techniques			
i. Animal breeding	ANIMAL BREEDING **1**:903–908	**1**:342f–343e/ **8**:1090f–1092a	**5**:425g
ii. Plant breeding	PLANT BREEDING **14**:496–500	**1**:341d–342f/ **7**:761d–762b/ **8**:1105f–1107g/ **8**:1111d–e	
7. Specialized crop farming techniques: dryland farming, tropical farming, hydroponics, greenhouse farming		**1**:354h–356h/ **12**:120a–c/ **18**:48b–d	

	articles	article sections	other references
8. Harvesting and crop processing		1:357a–f/ 7:764a–f/ 19:51c–52g/ 19:878a–f	7:273h–283e *passim*
9. Agricultural technology and weather		1:357f–360c/ 12:118h–119e	7:749e–g/19:702c–d
10. Agricultural technology and pollution		1:360d–362f/ 14:142h–143e/ 14:754b–d	1:345d–e/5:58g–60a *passim*/ 19:726f–h
B. Crop farming			
1. Horticultural crops and their cultivation	HORTICULTURE 8:1105–1113	7:901h–902a	
a. Fruits and nuts	FRUITS AND FRUIT FARMING 7:751–767	19:45h–46g	
i. Fruit and nut growing in the tropics, the subtropics, the warm temperate zone, and the cool temperate zone		7:751h–761d	
ii. Basic practices in fruit farming and marketing		7:761d–767d	
b. Vegetables and legumes	VEGETABLES AND VEGETABLE FARMING 19:43–53	7:904h–905a	
i. Edible vegetables		19:43b–46h	
ii. Basic practices in vegetable farming and marketing		19:46h–52g	
c. Flowers and ornamentals		7:904c–905c/ 8:1111e–1113e/ 13:648c–649f	
d. Horticultural practices: propagation, controls, and treatment		7:905d–907f/ 8:1105f–1111e/ 19:47e–51b	14:352c–e
2. Cereals	CEREALS AND OTHER STARCH PRODUCTS 3:1157–1163		
a. Origin, development, and characteristics of cereals		3:1157b–1160b/ 1:341d–342f	3:1164g–1166f *passim*/ 14:585e–586a
b. Basic practices in cereal farming and marketing		3:1160c–1163f	
3. Forest crops	FORESTRY 7:526–534		
a. History of forestry		7:526c–h	
b. Purposes of forest management		7:527a–528d	5:44h–45b
i. The multi-use concept		7:527a–g/ 5:54e–55c/ 19:916c–921c	
ii. Sustained yield		7:527g–528d	5:55d–e
c. Major types of forest trees and forest products		18:688f–689a	7:534h–542b *passim*
i. Main groups of forest trees: conifers, monocots, and broadleaves		7:528d–529e/ 5:1a–3b/ 7:539c–542b	
ii. Lumber	WOOD AND WOOD PRODUCTS 19:916–921	7:533g–534e	15:794e–f
iii. Rubber	RUBBER 15:1174–1177		
d. Techniques of forest management [see also 355.D.]		7:529f–533g	
i. Silviculture: tending growing crops of trees		7:529f–531b	
ii. Fire prevention and control		7:531c–532a	7:323b–d
iii. Insect and disease control		7:532a–e	
iv. Watershed management		7:532e–533a	5:48d–e

	articles	article sections	other references
v. Wildlife and recreation management		**7**:533b–g/ **5**:51c–54e	
4. Production of other major field crops *with special attention to*			
a. Coffee	COFFEE PRODUCTION **4**:818–820		
b. Tea	TEA PRODUCTION **18**:16–17		
c. Cocoa	COCOA PRODUCTION **4**:811–813		
d. Sugar	SUGAR PRODUCTION **17**:769–771	**17**:773b–f	**1**:339g–340b
e. Tobacco	TOBACCO PRODUCTION **18**:464–466		
C. Flock and stock farming			
1. Livestock and poultry farming	LIVESTOCK AND POULTRY FARMING **10**:1279–1287	**1**:364d–365a	
a. Production of major flock and stock animals		**10**:1279g–1287e	**7**:176a–f
i. Cattle		**10**:1279g–1281g/ **1**:343b–e	**3**:476g–h
ii. Swine		**10**:1281g–1282e/ **1**:342h–343a	
iii. Sheep and goats		**10**:1282f–1283g/ **1**:343a–b	
iv. Horses		**10**:1283g–1285a	
v. Other livestock		**10**:1285a–f	
vi. Poultry		**10**:1285f–1287e	
b. Livestock and poultry feed	ANIMAL FEED **1**:908–911	**3**:1162h–1163a	
2. Beekeeping	BEEKEEPING **2**:791–794		**9**:126g–131e *passim*
a. Honeybees and their colonies		**2**:791g–792e	
b. Colony manipulation		**2**:792e–793c	
c. The role of bees in honey and beeswax production and in pollination		**2**:793c–794b	**13**:652f–653d/**14**:745h–746c
d. Disease and pest control		**2**:794b–h	
D. Technology of hunting and fishing			
1. Hunting weapons and methods: firearms, compressed air and gas guns, bows and arrows [see also 452.B.5.c.]	GUNS, SPORTING AND TARGET **8**:498–501	**1**:698e–700c/ **1**:1082g–1083h/ **1**:1085a–1087e/ **9**:50c–52e	**16**:704h–708f *passim*
2. Fishing equipment and methods			
a. Commercial fishing techniques	FISHING, COMMERCIAL **7**:351–362		
i. Development of commercial fishing		**7**:351f–352g/ **19**:811b–813g	
ii. Methods and gear used in freshwater and saltwater fishing		**7**:352h–360f	
iii. Aquaculture: farming and harvesting carp, trout, mollusks, shellfish, and seaweed		**7**:360g–362c/ **7**:349c–h	
iv. Whaling: early and modern practices; recent trends	WHALING **19**:811–813		**7**:356b–d
b. Sport fishing equipment and methods [see 452.B.5.b.]			

	articles	article sections	other references
E. Food processing			
1. Fruit and vegetable processing		**19**:47b–d/ **19**:51f–52f	**7**:492d–f
2. Cereals, cereal products, and other starch products	CEREAL AND OTHER STARCH PRODUCTS **3**:1162–1172		**5**:902a–f
3. Bakery products: basic ingredients; types of products and production methods; market preparation; quality maintenance and testing	BAKING AND BAKERY PRODUCTS **2**:596–607	**3**:1168a–c	
4. Confectionery and candy production	CONFECTIONERY AND CANDY PRODUCTION **4**:1081–1084	**7**:494c–f	**4**:813h–815b
5. Meat and meat products	MEAT AND MEAT-PACKING **11**:745–753		
6. Fish and marine products	FISH AND MARINE PRODUCTS **7**:345–351	**7**:483d–f	
7. Dairying and dairy products	DAIRYING AND DAIRY PRODUCTS **5**:425–436		
a. Milk production and handling techniques		**5**:425d–427a	
b. Dairy products: fluid and concentrated milk, dried milk, ice cream, butter, and cheese		**5**:427b–435c	
8. Beverage production			
a. Technology of brewing	BREWING **3**:158–162	**3**:1170d–1171a	**1**:437f–h
b. Technology of wine making	WINE MAKING **19**:875–884		
c. Technology of producing distilled liquor	DISTILLED LIQUOR **5**:901–904		
d. Technology of producing nonalcoholic beverages			
i. Soft drinks	SOFT DRINKS **16**:1009–1011		
ii. Coffee		**4**:819g–820e	
iii. Tea	TEA PRODUCTION **18**:17–19		
9. Spices, herbs, and flavourings	SPICES, HERBS, AND FLAVOURINGS **17**:502–508		
10. Cane sugar, beet sugar, and other sweeteners	SUGAR PRODUCTION **17**:771–776	**3**:1172b–c	**2**:793d–e/**3**:829b–d/ **5**:901h–902a
11. Oils, fats, and waxes	OILS, FATS, AND WAXES **13**:527–531		**16**:916e–f
12. Eggs and egg products	EGG PRODUCTION, COMMERCIAL **6**:442–444		
13. Cocoa and chocolate products		**4**:813d–815d	
F. Food preservation	FOOD PRESERVATION **7**:489–496	**7**:350c–d/ **11**:748a–e	
1. Methods of preservation		**7**:490b–495c	

	articles	article sections	other references
a. Low-temperature preservation: refrigeration and freezing		7:490b–491d/ 5:320a–b/ 5:431c–e	7:765h–767a/11:748b–c
b. Preservation by drying and by smoking		7:491d–492a	
c. High-temperature preservation: canning and pasteurization		7:492a–493f	5:429e–430a/13:1067d–e
d. Fermentation and pickling		7:493g–494c	
e. Chemical preservation		7:494f–495a	
f. Preservation by heat radiation and by ionizing radiation		7:495a–b	
2. Food storage and packaging		7:495a–496a/ 3:1162a–f/ 13:857d–g/ 19:51g–52f	7:488e–g
G. Techniques for controlling the quality of food	FOOD, QUALITY CONTROL OF 7:486–489		
1. Evaluation of food quality		7:486f–487h/ 2:606e–607a	
a. Sensory evaluation		7:486f–487c	
b. Objective evaluation by chemical, instrumental, and microbiological methods		7:487c–h	2:606f–h
2. Control of food quality		7:487h–489a/ 2:605h–606e	
3. Regulation of food quality by legislation, grading, and inspection		7:489b–g/ 8:698d–g/ 11:752g–h	5:101c–e/11:748e–f
H. Food sources and new product development	FOOD, NEW SOURCES AND PRODUCTS 7:481–485		
1. History and development of new foods and new food products		7:481a–c	
2. Utilization of new food sources; *e.g.*, oilseeds, leaves, grasses, single-cell protein		7:481d–484c/ 7:503d–f	1:366a–b/1:489a–c
3. Development of new market forms		7:484d–485c/ 3:1171a–1172a	
4. Foods developed for space exploration		7:485c–g	
I. The history of agriculture	AGRICULTURE, HISTORY OF 1:324–346	9:899g–900g	5:425a–d/ 5:970a–973b *passim*/ 7:902a–903b/14:429h–430e
1. Origins of agriculture: in the Near East, the Americas, China, and Europe		1:324g–326b/ 17:927b–928b	6:1059f–1061c *passim*/ 12:913f–h/17:275c–e
2. Early agricultural societies: Sumer, Nile Valley, Meso-America, and Peru		1:326b–327g/ 9:899g–900a/ 11:951b–g/ 18:29b–e	1:847e–h/5:603d–g/6:461c–d/ 11:934g–936f *passim*
3. Agriculture in ancient China, India, and Southeast and Far East Asia		1:327g–330g/ 9:337d–338d/ 9:341g–342a	9:900a–e
4. Improvements in agriculture in the West: AD 600 to 1600		1:330g–333f/ 12:148e–149c/ 19:935b–d	
5. The crop-farming revolution in Europe: 1600–1800		1:333g–335g/ 6:232d–233d/ 18:37a–b	
6. The 19th-century power revolution on the farm (*c.* 1792–1914)		1:335g–337g/ 6:232d–233d/ 18:43d–e	11:226e–h
7. Scientific agriculture in the 20th century		1:337g–346h/ 18:48b–d/ 18:51h/ 19:939b–e	1:323c–324d *passim*
a. Mechanization		1:337h–339a	

	articles	article sections	other references
b. New crops and techniques		1:339a–341a	
c. Development of new strains: maize, wheat, rice		1:341d–342f/ 7:483a–b	
d. Natural and artificial animal breeding		1:342f–343e	
e. Other scientific applications		1:343f–345h	
i. Uses of electricity		1:343f–344e	
ii. Pest and disease control		1:344f–345h/ 14:139d–140c	
8. The future of agricultural technology		1:362f–366f	
a. Agricultural experimentation and research		1:362f–365b	7:501h–502b
b. Agricultural technology and the world food crisis		1:365c–366f/ 1:315f–317c	7:499e–501d *passim*/ 10:1279d–g

Section 732. Technology of the major industries

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 732 deal with ten main subjects. Subject A, previously treated in Section 712, is the principles of the organization of work and of production common to all industries. Subjects B through H are the major kinds of industries. Subject I is industrial research and development. Subject J is the technology of industrial safety.

Subject B is the manufacturing industries. The articles referred to give separate treatment to the technologies of the aerospace industry, the automotive industry, the clothing and footwear industry, and the furniture industry.

Subject C is the fabrication industries. The articles referred to give separate treatment to the technologies of the textile industry, the steel industry, the leather and hide industry, the fur industry, the floor covering industry, the electronics industry, the tool and die industry, the lumber industry, the cutlery industry, and the abrasives industry.

The articles referred to in connection with subject D, the process industries, treat separately the technologies of the chemical industry, the petroleum industry, the paper industry, the pharmaceuticals industry, the plastics industry, the rubber industry, the surface coating industry, the dye and pigment industry, the man-made fibre industry, industrial and residential gases, and the cosmetics and personal care industry.

Subject E is the construction industries. It is given separate treatment in the next section, Section 733.

Subject F is the service industries. The articles referred to treat separately the technologies of the hotel and motel industry; the technology of the restaurant industry, dealt with in Section 451; that of the food service systems; that of book, magazine, and newspaper publishing, dealt with in Section 441; and that of the security and protection industry. The transportation industry is treated separately in Section 734.

Subject G is the utilities industries. The articles referred to separately treat the technologies of the power industry, of the gas industry, and of the telephone and telegraph industries.

Subject H is the merchandising and marketing of consumer goods. The technologies involved in these processes are dealt with in Section 534.

The article referred to on subject I treats the origins of industrial research; the kinds and stages of proprietary research and development; and the placing of research contracts and the granting of patent rights.

The article referred to on subject J deals with developments in modern industrial safety engineering.

	articles	article sections	other references
A. Principles of organization of work and production [see 712]			
B. Manufacturing industries *with special attention to*			
1. The aerospace industry	AEROSPACE INDUSTRY 1:132–142		
a. Products: flight vehicles (*e.g.*, aircraft, guided missiles, spacecraft); propulsion systems; on-board and ground-support equipment		1:133h–136a	
b. Research and development: design and testing of commercial aircraft; search for new materials and propulsion systems; miniaturization		1:136a–139b	1:131c–f
c. Manufacturing facilities and techniques: fabrication, assembly, product assurance, and maintenance		1:139b–142d	
2. The automotive industry	AUTOMOTIVE INDUSTRY 2:528–535		2:509b–e/ 2:514a–527f *passim*
a. History of the automotive industry: developments before World War I; introduction of mass production; emergence of large-scale business organization; postwar developments		2:528b–531f/ 11:598e–h	7:520g–521g/15:1174f–h

	articles	article sections	other references
b. The modern automotive industry: diversity of the product line; manufacturing processes; sales and service organizations; international operations; economic and social effects		**2**:531f–535g/ **2**:519h–525e	**15**:1182d–e
3. The clothing and footwear industry [see also 451.B.2.]	CLOTHING AND FOOTWEAR INDUSTRY **4**:750–756		
a. Design of clothing and footwear		**4**:752e–753a	
b. Manufacturing processes and equipment		**4**:753a–756a	
4. The furniture industry	FURNITURE INDUSTRY **7**:807–811	**7**:781h–785h	**9**:697e–g
a. Materials: natural wood, plastics, and metals		**7**:808b–f	
b. Furniture production		**7**:808f–811c	
C. The fabrication industries *with special attention to*			
1. The textile industry	TEXTILE INDUSTRY **18**:170–188		
a. Development of the textile industry		**18**:171a–172g	**18**:42f–h/**19**:935h–936c
b. Production of yarn and fabrics		**18**:172g–184c/ **17**:1055h–1057h	**4**:752c/**9**:698c–g
c. Textile finishing processes: bleaching, scouring, mercerization, dyeing, and printing		**18**:184d–187f/ **5**:1102d–1103f	
d. Textile consumption and trade		**18**:187f–188g	
2. The steel industry [see also 725.B.]	STEEL PRODUCTION **17**:637–656	**9**:896g–898c/ **11**:623h–624d/ **18**:41e–42c	**2**:508d–g
a. Raw materials: pig iron, steel scrap, fluxes, oxygen, and refractory materials		**17**:642e–643e/ **4**:570g–571b	
b. Types of steelmaking processes: Bessemer process, the basic oxygen process, the open-hearth process, the electric process		**17**:643e–650h	
c. Finishing processes: solidification, casting, and rolling		**17**:650h–656g	
3. The leather and hide industry	LEATHER AND HIDES **10**:759–764		
a. Raw materials: animal skins and hides		**10**:761b–g	
b. Leather processing: tanning, dyeing, and finishing		**10**:761g–764a	
4. The fur industry	FURS **7**:812–816		
a. Fur processing: fur dressing and dyeing		**7**:815c–816a/ **7**:286d–287g	
b. Furriery: production of fur garments		**7**:816a–c	
5. The floor covering industry	FLOOR COVERINGS **7**:406–411		
a. History of floor coverings and carpet making		**7**:406d–407c/ **16**:16g–24b	
b. Production of handmade and machine-made carpets and rugs; linoleum, cork tiles, and other smooth-surfaced floor coverings		**7**:407d–411a/ **16**:12e–13c	**9**:695c–g
6. The electronics industry		**7**:248f–250g/ **9**:662c–664c	**2**:509e–g/**6**:542f–h/**6**:678b–d
a. Manufacture of electronic components and systems		**6**:690f–691b/ **7**:248f–g/ **15**:433h–434c	
b. Applications of electronic systems; *e.g.*, radio and television communication, sound recording and reproducing, information processing [see 735]			

	articles	article sections	other references
7. The tool and die industry	TOOL AND DIE MAKING **18**:487–489		
a. Fabrication of tools and dies		**18**:487g–489c	
b. Tool and die-making facilities		**18**:489d–e	
8. The lumber industry	WOOD AND WOOD PRODUCTS **19**:921–925	**7**:533h–534e	
a. Principal wood products; *e.g.*, lumber, veneer, plywood, particle board, fibreboard		**19**:921d–h/ **19**:922g–924b	
b. Wood treatment; *e.g.*, drying, preservation		**19**:921h–922g	
9. The cutlery industry	CUTLERY AND TABLEWARE **5**:385–389		
a. Materials used for cutlery and tableware; *e.g.*, plated materials, stainless steel		**5**:386d–387a	
b. Modern fabricating techniques		**5**:387a–388h	
10. The abrasives industry	ABRASIVES **1**:13–17		
a. Sources and uses of natural and manufactured abrasives		**1**:14a–15f	
b. Manufacture of abrasives and abrasive products		**1**:15g–17a	
D. The process industries *with special attention to*			
1. The chemical industry	CHEMICAL INDUSTRY **4**:125–138	**18**:42h–43c	**2**:508a–c
a. Divisions of the chemical industry: the heavy inorganic chemical industry, the fine chemical industry, and the heavy organic chemical industry		**4**:127b–133b/ **4**:113d–g/ **9**:96g–97c	**13**:125c–126a/**13**:822d–823b
b. Finished chemical products; *e.g.*, fertilizers, soaps and allied products, cosmetics, pharmaceuticals, surface coatings		**4**:133b–138a/ **14**:194c–199b/ **16**:915f–919e	
2. The petroleum industry [see also 724.B.2.]	PETROLEUM REFINING **14**:180–189		**14**:173g–174b/**18**:46b–d
a. Petroleum refining processes; *e.g.*, fractional distillation, cracking, reforming		**14**:181c–185b	
b. Petroleum products; *e.g.*, gasoline, kerosine, gas oils, lubricating oils		**14**:185b–187e/ **10**:159d–e	
c. Refinery plants and facilities		**14**:187h–189e	
3. The paper industry	PAPER AND PAPER PRODUCTION **13**:966–976		**5**:995f–996a
a. Development of the papermaking process		**13**:966d–967d	
b. Raw materials: wood and other fibres		**13**:967d–969g	
c. Processes for preparing pulp and for manufacturing paper and paperboard		**13**:969h–974f	
d. Properties and uses of paper		**13**:974h–976h	
4. The pharmaceuticals industry [see also 10/35.C.4.]	PHARMACEUTICALS, PRODUCTION OF **14**:191–199		**18**:47g–48a
a. Production of pharmaceuticals from natural sources and by chemical synthesis		**14**:192a–196g	**7**:350g–351a
b. Preparation of dosage forms; *e.g.*, solutions, dispersions, tablets		**14**:196g–199b	
5. The plastics industry	PLASTICS AND RESINS **14**:510–525		**11**:625a–d/**13**:855h–856h
a. History of the plastics industry		**14**:511c–g	**18**:47c–e

	articles	article sections	other references
b. Principles and processes of polymerization		**14**:511g–512c/ **14**:770e–771e	
c. Types of plastic materials; *e.g.*, thermosetting, thermoplastic, other resins		**14**:512d–517f/ **1**:89e–90f/ **4**:131e–g	
d. Plastics manufacture and fabrication		**14**:517g–523c/ **11**:620a–c	**11**:621a–c
e. Types of industrial plastics; *e.g.*, structural foams, sheets and films, laminates		**14**:523d–525c	
6. The rubber industry	RUBBER **15**:1174–1183		
a. Natural and synthetic rubber		**15**:1174b–1180d/ **4**:131g–132b/ **7**:263g–h	
b. Manufacturing processes: compounding, mastication, calendering, and vulcanization		**15**:1180d–1182d	
c. Major applications; *e.g.*, tires and tire products, industrial hoses, cables, belts		**15**:1182d–1183a/ **2**:525d–e	
7. The surface coating industry	PAINTS, VARNISHES, AND ALLIED PRODUCTS **13**:886–892		
a. Development of the surface coating industry		**13**:886h–887d	
b. Paint manufacture		**13**:887d–g	
c. Properties and use of pigments, varnishes, and paint binders		**13**:887h–890d	**4**:132d–133a/**10**:730c–d/ **10**:763g–h/**13**:531g–532a
d. Methods of applying coatings		**13**:891c–g	**10**:763h–764a
e. Economics of the coatings industry: future trends		**13**:891h–892e	
8. The dye and pigment industry [see also 122.E.1.t.]	DYES AND DYEING **5**:1099–1105	**4**:128e–f	**4**:571e–g
a. Manufacture of dyes and pigments		**5**:1100a–1102a/ **5**:1115b–h	**10**:730c–d
b. Techniques and equipments used for dyeing fibres and textiles		**5**:1102a–1104c/ **18**:186e–f	
c. Nontextile applications; *e.g.*, dyeing of paper, plastics, and leather		**5**:1104c–1105a/ **5**:1115h–1116e/ **10**:762h–763a	**5**:999d–h/**7**:815f–816a
9. The man-made fibre industry	FIBRES, MAN-MADE **7**:257–271	**15**:1146a–1146c	
a. Development of the man-made fibre industry		**7**:257g–258f	
b. Fundamental processes of production: spinning, orientation, stretching, filament modification		**7**:258f–260e/ **15**:1146c–1147f	
c. Chemical modification of natural fibres such as rayon, cellulose, and protein fibres		**7**:260e–263h	**4**:129g–130d
d. Production of synthetic fibres; *e.g.*, polyamide fibres, polyester fibres, polyvinyl fibres		**7**:263h–268a	**4**:130d–h/**14**:187d–e/ **14**:765f–767f *passim*
e. Production of inorganic synthetic fibres; *e.g.*, glass fibres, aluminum silicate fibres		**7**:268a–270g	**8**:203d–f
f. Economic aspects of man-made fibre production		**7**:270g–271c/ **13**:969d–g	
10. Production of industrial and residential gases	GASES, INDUSTRIAL AND DOMESTIC **7**:922–929		
a. Residential and industrial heating gases; *e.g.*, manufactured gas, natural gas, petroleum-based gases		**7**:922h–924e	**4**:134e–f/**5**:319g–320a
b. Gases produced by liquefaction of air; *e.g.*, oxygen, nitrogen, noble gases [see 724.C.7.]			

	articles	article sections	other references
c. Gases derived from other sources; *e.g.*, carbon monoxide, hydrogen		7:927a–929c	
11. The cosmetic and personal care industry			
a. Cosmetics and cosmetology	COSMETICS INDUSTRY 5:196–199		
b. Soaps and detergents	SOAPS AND DETERGENTS 16:914–919	4:137d–138a	4:860b–g
E. The construction industries [see 733]			
F. The service industries			
1. Hotels and motels	HOTEL AND HOTEL INDUSTRY 8:1117–1119		
2. Restaurants [see 451.B.1.d.iii.]			
3. Food service systems	FOOD SERVICE SYSTEMS 7:496–498		
4. Book, newspaper, and magazine publishing [see 441.D.]			
5. The transportation industry [see 734]			
6. Security and protection systems	SECURITY AND PROTECTION SYSTEMS 16:453–455		
a. Types of security systems and equipment		16:453h–455b/ 11:10h–12c	
b. Trends in the security industry		16:455b–f	
G. The utilities industries			
1. The power industry		2:510c–g/ 6:631b–632g	3:466e–467a/18:46d–g
2. The gas industry		7:922h–924e	5:319g–320a
3. The telephone and telegraph industries		11:598h–599a/ 18:77f–78d/ 18:92e–95e	2:509h–510b
H. The merchandising and marketing of consumer goods [see 534.H.5.]			
I. Industrial research and development	RESEARCH AND DEVELOPMENT, INDUSTRIAL 15:739–743	9:508a–g	
1. The origins of industrial research		15:739f–740e	
2. Proprietary research and development: product planning, basic and applied research, and cost analysis		15:741g–743c/ 17:662a–c	1:136b–c
3. The role of government: placing of research contracts; granting of patent rights		15:743c–h	
J. Technology of industrial safety	SAFETY ENGINEERING 16:137–145		
1. The industrial safety movement: accident prevention programs; methods of rating accident experience in companies and industries		16:137e–141g/ 8:698h–699c	
2. Safeguarding men and machines in the industrial environment: safeguarding machinery and working areas; safety principles in materials handling; control of radiation, chemical, and electrical hazards		16:141h–144e/ 1:588e–h	9:530g–532a *passim*/ 12:251g–h

Section 733. Construction technology

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 733 deal with three main subjects: A, general building construction; B, construction of civil engineering works; and C, prefabrication and shop fabrication.

After dealing with the history of construction, the outline of subject A treats the stages of preconstruction planning and surveying procedures. It goes on to the many kinds of building materials, to the methods for testing them, and to the kinds of construction machinery. Articles are then referred to that separately treat construction techniques—carpentry, masonry, steel construction, and concrete construction. The outline then turns to the technologies involved in the construction of component parts of buildings. It first deals with applications of soil mechanics in the laying of different kinds of foundations. It goes on to parts of superstructures, such as bearing walls, floors, and windows. Finally, the outline deals with auxiliary systems and members, covering plumbing, heating, ventilating, and lighting systems; auxiliary members such as elevators, chimneys, locks, and electrical wiring; and the applications of acoustics for the control of noise and for the provision of good hearing conditions.

Subject B is the construction of civil engineering works. Articles referred to separately treat the construction of dams, aqueducts, bridges, tunnels and other underground structures, harbours and sea works, lighthouses, and stadiums.

The article referred to on subject C treats the economics, the advantages, the procedures, the techniques, and the materials of prefabrication and shop fabrication.

articles	article sections	other references
A. General building construction		
BUILDING CONSTRUCTION **3**:452–468		
1. History of construction [see also 626.A.]	**3**:452e–456a	
a. Ancient construction materials and methods: the use of reeds and straw, thatching, wood, and masonry	**3**:452e–454e/ **11**:587a–g/ **18**:29f–h	**6**:465c–466h *passim*/ **19**:301f–302d
b. Development of modern materials and methods: introduction of metal and concrete construction; emergence of modern building systems	**3**:454e–456a/ **4**:1075c–e/ **17**:633d–634g/ **18**:43e–g	**14**:967c–d/**19**:460f–464b *passim*
2. Preconstruction planning	**3**:456a–457c/ **9**:699b–700c	
a. Design programming: site selection and acquisition	**3**:456a–d/ **9**:699c–f	
b. Drafting: development of schematic and detailed design; preparation of working drawings and specifications	DRAFTING **5**:973–977 **3**:456e–457c/ **9**:699f–700c/ **11**:677a	**5**:1003a–d
3. Surveying procedures: techniques for laying out building foundations [see also 723.G.1.]	**3**:457c–d/ **17**:833e–834b	
4. Building materials		
a. Kinds of building materials	**1**:1095h–1097c	**3**:461e–g/**3**:463b–e/ **8**:713g–714b
i. Earth, clay, and sod	**16**:1011f–h	**5**:442g–h/**7**:888e–g/ **16**:1012g–1013b
ii. Lumber	**1**:1096d–f/ **19**:919c–924b	
iii. Bricks and tiles: other fired clay and ceramics	**1**:1096b–d/ **3**:164c–165d	
iv. Stone	**1**:1095h–1096b/ **11**:588a–b/ **18**:756e–g	**8**:633f–h
v. Mortar, cement, portland cement, and plaster	CEMENT **3**:1078–1079	**11**:588h–589a
vi. Metals; *e.g.*, iron, steel, aluminum, copper	**1**:1096f–h/ **3**:185f–h/ **17**:656g–658e	**1**:649a–c/**3**:463c–e/ **8**:635g–637b/**9**:896g–898c *passim*
vii. Glass [see also 629.B.4.]	GLASS PRODUCTS AND PRODUCTION **8**:197–198	**8**:205d–e/**8**:714g–715a
viii. Concrete, reinforced concrete, and prestressed concrete	CONCRETE **4**:1075–1077 **1**:1096h–1097c/ **3**:186a–e/ **18**:757f–758a	**3**:165d–e/**5**:442e–f
ix. Composition materials	**7**:410c–411a	**3**:461e–f/**9**:695c–d/ **14**:523d–525c *passim*

	articles	article sections	other references
b. Testing of building materials	MATERIALS TESTING **11**:626–630	**11**:1077d–g	
i. Testing mechanical, thermal, and electrical properties of materials		**11**:627a–629d/ **11**:1077e–f	**15**:955h–956f/ **15**:1176h–1177a
ii. Testing for deterioration of materials		**11**:629d–630b	
iii. Nondestructive testing of materials		**11**:630b–f/ **11**:1077f–g	
5. Construction machinery		**15**:897h–898e	
a. Transport machinery		**12**:251c–d	
b. Lifting machinery; *e.g.*, cranes, cables, ropes	ROPES AND CABLES **15**:1144–1149	**12**:250h–251c	**8**:641c–h
6. Construction techniques			
a. Carpentry	CARPENTRY **3**:952–956		
i. Carpentry tools; *e.g.*, nonpowered and powered hand tools, fixed power tools		**3**:952c–953a	**8**:614c–624g *passim*
ii. Joining: types of joints; preparation and assembly of joints		**3**:953b–954e	
iii. Other carpentry functions; *e.g.*, framing of buildings, constructing concrete forms, building custom-made furniture		**3**:954f–956d/ **7**:809b–d/ **14**:966d–g	**3**:458g–459a/**3**:460f–g/ **3**:463f–h
b. Masonry construction	MASONRY CONSTRUCTION **11**:586–590	**3**:164g–165d	
i. Work methods: masonry tools, mortars, and bonding patterns		**11**:588f–589c	
ii. Physical properties of masonry materials; *e.g.*, compressive and tensile strength, durability		**11**:589d–h	**15**:952f–964e *passim*
iii. Modern applications; *e.g.*, brick-veneer walls, exterior curtain walls		**11**:589h–590d	**3**:463h–464a
c. Steel construction	STEEL CONSTRUCTION **17**:633–635	**3**:179f–180b/ **3**:186e–187f/ **14**:966g–967a	**3**:459a–e/**3**:460g–461a/ **3**:462f–463a
i. Skeleton construction: the development of the skyscraper		**17**:634a–g	**3**:459a–d/**19**:463b–464b
ii. Stiff-wall framing		**17**:634g–635a	
iii. Specialized structures; *e.g.*, exposition buildings, scientific installations		**17**:635b–c/ **3**:187g–188h	**17**:527f–h
d. Concrete construction		**4**:1077c–1079c	
i. Structural forms of concrete; *e.g.*, precast, cast-in-place		**3**:186a–e/ **3**:189h–190b/ **3**:955f–h/ **4**:1077c–1078a	**3**:459f–460b/**3**:461a–d/ **3**:462e–f/**14**:965f–966a
ii. Applications of concrete construction; *e.g.*, office and industrial buildings, bridges, retaining walls		**3**:180b–h/ **4**:1078b–1079c/ **5**:443c–444e/ **8**:634h–635e/ **14**:967b–e/ **18**:757c–d	
7. Building components		**3**:457d–468a/ **1**:1097c–1102c	
a. Foundations and footings	SOIL MECHANICS, APPLICATIONS OF **16**:1012	**3**:457d–458e/ **3**:190b–c/ **7**:81d–82b	
b. The structural frame		**3**:458e–460e/ **1**:1101e–1102c	**17**:634g–635a
c. Floor systems		**3**:460e–461g/ **9**:694h–695g	**3**:955c–e/**14**:965g–h
d. Roof systems		**3**:461g–463e/ **1**:1100b–1101e	**3**:955a–b/**14**:966e–f

	articles	article sections	other references
e. Space-enclosure systems		**3**:463e–464e/ **1**:1097c–g/ **11**:589h–590d	**3**:955e–f/**9**:695g–696d
f. Finish hardware; *e.g.*, locks, hinges, door knobs	LOCK **11**:10–12	**3**:464e–f	
g. Auxiliary systems		**3**:464f–468a	
i. Plumbing systems	PLUMBING **14**:574–577		**3**:464g–465e
ii. Heating, ventilating, and air-conditioning systems	HEATING, VENTILATING, AND AIR CONDITIONING **8**:709–728	**3**:465e–466e/ **15**:566b–h	**12**:251d–h
iii. Electrical wiring		**3**:466e–h	
iv. Systems for illumination: interior and exterior lighting	LIGHTING AND LIGHTING DEVICES **10**:961–963	**3**:466h–467a/ **9**:697g–698c	
v. Vertical transport systems; *e.g.*, elevators and moving stairways	ELEVATOR **6**:716–717	**3**:467a–g	
vi. Chimneys and flues		**3**:467h–468a	
8. Acoustics and sound-control techniques	ACOUSTICAL ENGINEERING **1**:54–57	**17**:32g–33e	**17**:36b–g
a. Criteria for sound-control design: factors that determine the quality of acoustical environments		**1**:54e–g	**17**:32g–33b
b. Control of indoor and outdoor noise: use of sound-absorbing materials and other techniques		**1**:54g–56a/ **14**:755a–g/ **17**:33h–34b	
c. Criteria for good hearing conditions; *e.g.*, proper sound distribution and reverberation time		**1**:56b–57d	**17**:33b–d
d. Sound amplification systems		**1**:57d–h	**17**:58d
B. Construction of civil engineering works *with special attention to*			
1. Dams	DAM **5**:440–447		**19**:650g–h
a. Basic problems in dam design: site investigation and testing, problems of materials, and the earthquake problem		**5**:442b–443b	
b. Modern concrete dams		**5**:443c–444e/ **4**:1078e–f	
i. Concrete gravity dams		**5**:443c–h	
ii. Concrete buttress and multiple-arch dams		**5**:443h–444b	
iii. Arch dams		**5**:444b–e	
c. Embankment dams		**5**:444f–445h	**16**:1013c–d
d. Auxiliary structures; *e.g.*, spillways, gates, sluices		**5**:445h–447a	
2. Aqueducts	AQUEDUCT **1**:1035–1042	**19**:650h–651b	
3. Bridges	BRIDGES, CONSTRUCTION AND HISTORY OF **3**:174–191	**18**:43e–g	
a. Development of the modern bridge: use of timber, iron, steel, and concrete; the foundation problem; suspension and movable bridges		**3**:177e–185e	**4**:1078d–e/**5**:1117g–1118a/ **15**:983g–984d/ **18**:653h–654a/ **18**:655g–656a
b. Contemporary developments in bridge engineering: improved materials, designs, and techniques; safety problems and solutions; future trends		**3**:185f–191e	
4. Underground construction	TUNNELLING AND UNDERGROUND EXCAVATION **18**:749–765		

	articles	article sections	other references
a. Tunnelling techniques: basic tunnelling systems; modern soft ground and rock tunnelling		**18**:752c–759a/ **16**:1013f–1014a	
b. Underground excavations and structures: rock chambers, shafts, and immersed tube tunnels		**18**:759b–763a	**12**:251h–254f *passim*
c. Future trends in underground construction: environmental and economic factors, potential applications, and improved technology		**18**:763b–765g	
5. Harbour and hydraulic works	HARBOURS AND SEA WORKS **8**:632–643	**10**:952h–953c	**14**:431d–e
a. Breakwaters, sea walls, and levees		**8**:633f–634e/ **4**:807d–f	
b. Docks and quays		**8**:634e–637f	
c. Loading and unloading facilities; *e.g.*, roll-on, roll-off facilities, bulk terminals		**8**:637f–639a	
d. Dry docks		**8**:639a–641a	
e Dredges, dredging, and reclamation		**8**:641a–643e	
6. Lighthouses and lightships	LIGHTHOUSE **10**:952–957		
7. Stadiums	STADIUM **17**:526–528		
C. Prefabrication and shop fabrication	PREFABRICATION AND SHOP FABRICATION **14**:964–967		
1. Economics of prefabrication		**14**:964e–f	
2. Advantages of prefabrication: reductions in cost and assembly time resulting from modular construction and use of interchangeable parts		**14**:964g–965e	
3. Production planning and procedures: influence of innovations in construction methods; use of modern management techniques		**14**:965f–966c	
4. Prefabrication techniques: methods used for construction using wood, steel, concrete, and other materials		**14**:966d–967g/ **3**:188h–189g	

Section 734. Transportation technology

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 734 deal with ten main subjects. The first six subjects concern the supporting systems, devices, and vehicles for the major kinds of transportation: A, roads and highways; B, vehicles and devices for road and highway transportation; C, rail transportation; D, stationary conveyance systems; E, water transportation; and F, air transportation. The next three subjects relate to all kinds of transportation: G, air-cushion machines; H, traffic control; and I, safety engineering. Subject J is the history of transportation.

The outline of subject A covers the construction and maintenance of automobile roads and of national highway and expressway systems.

The articles referred to in connection with subject B separately treat harness and saddlery, wagons and carriages, bicycles, automobiles and automotive systems, and trucks and buses.

The outline of subject C covers the history of railroad technology and the construction of the supporting systems and vehicles for rail transportation.

The various kinds of stationary conveyance systems, such as pipelines and conveyor belts, are treated in Section 725, on the technology of industrial processes.

The outline of subject E deals with the history of water transportation, and with the supporting systems and vehicles for water transportation. It begins with oar-propelled, wind-propelled, and power-propelled vessels. It goes on to ship operation, brokering, and charting; to world trade routes and merchant fleets; and to current problems of the shipping industry. Finally, it treats ship design and construction, canals and inland waterways, and harbour works.

Subject F is air transportation. The outline first deals with the types and the construction of lighter-than-air craft and of heavier-than-air craft. It goes on to the design, construction, and operation of airports, problems of air traffic control, and the air transport industry. Finally, it treats space travel, aeronautical and space research, and the history of flight.

The article referred to on subject G treats the design, construction, operation, and applications of air-cushion machines.

The articles referred to in connection with subjects H and I treat the problems of traffic control and of safety engineering for transportation systems on land, on water, and in the air.

The article referred to on subject J treats the history of transportation from the most primitive forms to the modern global transportation network. Future trends in transportation technology are dealt with at the end of the outline.

	articles	article sections	other references
A. Roads and highways and their construction	ROADS AND HIGHWAYS **15**:892–905		
1. Automobile roads		**15**:895g–900e	
a. Basic problems		**15**:895g–896b	
b. Elements of construction		**15**:896c–899h	
i. Surveying [see 723.G.1.]			
ii. Types of pavement: flexible and rigid		**15**:896c–897h/ **16**:1013d–e	
iii. Machinery and equipment [see 733.A.5.]			
iv. Factors considered in the design and construction of roads		**15**:898e–899h	
2. National highway and expressway systems		**15**:900e–903g	
a. Administration and financing of national highway systems		**15**:901e–g	
b. System planning: the process of assessing highway needs; determining the scope and requirements for a system; dealing with the relationships among governmental units concerned with the system		**15**:901h–903a	
c. Social, economic, and other effects of new expressways		**15**:903a–903g	
3. Operation and maintenance of automobile roads and highways		**15**:903g–905b	
4. Future highway trends		**15**:905c–f	
B. Vehicles and devices for transportation across country and on roads and highways			
1. Nonwheeled transportation devices; *e.g.*, bridles, saddles, harness, stirrups	HARNESS AND SADDLERY **8**:657–659		
2. Animal-drawn wheeled vehicles; *e.g.*, wagons, coaches, carriages	WAGONS AND CARRIAGES **19**:520–525	**5**:972c–973a	**18**:650f–g
3. Bicycles	BICYCLE **2**:981–984		
4. Automobiles	AUTOMOBILE **2**:514–527		
a. Development of the automobile: steam-powered, internal-combustion-powered, and electric-powered automobiles		**2**:514d–519g/ **17**:630d–g	**18**:655b–d
b. Modern automobiles		**2**:519h–527c	
i. Automotive systems: body, chassis, engine, cooling system, electrical system, transmission, and other mechanical subsystems		**2**:519h–525e	**11**:231b–e/**18**:776c–d
ii. Improvements in automotive design to minimize accidents and pollution problems		**2**:525f–527c	**14**:751d–g
5. Trucks and buses	TRUCKS AND BUSES **18**:721–723		**11**:618b–c
C. Rail transportation	RAILROADS AND LOCOMOTIVES **15**:477–495		
1. Development of railroads and locomotives		**15**:478c–482d/ **17**:630b	**18**:44a–c/**18**:653c–654a
2. Modern railroad technology		**15**:482e–495b	
a. Locomotives; *e.g.*, steam, electric, diesel-electric		**15**:482e–486b	
b. Railroad car design: freight cars, coaches, and sleeping cars		**15**:486c–487h	**11**:618c–f
c. Location and construction of railroad track and roadway		**15**:487h–489f	
d. Railroad operation and control		**15**:489f–491d	
e. The future of railroads		**15**:492h–495b	**18**:663a–e

	articles	article sections	other references
D. Stationary conveyance systems; *e.g.*, pipelines, conveyor belts [see 725.C.2.]			
E. Water transportation	TRANSPORTATION, WATER **18**:663–674		
1. History of water transportation		**18**:664f–668a	
2. Ships and other waterborne vessels	SHIP **16**:676–688		
a. Oar-propelled vessels		**16**:677b–d/ **2**:1157c–f	
b. Wind-propelled vessels	SAILS AND SAILING SHIPS **16**:157–163	**16**:677e–679e/ **18**:651g–652b	**2**:1165b–1166a
i. Military and commercial sailing vessels; *e.g.*, trading ships, galleons, galleasses, frigates		**16**:157a–162e/ **16**:677e–678e/ **12**:888f–890a/ **18**:664f–665d	
ii. Pleasure sailing craft		**16**:162f–163c	**2**:1163e–g
iii. Sail design and arrangement		**2**:1166h–1167d	**16**:160g–161a
iv. Rigging		**16**:678e–679e	
c. Power-propelled vessels		**16**:679e–687e/ **1**:393g–395b	**11**:618f–h
i. Power units for propulsion [see E.7.c.]			
ii. Propulsion systems; *e.g.*, paddle wheels, screw propellers, water jets		**16**:681e–h/ **16**:691c–e	
iii. Special types of ships: container ships, barge tows and carriers, ferryboats, ice-breakers, tankers, and hydrofoils		**16**:683e–687e/ **2**:1171b–d	**1**:392b–395b *passim*/ **12**:863a–c/**18**:668b–g
3. Ship operation, brokering, and chartering		**16**:687e–688a/ **18**:669b–670c	
4. International maritime law [see 553.D.5.b.]			
5. World trade routes and merchant fleets		**18**:672e–673h	
6. Problems of the shipping industry: increased volume of cargo, competition from air travel, rising costs of ship operation and construction, and pollution of ocean and seacoasts		**18**:673h–674f	
7. Ship design and construction	SHIP DESIGN AND CONSTRUCTION **16**:688–697		
a. Ship design: hydrodynamic and hydrostatic factors that influence ship stability and manoeuvrability; structural strength and safety considerations		**16**:689d–693c/ **12**:888g–890a/ **16**:686e–687e	
b. Shipbuilding, shipyard layout and construction; planning, fabrication, and assembly; launching, outfitting, and trials		**16**:693c–696a/ **18**:651e–f	
c. Power units for propulsion: steam generators, internal-combustion engines, gas turbines, and nuclear reactors		**16**:696a–697g/ **12**:890b–e/ **16**:680c–681a/ **17**:630b–g	**5**:727h–728a/**16**:687g–h/ **18**:654c–f
8. Canals and inland waterways	CANALS AND INLAND WATERWAYS **3**:753–763		
a. History of canal building and waterway construction		**3**:753b–756e/ **18**:652g–653c	
b. Modern waterway engineering: design and construction of channels, locks, lock gates, and related equipment; inland waterway craft; maintenance of waterways		**3**:756e–759b	
c. Major waterway systems and networks		**3**:759b–763a	
9. Harbour works: docks and quays; bulk terminals [see 733.B.5.]			

F. Air transportation

	articles	article sections	other references
	TRANSPORTATION, AIR **18**:633–648		
1. Aircraft: configurations, flight characteristics, missions, and special uses	AIRCRAFT **1**:369–382		
a. Lighter-than-air craft		**1**:370c–372a/ **7**:382b–384d	
i. Balloons		**1**:128h–129a/ **7**:382f–383f/ **7**:392b–c	**1**:370d–h/**14**:445h–446b
ii. Airships		**7**:383g–384d/ **7**:392c–393e/ **7**:397b–f	**1**:370h–372a
b. Heavier-than-air craft		**1**:372a–382h/ **1**:134a–c/ **7**:384d–385g	
i. Basic aircraft principles and components: aerodynamics, propulsion systems, control systems, flight instruments, and flight simulators		**1**:372a–377a/ **1**:130c–g/ **10**:156d–159a	**1**:135c–d/**4**:1049a–b/ **8**:528c–d
ii. Fixed-wing aircraft: airplanes, gliders, and sailplanes		**1**:377b–380e/ **1**:126h–127a/ **1**:387d–388a	
iii. Rotary-wing aircraft: autogiros, helicopters, and ornithopters		**7**:391g–392a/ **7**:397f–398a/ **7**:402f–g	**1**:125g–126a/**1**:380e–382a
iv. Experimental and research aircraft: supersonic transport planes, STOL aircraft and convertiplanes, and hypersonic aircraft		**1**:390h–391d	**1**:382a–h
2. Design, construction, and operation of airports		**18**:637b–639e	
a. Early airports developed from landing fields		**18**:637c–e	
b. Elements of a modern airport: airport management and control; passenger and cargo terminals; runway, taxiway, and apron systems; airport services		**18**:637e–639e	
3. Air traffic control: control in different types of airspace; navigational aids and procedures; operation of air traffic control		**18**:639f–644b/ **18**:576b–578d	
4. Air transport industry		**18**:644b–648c/ **1**:378f–379b/ **7**:398h–401d/ **18**:657b–f	
a. The structure of the modern airline		**18**:644b–645c	
b. General aviation: business and private aircraft		**18**:645d–646f/ **1**:378f–h/ **7**:400f–401d/ **7**:403g–404c	
c. Air cargo: new transport aircraft and containers; shipping services		**18**:646g–647g	**11**:619a–b
d. Economic effects of the air transport industry		**18**:647g–648c	
5. Space travel [see 738.C.]			
6. Aeronautical and space research		**1**:136a–139b/ **7**:405b–d/ **17**:362g–373c	**10**:405h–406b/**18**:732f–g
7. History of flight	FLIGHT, HISTORY OF **7**:380–405		
a. Early ideas about flying		**7**:381e–382b	
b. Developments to 1900: balloons, airships, and first powered flights		**7**:382b–385g	**1**:370d–371c *passim*/ **1**:383c–d/**12**:410d–411c
c. Developments from 1900 to 1914: contributions of A.P. Langley, the Wright brothers, G. Curtiss and I. Sikorsky		**7**:385g–393g	**1**:383d–f/**16**:750h–751a/ **18**:48h–49b/ **19**:1032b–1033a
d. Developments during the World War I era; *e.g.*, military aircraft and armament of Germany, France, and England		**7**:393g–395d/ **1**:384a–387b	**1**:371f–h/**18**:49b–c

	articles	article sections	other references
e. Developments from 1918 to 1930: promotion of aeronautics research; rise of commercial transport		7:395d–399c/ 1:387b–388e	10:991h–992b/18:633d–e
f. Developments from 1930 to 1945: commercial aviation, military aviation, and general aviation		7:399c–403a/ 1:388f–390g/ 18:633e–634a	
g. Developments since 1945: jet-powered transport, supersonic transport, and reconnaissance aircraft		7:403a–405g/ 1:131f–h/ 1:382a–h/ 1:390g–391h/ 18:634b–637b	19:594f–g
G. Air-cushion machines	AIR-CUSHION MACHINES 1:392–395		
1. Development of air-cushion vehicles		1:392c–393f	18:52c–d
2. Design, construction, and operation of air-cushion vehicles		1:393g–395b	
3. Applications; *e.g.*, air-cushion trains and load lifters, industrial pallets		1:395c–g	
H. Traffic control: history, problems associated with traffic, government regulations, and conventional and computerized techniques of control	TRAFFIC CONTROL 18:571–580		
1. On roads and highways		18:572a–574b/ 15:903h–905a	2:511g–h/18:662h–663a
2. On railways		18:574b–576b	2:511c–f
3. In air		18:576b–578d/ 18:639f–644b	2:511a–c
4. On water		18:578e–580b	
5. In space			2:510g–511a
I. Safety considerations in transportation engineering		2:525f–526d/ 15:902d–903b/ 15:903h–904c/ 16:144e–h	18:723c–d
J. History of transportation	TRANSPORTATION, HISTORY OF 18:648–658		
1. Primitive transportation; *e.g.*, travois, slide car, sledge, pack animal, dugout		18:648f–649e/ 1:122c–f	
2. The wheel and the road: development of the vehicle wheel; roads of the ancient world; beginnings of the modern road		15:892b–895g/ 15:899h–900e/ 18:649e–651c/ 18:658f–659b	19:520g–525b *passim*
3. Sails and oars: beginnings of shipping and shipbuilding; growth of inland waterways		18:651c–653c/ 16:157a–162c/ 16:676h–679e/ 16:688e–g/ 18:664f–665d	
4. Steam transportation		18:653c–655b/ 18:44a–e	
a. The railroad: the first locomotives; the spread of railways; the construction of railroad bridges and tunnels		18:653c–654b/ 15:478f–482d	2:515c–516b/18:44a–b
b. Steam navigation: the first steamships; introduction of iron ships; decline of sailing fleets		18:654c–655b/ 16:162c–e/ 16:679e–681a/ 18:665d–h	16:688g–h/18:44c–e
5. Development of modern transportation		18:655b–658b/ 2:514d–519g	
a. Construction of road vehicles, roads, bridges, and tunnels		18:655b–656b/ 6:231h–232d/ 18:750f–752a/ 18:762b–763a	18:721g–722a
b. Development of mass urban transport and traffic networks		18:656b–657a	

articles	article sections	other references
c. Development of the air transport industry	**18**:657b–f/ **7**:403a–f/ **18**:633a–637b	**18**:48h–49c
6. Transportation trends: new aircraft designs; new forms of traction for railways; the application of electronics to improve traffic control	**18**:657f–658b/ **1**:382a–d/ **1**:395c–d/ **7**:405d–g/ **18**:573c–574b/ **18**:662h–663e	**15**:493e–495b

Section 735. Technology of information processing and of communication systems

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 735 deal with 11 main subjects. Subject A, communication and information theory, is dealt with in Section 10/23 of Part Ten. The last subject, K, is electronics, which has applications in various kinds of communication systems. The other nine subjects are particular aspects of the technology of information processing and of the technology of communication. They fall into three groups. The first group has three subjects: B, calculating devices; C, office machines; and D, computers. The next group has four subjects: E, general information-recording devices; F, sound recording and reproduction; G, the technology of photography; and H, information processing. The last group has two subjects: I, major systems of communication; and J, major systems of detection and remote sensing.

The outline of subject B deals with the earliest devices for performing arithmetic operations, and with modern mechanical and electromechanical calculators.

The outline of subject C, office machines, treats the several kinds of writing and reproducing machines and of calculating and accounting machines.

The outline of subject D, computers, begins with the early and the 20th-century developments in the history of computers. It goes on to deal with basic computer functions and the properties that distinguish computers from calculators. It next treats the types of computers—analogue computers, digital computers, and hybrid computer systems. Finally, after dealing with programming systems and programming languages, it treats the current important uses of computers.

The outline of subject E begins with simple writing implements and such recording devices as typewriters. It goes on to the history of printing and to the types of modern printing machines and processes. Finally, dealing with the production of printing plates, the outline covers the various kinds of mechanical techniques, such as woodcut, etching, and lithography, and the basic processes of photoengraving.

Subject F is sound recording and reproducing devices. The outline first deals with mechanical systems, treating the history, processes, and instruments of phonograph recording. It goes on to deal with magnetic systems, treating the media, the processes, and the instruments involved in tape recording. It next treats optical systems such as motion-picture sound tracks. It goes on to such auxiliary equipment for sound recording and reproduction as microphones, amplifiers, loudspeakers, and speaker systems. Finally, it treats high fidelity concepts and systems.

Subject G is information recording by the production of visual images. Dealing with still photography, the outline covers the history and basic technology of photography, the instrumentation of photography, the photographic processes, special techniques of photography, and the photography industry. Dealing with motion-picture photography, the outline treats professional motion-picture photography, motion pictures for scientific purposes, and amateur motion-picture photography. Finally, the outline treats the principles and applications of holography—a recently invented means of creating a unique photographic image that, when illuminated by a laser beam, organizes the light into a three-dimensional representation of the original object.

The outline of subject H, information processing, treats the primary and secondary information media; information storage and retrieval systems and devices; and the theory and practice of information processing systems.

Subject I is the major systems of communication. Articles referred to separately treat postal systems and equipment; telegraph systems and equipment; telephone and telecommunication systems and equipment; radio communications systems and equipment; television communications systems and equipment; communication satellite systems and equipment; and coding and decoding devices and techniques.

Subject J is major systems of detection and remote sensing. Articles referred to separately treat radar systems and equipment, and sonar systems and equipment.

Subject K is electronic components and techniques. The outline treats the active and passive electronic components, as well as integrated circuits; sensing devices and transducers, including piezoelectric devices; and electronic circuitry.

articles	article sections	other references
A. Communication and information theory [see 10/23.F.]		
B. Calculating devices		
1. Devices for counting and for performing simple arithmetic processes; *e.g.*, the abacus, tally sticks	**11**:691c–g	**4**:1046a–b
2. Mechanical and electromechanical calculators [see C.2., below]		
C. Office machines		
1. Writing and reproducing machines	OFFICE MACHINES **13**:509–515	
a. Typewriters [see E.2., below]	**13**:510b–512b	

	articles	article sections	other references
b. Dictating and transcribing machines		**13**:510c–d	
c. Duplicating machines and processes; *e.g.*, stencil, hectography, offset, imprinting		**13**:510d–511c/ **5**:977f–h	
d. Copying machines and processes; *e.g.*, photocopy, thermography, electrostatic copy, facsimile		**13**:511c–512b/ **14**:342b–d	
2. Computing and accounting machines		**13**:512b–514d	
a. Calculating machines; *e.g.*, adding-listing, key-driven, and rotary machines; modern electronic calculators		**13**:512b–513d/ **11**:691g–692b	
b. Specialized calculating and accounting machines; *e.g.*, cash registers, billing machines, classifying and tabulating machines		**13**:513d–514d	
3. Miscellaneous office machines; *e.g.*, coin-wrapping or dispensing machines, mail-handling machines, check-writing machines		**13**:514d–515a	
D. Computers [see also 10/23.A.6. and 7.]	COMPUTERS **4**:1045–1058		**18**:810f–g
1. History of computers		**4**:1046a–1047f	
a. Early developments: the abacus, Napier's bones, Babbage's "Analytical Engine," and other mechanical devices; contributions of G. Boole; first applications of punched cards		**4**:1046a–1047b/ **11**:691c–692f	**11**:67b–e
b. Developments in the 20th century: the Harvard Mark I, ENIAC, and other automatic calculators; contributions of J. von Neumann		**4**:1047c–f/ **11**:692g–693a	
2. Basic computer functions: the properties that distinguish computers from calculators—the ability to make decisions based on stored instructions, and memory capability		**4**:1047c–1048b/ **11**:731a–c	**13**:513b–d
3. Types of computers		**4**:1048b–1053a	
a. Analogue computers: computers that operate by manipulating electrical potential or other continuously variable physical quantities that represent, or are the analogue of, numbers or physical variables		**4**:1048d–1049f/ **9**:661g–662b/ **11**:687h–690h	
b. Digital computers: computers that perform discrete counting operations and in which numbers or physical variables are encoded as binary numbers composed of the binary digits 0 and 1		**4**:1049f–1052g/ **9**:661c–g/ **11**:692g–695e	**7**:249b–f
c. Hybrid computer systems: systems incorporating interconnected analogue and digital computers		**4**:1052h–1053a/ **11**:690h–691c	
4. Programming systems and programming languages		**4**:1053b–1058f	
a. Fundamentals of programming; the encoding and entering of instructions into computer memory; the concept of software; the systems approach to writing computer programs		**4**:1053b–1054d	
b. Language categories		**4**:1054d–1058f	
i. Algorithmic and procedural languages; *e.g.*, Fortran, Algol, Cobol		**4**:1054f–1055h	
ii. Timesharing languages; *e.g.*, BASIC, Quiktran, CAL		**4**:1055h–1056b	
iii. List-processing languages; *e.g.*, Snobol, COMIT, Lisp		**4**:1056b–1057a	
iv. Simulation languages; *e.g.*, Simscript, GPSS, Dynamo		**4**:1057b–1058b	
v. Process control languages; *e.g.*, APT		**4**:1058b–f	
5. Computer applications		**11**:695e–696a	
a. In industry, transportation, and communications		**1**:136g–h/ **2**:512g–513a/ **5**:129h–130b/ **5**:977c–e/ **9**:639d–g/ **12**:907e–f/ **14**:1061e–1062c/ **18**:76b–f/ **18**:578a–d	**11**:687g–h/**15**:489h–490a/ **18**:573c–f/**18**:575d–g
b. In the physical, biological and technological sciences		**9**:641a–b/ **15**:873b–874e	**11**:758e–759a/**19**:700d–f/ **19**:1168f–g

	articles	article sections	other references
c. In linguistics, economics, and other social sciences		**5**:721f–g/ **9**:679e–f/ **10**:1012b–c	**6**:201e–g/**9**:784c–e
d. In other fields		**6**:676d–677d/ **10**:873b–874a	**2**:979h–980b/**4**:205b–f/ **15**:911d
E. General information-recording devices			
1. Simple recording implements and devices; *e.g.*, writing implements, slates, chalkboards	WRITING IMPLEMENTS **19**:1045–1047		
2. Typewriters: mechanical printing devices	TYPEWRITER **18**:809–810		
3. Printing machines and processes	PRINTING **14**:1051–1073		
a. History: origins in China; the invention of printing in the West by Gutenberg; developments in the 19th and 20th centuries		**14**:1052g–1059c	**1**:110a–e/ **8**:505c–506b *passim*/ **18**:34g–h/**18**:814b–824a *passim*
b. Modern printing techniques		**14**:1059c–1073c	
i. Composition and typesetting: mechanical, photographic, and letterpress systems		**14**:1059c–1066c	**18**:810c–e
ii. Printing (press operation): colour, letterpress, rotogravure, offset, and other printing processes; printing inks		**14**:1066d–1073c/ **14**:522d–e	**14**:1075a–1084b *passim*
iii. The future of printing		**14**:1073c–g	
4. Production of printing plates: engraving and other techniques			
a. Mechanical techniques		**14**:1075a–1083d	
i. Relief processes; *e.g.*, woodcut		**14**:1075b–1077a	
ii. Intaglio processes; *e.g.*, mechanical engraving, etching		**14**:1077b–1081b	
iii. Surface-printing processes; *e.g.*, lithography		**14**:1081c–1082g	**13**:510e–511b
b. Photomechanical techniques: photoengraving	PHOTOENGRAVING **14**:300–306		
i. Basic production processes: photoengraving equipment and the sequence of operations in plate production		**14**:303c–304b	**14**:1068g–1069e
ii. Colour plate production		**14**:304b–h	
iii. Production specifications: control of plate quality		**14**:304h–305b	
iv. Production of intaglio or offset plates by photomechanical methods		**14**:305b–306c	**14**:1070b–d/**14**:1071c–g
F. Sound recording and reproducing devices [see also 128.E.]	SOUND RECORDING AND REPRODUCING **17**:51–60	**17**:32b–g	
1. Mechanical systems: phonographs		**17**:51h–55f	**17**:32c–e
a. Early history: acoustical recording and reproducing		**17**:51h–52h	**12**:693e–694e
b. Electrical recording and reproducing		**17**:53a–e	
c. Record groove parameters: groove dimensions and spacing		**17**:53c–g	
d. Record materials and production processes		**17**:53h–54c	
e. Phonographs and record changers: stylus shapes and materials; pickups; motor and drive systems		**17**:54d–55f	**14**:462c–d
2. Magnetic systems: tape recorders		**17**:55f–57d	
a. Early history: development of magnetic wire and magnetic tape systems		**17**:55f–g	
b. Recording media: the magnetic coating and plastic base materials employed in modern recording tape		**17**:55h–56b	**11**:339d–e
c. Recording and playback processes		**17**:56c–h/ **12**:549c–f	
d. Tape recording machines		**17**:56h–57d/ **13**:510c–d	
3. Optical systems: motion-picture sound tracks		**17**:57d–e	**12**:548h–549f *passim*

	articles	article sections	other references
4. Auxiliary equipment			
a. Microphones and amplifiers		17:57e–58e	
		17:57f–58b/ 17:31e–32b	
b. Loudspeakers and speaker systems		17:58b–e	11:338g–h
5. High fidelity concepts and systems: monaural, monophonic, stereophonic, and quadraphonic reproduction		17:58f–60b	
G. Information recording by the production of a visual image: the technology of photography			
1. Still photography [see also 628.D.]	PHOTOGRAPHY, TECHNOLOGY OF 14:328–346		
a. History and basic technology		14:328d–330c	14:309c–316c *passim*
b. Cameras and lenses		14:330d–335a	
i. Camera technology		14:330d–333d/ 14:307f–308b	
ii. Photographic lenses [see also 128.D.]	OPTICAL ENGINEERING 13:603–605	14:333d–335a/ 14:307c–f	
c. The photographic process		14:335b–341b/ 14:308c–309b	
i. Black-and-white photography: films, picture-taking technique, processing and printing		14:335b–338e/ 14:308c–309a	14:303c–h
ii. Colour photography: colour reproduction and colour films; processing and printing; transparency projection		14:338e–341b/ 14:309a–b	
d. Special techniques		14:341b–345c	
i. Polaroid photography		14:341b–342a	
ii. Special photosensitive systems: electrophotography, colloid, photopolymer, and other processes		14:342a–h	15:461e–462b
iii. Special techniques and applied photography; *e.g.*, high-speed, stroboscopic, aerial, underwater, and stereoscopic photography		14:342h–345g/ 10:872f–873b	18:100h–101a
e. The photography industry		14:345g–346d	
2. Motion-picture photography [see also 623]	MOTION PICTURES, TECHNOLOGY OF 12:540–555		12:500f–504b *passim*
a. History: early film devices; introduction of sound, colour, wide screen, and stereoscopic pictures; growth of amateur motion-picture photography		12:540b–544b	12:511b–539d *passim*
b. Professional motion-picture photography		12:544c–552e	
i. Equipment; *e.g.*, cameras, film, lights		12:544b–547h	
ii. Film processing and printing		12:548a–g	
iii. Sound recording techniques		12:548h–549h	
iv. Special effects		12:549h–550c	
v. Projection techniques and equipment		12:550c–551f	
vi. Animation		12:551g–552a	
vii. Motion-picture films in television		12:552a–e	
c. Motion pictures for scientific purposes		12:552e–553h	
i. Time-lapse cinematography		12:552e–f	
ii. High-speed cinematography		12:552f–553h	
d. Amateur motion-picture photography		12:553h–555a	
3. Holography: laser photography [see also 128.B.4.]	HOLOGRAPHY 8:1007–1011	13:620c–621f	
a. Principles and basic types of holography		8:1007g–1010a/ 13:620c–621a	17:34d–e/18:842b–d
i. Continuous-wave (CW) laser holography: techniques for producing three-dimensional images of stationary objects		8:1007h–1008g	

	articles	article sections	other references
ii. Pulsed-laser holography: techniques for studying moving objects and systems		**8**:1008g–1009e	
iii. Nonphotographic holography: the recording of holograph images on materials other than photographic plates		**8**:1009e–1010a	
b. Experimental difficulties in holography: conditions that impair the quality of holograph images		**8**:1010a–d	
c. Applications of holography; *e.g.*, holographic interferometry		**8**:1010d–1011b/ **13**:621b–f	
H. Information processing	INFORMATION PROCESSING **9**:567–574	**10**:872c–874a	
1. Information media		**9**:568c–570e	
a. Primary media; *e.g.*, scholarly journals, report literature, information exchange groups, newsletters		**9**:568c–569f	
b. Secondary media; *e.g.*, abstracts, reviews, reference books, manuals		**9**:569f–570e/ **2**:978b–980b	
2. Storage and retrieval: indexes and indexing, files, and information centres; recording of information on microforms		**9**:570e–573f/ **10**:872c–873b/ **14**:345d–g/ **14**:673e–h	**10**:865f–866a/**13**:511f–g
3. Information-processing systems: the application of modern data-processing technology to the problem of information storage and retrieval		**9**:573f–574a/ **10**:873b–874a	
I. Major systems of communication			
1. Postal systems and equipment	POSTAL SYSTEMS **14**:883–892		
a. General considerations: postal operations and management		**14**:883e–884a	
b. Development of postal systems from ancient message-relay systems to the introduction of airmail		**14**:884a–886f	
c. National postal systems: the development and present status of postal service in the U.S., Great Britain, France, the U.S.S.R., China, and other nations		**14**:886f–890a	
d. Postal services in the developing countries		**14**:890a–f	
e. The international system: the Universal Postal Union		**14**:890g–891c	
f. Emerging postal technology: the mechanization and automation of mail handling		**14**:891c–892e	
2. Telegraph systems and equipment	TELEGRAPH **18**:66–78	**15**:431g–432b	
a. History: early acoustical and optical signal systems; development of electrical telegraph systems		**18**:67a–73d	**6**:309b–d/**12**:458e–f
b. Modern telegraphy		**18**:73d–78d	
i. High-speed data transmission: equipment and techniques for sending digital signals; teleprinter codes and systems		**18**:73e–76b	
ii. Use of digital computers and peripheral units in telegraph systems		**18**:76b–f	
iii. Telegraph networks: private wire systems, teleprinter subscribers' exchanges, and public telegraph services		**18**:76f–78d/ **18**:94e–96c	
3. Telephone and telecommunications systems and equipment	TELEPHONE AND TELE-COMMUNICATIONS SYSTEMS **18**:82–96	**15**:429c–430h	
a. History: development of the telephone and of long-distance telephony		**18**:83a–86h	**2**:827e–h/**17**:970f–g
b. Principles and problems of telecommunications: digital systems, analogue-to-digital conversion, modulation techniques, and examples of communications systems		**18**:86h–92e/ **18**:73e–76b	**17**:974g–h
c. Telecommunications networks: telephone and data-message networks		**18**:92e–96c/ **2**:509h–510b/ **18**:76f–78d	**18**:122d–g
d. Future trends in communication		**18**:96c–g	

	articles	article sections	other references
4. Radio communications systems and equipment	RADIO **15**:423–434	**16**:264d–266f	
a. Basic physical principles and equipment of radio communications		**15**:423h–426c/ **18**:91a–e	
b. Early history		**15**:426c–427e/ **3**:309e–311e	**11**:490c–491b
c. Radio circuitry		**15**:427e–429c/ **1**:966d–968f	**14**:463c–d
i. Components		**15**:427e–429a	
ii. Concepts of selectivity and sensitivity		**15**:429a–c	**16**:265b–266e
d. Applications		**15**:429c–433h	**15**:489g–h
i. Radiotelephony		**15**:429c–430h/ **18**:91f–92c	
ii. Marine and air radio communications		**15**:430h–431g	**18**:640f–h
iii. Radiotelegraphy		**15**:431g–432b	**18**:74c–e
iv. Amateur and professional radio operation: noncommercial uses		**15**:432c–h	
v. Radio broadcasting	BROADCASTING **3**:309–322		
vi. Special applications; *e.g.*, remote-control radio, radio paging, citizens' band and industrial radio, radio telemetry		**15**:432h–433h/ **12**:908a–d	**12**:58b–c/**18**:80f–h
e. Radio receiver manufacturing [see 732.C.6.]			
5. Television communications systems and equipment	TELEVISION **18**:105–123		
a. History: early mechanical scanning systems; invention of modern electronic systems; development of colour television		**18**:105g–108a/ **3**:311f–312a	
b. Principles of picture transmission and reception		**18**:108b–116b	
i. Basic considerations: the determination of standards for television images		**18**:108b–110b	
ii. The television picture signal		**18**:110c–111b	
iii. Television camera tubes and video amplification		**18**:111b–113e	**14**:300b–c
iv. The television channel		**18**:113e–114a	
v. The television transmitter and receiver		**18**:114b–115d	
vi. Television picture tubes		**18**:115d–116b	**6**:689h–690f
c. Compatible colour television		**18**:116b–119g	
i. Basic principles: the U.S. system and European colour systems		**18**:116b–117h	
ii. Colour cameras and picture tubes		**18**:117h–118h	**15**:526c–d
iii. Colour transmitters and receivers		**18**:118h–119g	
d. Applications of television		**18**:119g–123b	
i. Television recording		**18**:119g–121c	
ii. Television broadcasting	BROADCASTING **3**:309–322	**18**:121c–g	**16**:268e–f
iii. Closed-circuit television		**18**:121h–123b/ **18**:94b–e	
6. Communication satellite systems and equipment [see also 738.C.3.]	SATELLITE COMMUNICATION **16**:261–268		
a. History: theoretical proposals; early communication satellites and communication experiments; evolution of attitude-control systems that maintain proper satellite orientation		**16**:261f–263c	
b. Development of communication satellite systems technology		**16**:263c–264d	
i. Space technology: launching and guidance techniques; attitude-control and station-keeping mechanisms		**16**:263d–264a	

	articles	article sections	other references
ii. Electronic technology: advances in power supply devices and in other components essential to communication satellites		**16**:264b-d	
c. Operational considerations		**16**:264d-266f	
i. The radio signal		**16**:264d-265e	
ii. Equipment; *e.g.*, Earth-station antennas, transponders		**16**:265f-266f	
d. Satellite systems		**16**:266f-268f	
i. Existing satellite systems: the Intelsat, U.S. military, and other programs		**16**:266f-267e	
ii. Future developments: proposed satellite systems; political considerations and technical problems		**16**:267e-268f	
7. Coding and decoding devices and techniques: signal security and intelligence; history of cryptology	CRYPTOLOGY **5**:322-333	**10**:657d-e	
J. Major systems of detection and remote sensing			
1. Radar systems and equipment	RADAR **15**:368-378		
a. Basic principles of radio wave propagation and reflection [see also 128.B.]		**15**:368e-369d/ **12**:909f-h	
b. Development of radar		**15**:369d-372e	
c. Radar performance characteristics; *e.g.*, range, resolution, Doppler shift		**15**:372f-374f	
d. Radar equipment; *e.g.*, continuous-wave and pulsed-Doppler radar, radar receivers and antennas		**15**:374f-376g	
e. Applications and future developments		**15**:376g-378a/ **12**:909h-910a	**10**:688d-e/**12**:57h-58b/ **18**:365d-g/**18**:577e-g/ **18**:640h-641b/**18**:643a-d/ **19**:599g-h/**19**:600e-601c
2. Sonar systems and equipment	SONAR **17**:1-4		**9**:99g-100a
a. Development of sonar		**17**:1a-e	
b. Basic physical principles: operation of a simple sonar system; propagation of acoustic waves in water		**17**:1f-2e	**17**:33g-h/**19**:600a-b
c. Inherent limitations of sonar resulting from background noise, reverberation, and other factors		**17**:2e-h	
d. New applications and techniques; *e.g.*, side-scan sonar		**17**:3a-4c	
e. Principles of electro-acoustic transducers [see K.2.b., below]			
K. Electronic components and techniques used in communications	ELECTRONICS **6**:678-686		
1. Components		**6**:679a-682e	**4**:1052b-d
a. Active components		**6**:679b-680f	**15**:427f-428a
i. Vacuum and gas-filled tubes	ELECTRON TUBE **6**:687-691	**6**:679b-680b/ **11**:318f-319a/ **18**:111b-113d/ **18**:115d-116b	**15**:373f-374c/**18**:118c-h
ii. Semiconductor devices	SEMICONDUCTOR DEVICES **16**:512-521	**6**:680c-e/ **14**:300a-d	**6**:691c-f/**9**:659d-g/ **15**:396h-397c/**18**:325g-h
b. Passive components		**6**:680g-682e	**9**:659g-660a
i. Resistors, capacitors, and inductors		**6**:680h-681g	
ii. Ferrites	FERRITES **7**:248-250	**11**:327c-h/ **11**:335d-h	**11**:339f-g
iii. Other solid-state devices		**6**:681h-682e	
iv. Antennas and wave guides	ANTENNAS AND WAVE GUIDES **1**:966-968		**6**:664b-d/**15**:376b-g/ **15**:428f-h/**16**:265f-266b/ **18**:101h-103g *passim*
c. Integrated circuits: miniature arrays of interconnected active or passive circuit elements	INTEGRATED CIRCUITRY **9**:658-664	**6**:680e-f/ **16**:520g-521b	
i. Their structure, properties, and functions		**9**:659b-662c	**13**:512h-513a

	articles	article sections	other references
ii. Their fabrication		**9**:662c–664b	
2. Sensing devices and transducers		**6**:682f–683c/ **18**:840f–841d	**18**:80d–f
a. Piezoelectric devices	PIEZOELECTRIC DEVICES **14**:461–463		
i. Piezoelectric transducers		**14**:462b–463b	
ii. Applications of freely vibrating crystals		**14**:463b–g	
iii. Specialized applications		**14**:463f–g	
b. Microphones and other pickups for sound and vibration		**14**:462b–463b/ **17**:4d–f	
c. Sensors; *e.g.*, temperature, stress, strain, proximity, chemical, and optical sensors		**6**:682h–683c	**19**:599c–600d *passim*/ **19**:602a–e
3. Circuitry		**6**:683d–686h/ **16**:519c–521c	**15**:375b–376b/**15**:428a–e
a. Power supply circuits		**6**:683d–683g	
b. Switching and timing circuits		**6**:683h–684d/ **11**:337g–338b	**16**:519g–520a
c. Amplifier circuits		**6**:684e–685f	**15**:428d–e/**16**:519c–f
d. Oscillators		**6**:685g–686d	**16**:519f–g
e. Special circuits		**6**:686d–h/ **11**:337d–g/ **11**:693h–694b/ **16**:520g–521b	

Section 736. Military technology

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 736 deal with three main subjects: A, offensive and defensive delivery and payload systems; B, military logistics systems; and C, purely defensive equipment and systems.

The outline of subject A deals with primitive and ancient weapons and delivery systems, and with early gunpowder weapons. In treating the development of modern weaponry, the outline covers advances in gunnery; in military small arms; in ammunition; in mines, grenades, and chemicals; in rockets and missile systems; in tanks and armoured vehicles; in naval craft and delivery systems; in aircraft delivery systems; in nuclear warheads and missile delivery systems; and in nonballistic weapons, including chemical, biological, and psychological warfare. The outline concludes with future weapons trends.

The outline of subject B first deals with the history and development of logistics systems from early warfare into the 20th century. It then treats, in dealing with logistics problems in a nuclear age, the stages and the processes of weapon development and maintenance; the logistics problems involved in air, land, and water transport, in supply and maintenance, and in providing ground support services; and the logistics problems posed by the nuclear threat.

Subject C is purely defensive equipment and systems. The outline covers individual protective gear, such as body armour and helmets; early forms of fortification; such modern fortifications as pillboxes, bunkers, bomb shelters, trenches, and coastal batteries; and the development of warning and detection techniques, including antimissile missiles.

	articles	article sections	other references
A. Offensive and defensive delivery and payload systems	WEAPONS AND DELIVERY SYSTEMS **19**:680–696		
1. Development of early weaponry		**19**:680g–685g	
a. Primitive and ancient weapons and delivery systems		**19**:680g–683c/ **1**:122e–f/ **6**:863b–d	**19**:573g–577b *passim*
i. Shock weapons; *e.g.*, clubs, stone axes, swords		**19**:680g–681b	**3**:1181d–e
ii. Missile weapons and delivery systems; *e.g.*, spears, javelins, slings, crossbows		**19**:681b–682a/ **1**:698e–g/ **19**:576h–577b	**8**:488c–d
iii. Siege weapons and methods; *e.g.*, catapults		**19**:682b–c	
iv. Weapons and supply carriers; *e.g.*, horses, elephants, camels		**19**:682c–d/ **11**:78a–c/ **19**:575h–576g	

	articles	article sections	other references
b. Gunpowder weapons; *e.g.*, artillery, matchlocks, muskets, rifles, rockets		**19**:683d–685g/ **8**:488f–489f/ **15**:924e–925c/ **16**:894e–897d/ **19**:577b–d	**6**:863g–h/**12**:888a–c
2. Development of modern weaponry		**19**:685h–695f	
a. Modern advances in artillery and gunlike weapons; *e.g.*, recoilless rifles, mortars, breechloaders, explosive shells	GUNNERY **8**:488–498	**19**:685h–687g/ **2**:659g–660c/ **16**:897d–898c	**12**:890e–891a/**19**:592f–593a
b. Modern advances in military small arms: machine guns, automatic rifles, pistols, submachine guns, and support weapons	SMALL ARMS, MILITARY **16**:894–904	**19**:687g–689a	
c. Ammunition; *e.g.*, smokeless powder, propellants, high explosives, projectiles, fuses, complete rounds	AMMUNITION **1**:698–703	**8**:493e–h/ **8**:500a–f	**16**:897f–h/**19**:592g–h
d. Mines, grenades, and chemicals		**19**:689a–d/ **7**:88f–89c/ **12**:893g–894a/ **12**:895g–896a	
e. Rockets and missiles	ROCKETS AND MISSILE SYSTEMS **15**:924–942	**19**:689d–g	
i. Development of rockets and guided missiles		**15**:924e–928b/ **1**:703a–b/ **7**:398c–d/ **7**:402d–f/ **8**:496d–497a	**3**:122d–123c/**8**:222d–223c/ **17**:974h–975b
ii. Military systems from World War II to present time; *e.g.*, rockets, guided missiles, space vehicles, drones, decoys, warheads		**15**:928b–936e/ **12**:897d–g/ **12**:899c–900e/ **17**:752h–753e	**1**:134c–f/**1**:389g–h/**8**:497b–h/ **15**:377f–g
iii. Rocket-propulsion systems: propellant rocket motors; nuclear propulsion, electrical propulsion		**15**:936e–941a	**1**:700e–g/**2**:658e–f/ **10**:405h–406b/**14**:509a–b
iv. Applications of rocket power; *e.g.*, sounding rockets, aircraft propulsion, jet-assisted takeoff		**15**:941a–942f/ **1**:390f–g/ **19**:696d–e	
f. Modern land weapons carriers	TANKS AND ARMOURED VEHICLES **17**:1019–1025	**19**:690a–691f/ **8**:494f–495b	
i. Tanks		**17**:1019a–1023g	**19**:690b–691b
ii. Armoured vehicles: airborne and amphibious vehicles, armoured personnel carriers, self-propelled artillery, and tank destroyers		**17**:1023h–1025a/ **19**:691c–f/ **12**:896d–e	
g. Naval ships and craft: naval delivery systems	NAVAL SHIPS AND CRAFT **12**:884–901		
i. Naval vessels in ancient history		**12**:885b–887c	
ii. Northern European war vessels: Viking vessels; English warships		**12**:887d–h/ **16**:678c–e	**16**:157f–158b
iii. War vessels in the age of gun and sail; *e.g.*, gun-armed warships, galleasses, galleons, frigates		**12**:887h–890a/ **19**:583b–e	**16**:158h–159e
iv. Developments in the age of steam and iron: ship construction and armament; warship improvements		**12**:890b–892g	**7**:776c–777a/**19**:583e–f
v. Developments in the early 20th century: Dreadnought battleships, cruisers, destroyers, submarines, amphibians		**12**:892g–896e/ **17**:749b–750g/ **16**:682g–683b/ **19**:691f–692c	**19**:583f–584a
vi. Warships in the nuclear age: *e.g.*, nuclear-powered submarines, carriers, seaborne missiles, torpedoes	SUBMARINE **17**:750–753	**12**:896e–901b/ **16**:686c–e/ **8**:497b–498b	**11**:86d–e/**13**:316d–f/**15**:931e
vii. Navies of the future		**12**:901c–e	
h. Aircraft delivery systems	AIRCRAFT, MILITARY **1**:383–391	**19**:692c–693e	

	articles	article sections	other references
ii. World War I military and naval aircraft: reconnaissance airplanes, fighter planes, bombers, gunships, carrier-based aircraft		1:384a–387b	12:894b–c/19:692c–g
iii. Improvement and development of military aircraft between the world wars		1:387b–388g	
iv. World War II aircraft; *e.g.*, bombers, gliders, transports, jets, rocket-powered airplanes		1:388h–390g/ 1:380b–e/ 7:401h–402f/ 19:585f–586c	11:81d–f/12:894g–895b/ 15:370f–371e *passim*/ 15:941h–942b/ 19:692h–693d
v. Military aircraft in the supersonic age; *e.g.*, supersonic fighters and bombers, pilotless craft, helicopters		1:390g–391h/ 1:379b–380b/ 7:404c–405a	15:935c–d
i. Nuclear warheads and missile systems	NUCLEAR WEAPONS 13:324–328	19:693e–694f/ 15:936c–e	18:49h–50f
i. Fission weapons: atomic bombs		13:324e–326g/ 13:310c–f/ 19:693e–g	13:315b–e
ii. Thermonuclear weapons		13:326g–327f	
iii. Deployment of nuclear weapons		13:327f–328a	
iv. Intercontinental delivery systems		19:693h–694d	15:930c–931f
j. Nonballistic weapons		19:694f–695f	
i. Chemical warfare		19:694f–695a	
ii. Biological warfare		19:695b	
iii. Psychological warfare		19:695c–e	
3. Future trends in weaponry		19:695f–696g/ 16:903b–904a	
B. Logistics systems	LOGISTICS SYSTEMS, MILITARY 11:77–87	19:587g–597f	
1. History and development of logistics systems		11:78a–83f/ 19:591b–593h	
a. In early wars: supply depots, transport by elephants and camels, wall fortifications		11:78a–c	
b. During the 17th and 18th centuries: pack and wagon trains, requisition magazines		11:78c–g/ 19:591b–g	
c. During the 19th century: effects of the Industrial Revolution; the introduction of railways; the improvement of transport and communication		11:78h–79d/ 19:591h–592d	
d. During the 20th century: improved motor, air, and shipping transport; modified supply systems; improved engineering services; air, missile, and naval support services		11:79e–83f/ 19:592e–593h	
2. Logistics problems in the nuclear age		11:83f–87e	
a. Weapon development; *e.g.*, procurement, research, maintenance and repair, control of ordnance stores		11:83f–85h	
b. Logistics problems in limited war operations		11:85h–86g/ 19:595b–597a	
i. Movement of forces: air, land, and water transport		11:86a–e/ 19:595b–e	6:864g–h
ii. Supply and maintenance		11:86e–g	19:590d–591b/19:596b–597a
iii. Ground support services: signal communications, intelligence services, and engineering services	ENGINEERING, MILITARY 6:862–866		19:596a–b
c. Logistics and the nuclear threat		11:86g–87b	
d. Peaceful uses of military logistics		11:87b–e	
C. Purely defensive equipment and systems			
1. Individual protective gear			
a. Body armour	ARMOUR 2:27–30	2:28c–f	19:582g–h

	articles	article sections	other references
b. Helmets		2:29f–h	
c. Ancient and medieval armour		2:29h–30d	
2. Fortifications: permanent, semipermanent, and field fortifications	FORTIFICATIONS 7:548–555		
a. Early fortifications: forts, fortresses, towers, palisades, garrison camps, and entrenchments		7:549b–551e	6:863b–g/12:153d–h
b. Modern fortifications: pillboxes, bunkers, bomb shelters, trenches, and coastal batteries		7:551f–555f	
3. Warning and detection systems	WARNING AND DETECTION SYSTEMS, MILITARY 19:598–602		
a. Development of warning and detection techniques		19:598f–599c	6:864d–e/6:865a–b
b. Modern detector technology: electromagnetic sensors and acoustic techniques [see also 735.J.]		19:599c–600d	15:432d–f
c. Warning systems in air defense: ballistic missile defense; space surveillance; aerial reconnaissance		19:600e–602a	1:391d–g/17:372h–373a
d. Outlook for the future		19:602a–f	
4. Antimissile missiles: deployment techniques and launch systems		17:899h–900c	15:931g–933c

Section 737. Technology of the urban community

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 737 deal with four main subjects: A, basic engineering services of the city; B, the technology of basic social services of the city; C, the technological response to new urban problems; and D, the history of city engineering.

The outline of subject A begins with the construction and operation of urban water-supply systems. It next deals with sanitation systems—systems for the disposal of sewage and refuse and for street clearance and cleaning. It goes on to the problems, elements, and new concepts of urban transportation systems. After indicating that the technology of city-to-city transportation systems is dealt with in Section 734, the outline then treats the technology of electric power, covering power generation; the types, design, and construction of power transmission systems; power distribution networks in metropolitan areas; the organization and operation of power systems; and the international aspects of the technology of electric power. Finally, it deals with fire prevention and control, covering the classes of fires, and the equipment and techniques for fire-detection and fire-extinguishing.

The outline of subject B deals first with police technology, covering traffic control technology and crime control technology. It then deals with the design, construction, and maintenance of such recreational facilities as parks and playgrounds, planetariums and aquariums, stadiums, and racetracks.

Subject C is the technological responses to new urban problems. The outline begins with pollution control, treating the types, sources, effects, and control of air pollution; problems about water pollution, and about land and soil pollution; other kinds of pollution such as noise and radiation; and the global aspects of pollution. It then deals with the planning of cities; the systems approach to urban design and construction; and the development of new towns.

The outline of subject D covers the engineering of ancient and medieval cities, the technological development of the modern city, and the engineering problems of the megalopolis, including overcrowding, pollution, and nuclear-reactor dangers.

	articles	article sections	other references
A. Basic engineering services of the city			
1. Water-supply systems	WATER-SUPPLY SYSTEMS 19:648–654		
a. Supply of and demand for water: domestic, public, and industrial water requirements; water sources and quality [see also 222.D.6.]		19:649d–650e/ 19:646b–g	
b. Collection, treatment, and distribution		19:650e–653b/ 11:626e–f	
i. Dams [see 733.B.1.]			
ii. Aqueducts and conduits [see 733.B.2.]			
iii. Treatment plants: water-purification techniques and equipment		19:651b–h	
iv. Desalting techniques and equipment		19:651h–652f	

	articles	article sections	other references
v. Distribution systems		**19**:652g–653b/ **14**:575b–e	
c. Typical water-supply systems		**19**:653b–f/ **1**:1041g–1042g	
d. The cost of water		**19**:653f–654a	
e. Future development of water-supply systems: technological responses to increased demand		**19**:654a–b/ **19**:646g–647f	
2. Sanitation systems			
a. Development and operation of sewage disposal systems	SEWAGE SYSTEMS **16**:582–585	**14**:577c–g	**2**:570f–571e
i. Development of treatment methods		**16**:582f–583a	
ii. Modern trends; *e.g.*, reuse of treated waste water		**16**:583b–d	**14**:753a–d/**18**:764c–f
iii. Typical city sewer systems		**16**:583e–584h	
iv. Worldwide sewage disposal problem		**16**:584h–585c	
b. Construction and operation of street clearance and refuse disposal systems	REFUSE DISPOSAL SYSTEMS **15**:573–576		
i. Basic problems of solid waste management		**15**:573e–f	
ii. Modern collection and disposal methods		**15**:573g–575b/ **11**:625e–f	
iii. Reclamation and recycling of solid materials		**15**:575b–d	
iv. Street cleaning: sweeping and snow and ice removal		**15**:575e–h	
v. Special problems; *e.g.*, disposal of toxic or radioactive wastes		**15**:575h–576b	
3. Urban transportation systems	TRANSPORTATION, URBAN **17**:658–663	**18**:572a–574b	
a. Problems of urban transportation		**18**:659b–660c/ **15**:903c–g/ **18**:572d–e	**18**:656d–e
b. Elements of urban transportation: surface, subway, and elevated transit systems and related facilities		**18**:660c–662c/ **18**:572f–573g	
c. New concepts and new technology: the systems approach to metropolitan transit; the gravity-vacuum tube system and other recent proposals		**18**:662c–663e/ **18**:573g–574b	**15**:494g–495b
4. Technology of city-to-city transportation systems [see 734]			
5. Technology of electric power	ELECTRIC POWER **6**:625–637		
a. Power generation [see 721.C.7.]			
b. Power transmission		**6**:625a–629e	
i. Types of transmission systems: direct current, alternating current, and three-phase systems		**6**:625a–626b	
ii. Transmission line design and construction: choice of transmission voltage, conductor material, and other factors; underground cables		**6**:626d–629e	
c. Power distribution		**6**:629e–631b	
i. Voltage considerations: voltage reduction from transmission to distribution systems; maintenance of proper voltage without interruption		**6**:629e–630h	
ii. Power networks: power distribution in metropolitan areas		**6**:630h–631b	
d. Electric power systems		**6**:631b–633g	
i. The electric utility: organization and operation of power systems		**6**:631b–632a	
ii. System characteristics: load factors and their effects on power systems		**6**:632a–g	
iii. Interconnection of power systems		**6**:632h–633g	
e. International aspects of electric power		**6**:633g–637e	
i. Multinational interconnections		**6**:633g–634d	

	articles	article sections	other references
ii. World electric power statistics		**6**:634d–637e	
6. Fire prevention and control	FIRE PREVENTION AND CONTROL **7**:314–323	**7**:531c–532a	
a. Fire prevention		**7**:314c–315c	
b. Classes of fires		**7**:315d–f	
c. Fire-detecting and fire-extinguishing equipment		**7**:315g–321g	
i. Alarm and signalling systems		**7**:315g–316h	
ii. Automatic sprinkler installations		**7**:317a–318c	
iii. Fire-extinguishing equipment		**7**:318c–320b	
iv. Fire-extinguishing agents		**7**:320b–321g	
d. Fire-fighting techniques		**7**:322f–323f	
B. Technology of the basic social services of the city			
1. Police technology	POLICE TECHNOLOGY **14**:671–677		
a. Traffic control technology [see 734.H.1.]			
b. Crime control technology		**14**:672b–677c	
i. Modern surveillance systems		**14**:672b–673a	
ii. Crime reporting and records: use of fingerprints, modus operandi, and reference files		**14**:673a–h	
iii. Police communication systems		**14**:673h–674b	
iv. Interrogation methods and equipment: use of the polygraph; detection of narcotics and dangerous drugs		**14**:674b–f	
v. Police weapons and restraining and protective devices		**14**:674f–675b	
vi. Laboratory procedures: facilities and equipment; evidence and its examination		**14**:675b–677c	
2. Design, construction, and maintenance of recreational facilities; *e.g.*, parks, stadiums, race tracks, planetariums, aquariums		**1**:1027b–1028g/ **3**:64e–65f/ **7**:890g–891g/ **8**:1099f–1100c/ **12**:654e–659a/ **18**:1063d–1064c/ **19**:1161h–1163e	**17**:527b–528a
C. Technological responses to new urban problems			
1. Control of air, water, land, and other pollution	POLLUTION CONTROL **14**:749–756	**5**:58e–60a/ **9**:641g–642h	**18**:659f–660a
a. Air pollution: types, sources, effects, and methods of abatement		**14**:750e–752f/ **1**:360h–361e/ **2**:328h–329d/ **2**:526d–527c/ **5**:49c–50c/ **18**:1049g–1051h/ **19**:647g–648e	**6**:621f–h/**9**:642e–f
b. Water pollution: degradable and nondegradable wastes; the special problem of waste heat		**14**:752f–754a/ **5**:58g–59b/ **6**:976b–e/ **11**:626e–f/ **14**:577c–g	**1**:361e–362f *passim*/ **2**:570f–571e/**9**:642g–h/ **10**:601c–d
c. Land and soil pollution: agricultural or mineral solid wastes and municipal wastes; the recycling, recovery, and re-use of materials		**14**:754b–h/ **5**:59c–d/ **18**:763b–d	**1**:361e–362f *passim*/ **11**:623f–626d *passim*/ **19**:726f–h
d. Other kinds of pollution; *e.g.*, noise, radiation		**14**:755a–756a/ **5**:59d–60a	**18**:659g–660a
e. Global aspects of pollution: consequences of the worldwide pollution of the atmosphere and oceans and other aspects of international pollution		**14**:756b–h	
2. The planning of cities and urban environments: the systems approach to urban design and construction; the development of new towns		**3**:455e–456a/ **18**:1061d–1065d	**17**:976a–b

	articles	article sections	other references
D. History of city engineering			
1. Engineering of ancient and medieval cities; *e.g.*, stone and timber construction, drainage, harbour works		1:1035g–1039b/ 8:633a–f/ 11:587a–g/ 16:582b–d/ 18:1074g–1075e/ 18:1075h–1076c/ 19:934e–g/ 19:936f–h	14:750a–b/18:1081c–e/ 19:648g–649b
2. Development of the modern city; *e.g.*, transport, housing, sanitation, iron and steel construction, electric communications		1:1039b–1041e/ 6:616h–617e/ 6:716a–e/ 16:582b–f/ 17:633d–634g/ 18:85b–e/ 18:656b–c/ 18:658f–659b/ 18:1081g–1082e	14:750b–d/ 18:1076h–1077f *passim*/ 19:649b–d
3. Engineering problems of the megalopolis; *e.g.*, overcrowding, pollution, nuclear-reactor dangers		1:1041e–1042g/ 2:526d–527f/ 13:321f–h/ 18:53f–54d/ 18:638e–639e/ 18:657f–658b/ 18:659b–660b/ 18:1077g–1078d	2:535b–e/14:750d–e/ 15:903c–d

Section 738. Technology of Earth and space exploration

[for Part Seven headnote see page 437
for Division III headnote see page 462]

The articles and parts of articles referred to in Section 738 deal with the techniques and equipment: A, of surface and underground exploration; B, of underwater exploration; and C, of space exploration.

The article referred to on subject A treats the types and purposes of surface and underground exploration, and the indirect and direct methods of exploration.

The outline of subject B treats the history of underwater exploration; surface and underwater research vessels, such as floating instrument platforms, bathyscaphes, and remote underwater manipulators, and their facilities; the life-support systems that maintain sea-level pressure and maintain ambient pressure; and recent advances and future trends in undersea exploration.

After dealing with the history of space exploration prior to Sputnik I, the outline of subject C deals with the characteristics of space affecting space flight; with the technology of spacecraft subsystems; with launch principles and techniques; and with the mechanics and techniques of space flight. Treating space programs since 1957, the outline covers space launch vehicles, unmanned space probes, manned space programs, the use of Earth-oriented satellites, and current proposed missions and new technology. Finally, it treats research on unidentified flying objects.

	articles	article sections	other references
A. Techniques and equipment of surface and underground exploration	EXPLORATION, SURFACE AND UNDERGROUND 7:79–82		
1. Types and purposes of exploration		7:79e–80b	
a. Scientific exploration: the determination of the properties of the Earth's interior		7:79f–h	6:48c–49c
b. Resource exploration: the discovery of sources of ores, fuels, and water		7:79h–80b/ 12:247h–248e	
c. Exploration for construction: the planning of tunnels, foundations, and other works		7:80b/ 18:752d–g	3:457f–g
2. Methods of exploration		7:80c–82d/ 14:177c–f	
a. Indirect methods: use of maps; remote sensing techniques; geophysical and geochemical methods		7:80c–81c/ 6:22g–h/ 6:85h–86a/ 11:482a–h/ 12:247h–248e/ 14:177e–f/ 16:491e–492b	6:48c–49c *passim*/11:479b–c/ 11:499f–h/17:372f–g
b. Direct methods: on-site testing by means of excavation, boring, and sampling of soil, rock, permafrost, and ice		7:81d–82d/ 14:177c–d/ 18:759h–760c	3:457d–g

	articles	article sections	other references
B. Techniques and equipment of underwater exploration	UNDERSEA EXPLORATION **18**:843–853	**7**:82d–f/ **14**:343e–g	
1. History of underwater exploration: development of modern scientific oceanography		**18**:843h–844f/ **6**:83e–84b	**12**:825d–e/**14**:446c–g
2. Research and exploration vessels		**18**:845h–848c	**9**:125b–c
a. Surface vessels: their equipment and facilities		**18**:845h–846d	
b. Fixed platforms; *e.g.*, the floating instrument platform (Flip)		**18**:846d–847e	
c. Submersibles; *e.g.*, bathyscaphes [see B.3.a., below]			
d. Aircraft and satellites: application of remote sensing and satellite telemetry		**18**:847f–848a	
e. Buoys and other unmanned units; *e.g.*, the remote underwater manipulator (RUM)		**18**:848a–c	
3. Life-support systems	LIFE-SUPPORT SYSTEMS **10**:923–927		
a. Systems that maintain sea-level pressure; *e.g.*, submarines, deep submersibles		**10**:923e–924g	**14**:446c–g
b. Systems that maintain ambient pressure; *e.g.*, diving suits, scuba gear, caissons, and undersea habitats		**10**:924h–927d	
4. Techniques and equipment of oceanographic measurement [see 723.G.4.]			
5. Recent advances and future trends in underwater exploration; improved drilling and core-sampling techniques		**18**:852f–853b	
C. Techniques and equipment of space exploration	SPACE EXPLORATION **17**:357–375		**16**:261b–268f *passim*
1. History of space flight prior to Sputnik I: early speculations and fictional accounts; development of space flight theory and technology during the 20th century		**17**:357h–358d/ **15**:924e–931c/ **16**:261f–g/ **17**:376d–377f	**3**:122d–123b/**8**:222d–223c/ **10**:405h–406b/ **18**:732b–733a *passim*
2. Elements of space flight		**17**:358d–362g	
a. The environment of space: the definition of space; characteristics affecting space flight		**17**:358d–f/ **1**:142h–144g	
b. Technology of spacecraft subsystems		**17**:358f–360a/ **5**:320g–321d	
i. Systems that maintain the spacecraft as a functional unit; *e.g.*, power, propulsion, control, guidance, instrumentation		**17**:358f–360a/ **16**:264b–d/ **18**:288e–289c	**1**:135d–f/**2**:510g–511a/ **18**:79h–81d *passim*
ii. Systems that support life within the spacecraft, in free space, and on the lunar surface	LIFE-SUPPORT SYSTEMS **10**:917–923	**1**:146f–147b/ **15**:747e–f	
c. Launch principles and techniques: gravitational forces, staging techniques, and acceleration rates		**17**:360a–c	
d. Mechanics and techniques of space flight		**17**:360d–362g	
i. Types of trajectories: suborbital, Earth orbital, Earth escape, and interplanetary		**17**:360d–361g	
ii. Navigation in space; *e.g.*, the application of inertial guidance		**17**:361g–362b	**16**:263e–264a
iii. Rendezvous and docking		**17**:362b–e	
iv. Re-entry and recovery		**17**:362e–g	
3. Space programs since 1957		**17**:362g–373c/ **18**:52g–53f	
a. Space launch vehicles: rockets designed to provide orbital or escape velocity for manned or unmanned spacecraft		**17**:363b–366a/ **15**:934h–935b	**16**:263d–e
b. Unmanned space probes		**17**:366a–367g/ **9**:789c–790a	
i. The use of sounding rockets to explore the upper atmosphere of Earth		**17**:366a–e/ **15**:941a–h	

	articles	article sections	other references
ii. The use of orbiting satellites for scientific purposes; *e.g.*, to measure the natural phenomena of space; to study the relationship between Sun, Earth, and space; to test instrumentation and communication techniques		**17**:366e–367b/ **16**:261h–262f/ **16**:266f–267e	
iii. The use of unmanned spacecraft to probe the Moon and planets		**17**:367c–g/ **12**:419b–420c	**11**:519c–d
c. Manned space programs: the Mercury, Gemini, and Apollo programs of the U.S.; the Vostok, Voskhod, and Soyuz programs of the U.S.S.R.		**17**:367g–371d	
d. The use of Earth-oriented satellites: communications, Earth survey, and navigation satellites		**17**:371d–373c/ **16**:261h–262f/ **16**:266f–267e	**12**:58f–h/**18**:847h–848a
4. Contributions of space exploration to advances in the physical sciences		**17**:373d–374f/ **6**:5d–6g/ **6**:21e–f/ **9**:789c–d/ **11**:522h–523f/ **12**:418e–420g/ **12**:429h–431b/ **17**:804h–805a	**18**:104g–105a/**19**:21e–h/ **19**:79c–80g *passim*
5. Future developments: proposed missions and new technology		**17**:374f–375f/ **16**:267e–268f	
6. Research on unidentified flying objects	UNIDENTIFIED FLYING OBJECTS **18**:853–856		

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AGRICOLA, GEORGIUS **1**:314
ARMSTRONG, EDWIN H. **2**:35
BELL, ALEXANDER GRAHAM **2**:827
BESSEMER, SIR HENRY **2**:870
BRAUN, WERNHER VON **3**:122
CARNOT, SADI **3**:915
CARVER, GEORGE WASHINGTON **3**:972
DE FOREST, LEE **5**:552
DIESEL, RUDOLF **5**:725
EADS, JAMES BUCHANAN **5**:1117
EDISON, THOMAS ALVA **6**:308
EVANS, OLIVER **6**:1131
FORD, HENRY **7**:520
FULLER, R. BUCKMINSTER **7**:774
FULTON, ROBERT **7**:775
GODDARD, ROBERT HUTCHINGS **8**:222
GUTENBERG, JOHANNES **8**:505
KÁRMÁN, THEODORE VON **10**:405
LEONARDO DA VINCI **10**:809
LINDBERGH, CHARLES A. **10**:991
MCCORMICK, CYRUS HALL **11**:226
MARCONI, GUGLIELMO **11**:489
MONTGOLFIER, JACQUES-ETIENNE AND JOSEPH-MICHEL **12**:409
MORSE, SAMUEL F.B. **12**:458
PICCARD FAMILY **14**:445
POPOV, ALEKSANDR STEPANOVICH **14**:799
ROEBLING, JOHN AUGUSTUS AND WASHINGTON AUGUSTUS **15**:983
SIEMENS FAMILY **16**:731
SIKORSKY, IGOR **16**:750
STEINMETZ, CHARLES PROTEUS **17**:668
TAYLOR, FREDERICK WINSLOW **18**:1
TELLER, EDWARD **18**:127
TESLA, NIKOLA **18**:161
TREVITHICK, RICHARD **18**:692
TSIOLKOVSKY, KONSTANTIN EDUARDOVICH **18**:732
VAUBAN, SÉBASTIEN LE PRESTRE DE **19**:37
WATT, JAMES **19**:662
WHITNEY, ELI **19**:821
WIENER, NORBERT **19**:823
WRIGHT, ORVILLE AND WILBUR **19**:1032

Introduction to Part Eight: **Religion as symbolism**

by Wilfred Cantwell Smith

There is more to human life than meets the eye. More to oneself; more to one's neighbour; more to the world that surrounds us. There is more to the past out of which we come; and especially, it would seem, more to the present moment, maybe even infinitely more. There is more to the interrelationships that bind us together as persons. And the further we probe, men have always found, the deeper the mystery, or the reward, or the involvement. It is this "more," perhaps, that provides at least one of the bases for human religion. We men have seldom been content to be "superficial," to remain on the surface, to imagine that reality does not transcend our finite grasp; and throughout most of our history on this planet we have ordered our lives, both personal and cultural, in terms of that transcendence.

Yet how is one to point to what one does not visually see? How to resort to a milieu beyond all space? How to talk or to think about what transcends not only words but the reach of the mind? How even to feel about what one does not touch? Man's inherent and characteristic capacity to do these things finds expression through his special relation to symbols. These have proven over the centuries sometimes more, sometimes less, adequate to such a task, but in any case indispensable, and ubiquitous. Such symbols, it turns out, have the power not merely to express men's otherwise inchoate awareness of the richness of what lies under the surface, but also to nurture and to communicate and to elicit it. They have an activating as well as a representational quality, and an ability to organize the emotions and the unconscious as well as the conscious mind, so that into them men may pour the deepest range of their humanity and from them derive an enhancement of the personality. Without the use of symbols, including religious symbols, man would be radically less than human.

Quite diverse types of things have served the purpose: a beaver, the sky, a ceremonial procedure, silence; erotic love, or austere asceticism; the Qur'ān; a historical figure; reason. The variety has been immense, different groups having chosen different things to serve them as symbols, not all equally successful. Virtually universal, however, is that men have found it possible to designate some item from within the visible world and to sacralize it in such a way that it becomes then for them the symbol or locus of the invisible, the transcendent. In Japan, a simple open gateway (*torii*) marks off the shrine precincts: one passes through it, leaving behind psychologically, symbolically, the humdrum ordinary world to enter the sacred space of the temple; and after worship, one again moves through the gate in the other direction, to re-enter now the realm of everyday life, but as a renewed person. Virtually all peoples have set aside some portion of what outsiders would regard as ordinary terrain to serve for them as sacred space, erecting in it temple, church, or shrine whereby is then represented for them, often with great force, quite another dimension of reality.

Similarly with time: the Jew, for instance, sets apart one day in seven, whereby the other six days symbolize the mundane world with its bitter imperfections, perhaps its devastating pain, and at best its transient successes, while the Sabbath creatively represents the inviolate splendour of transcendence—with which therefore the other six days, however bleak, cannot keep him out of touch. Every people has its festivals, weekly or seasonal or occasional, its sacred times when life in its empirical and work-a-day aspects is transcended and life in its timeless dimension is reaffirmed, reactivated: moments when truth, significance, worth are recognized and cultivated—and carried back then into the ordinary world.

Men are somehow aware, if only through imaginative vision or sensibility or our special capacity for hope, not only of what is but also of what ought to be. They have sensed that the *status quo* (nowadays, the *fluxus quo*) is not the final truth about man or the world. They have felt, to take one example, that social justice and concord, personal righteousness, health, joy, stand over against the current observable condition of strife, loneliness, wickedness, poverty, and sorrow not as fancy against truth, wishful and irrational dreaming against reality, but in some fashion *vice versa*—as a norm by which the present imperfect world is judged, in some sense a truth in relation to which empirical actuality is in some sense an error. This too has been affirmed symbolically. One rather common way of doing so has been by representing a more perfect world elsewhere. Some have located their utopias chronologically in the past ("Once upon a time"; or Golden Age theories, as in Greece and India); or in the future (millennialisms, a coming just ruler, secular ideas of progress, a life after death); or geographically, somewhere else (the medieval Irish "Isle of the Blessed" in the then inaccessible Western Sea); or high above the sky (heaven, the heaven of heavens); or in a domain beyond time (Paradise); or in another realm than this universe (a metaphysical order, idealist realities).

However it be symbolized and articulated, a moral dimension to human life has been perceived and affirmed. Man has been aware not only of the profitable and the disadvantageous but also of the better and the worse, and has been inspired by some power to pursue the better; he has known that some actions are right, some wrong, and that it matters. At most times and most places, morality has been an integral part of the religious complex (although situations have on occasion arisen when the two have become historically dislocated—when a given form of religion has seemed not good; or to put it another way, when man's sense of what is worthwhile, and the inherited symbols by which worth used to be formulated, have no longer converged).

If the panorama of man's religious life is, in its outward form, selected mundane data symbolizing the more than mundane, then the task of the student of religion is to know those data but to consider them not in themselves but in their role in men's lives. Our concern is not primarily the doctrines and scriptures and prayers and rites and institutions; but rather, what these do to a man. Not the tribal dance, so much as what happens to the African dancing; not the caste system, so much as what kind of person the Hindu becomes within it, or without it; not the events at Sinai, so much as what role the recounting of these events has played in both Jewish and Christian life over the centuries since; not the Qur'ān so much as what the Qur'ān means to a Muslim.

In illustration, let us consider as an example a statue of the Buddha, and take note specifically of one small part of it, the pose of the right hand. Among several such stylized poses used throughout the Buddhist world, we may choose just

one, the *abhaya mudra* ("fearlessness pose"), in which the right arm is somewhat raised, that hand held straight up, palm facing out. Over and above the more universal significance of such a gesture (power, authority, benediction), in the Buddhist case this represents also an incident from the life of the Buddha, in which reputedly a wild elephant charging him and his group was stopped in its tracks when the Teacher raised his hand so, and became tame. The gesture gives artistic expression, then, to the Buddha's fearlessness in the face of the threat, and also to his conferring of fearlessness, and of grounds for fearlessness, on his disciples: his serene triumph over danger.

To say that this particular feature of sculpture symbolizes for Buddhists the overcoming of fear is to indicate not merely that it depicts an event in someone else's life, but also that it effects a change in one's own—since, to repeat, symbols not only represent but activate. The animal in its fury in the remembered anecdote may itself be taken as symbolic, representative of the pressures and assaults of life, which faith in the Buddha gives one the inner resources to withstand: the passions, for instance, to which such faith bestows on one the power quietly to say "no." To understand this particular item in the religious life of Buddhists, accordingly, is to know the history of how a Japanese emperor or a Thai merchant or a Chinese peasant through contemplating it in some nearby temple has had his life transformed, his fear removed, his personality healed. A parallel may be observed of the role in the lives of Christians, over the centuries, of the story of Christ's stilling of the tempest. His words, "Peace, be still!" read in the Lesson, and the portrayal of the scene in stained-glass windows, have served to symbolize, for men of faith, on the one hand Christ's power over the elements in his own life, and on the other hand the power that their faith in Him has in their lives, they have then found, to confer peace, to quell storms.

A special sort of symbolization, developed characteristically in, for instance, the Western world but by no means only there, has been the conceptual. A few recent philosophers have itched to legislate that concepts must be used to refer only to the sensible or phenomenal world; that it is illegitimate to use them symbolically to refer to a transcendent order. It would be manifestly stultifying to apply so austere a restriction to art or to most other human pursuits, apart from the natural sciences (from which these men have learned it). Such an orientation has seemed to work rather well with the "objective" world—better, with the objective facets of the world (at least, until one raises moral questions about atomic bombs or ecology); but it appears stubbornly to misunderstand life in its distinctively human form.

One of the most powerful symbols in human history has, without question, been the *concept* "God." This concept, like other religious and other human symbols, has demonstrably meant different things to different persons and groups and ages; yet it is hardly too drastic an oversimplification to suggest that the concept has on the whole at least subsumed, integrated, deepened, and made operationally effective in the lives of many hundreds of millions of persons and in the life and social cohesion of many thousands of communities their awareness and their potential awareness of the entire range of transcendence with which they are surrounded or endued—of grandeur, order, meaning, aspiration, awe, hope, virtue, responsibility, rapport, integrity, worth, renewal. The highest, deepest, most comprehensive that they were capable of attaining, individually and socially, was organized, focussed, and nurtured in and through this concept. (Given the distinction, observed by all believing theorists, between God and men's ideas of God, such theorists may themselves make this same point by saying that God has used the idea of God to enter men's lives; that the concept has served as a sacrament. More recent developments, with the concept "God" no longer serving so effectively, as a symbol, for many, will be touched on below.)

Although correlative conceptualizations are virtually worldwide and history-long, this particular concept was developed in its most powerful and characteristic form in the Near East and has permeated, at times dominated, the civilizations that have emerged from there to cover almost half the planet, especially the Islāmic and the Judaeo-Christian. The Indian counterpart has been in many respects closely similar; in many, subtly different. China and Japan, although also employing symbolic concepts richly, have tended toward other religious and cultural patterns than this particular one.

Even so major a symbol, however, as the concept "God," however all-embracing it may seem, is in the end significant not in isolation but within a whole system of ideas, practices, values, and the like, forming a pattern of which it is no doubt the keystone but not the totality. Certainly minor symbols like the pose of the right hand in a piece of sculpture or medium ones like the ceremonial holiness of the Sabbath, however significant they have been in the lives of many millions of persons, derive their meaning and their power from each being one item within a large pattern of symbolic structures, such as the Buddhist complex or the Christian.

And even these great complexes, each of which has an elaborate and ever-changing history, constitute systems to be understood not in themselves, as structures to be looked at, but rather in terms of the ambience that they make available for men and women to live within. "In order to understand Buddhists, one must look not at something called Buddhism, but at the universe, so far as possible through Buddhist eyes." It is not the symbols themselves that one must grasp, so much as the orientation that they induce: how the whole complex of symbols enables those who live in terms of it to see a sunset, a broken marriage, prosperity, the onset of cancer, one's election to public office.

The religious history of the Hindu community is a history, in part, of traditional ceremonial and ideological and sociological patterns. Yet in more significant part it is a history, however difficult this may be to discern, of fortitude and of quiet humaneness, of a conviction that life is worth living and death worth dying, that goals are worth striving for, that the immediate is caught up in the eternal. The Buddhist metaphors have served to kindle in the mind and heart of the Buddhist the perhaps unconscious awareness that one's own fortune is not a reason for gloating, or one's neighbour's fortune, for envy; that knowledge is more important than wealth, and wisdom than knowledge; that the world is to be appreciated and not merely exploited; that one's fellow is to be treated as an end, not merely as a means; that sorrow is not a reason for despair. Islāmic law, theology, architecture, and the rest have been symbols that at their best have crystallized and nurtured, for Muslims, the courage and serenity, the sense of order and the aspiration to justice, the forbearance, the humility, the participation in community, that the Islāmic system traditionally inspired. Christian symbols have given both form and actuality, among Christians,

to many things, including for instance the ability of human suffering to become redemptive.

Of course, religious symbols and sets of symbols have been used also for mean and destructive purposes. Man's wickedness, and not only his capacity for virtue, has been expressed and even encouraged by his symbol systems, at times. Through them he has found his freedom, his transcendence of the immediately given, his ability to move beyond being merely an organism reacting to its environment; but sometimes he has used these destructively, or has become a victim of their inherent ambiguities. Nothing has turned a society into a community so effectively as religious faith: to share common symbols is about the most powerful of social cohesions. And yet few gulfs have been greater than those that separate differing religious communities, few hostilities so fierce as those between groups whose symbols differ.

Religious symbols do not raise man above the human level; only to it.

A final word about history. The history of religion has at times been mistaken for the history of its symbols; but this is superficial. The same symbols have discernibly changed their meanings over time, and indeed from person to person, and even within one person's life; also, persisting or widespread orientations and perceptions have been expressed in strikingly different symbolizations. The true history of religion is more deeply personalist—not in the sense of individualist: the personal is also the social, and especially so in the religious realm. The true history of religion, not yet written, is the history of the depth or shallowness, richness or poverty, genuineness or insincerity, splendid wisdom or inane folly, with which men and women and their societies have responded to such symbols as were around them. It is also, however, the tale, and to some degree this can be told, of when and in what fashion they have forged new symbols, or neglected or found themselves unable to respond to old. And nowadays it is also the story of how they deal or fail to deal with a plurality of symbolisms.

A man's faith is in some sense the meaning that his religious symbols have for him; but more profoundly, it is the meaning that life has for him, and that the universe has, in the light of those symbols. For religious symbols do not "have" meanings of their own; they crystallize in various ways the meaning of the world, of human life. There is a history of their varying ability to do this, at various times and places (or of men's varying ability to have them do it). How new symbols or patterns of symbols emerge is too complex or controversial a question to be summarized here; but how they develop once launched, how they are reinterpreted (sometimes radically) over the centuries, how their success in pointing beyond themselves often gives way to a rigidity and narrowness in which they or their institutions are prized or defended simply in themselves; how iconoclastic movements arise, to shatter the symbols (literally, smashing idols; or figuratively, attacking concepts and mores), whether in the name of something higher or out of misunderstanding, and often both; saddest of all, how a time may arrive when the symbols no longer serve a community, no longer communicate a transcendent vision, and then a profound malaise settles on the society and life comes to seem without meaning, and men become alienated from each other and even from themselves and from the world in which they live—all this the historian can trace.

In recent Western history an aberrational tendency has arisen to imagine that human life is fundamentally or naturally "secular," and that religion has been an added extra, tacked on here and there to the standardly human. This now appears to be false. Rather, the various religious systems have expressed varying ways of being human. The historian cannot but report that it has been characteristic of man to find that life has meaning and to formulate that meaning in symbolic ways, whether grotesque or sublime.

Part Eight. Religion

The outlines, and the articles and parts of articles referred to, in the eleven sections of Part Eight set forth studies of religion in general and studies of the particular religions. The ways in which religion is related to studies of human society, the fine arts, the history of civilizations, and science and philosophy are dealt with in Parts Five, Six, Nine, and Ten.

The articles referred to in Section 811 of Division I treat diverse views of the nature, purpose, validity, and value of religion. Those referred to in Section 812 deal with problems and methods of the empirical, comparative, and phenomenological study of religion and religious experience, in efforts to discern, describe, and understand religious phenomena.

The outlines and the articles referred to in the nine sections of Division II deal with the particular religions of mankind, in different cultural stages, historical eras, and world areas.

Division I. Religion in general 501
II. The particular religions 517

Division I. Religion in general

The outlines, and the articles and parts of articles referred to, in the two sections of Division I deal with diverse views of the nature, purpose, validity, and value of religion, and with the problems, methods, and results of the empirical, comparative, and phenomenological study of religions and of religious experience.

The articles referred to in Section 811 treat divergent views of the nature and characteristics of religion; views of the meaning of religion and religious phenomena from within the particular religions; views and attitudes concerning religion or religious beliefs and claims from positions outside the particular religions; the history, themes, and problems of the philosophy of religion; and the nature of theology, its relation to the history of religions and to philosophy, its religious and cultural significance, and its themes and functions.

The articles referred to in Section 812 deal with the basic problems and methods of the descriptive study of religion including the criteria used to classify the particular historical religions, which are treated separately and descriptively in Division II; the relation of religion to other spheres of human experience; the nature, elements, and varieties of religious experience; and the basic patterns of religious thought, action, and association.

Section 811. Diverse views about religion 501
812. Religion as an object of study; religious experience and phenomenology 511

Section 811. Diverse views about religion

The articles and parts of articles referred to in Section 811 deal with five main subjects: A, divergent views of the nature and characteristics of religion; B, views of the meaning of religion and religious phenomena from within the particular religions; C, views and attitudes concerning religion, or religious beliefs and claims, from positions outside the particular religions; D, the philosophy of religion; and E, theology.

The outline of subject A begins with the givenness of religion as a fact of human experience, culture, and history. It then treats views of religion as the relation between man and the supernatural; views of the inner attitudes and dispositions characterizing religion and of the human faculties or functions involved in religion; and views of the prescribed or institutional character of religion.

The outline of subject B begins with views of the origin of religious beliefs, practices, and institutions. It goes on to views of the nature of the divine or sacred and its relation to the world and to men. Here, it first treats views about the knowability, the essence, the personal character, and the unity of the divine or sacred. It next treats views of the transcendence or immanence of the divine or sacred and the relation of the divine or sacred to the universe. After dealing with views of the approachability of the divine or sacred by man, it treats views of the divine or sacred as concerned and active with respect to human welfare, or as hostile or destructive toward men. Turning to views of the significance of religious beliefs and practices for men, the outline covers views of the dispositions and behaviour required of man by or toward the divine or sacred; views of the role of religion in human life; affirmations or rejections of the religious value of formal observances and institutions or prescribed dispositions; affirmations or rejections of the truth or value of imaginative expressions of religious beliefs and doctrines; divergent views concerning the initiating or decisive source of religious assent, volition, or action; and views about the criteria of true belief and right action. Finally, the outline of subject B treats diverse positions taken by particular religions with regard to the truth or worth of other religions, and criticisms of religion from within the particular religions.

Subject C involves views and attitudes concerning religion, or religious beliefs and claims, from positions outside the particular religions. The outline begins with the positions of atheism and agnosticism and with philosophical views rejecting some or all religious beliefs and claims as false or worthless. It goes on to treat various naturalistic explanations of the origin and development of religious beliefs and practices. It next deals with views that acknowledge some validity in religion in general or in particular beliefs and practices. Finally, the outline treats modern alternatives to traditional religious beliefs, practices, and institutions with special attention to Existentialism, secular religion, and Marxism.

The article referred to on subject D treats the history, themes, and problems of the professional discipline of the philosophy of religion, as well as the common or typical views about and attitudes toward religion.

The article referred to on subject E deals with the nature of theology, its relation to the history of religions and to philosophy, its religious and cultural significance, and its various themes and functions.

	articles	article sections	other references
A. Divergent views of the nature and characteristics of religion	RELIGION, PHILOSOPHY OF **15**:591–594		
1. The givenness of religion as a fact of human experience, culture, and history		**15**:592d–593b	**18**:274h–275b
2. The view of religion as the relation between man and the supernatural, the divine, the sacred, or the "wholly other"		**15**:593b–f/ **15**:601b–602b/ **12**:17g–18f/ **12**:788c–e/ **15**:648g–649c/ **16**:122h–123c	
3. Views of the inner attitudes and dispositions characterizing religion and of the human faculties or functions involved in religion		**15**:593f–g/ **4**:555a–f/ **5**:928e–h/ **12**:787g–788c/ **12**:796f–h/ **12**:864b–f/ **15**:614a–d/ **15**:622b–623f/ **15**:648e–g/ **15**:786c–e	**1**:157d–h/ **1**:311e–314c *passim*/ **14**:948f–g/**17**:906f–h
4. Views of the prescribed or institutional character of religion		**15**:593g–594a/ **5**:730b–e/ **15**:606a–608h/ **15**:649c–e	**6**:979f–g
B. Views of the meaning of religion and religious phenomena from within the particular religions	RELIGION, PHILOSOPHY OF **15**:594–595		
1. Views of the origin of religious beliefs, practices, and institutions			
a. Views of establishment by supernatural power		**2**:550e–g/ **6**:506b/ **10**:284d–f/ **11**:1004d–g/ **12**:918f–919a/ **15**:1060c–h/ **16**:673c–e	**2**:588h–589a/**7**:63c–d/ **10**:98e–100a/**10**:643d–f/ **12**:488d–f/**17**:1046h–1047a
b. Views of derivation from ancestral authority and tradition		**5**:927g–928e/ **10**:111b–f	**1**:835d–837f *passim*/ **4**:422e–425h *passim*/ **4**:1099g–h/**7**:312d–g/ **10**:303d–304a/**16**:673c–e
c. Views of origin in insights provided by special personal experience or vocation		**2**:1093f–1094b/ **3**:404g–405d/ **3**:419c–420c/ **4**:465b–466a/ **4**:534d–535e/ **4**:1100b–f/ **8**:536b–537c/ **8**:686e–g/ **12**:801e–f/ **16**:744a–e/ **19**:1171f–1172a	**2**:588b–d/**3**:371c–373e/ **10**:8c–e/**10**:154b–155b/ **10**:304c–g/**11**:347d–348b/ **11**:442g–443f/**12**:271a–b/ **12**:442f–g/**12**:489e–490a/ **15**:343d–f
2. Views of the nature of the divine or sacred and its relation to the world and to men			
a. Views of the knowability of the divine or sacred		**12**:788h–789g	

	articles	article sections	other references
i. The divine or sacred as utterly unknowable or inexpressible		**3**:414h–415e	**4**:423h–424a/**4**:549h–550b/ **5**:242h–243b/ **10**:183d–190g *passim*/ **17**:1036g–1037b
ii. The divine or sacred as partially knowable or expressible		**6**:145d–e/ **16**:673f–g/ **18**:276f–g	**8**:895d–f/**9**:1014b–d/ **14**:256h–261d *passim*/ **15**:993g–994a/ **16**:353h–354e
iii. The divine or sacred as completely knowable or expressible		**12**:787a–c	**10**:102d–h/**10**:104d–f
b. Views of the essence of the divine or sacred			
i. The divine or sacred as absolute, infinite, unconditioned being or power			**3**:375f–g/**3**:425g–h/ **4**:423h–424a/**8**:892d–g/ **8**:895d–f/**12**:877g–878b/ **17**:1036g–1037b
ii. The divine or sacred as absolute spiritual realm or state			**8**:924c–f/**9**:329c–h
iii. The divine or sacred as absolute emptiness or nothingness			**3**:380d–f/**9**:323h–324b/ **10**:186f–h
c. Views of the personal character of the divine or sacred			
i. The divine or sacred as an impersonal power, order, law, or state			**4**:423h–424a/**4**:1096c–e/ **8**:924c–f/**8**:929g–930e/ **10**:105g–h/**12**:877g–878b/ **17**:1035b–c
ii. The divine or sacred as a personal being or personal beings		**2**:189h–192f/ **2**:664g–666c/ **3**:1069b–1070f/ **4**:425h–426c/ **4**:477e–478b/ **5**:239h–240d/ **6**:504h–506a/ **8**:36f–38f/ **8**:408c–f/ **10**:98e–100a/ **10**:111b–f/ **12**:878c–881a/ **16**:673c–g/ **17**:967g–968h/ **18**:265e–g	**8**:404h–405b/ **8**:890b–900f *passim*/ **8**:930e–931h/**9**:913c–d/ **10**:286c–d/**11**:720h–721d
d. Views of the unity of the divine or sacred			
i. The divine or sacred as comprising a multiplicity of powers or deities	POLYTHEISM **14**:784–787	**1**:912f–913a/ **1**:1057h–1058e/ **2**:189h–192f/ **2**:550e–g/ **2**:664g–666c/ **3**:422g–423h/ **3**:1069b–1070f/ **4**:425h–426c/ **8**:36f–38f/ **8**:408c–409b/ **8**:929g–931h/ **9**:259h–260c/ **9**:871b–d/ **10**:111b–f/ **10**:449e–f/ **12**:879c–881b/ **12**:918f–919e/ **15**:1063a–1065a/ **16**:673c–g/ **16**:874f–875c/ **17**:967g–968h	**6**:504h–506a *passim*/ **8**:404h–405b/**8**:750g–751a/ **8**:890b–900f *passim*/ **10**:98e–100a/**11**:720h–721d/ **11**:1004b–d/**17**:1041d–e
ii. The divine or sacred as especially present in one of many powers or deities		**8**:889c–d	**2**:191a–c/**2**:665d–f/ **7**:311h–312b/**8**:36g–37a/ **8**:408c–e/**10**:451b–c/ **12**:288d–289a/**12**:382c–d/ **12**:878d–879a/**12**:917b–c/ **17**:938g–939a/**17**:967g–h

	articles	article sections	other references
iii. The divine or sacred as consisting of two primal powers or deities	DUALISM, RELIGIOUS **5**:1066–1070	**1**:873c–d/ **4**:423h–424d/ **5**:240g–241a/ **9**:870e–871b/ **10**:9g–10b/ **12**:801b–e/ **19**:1173b–f	**5**:241g–h/**8**:216f–g/**8**:894c–h/ **9**:331c–g/**11**:445e–446e/ **12**:382h–383a
iv. The divine or sacred as one unique power or being	MONOTHEISM **12**:381–384	**1**:1059d–g/ **4**:478b–e/ **5**:239h–240f/ **19**:1173b–f	**6**:508f–g/**9**:913c–d/ **10**:285d–f
e. Views of the transcendence or immanence of the divine or sacred		**5**:242b–h	
i. The divine or sacred viewed as utterly separate from the universe and in no respect present in it	DEISM **5**:561–563		**6**:888g–889h/ **8**:214d–218d *passim*/ **8**:892d–g/**9**:1014b–d/ **15**:530e–h
ii. The divine or sacred viewed as essentially distinct from the physical universe but present in it in some significant respect	THEISM **18**:265–269	**4**:477g–h/ **4**:560b–h/ **8**:890e–g/ **12**:24d–g	**8**:924g–925b/**9**:191h–192b/ **10**:285g–286b/ **12**:381b–384e *passim*
iii. The divine or sacred viewed as essentially present in the universe and not existing apart from it	PANTHEISM AND PANENTHEISM **13**:948–954	**4**:423h–424d/ **10**:111b–f/ **12**:918f–919a/ **16**:673f–g	**12**:877g–878b
iv. The divine or sacred viewed as the one reality in which all things exist			**9**:946g–947a/**10**:185e–186b/ **13**:948d–954e *passim*/ **17**:1037g–h
v. Views of intermediate beings, powers, or principles	ANGELS AND DEMONS **1**:871–876	**4**:479d–480g/ **8**:216f–217a/ **19**:1173b–f	**3**:370h–371b/**4**:516f–h/ **7**:312b–d/**8**:38f–h/**8**:686g–h/ **9**:913e–h/**10**:292g–h/ **16**:874c–e
f. Views of the relation of the divine or sacred to the universe		**5**:1069f–1070c/ **13**:949h–950c	
i. Views of the divine or sacred origin of the universe	CREATION, MYTHS AND DOCTRINES OF **5**:239–243	**1**:912d–f/ **4**:411f–412d/ **4**:556g–557c/ **6**:74e–75b/ **8**:216f–g/ **9**:870e–871b/ **10**:98e–100a/ **11**:1003e–1004b/ **12**:289f–h/ **12**:918f–919a/ **19**:1173f–h	**1**:237f–g/**7**:311d–g/**7**:464c–d/ **8**:36c–e/**8**:404c–h/ **8**:928g–929b/**9**:949g–h/ **9**:1024b–e/**10**:184g–185a/ **10**:292b–d/**11**:720d–h/ **11**:1010g–1011e/**12**:799c–h/ **14**:1044a–e/ **17**:1035h–1036a
ii. Views of the divine or sacred preservation or governance of the universe	PROVIDENCE, RELIGIOUS DOCTRINES AND MYTHS OF **15**:134–136	**4**:423h–424d/ **8**:408c–g/ **9**:1023f–h/ **12**:800f–g/ **12**:919a–e	**4**:478g–479a/**8**:750d–e/ **8**:890f–g/**9**:1017g–h/ **10**:285g–286a/ **11**:1009g–1010b/**12**:783e–f/ **14**:1044e–g/**17**:1035d–h/ **17**:1038c–e
iii. Views of the divine or sacred destruction of the universe	ESCHATOLOGY **6**:958–962	**8**:39e–g/ **12**:799h–800b/ **12**:920c–921a	**2**:550a–b/**8**:929e–f/ **19**:1174d–f
iv. Views of the divine or sacred salvation or re-creation of the universe	SALVATION **16**:201–204	**18**:411a–413b	**2**:550a–b/**8**:405d–f/**8**:929c–e/ **9**:871f–h/**11**:1021a–c
g. Views of the approachability of the divine or sacred by man		**4**:425h–426f/ **6**:143h–144c/ **8**:408g–409a/ **8**:889h–890b/ **14**:951a–953b/ **15**:1060c–h/ **16**:673f–g	**2**:548h–552b *passim*/ **3**:415b–c/**4**:549b–e/ **14**:1007f–1012c *passim*
h. Views of the divine or sacred as concerned and active with respect to human welfare			
i. Divine love			**10**:287d–288a/**15**:101c–102e

	articles	article sections	other references
ii. Divine justice		**19**:1174b–f	**4**:508a–d/**6**:908h–909d/ **8**:408c–409b *passim*/ **9**:1014d–f/**15**:562b
iii. Creation		**1**:913f–g/ **4**:556g–557c/ **8**:216f–217a/ **12**:918f–919a/ **19**:1173h–1174b	**1**:237f–h/**2**:899d–900a/ **4**:411f–412a/**7**:464a–c/ **8**:36c–e/**8**:404g–h/**9**:913e–f/ **9**:949g–h/**11**:1004d–g/ **11**:1009f–g/**12**:799f–g
iv. Providence	PROVIDENCE, RELIGIOUS DOCTRINES AND MYTHS OF **15**:134–136	**8**:962a–c/ **18**:412e–413b	**2**:900f–h/**4**:414b–d/ **4**:478g–479a/ **8**:408c–409b *passim*/ **8**:890f–g/**8**:923h–924b/ **10**:285g–286a/**14**:1044e–g/ **18**:266e–g
v. Revelation	REVELATION **15**:783–786	**3**:381d–e/ **3**:424e–g/ **7**:60g–61c/ **12**:270c–e/ **15**:62b–63a/ **15**:343d–f/ **15**:993d–994b	**2**:588h–589a/**4**:478e–f/ **4**:548g–549b/ **8**:214d–218d *passim*/ **8**:932h–933d/**9**:913g–914c/ **10**:186f–187a/**11**:442h–443b/ **16**:831c–d/**17**:1041c–d/ **17**:1048e–1049a
vi. Salvation	SALVATION **16**:201–204	**3**:380d–381a/ **4**:488c–490g/ **8**:216h–217c/ **8**:889f–890b/ **10**:10b–e/ **10**:103e–104a/ **12**:336f–337b/ **19**:1174b–d	**8**:750e–h/**11**:445c–e/ **12**:936h–937c/**15**:101c–102e
vii. Miracles	MIRACLE **12**:269–274	**16**:166a–c	**8**:685e–687c *passim*/ **9**:914a–c/**17**:1046c–d
viii. Covenant	COVENANT **5**:226–230	**9**:871d–872a/ **10**:287d–289a/ **10**:303d–305a/ **12**:288h–289b/ **12**:921b–f	**12**:489e–490a/ **15**:304b–308f *passim*
ix. Eschatology	ESCHATOLOGY **6**:958–962	**1**:101g–102d/ **8**:39d–g/ **8**:217d–e/ **8**:409a–b/ **10**:293a–294a/ **11**:1018a–1020h/ **12**:200g–203b/ **12**:799h–800b/ **19**:1174c–f	**2**:550a–b/**4**:505h–506c/ **4**:535a–b/**5**:1066c–e/ **5**:533a–538g *passim*/ **9**:914c–d/**9**:950c–e/ **9**:1023d–f/**10**:288d–289a
x. The divine or sacred viewed as the originator or sponsor of the arts and sciences and of social and political institutions		**8**:408c–f/ **8**:903e–904c/ **11**:1004g–h/ **12**:919a–e	**12**:880b–d/**12**:917d–e/ **15**:1060c–1065h *passim*/ **16**:119f–h
i. Views of the divine or sacred as hostile or destructive toward men		**1**:874c–e/ **1**:913c–d/ **8**:39e–g	**3**:422e–g/**8**:406a–b/ **8**:408c–410a *passim*/ **8**:893h–894d/**8**:931c–g/ **11**:1010d–g/**16**:874g–h/ **19**:1174d–f
3. Views of the significance of religious beliefs and practices for men			
a. Views of the dispositions and behaviour required of man by or toward the divine or sacred			
i. Faith		**1**:313d–314c/ **15**:992d–993b	**3**:425c–g
ii. Obedience			**5**:226d–230e *passim*/ **9**:913e–914a/**10**:286e–h
iii. Love		**8**:925b–926e	**4**:521h–522a
iv. Physical or spiritual purification		**14**:201b–c/ **16**:117e–g/ **16**:673g–h	**4**:524b–c/**4**:548d–g/ **11**:446h–447c/**12**:290c–d/ **12**:781h–782c

	articles	article sections	other references
v. Devotion or worship		**1**:835f–836b/ **2**:551d–h/ **3**:396e–397b/ **3**:1070h–1071e/ **4**:425h–426d/ **4**:495c–497b/ **6**:147d–h/ **6**:506g–508b/ **8**:38h–39c/ **8**:900g–902e/ **10**:294d–296f/ **11**:722a–e/ **11**:1004h–1005e/ **12**:941b–f/ **14**:951a–953b/ **14**:986a–e/ **14**:1045h–1046f/ **15**:996b–998d	**1**:1058e–1059c/**2**:191f–192b/ **8**:408h–409a/**8**:923h–924b/ **9**:261c–e/**9**:319a–e/ **9**:918f–919a/**10**:11d–12d/ **14**:34h–35b/**15**:104g–105c/ **16**:746f–747d/ **17**:1041h–1042c
vi. Dedication or service: life-discipline and moral action		**3**:390d–391c/ **3**:428e–430d/ **4**:488c–490g/ **4**:517h–518d/ **4**:522a–526d/ **7**:744h–745b/ **9**:920c–f/ **9**:947d–f/ **10**:10b–h/ **10**:289a–292a/ **14**:1046f–h/ **15**:323c–h/ **15**:1000g–h/ **15**:1006b–d/ **16**:167a–b/ **19**:1175g–h	**2**:901b–902b/**4**:536a–d/ **4**:1092c–h/**4**:1093d–f/ **8**:890c–900f *passim*/ **9**:318c–e/**9**:914d–f/ **10**:101d–g/**12**:919f–g/ **13**:395h–396a/**15**:106d–f/ **15**:562h–563a/**17**:1036c–e
vii. Mystical exercises		**3**:417g–418g/ **8**:923d–h/ **9**:945a–946b/ **10**:10h–11d/ **17**:1038g–1039a	**3**:378b–d/**4**:548d–g/ **9**:191a–c/**10**:104c–f/ **10**:183d–190g *passim*/ **12**:789g–790b
viii. Ascetic exercises		**2**:137a–g/ **4**:523e–524g/ **6**:147b–d/ **8**:904d–905b/ **15**:640h–641b/ **17**:1039d–1040e	**3**:424c–e/**4**:1098b–d/ **9**:321c–d/**9**:919d–h/ **11**:446f–447b
ix. Magical acts		**3**:399a–c/ **4**:426d–f/ **5**:916g–918c/ **10**:533c–e/ **11**:298e–299d/ **11**:1006b–e/ **12**:920b–c/ **14**:987g–988a/ **14**:1046h–1047b/ **17**:1042c–e	**9**:261a–c/**11**:576a–577d/ **11**:869c–d/**13**:207a–b/ **14**:782g–783c/ **17**:123h–124d
x. Diverse emphases on individual or communal action		**2**:551g–552b/ **3**:391c–392h/ **4**:1097e–1098e/ **6**:146h–147d/ **6**:506g–508b/ **7**:744h–745b/ **8**:217h/ **8**:686d–e/ **8**:904d–905b/ **9**:947b–d/ **10**:10h–11d/ **10**:294d–295b/ **12**:443e–444a/ **15**:102e–103a/ **15**:990g–992b/ **15**:1065a–d/ **16**:673h–674c/ **18**:529f–530c/ **19**:1174f–1175f	**3**:1040h–1043f *passim*/ **4**:525g–526d/**9**:260g–h/ **10**:290h–291c/**12**:337g–338e/ **13**:226g–227a/**17**:1041f–g/ **17**:1047c–e

	articles	article sections	other references
b. Views of the role of religion in human life			
i. The safeguarding of human existence		**3**:399a–c/ **4**:426c–f/ **4**:1097e–1098e/ **5**:732a–736d/ **8**:408c–f/ **12**:920c–921a/ **14**:1045g–h	**1**:923g–924a/**4**:414a–d/ **8**:685e–687c *passim*/ **8**:750d–e/**8**:890f–g/ **14**:782g–783c/ **15**:1060c–1065h *passim*/ **19**:799d–e
ii. The sacralization of human existence		**2**:550e–g/ **2**:666d–f/ **4**:423h–425c/ **4**:486g–487g/ **4**:557d–558b/ **6**:143h–144c/ **6**:503g–504b/ **7**:312g–313b/ **8**:408g–410b/ **10**:294b–d/ **12**:919a–e/ **14**:1044g–1045a/ **15**:1062b–h	**4**:501b–h/**4**:549f–h/ **9**:918f–919a/**10**:289a–b/ **12**:155c–d/**14**:460c–d/ **16**:163e–167h *passim*
iii. The working of man's salvation or atonement		**3**:380d–381a/ **3**:414h–415g/ **4**:488c–490g/ **6**:960c–961b/ **8**:216h–217c/ **8**:889g–890b/ **10**:10b–e/ **10**:111f–112h/ **12**:336f–337b/ **12**:919f–h/ **15**:998d–g/ **16**:202h–204c/ **19**:1174b–d	**2**:550b–c/**3**:427g–428b/ **8**:750e–h/**9**:945f–946b/ **9**:950c–e/**10**:103e–104a/ **11**:445c–e/**11**:1021a–c/ **12**:778f–783a *passim*/ **15**:101c–102e/**15**:593e–f
iv. The preparation of man for his state after death and actions on behalf of the dead		**2**:550h–551a/ **3**:1070f–h/ **4**:425c–h/ **4**:507f–508e/ **6**:506d–g/ **8**:217d–e/ **8**:409a–b/ **9**:871d–f/ **11**:721e–f/ **14**:985c–g/ **14**:1046d–f/ **16**:440g–441g/ **17**:1039b–c/ **19**:1174b–f	**2**:666h–667c/**3**:394h–395a/ **5**:533a–538g *passim*/ **7**:312d–g/**8**:39d–e/**9**:914c–d/ **10**:111d–113d *passim*/ **10**:289b–f/**15**:1065g–h/ **16**:875e–876e/**17**:512d–g/ **19**:1175c–d
v. The provision of a way of life and a code of conduct		**3**:390d–391c/ **3**:428e–430d/ **3**:1041b–d/ **4**:424d–e/ **4**:500d–501h/ **4**:522a–526d/ **8**:218c–d/ **10**:10e–h/ **10**:289a–292a/ **16**:167a–b/ **17**:1039d–1040e/ **19**:1175g–h	**2**:1095b–c/**4**:536a–d/ **4**:1092c–h/**4**:1093d–f/ **4**:1102a–c/ **8**:890c–900f *passim*/ **9**:914d–f/**9**:1014f–h/ **10**:101d–g/**17**:1036c–e
vi. The re-enactment of the historical or mythical origins of the world, man, or religious practices and institutions		**8**:890g–891f	**6**:959c–e/**7**:201f–g
vii. Cooperation with the divine or sacred in the re-creation or redemption of the world		**4**:520h–522e/ **6**:296f–h/ **6**:959e–960a	**12**:202f–203b
viii. The provision of immediate experience or perfect knowledge of ultimate reality		**3**:414h–415g/ **10**:10d–e/ **12**:788c–789g/ **14**:950g–951a/ **14**:1046f–h	**3**:387a–h/**4**:548g–549b/ **8**:214d–218d *passim*/ **8**:923c–926h *passim*/ **9**:1020g–1021a/**10**:102d–h/ **10**:191e–193h *passim*/ **18**:276a–278c *passim*

	articles	article sections	other references
ix. The provision of valued feelings or states of mind		**3**:416h–418g/ **4**:562d–g/ **5**:919f–920a/ **12**:788a–c/ **12**:942b–g/ **14**:201d–e	**12**:778f–783a *passim*/ **17**:512f–513c/**18**:277f–278a
x. The healing of mind or body		**4**:516d–517h/ **15**:998h–999a	**4**:562d–564b *passim*/ **8**:685e–687c *passim*/ **13**:15d–f
xi. The unification of society, the conservation of tradition and culture, or social reformation		**1**:837c–g/ **3**:392h–393c/ **4**:508f–514a/ **6**:151b–g/ **6**:503g–504b/ **8**:407g–408f/ **8**:903e–904c/ **8**:918a–920a/ **10**:114e–115a/ **11**:1021a–1022a/ **12**:289c–f/ **12**:916b–917e/ **12**:942b–d/ **13**:847d–851e/ **15**:116g–117f/ **15**:1000e–1001e	**2**:589a–c/**4**:1093f–g/ **9**:914f–915a/**11**:721h–722a/ **12**:880b–d/**12**:936h–937c/ **13**:1044g–1052a *passim*/ **15**:104d–e/**15**:641h–642c/ **15**:1060c–1065h *passim*/ **16**:118e–122e *passim*/ **17**:1041a–b
c. Affirmations or rejections of the religious value of formal observances and institutions or prescribed dispositions		**2**:589c–g/ **3**:391c–395b/ **3**:773c–e/ **4**:483c–485a/ **7**:710h–711c/ **9**:260c–261g/ **9**:938b–e/ **10**:294b–298e/ **11**:199d–h/ **13**:552e–g	**1**:886h–887c/**3**:985a–d/ **6**:162f–g/**8**:218a–c/ **8**:890g–891a/**9**:920a–c/ **10**:287a–c/**15**:104f–105e/ **17**:1046h–1047e
d. Affirmations or rejections of the truth or value of imaginative expressions of religious beliefs and doctrines		**3**:418h–419c/ **4**:410f–g/ **5**:239b–f/ **8**:927a–928g/ **9**:924b–c/ **9**:946b–e/ **9**:949a–c/ **10**:191b–e/ **12**:797g–798d/ **15**:641b–d/ **17**:1036e–f	**4**:551a–c/**8**:402e–406f *passim*/ **10**:298e–299e/**13**:206g–207a/ **15**:1060a–b
e. The initiating or decisive source of religious assent, volition, or action			
i. Viewed as residing primarily or solely in the divine or sacred: grace as the source		**11**:199b–c	**10**:103e–104a/**10**:112d–f/ **9**:916d–g/**15**:101c–102e/ **15**:995g–h/**15**:1013f–h
ii. Viewed as residing primarily or solely in human power, virtue, or technique: works as the source		**10**:10b–g/ **11**:298e–299d/ **12**:920b–c	
iii. Viewed as residing both in the divine or sacred and in human action: grace and works as cooperative sources		**12**:919f–h	**2**:969d–e/**9**:915e–f/ **15**:1060c–1065h *passim*/**19**:1172h–1175h *passim*
f. Diverse criteria of true belief and right action: the canons of orthodoxy and heterodoxy			
i. Conformity with the teachings handed down from the original age of faith		**4**:491a–d/ **4**:537e–538a/ **5**:836c–e/ **10**:284g–285c/ **11**:905b–e/ **15**:988c–989a	**3**:419c–e/**3**:432d–f/ **4**:422e–g/ **7**:60f–68b *passim*/ **8**:536b–538f *passim*/ **8**:932h–933d/**9**:313h–314a/ **9**:314e–g/**9**:916g–917b/ **15**:103a–f/ **15**:341h–345c *passim*

	articles	article sections	other references
ii. Conformity with the judgment of established religious authorities and institutions		**4**:497b–498d/ **6**:146b–c/ **8**:933e–934a/ **9**:920f–921d/ **9**:938b–e/ **12**:921b–f/ **15**:785f–g/ **15**:992c–d	**1**:888d–f/**9**:1016a–b/ **10**:286e–287a
iii. Confirmation by personal or group experiences of illumination or salvation		**4**:483c–484b/ **7**:743a–c/ **14**:202f–g/ **15**:786a–b	**3**:428b–g/**4**:548d–550b/ **9**:1018h–1019a/**10**:287a–c/ **12**:778f–783a *passim*/ **14**:34g–h/ **18**:276a–278c *passim*
iv. Approximation to eschatological ideas or models		**1**:101d–102d/ **4**:506g–507b/ **9**:871f–872a/ **10**:293a–294a/ **15**:63a–68a/ **19**:1174b–f	**2**:929c–d/**10**:288d–289a/ **10**:321g–322c/ **12**:200d–203e *passim*/ **15**:116e–g/**17**:1037h–1038c
v. Confirmation by historical events or miracles		**5**:916g–918c/ **7**:64h–65c/ **10**:284d–f/ **10**:307g–309b/ **12**:271g–273e	**9**:914a–c/**9**:1017h–1018c/ **11**:1021c–e/**12**:488f–489e/ **15**:596c/**17**:512g–513c
vi. Conformity with accepted current secular knowledge and standards of conduct			**7**:64f–h/**18**:861f–h
vii. Confirmation by human reason: religious rationalism and religious agnosticism		**4**:1095c–e/ **9**:1021h–1022d/ **10**:322f–323e/ **15**:113d–h/ **15**:992g–993b	**4**:1101b–c/**9**:1014c–d/ **10**:208b–216h *passim*/ **15**:528f–g/**16**:353d–h/ **16**:354e–355a
4. Diverse positions taken by particular religions with regard to the truth or worth of other religions			
a. The position that other religions are false or idolatrous		**15**:988c–989a/ **19**:1015c–g	**4**:491h–492b/**10**:287d–288a
b. The position that some other religions are based on authentic revelations or intuitions of the divine or sacred		**4**:424c–d/ **6**:293d–h/ **10**:109d–h/ **14**:258d–260d/ **16**:672c–e	**9**:914a–c/**9**:1023b–d/ **10**:299h–300d/ **11**:444h–445b
c. The position that all forms of religion result from and manifest an authentic relation to the divine or sacred		**15**:623f–h	**18**:861f–h
d. The position that every religion or every major religion is the proper spiritual expression of a particular people or culture			**2**:588h–589a/**8**:888h–889a
e. Types of actions or attitudes taken by religions toward one another		**3**:397h–399g/ **4**:423a–g/ **4**:491h–492e/ **4**:526d–528h/ **4**:538g–539e/ **6**:1015g–1016c/ **8**:751c–e/ **8**:906f–907f/ **9**:925g–926d/ **10**:13h–14c/ **10**:109d–h/ **10**:299f–300e/ **12**:784h–785g/ **12**:917f–918a/ **15**:107b–h/ **15**:607g–608e/ **15**:993b–d/ **15**:1061e–1063a/ **16**:672c–673b/ **17**:1034f–1035a/ **17**:1043b–g/ **17**:1047f–1048a/ **19**:1015h–1016b	**4**:1099b–c/**10**:288b–d

	articles	article sections	other references
5. Criticisms of religion from within the particular religions: complaints based on alleged narrowness, sectarianism, traditionalism, conventionalism, materialism, and immorality of believers		**15**:595a–d/ **15**:624d–g	**15**:613h–614a
C. Views and attitudes concerning religion or religious beliefs and claims, from positions outside the particular religions	RELIGION, PHILOSOPHY OF **15**:595–598		
1. The view that no divine or sacred being or power exists	ATHEISM **2**:258–262	**1**:985b–e	**6**:889h–890c/**8**:735b–d
2. The view that man does not or cannot know anything about an ultimate being or power	AGNOSTICISM **1**:311–314		**16**:830b–834b *passim*
3. Philosophical views rejecting some or all religious beliefs and claims as false or worthless		**15**:595e–596f	
a. Criticisms based on the alleged incompatibility of religious beliefs with philosophical or scientific knowledge		**15**:595e–g/ **12**:273f–274b/ **15**:530c–531b	**4**:479a–b/**6**:890c–f/**12**:18b–e/ **14**:248g–h/**14**:877d–f/ **16**:374d–h
b. Criticisms based on moral failings of believers or on their sectarian divisions		**15**:595g–596b	
4. Naturalistic explanations of the origin and development of religious beliefs and practices		**15**:596f–597c	**14**:1041b–f
a. Psychological and psychoanalytic explanations		**12**:796f–h/ **15**:621b–622b	**1**:872h–873b/**10**:336a–b/ **14**:949b–d/**15**:300h–301c/ **15**:596f–597a/**15**:864b–e/ **18**:267h–268a
b. Historical or cultural explanations		**1**:922e–923d/ **4**:657c–658f/ **15**:604f–h/ **15**:618f–619e	**11**:301b–h/**15**:597a–c/ **15**:631d–632a/ **15**:863g–864b/**17**:13e–f
c. Social or economic explanations		**6**:223h–224f/ **15**:620b–f	**15**:619f–g
5. Views acknowledging some validity in religion in general or in particular beliefs and practices		**15**:597d–e	
a. The view that religion is directed toward an absolute reality or value		**15**:597d–e/ **4**:479b–d	**1**:984f–985b/ **5**:561h–563e *passim*/ **7**:77h–78c/**10**:28e–h/ **15**:650a–c/**17**:510a–d/ **18**:268b–e
b. The view that religious beliefs and practices have a good effect on the moral and spiritual state of believers		**15**:597e/ **15**:646c–g	**18**:705a–b
6. Modern alternatives to traditional religious beliefs, practices, and institutions *with special attention to*		**15**:597e–598d	**12**:803a–d/**16**:125f–h
a. The quest for authentic existence	EXISTENTIALISM **7**:73–78	**15**:597e–h	**8**:734h–735a
b. Secular religion		**15**:597h–598a/ **4**:507b–f/ **4**:530e–532b/ **7**:202a–b/ **10**:293h–294a/ **14**:692h–693b	**11**:1019g–1020a
c. Marxism		**15**:598a–d	**11**:553e–560e *passim*
D. The professional discipline of the philosophy of religion: its history, themes, and problems	RELIGION, PHILOSOPHY OF **15**:598–603	**15**:622b–623h	**18**:274g–h
E. Theology: its nature and relation to the history of religions and to philosophy; its religious and cultural significance; its themes and functions	THEOLOGY **18**:274–276	**15**:623h–625a	**15**:614e–g/**15**:628f–h

Section 812. Religion as an object of study; religious experience and phenomenology

[for Part Eight headnote see page 501
for Division I headnote see page 501]

Section 812 treats the results of empirical, comparative, and phenomenological studies of religions and religious movements, which are covered separately and historically in the nine sections of Division II. The articles and parts of articles referred to in Section 812 deal with four main subjects: A, basic problems and methods of the descriptive study of religion; B, the relation of religion to other spheres of human experience; C, the nature, elements, and varieties of religious experience; and D, the basic patterns of religious thought, action, and association.

The outline of subject A deals first with the problem of defining religion and discerning religious phenomena, with questions about neutrality and subjectivity in the study of religion, and with the history of the study of religion. It next treats the diverse approaches to the understanding of religion in general and of the particular religions. It then treats the uses and principles of various classifications of religions; the distinction between the religions of primitive and civilized cultures; and the classification of secular movements and ideologies among the religions of the modern world.

The outline of subject B deals with the role and position of religion in relation to such other spheres of human experience as magic, art, morality, philosophy, science, and society.

The outline of subject C first deals with the significance of the elucidation of religious experience for the study of religion. After treating the nature, marks, and structure of religious experience, it deals with questions about the cognitive import or objective validity of religious experience. It goes on to the distinction between immediate and mediated religious experience and to the means of preparation for religious experience. Finally, it treats the situational contexts and forms of expression of religious experience and the types of religious experience and religious personality.

The outline of subject D begins with the concept of the sacred, or holy, and with issues about viewing finite things and beings as sacred. Dealing with natural objects or forces viewed as manifestations or bearers of the sacred, the outline covers the worship and veneration of cosmic powers or forces; the worship or veneration of celestial and terrestrial objects, forces, and dimensions; the role of natural substances or objects in religious beliefs and practices; the role of animals and plants in religious beliefs and practices; and modern philosophical and scientific versions of the sacredness of nature or of natural things. Dealing with human conditions, qualities, activities, or institutions viewed as sacred, the outline covers beliefs and practices regarding the dead; the veneration of kings and heroes; passage rites; religious dietary laws and customs; the holding sacred of social institutions or groups of people; and the sacredness of the soul or mind. Next dealt with are the several kinds of religious communities and the several kinds of religious personages, such as the priest, the prophet, the saint, the monk, the diviner, the shaman, and the mystic. The articles referred to that deal with the intellectual expression of religious thought treat creeds and confessions, doctrines and dogma, theology, sacred scriptures, and myth. Those dealing with precepts and codes of action treat asceticism, celibacy, nonviolence, and birth control. Those dealing with religious worship treat purification rites, sacraments, sacrifice, prayer, ceremonial and ritualistic objects, and religious dress and vestments. The last matters that are dealt with are religious symbolism, art, and iconography; religious education; religious celebrations and commemorations; and witchcraft.

articles	article sections	other references
A. The basic problems and methods of the descriptive study of religion		
RELIGION, STUDY OF 15:613–627		15:634b–d
1. The problem of defining the essence of religion and discerning religious phenomena [see also 811]	15:613d–g/ 8:1158b–e/ 15:605f–606a/ 15:628b–f/ 16:125f–126a/ 17:900d–f	
2. The question whether religion can be adequately understood from an external viewpoint: neutrality and subjectivity in the study of religion	15:613h–614g/ 15:594b–d/ 15:628f–629a	
3. The history of the study of religion from the Greco-Roman period to the present day	15:614g–617b/ 1:922c–923d/ 12:795g–796b/ 14:1040g–1041f/ 15:631d–632h/ 16:122h–123c/ 16:129a–130c/ 18:697g–698b	6:792f–g/18:267h–268a
4. Diverse approaches to the understanding of religion in general or of the particular religions	15:617b–627a/ 12:796b–e/ 15:592d–593b/ 15:604b–605e/ 15:647d–h/ 16:118f–h/ 19:897d–g	4:550f–551a/15:863g–864e
a. Historical, archaeological, and literary studies	15:617d–618f/ 2:664b–f/ 6:915h–916a/ 8:822g–823a/ 14:984d–985c/ 15:629b–h	10:146c–f/11:1001h–1002g/ 17:1051c–e

	articles	article sections	other references
b. Anthropological studies		**15**:618f–620a/ **1**:916f–918f/ **1**:922d–923d/ **11**:301b–h/ **19**:899e–900b	**1**:837c–f/**15**:631d–632a/ **18**:531d–533f
c. Sociological studies		**15**:620b–621a	**19**:715h–716e
d. Psychological studies		**15**:621b–622b/ **11**:301h–302b/ **12**:796f–h	**1**:872h–873b/**10**:336a–b/ **14**:949b–d/**15**:300h–301c
e. Philosophical studies		**15**:622b–623h/ **15**:629h–631d/ **15**:786c–e/ **1**:984c–985b	**1**:312h–313d/ **15**:598d–601b *passim*/ **15**:647d–648g *passim*/ **18**:267d–f
f. Theological studies		**15**:623h–625b/ **1**:313d–314a/ **16**:166d–g/ **18**:274a–h	**7**:77h–78c/**15**:628f–h
g. The history and phenomenology of religion: particular, comparative, and structural studies		**15**:625b–627a/ **3**:403c–h/ **4**:528h–529c/ **15**:632a–633e	**7**:62g–63a/**13**:769h–770e
5. The use of classifications of religious communities or of religious phenomena	RELIGIONS, CLASSIFICATION OF **15**:628–634		
a. The function and significance of classifications: the provision of a systematic and coherent account of man's religious experience		**15**:628b–f	
b. Principles of classification: normative, geographical, ethnographic, linguistic, philosophical, morphological, and phenomenological approaches to the classification of religions		**15**:628f–634a	
c. The distinction between the religions of primitive and civilized cultures [see also 821.B.]		**1**:922b–d/ **4**:657c–658d/ **11**:298a–c/ **11**:301b–e/ **14**:988a–h/ **14**:1043b–d/ **15**:604f–h/ **18**:700f–701b	
d. The classification of secular movements and ideologies among the religions of the modern world [see also 524.D., 541.E.3.]		**9**:194d–195a/ **11**:1019g–1020a/ **12**:802f–803d	**8**:824c/**9**:198b–c
B. The relation of religion to other spheres of human experience			
1. Religion and magic	MAGIC **11**:298–302	**14**:1046h–1047b/ **16**:270a–d/ **19**:895c–897g	**1**:923a–d
2. Religion and art [see also D.4.f., below; 611.B.5.c.vii.]		**1**:1090d–1091g/ **2**:115g–117c/ **2**:130g–131a/ **12**:798d–799c/ **13**:883b–d/ **17**:904f–g/ **17**:905e–f	**1**:157d–h/**1**:159f–160a/ **7**:474e–475g/**16**:435d–e/ **17**:906c–d
3. Religion and morality [see also 10/51.B.6.]		**5**:729c–730e/ **14**:949h–950a/ **16**:202d–f	**6**:979f–g/ **13**:1049d–f/ **15**:593g–594a/ **15**:595g–596a
4. Religion and philosophy [see also 10/51]		**1**:985e–f/ **4**:555a–f/ **12**:32h–33b/ **14**:256h–257a/ **15**:622b–623h/ **15**:786c–e	**14**:248g–h/ **15**:592b–603e *passim*/ **18**:274g–h
5. Religion and science		**12**:797c–797g/ **17**:1043h–1044a	**11**:823d–e/**16**:392f–393a

	articles	article sections	other references
6. Religion and society [see also 521, 524, 541]	RELIGION, SOCIAL ASPECTS OF **15**:608–611	**1**:620h–621b/ **1**:923d–924c/ **4**:590a–b/ **5**:730f–732a/ **7**:202d–e/ **12**:792h–793c/ **12**:796h–797c/ **13**:846a–847d/ **13**:1044h–1045g/ **13**:1047f–1049a/ **14**:818e–f/ **14**:988a–h/ **15**:593a–b/ **15**:593h–594a/ **15**:649c–e/ **17**:908c–d/ **18**:698b–699c/ **19**:1014g–1015c/ **19**:1042h–1043b	**4**:594e–595a/**4**:850a–d/ **15**:300e–f/**18**:275c–e
C. Religious experience: its nature, elements, and varieties	RELIGIOUS EXPERIENCE **15**:647–651		
1. The significance of the elucidation of religious experience for the study of religion		**15**:647d–h/ **14**:1040d–g/ **15**:611g–612f	
2. The nature and marks of religious experience: the question of whether religious experience is a special kind of experience or an aspect or dimension of all experience; religious experience and moral, aesthetic, and other kinds of experience		**15**:648a–g	
3. The structure of religious experience [see also 811.A]		**15**:648g–649e	
a. Personal concerns, attitudes, feelings, and states: the subject of religious experience—the religious self		**15**:648g–649a/ **12**:791e–792c/ **14**:949f–951a/ **14**:1045g–h	
b. Reference to an ultimate ground or power of reality: the object of religious experience—the sacred "other"		**15**:649a–c/ **12**:788c–789g/ **14**:1043d–1044a/ **16**:125b–f/ **16**:638h–639b	**15**:865a–b/**18**:267b–d
c. Social forms or expressions: the social context, the shaping or having of religious experience; tension between the individual and social factors		**15**:649c–e/ **15**:593g–594a	**15**:608e–612f *passim*
4. The question of the cognitive import or objective validity of religious experience		**15**:649e–h	**15**:595e–g/ **15**:613b–627g *passim*
5. Immediacy and mediation of religious experience		**15**:649h–650e/ **15**:593f–g/ **15**:594b–h	
a. Revelation and mystical immediacy: direct relation with the "other"	MYSTICISM **12**:786–793	**15**:649h–650a/ **3**:417g–418g/ **4**:548g–550b/ **8**:923d–h/ **10**:183f–184a/ **12**:270c–e/ **14**:950g–951a/ **15**:785g–786b/ **17**:1043f–g	**1**:157d–h/**9**:191a–c/ **15**:601h–602b
b. Mediation through critical analysis and interpretation of religious experience		**15**:650a–c/ **14**:949b–f/ **17**:903d–e	**14**:114h–115b/**16**:640c–d
c. Means of preparation for religious experience: rational dialectic, moral purification, bodily discipline, drugs, and uncalculated openness		**15**:650c–e/ **12**:789g–790c/ **14**:200h–201b/ **14**:1046f–h/ **19**:1016b–d	**5**:1048h–1049c
6. Situational contexts and forms of expression regarding religious experience		**15**:650e–651f	
a. Worship and devotion		**15**:650e–f/ **19**:1014a–1016g	**15**:864f–865a/ **16**:115a–118c *passim*

	articles	article sections	other references
b. Life crises and rites of passage		**15**:650f–g/ **13**:1049c–f/ **14**:1046b	**15**:641d–g/**15**:865h–866c
c. Secular situations and forms		**15**:650g–h	**15**:597h–598a
d. Verbal, conceptual, and symbolical modes; *e.g.*, myth, literature, philosophy, theology		**15**:650h–651b/ **5**:534c–535a/ **5**:928e–h/ **6**:960a–c/ **12**:790c–791d/ **16**:126d–g/ **17**:900f–902b	**1**:160c–g/**14**:1045a–f/ **15**:866d–e/**18**:267f–h
7. Types of religious experience and personality; *e.g.*, the mystic, the monk, the priest, the prophet [see also D.4.b., below]		**15**:651b–f/ **2**:135g–136c/ **5**:918c–920a/ **12**:336d–337b/ **12**:787g–788c/ **14**:1008a–d/ **14**:1047c–d/ **15**:62b–63a/ **15**:640h–641b/ **16**:166a–167h/ **16**:639e–640a	**2**:107a–c/**12**:271a–d/ **18**:274h–275b
D. Religious phenomenology: the basic patterns of religious thought, action, and association			
1. The sacred or holy	SACRED OR HOLY **16**:122–126	**17**:902b–903c	**14**:948h–949a
a. Separation of the sacred from the profane: related dichotomies; *e.g.*, pure–impure, clean–unclean		**16**:123c–e/ **12**:788c–e/ **14**:1043d–e/ **19**:1014d–f	**15**:650g–h/**15**:864f–865a
b. The ambivalence in man's response to the sacred		**16**:123f–h/ **1**:914c–f/ **12**:789d–790c	**15**:865d–f
c. Problems involved in viewing finite things and beings as sacred		**16**:166d–g	**15**:594f–h
2. Natural objects or forces viewed as manifestations or bearers of the sacred	NATURE WORSHIP **12**:877–884		
a. Nature as a sacred totality: the worship and veneration of cosmic powers or forces; *e.g.*, mana		**12**:877g–878b/ **1**:924c–g	**1**:923f–g
b. The worship or veneration of celestial and terrestrial objects, forces, and dimensions: personified or divinized forms of sacred natural things		**12**:878c–882a/ **5**:239h–241e/ **5**:534c–e/ **5**:1069f–1070d/ **17**:907f–908c	**14**:785d–h
i. The sky and sky gods: the high and sovereign god of heaven		**12**:878d–879b/ **5**:239h–240d	
ii. The earth and earth deities: "mother earth"; the special sacrality of mountains as the abode of the gods; mythical views of earthquakes and tides		**12**:879c–880a/ **3**:1175f–1176b/ **5**:240c–f/ **6**:74c–75b/ **12**:270f–h	
iii. The sun and the moon: sun worship and sun gods; moon worship and beliefs; the sun and moon as world parents; beliefs about eclipses of the sun and moon		**12**:880a–881b	**16**:119c–d
iv. The stars and constellations: astral beliefs and worship		**12**:881c–882a	
v. The use of celestial bodies in predicting future events	ASTROLOGY **2**:219–223		**5**:918d–f
vi. Sacred space and time: the religious significance of seasonal changes; the role of fertility in myth and ritual		**4**:959f–h/ **7**:198d–200e/ **12**:800c–h/ **14**:987c–f/ **14**:1044a–g/ **16**:131h–132b/ **18**:411a–412e/ **19**:1016h–1017e	

	articles	article sections	other references
c. The role of natural substances or objects in religious beliefs and practices			
i. The veneration of water, fire, and other substances		**12**:882a–883h	**8**:685h–686c
ii. The use of natural things in religious rites and sacraments		**5**:918f–919f/ **12**:788a–c/ **14**:200a–g/ **19**:1017f–h	**3**:1174f–1182c *passim*/ **7**:414a–f/**11**:299h–300a/ **12**:271d–f/**15**:302c–f/ **16**:115a–118c *passim*
iii. The transmutation of natural substances or elements	ALCHEMY **1**:431–436		
d. The role of animals and plants in religious beliefs and practices			
i. Views and actions centred on the special relationships believed to exist between mankind and animals or plants; *e.g.*, animalism, totemism		**12**:883h–884d/ **14**:986e–987b/ **14**:1046c–d/ **16**:131a–c/ **18**:529e–530c	
ii. The depiction of animals and plants in myth and legend	ANIMALS AND PLANTS IN MYTH AND LEGEND **1**:911–918		**3**:1178c–e/**7**:135e–f/ **14**:785h–786c/**16**:560c–d/ **17**:906h–907d
e. Modern philosophical and scientific versions of the sacredness of nature or natural things		**12**:787e–g/ **13**:954a–e	
3. Human persons, conditions, qualities, activities, or institutions viewed as sacred			
a. Beliefs and practices regarding the dead	DEATH RITES AND CUSTOMS **5**:533–538	**5**:527a–c/ **14**:985c–g/ **17**:778a–e	
i. Immortality and transmigration		**5**:533c–535a/ **6**:735h–736b/ **18**:411a–412e	**15**:602c–d
ii. Funerary rites and customs		**5**:535b–537c/ **11**:581h–583b/ **13**:1051g–1052a	**1**:1091d–g/**3**:1180b–1181a/ **6**:736c–741f *passim*/ **7**:201d–e
iii. Veneration of the dead	ANCESTOR WORSHIP **1**:835–837	**5**:537d–538b/ **1**:913g–h/ **14**:1046d–f	**3**:393g–h/**3**:1178g–h/ **11**:580h–581c/**12**:271d–e
b. The veneration of kings and chieftains	SACRED KINGSHIP **16**:118–122	**11**:1021a–1022c/ **12**:801f–h	
c. The veneration of heroes	HERO WORSHIP **8**:822–824	**1**:913b/ **6**:907g–908c/ **12**:800b–c	
d. Life crises and basic biological and human activities viewed as possessing a sacral dimension *with special attention to*			
i. Passage rites	PASSAGE RITES **13**:1044–1052	**10**:479c–e/ **14**:1046b	**3**:1179f–1181a/**7**:170c–d/ **7**:200e–201e/**12**:802b–d/ **15**:641e–g/**15**:650f–g/ **15**:865h–866c
ii. Dietary regulations	DIETARY LAWS AND FOOD CUSTOMS **5**:728–736		**1**:441d–442b/**1**:449g–450a/ **2**:136d–f
e. Social institutions and groups viewed as sacred; *e.g.*, sacred peoples, castes, group totems		**3**:982e–h/ **18**:529f–530c	**5**:226d–230e *passim*
f. The soul or mind viewed as sacred		**1**:915g–916b/ **12**:18f–h/ **16**:201f–202c	
4. The forms of specifically religious or cultic associations, thought, and action			
a. Types of religious organization; *e.g.*, the church, sects, orders	RELIGION, SOCIAL ASPECTS OF **15**:606–608	**3**:982e–h/ **12**:337g–340d	

	articles	article sections	other references
b. Religious personages *with special attention to*		**14**:1047c-d/ **15**:608e-h/ **15**:651b-f/ **19**:1018b-c	**16**:124h-125b/**17**:908f-g
i. The priest	PRIESTHOOD **14**:1007-1012		**12**:339f-h/**16**:120d-f
ii. The prophet	PROPHECY **15**:62-68		**4**:850a-c
iii. The saint	SAINT **16**:163-167		**12**:271b-d
iv. The monk	MONASTICISM **12**:335-343		
v. The diviner	DIVINATION **5**:916-920	**3**:901e-902a/ **5**:1011c-e	**7**:866h-867b
vi. The shaman	SHAMANISM **16**:638-641	**3**:1127g-1128g/ **16**:725h-726b	**3**:1125f-g
vii. The magician		**11**:299d-300d/ **14**:987g-988a	**16**:119h-120b/**19**:896f-h
viii. The mystic		**12**:792c-793c/ **14**:950g-951a	
c. Religious thought and its intellectual expressions *with special attention to*			**15**:650h-651b
i. Creed and confession	CREED AND CONFESSION **5**:243-246		
ii. Doctrine and dogma	DOCTRINE AND DOGMA **5**:927-929		**4**:551a-c
iii. Theology	THEOLOGY **18**:274-276	**16**:167d-e	**1**:984c-985b/**15**:614e-g/ **15**:628f-h
iv. Sacred scriptures	SACRED SCRIPTURES **16**:126-128	**15**:640d-f/ **15**:785d-e	**3**:1084h-1085b
v. Myth	MYTH AND MYTHOLOGY **12**:793-803	**5**:239b-f/ **7**:132g-135c/ **14**:1045a-b/ **16**:167g-h	**1**:911h-918f *passim*/ **7**:462e-463b/**7**:464a-d/ **15**:865c-d/**16**:127g-128a
d. Standards of cultic, ethical, or spiritual purity: precepts and codes *with special attention to*		**5**:730b-e/ **15**:298h-301c	
i. Asceticism	ASCETICISM **2**:135-137	**5**:729g-730b/ **12**:336d-337a/ **14**:1046f-h	**12**:789g-790b
ii. Celibacy	CELIBACY **3**:1040-1043		**2**:136c-d/ **12**:335h-343d *passim*
iii. Nonviolence	PACIFISM AND NONVIOLENT MOVEMENTS **13**:845-853		
iv. Birth control	BIRTH CONTROL **2**:1070-1072		
e. Religious worship *with special attention to*	WORSHIP **19**:1014-1018		**16**:124a-e
i. Purification rites	PURIFICATION RITES AND CUSTOMS **15**:301-304		**3**:1179d-f/**16**:123d-e
ii. Sacrament	SACRAMENT **16**:115-118		
iii. Sacrifice	SACRIFICE **16**:128-135	**14**:986a-e/ **14**:1045h-1046a	**3**:1181a-1182a/**5**:241h-242b/ **15**:865f-g
iv. Prayer	PRAYER **14**:948-953	**17**:903d-e	**3**:1178h-1179d

	articles	article sections	other references
v. Ritual	RITUAL **15**:863–866	**1**:915c–f/ **5**:535b–537c/ **11**:300e–h/ **13**:1045g–1047f/ **15**:641b–d/ **16**:120g–122e/ **17**:904h–905g/ **18**:236d–e	**3**:1182a–b/**8**:1160c–d/ **12**:797g–798b/**16**:126d–e
vi. Ceremonial and ritualistic objects	CEREMONIAL AND RITUALISTIC OBJECTS **3**:1174–1182	**2**:760d–g/ **16**:166g–167a/ **17**:902h–903b	**7**:474e–475g/ **11**:580d–585c *passim*/ **12**:729e–g/**14**:65a–d/ **15**:302d–f/**16**:640e–h
vii. Religious dress and vestments	RELIGIOUS DRESS AND VESTMENTS **15**:634–639	**3**:1175b–d/ **11**:578h–579g	
f. Religious symbols and their interpretation: their mental, material, and behavioral forms; religious art and iconography	SYMBOLISM AND ICONOGRAPHY, RELIGIOUS **17**:900–909	**3**:1178a–h/ **12**:790c–791d/ **13**:883b–d/ **13**:885b–g/ **14**:1045b–f/ **19**:1042h–1043b	**3**:1174h–1175b/**12**:798b–c/ **13**:1047a–c/**16**:436h–437a
g. Religious education	RELIGIOUS EDUCATION **15**:640–646	**6**:427h–429g	
5. Religious, social, or cultural celebrations and commemorations; *e.g.*, periodic or occasional feasts, festivities, events	FEAST AND FESTIVAL **7**:197–202	**13**:861d–e	**1**:924a–b/**5**:537a–b/**7**:475e–g/ **16**:121h–122b/**16**:124f–h/ **16**:271d–e/**18**:257g–h
6. Witchcraft	WITCHCRAFT **19**:895–900		

Division II. The particular religions

[for Part Eight headnote see page 501]

Division I dealt with diverse views concerning the nature, purpose, validity, and value of religion, with the methods and results of the empirical and comparative study of religions, and with the distinctions and criteria used to classify the particular historical religions. The outlines, and the articles and parts of articles referred to, in the nine sections of Division II treat the particular religions of mankind, in different historical eras and world areas.

The articles referred to in Section 821 deal first with studies reconstructing the beliefs and practices of prehistoric religion and then with studies of the historical primitive religions in major world areas.

The articles referred to in Section 822 treat the religions of ancient peoples and civilizations: Near Eastern religions; Iranian religions; Greek, Roman, and Hellenistic religions; Slavic, Celtic, Germanic, Baltic, and Finno-Ugric religions; and the religions of pre-Columbian American civilizations.

The articles referred to in Section 823 deal primarily with the history; with the intellectual, spiritual, and imaginative expressions; and with the beliefs, practices, and institutions of Hinduism but also with Jainism, Sikhism, and Parsiism.

The articles referred to in Section 824 deal with the history; with the intellectual, spiritual, and imaginative expressions; and with the beliefs, practices, and institutions of Buddhism.

The articles referred to in Section 825 treat the indigenous religions of East Asia and deal with the characteristics and development ot Chinese religion, with Confucianism, with Taoism, and with the religions of Korea and Japan.

The articles referred to in Sections 826, 827, and 828 deal,

Section 821. Prehistoric religion and primitive religion 518
822. Religions of ancient peoples 520
823. Hinduism and other religions of India 525
824. Buddhism 529
825. Indigenous religions of East Asia: religions of China, Korea, and Japan 532
826. Judaism 536
827. Christianity 539
828. Islām 555
829. Other religions and religious movements in the modern world 558

respectively, with the three major monotheistic religions: Judaism, Christianity, and Islām.

The articles referred to in Section 829 present studies of new religious movements among tribal peoples and deal also with Negro cults in Western cultures, with theosophical and Spiritualist groups, and with modern offshoots of Islām.

Section 821. Prehistoric religion and primitive religion

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 821 deal with two main subjects: A, prehistoric religion; and B, primitive religion.

The outline of subject A first deals with the materials from which inferences are drawn about prehistoric religion and with the methods for their interpretation by analogy with modern primitive religions. Dealing with the major inferred beliefs and practices, the outline covers burial customs and cults of the dead; cannibalism; sacrifices; hunting rites and animal cults; female fertility deities; and shamanism, sorcery, and magic. Finally, it treats inferences about the religions of various prehistoric cultural stages: food-gathering, hunting, and pastoral-agricultural.

The outline of subject B first deals with the nature, significance, and general characteristics of religion in primitive cultures and with the importance of primitive religion in modern views of man's nature and of religion. Treating primitive world views, the outline covers distinctions between the sacred and profane; dynamistic, demonistic, and theistic views of the sacred; animism; primitive cosmogonies and cosmologies; and primitive views of man's nature, origin, vocation, and destiny. It goes on to myth, symbolism, and art and iconography in primitive religion. Dealing with primitive practices and institutions, it covers various kinds of sacrifice and kinds of purification and passage rites; worship centred on natural objects or forces; totemism; ancestor and hero worship; and the roles of asceticism, shamanism, divination, and spiritualistic practices. Finally, the outline treats the primitive religions of the major world areas.

	articles	article sections	other references
A. Prehistoric religion	PREHISTORIC RELIGION 14:984–989		
1. The study of prehistoric religion: nature, scope, methods of interpretation, and problems special to the subject [see also 10/41.B.]		14:984b–985c	
a. The conjectural or constructed nature of descriptions of prehistoric cultural and religious phenomena		14:984b–e	
b. The scholarly use of prehistoric art, artifacts, burial sites, and other material remains		14:984e–f/ 18:218f–219b	17:705c–d
c. Methods of interpreting archaeological materials by analogy with modern primitive religions		14:984f–985c	
2. Inferred prehistoric religious beliefs and practices		14:985c–988a	5:291a–c/7:198h–199b
a. Burial customs and cults of the dead		14:985c–g/ 17:707c–d	
b. Cannibalism		14:985g–986a	8:1034c–e
c. Sacrifices: human, animal, and other offerings		14:986a–e	
d. Hunting rites and animal cults		14:986e–987b	
e. Female fertility deities		14:987c–f	
f. Shamanism, sorcery, and magic		14:987g–988a	
3. Religions attributed to various prehistoric cultural stages and regions [see also 511]		14:988a–h/ 1:912h–913a	16:638c–d
a. Religion of the hunters and gatherers		14:988b–e/ 5:730f–731b	
b. Religion of the herdsmen and farmers		14:988e–g	
B. Primitive religion [see also 812.A.]	PRIMITIVE RELIGION 14:1040–1047		
1. The nature and significance of primitive religion		14:1040d–1043d	
a. Primitive religion as the religion of peoples living in small-scale, economically simple, nonliterate societies, or as man's basic religious constitution; the problematic meanings of the term "primitive"		14:1040d–1041a	
b. The importance of primitive religion in modern views of man's nature and religion: the major interpretations; *e.g.*, those of Frazer, Tylor, Durkheim, Lévi-Strauss		14:1041a–1043d/ 4:657c–658d	11:298a–c/11:301b–e/ 15:604f–g

	articles	article sections	other references
2. Primitive views of reality		**14**:1043d–1045a/ **1**:915f–916d/ **13**:846a–f	**5**:1011a–b
a. The distinction between the sacred and the profane		**14**:1043d–e/ **16**:123c–h	
b. Dynamistic, daemonistic, and theistic views of the sacred: the concept of mana; diverse emphases on divine unity and divine multiplicity		**14**:1041h–1042b/ **14**:1043e–1044a/ **1**:912d–f/ **5**:1069a–c/ **12**:877g–882a	**12**:382d–g/**12**:383b–c/ **14**:785a–c/**15**:593b–d
c. Animism: external reality viewed as living presence	ANIMISM **1**:922–924	**1**:835d–f	
d. Diverse views concerning sacred time and times, sacred space and places, and man's nature, origin, and destiny: primitive cosmogonies, cosmologies, and eschatologies		**14**:1044a–1045a	**5**:239b–242b *passim*/ **6**:960c–e
3. The nature and function of myth and symbol in primitive religion: their role in ritual; the iconographic character of primitive art		**14**:1045a–f/ **14**:1032e–g	
4. Primitive religious practices and institutions		**14**:1042c–1043a/ **14**:1045g–1047d	
a. Rites expressing man's experience of the sacred and its relation to critical events in life: sacrifice and purification and passage rites		**14**:1045g–1046b/ **15**:641d–g	**8**:1160c–d/**11**:584f–585b/ **16**:115f–g
b. Worship or veneration centred on natural objects or forces; *e.g.*, animal cults, tree cults		**14**:1046c–d/ **1**:912f–915f/ **12**:882a–884a	**14**:201f–g
c. Totemism: a socio-religious system in which men are intimately related to plants, animals, or other natural phenomena, possessed of transcendent status and power, and emblematic of social groups; *e.g.*, the family or clan	TOTEMISM **18**:529–533	**12**:884a–d	**11**:581c–g
d. Human centres of cult and devotion: ancestors, kings, heroes		**14**:1042c–f/ **14**:1046d–f	**1**:836c–f/ **11**:580h–581c/ **16**:119a–c
e. Special disciplines and practices employed to attain religious states: the roles of asceticism, shamanism, divination, and spiritualistic practices		**14**:1046f–1047b/ **5**:916g–918c/ **14**:951b–c/ **14**:1008d–f/ **16**:640a–d/ **19**:895c–897g	**2**:137a–b/**11**:299c–300d/ **11**:583b–584b
5. The primitive religions of the major world areas			
a. Africa: traditional religions of the indigenous African peoples		**1**:237f–238a/ **1**:285b–e/ **6**:113h–114c/ **6**:168c–d/ **8**:476b–c/ **10**:449e–f/ **18**:531c–d	**1**:234e–f/**1**:251f–252f *passim*/ **6**:1015f/**10**:451b–c/ **19**:799c–e
b. Australia and Oceania: religions of the Pacific Island peoples		**2**:427h–428b/ **11**:869c–d/ **13**:455d–e/ **13**:456c–g/ **18**:530c–g	**2**:424e/**6**:75a–b/**12**:125f–h/ **14**:782d–783c
c. The Americas: religions of Indians of North, Central, and South America		**1**:697a–c/ **3**:622c–e/ **6**:172b–e/ **13**:226d–227a/ **13**:248b–d/ **17**:115d–116a/ **17**:221e–222b/ **17**:308e–g	**1**:660d–663c *passim*/ **1**:671a–f/ **1**:672d–676d *passim*/ **1**:677d–h/**9**:259g–h/ **13**:206g–207b/ **13**:229g–230a/**13**:254b–e/ **15**:303d–e/**17**:122e–g/ **17**:123h–124f
d. Asia: aboriginal religions of Asian peoples		**3**:1127g–1128g/ **16**:725h–726b/ **17**:264f–265c/ **18**:530g–531b	**3**:1125f–g/**8**:823h–824a/ **8**:909d–f/**10**:533f–g/ **16**:638c–640h *passim*/ **17**:129f–130e *passim*/ **17**:225a–e/**17**:227a–c/ **17**:233b–e/**17**:256f–h
e. The Arctic: religions of the Eskimo, Aleuts, Lapps, Chukchi, Samoyeds, and other Arctic peoples		**6**:134f–g	**5**:730g–731b/ **7**:310b–313h *passim*/ **19**:791b–f

Section 822. Religions of ancient peoples

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 822 deal with nine main subjects: A, religions of the ancient Near Eastern peoples; B, religions of the Iranian peoples; C, Greek religion; D, Roman religion; E, religions of the Hellenistic world; F, religions of the early peoples of eastern and central Europe; G, religions of the ancient Celtic and Germanic peoples; H, religions of the early peoples of northeastern Europe; and I, the religions of pre-Columbian American civilizations.

The accounts of these particular religions cover such topics as the historical development of the religion; its literature, mythology, art, and iconography; and its beliefs, worship, practices, and institutions.

The outline of subject A first deals with characteristics of the ancient Near Eastern religions. Then the articles referred to separately treat Mesopotamian religions, those of the Sumerians and Akkadians; Egyptian religion; the religions of the ancient peoples of Asia Minor; Syrian and Palestinian religions; and religions in the Arabian Peninsula.

A. Religions of the ancient Near Eastern peoples

1. Characteristics of the ancient Near Eastern religions

   a. The creation of religious literature: myths, liturgies, wisdom literature

   b. The sacrality of natural forces: the view that the universe is divinely created and ordered; a multiplicity of gods

   c. The sacrality of society and its institutions: divine or sacred kingship: common values governing the relations between adherents of different areas and cults—"international religion"

   d. Myth as the basic mode of religious thought: the importance of etiological myths, and their relation to ritual

   e. The use of magic, witchcraft, divination, prophecy, astrology, or exorcism

   f. Seasonal patterns of rituals and festivals: vegetation and fertility rites

2. Mesopotamian religions

   a. Historical development of the religious beliefs and practices of the Sumerians and Akkadians

   b. Religious literature and mythology

   c. The Mesopotamian world view: gods and demons; beliefs about the origin of the universe and about the nature and destiny of man

   d. Practices and institutions: sacred times and places

   e. Magic, divination, astrology, and witchcraft

   f. Religious art and iconography

3. Egyptian religion

   a. Historical developments from the late Neolithic Period to the Hellenistic Age

The outline of subject B begins with general characteristics of the Iranian religions and then gives separate treatment to Zoroastrianism and to Mithraism.

Subjects C and D are ancient Greek religion and ancient Roman religion, including their historical development, their mythology, and their practices and institutions.

The outline of subject E begins with the general characteristics of Hellenistic religions. It then covers mystery religions, Gnosticism, Manichaeism, Hellenistic religious philosophies, and quasi-scientific and magical cults.

The outline of subject F covers the Scythian religion, the religions of the Sarmatians and associated peoples, and the religion of the pre-Christian Slavic peoples.

Subject G is the religion of the Celts and the religion of the Germanic peoples.

Subject H is the religion of the Baltic peoples and the religion of the Finno-Ugric peoples.

Subject I encompasses the Inca, Mayan, and Aztec religions.

articles	article sections	other references
NEAR EASTERN RELIGIONS, ANCIENT **12**:916–921	**10**:303a–d	**12**:914h–915c
	12:918b–f	
	12:918f–919a/ **13**:951c–e	**5**:1066e–g/**14**:787b–c
	12:919a–h/ **12**:921b–f/ **5**:226g–227a	**15**:641h–642b/ **16**:118e–122e *passim*/ **18**:219b–c
	12:919h–920b	**11**:1008a–c/**19**:1014c–d
	12:920b–c/ **2**:220f–221c/ **15**:63a–f	**11**:298f–g/**19**:897g–898a
	12:920c–921a	**12**:778f–783a *passim*
MESOPOTAMIAN RELIGIONS **11**:1001–1006		
	11:1002h–1003c	
MESOPOTAMIAN RELIGIOUS LITERATURE AND MYTHOLOGY **11**:1007–1012	**11**:1003d–f/ **6**:908c–f/ **10**:1088b–e	**6**:920f–921b
	11:1003g–1004g	**6**:74e–g
	11:1004g–1006b/ **18**:219d–e	**7**:199h–200b/**11**:971h–972b/ **14**:951d–e
	11:1006b–e/ **2**:220f–221a	**15**:63b–d/**17**:1009a–d
	11:1006e–f	**19**:259c–h
EGYPTIAN RELIGION **6**:503–509		**19**:249b–c
	6:508d–e	**1**:401f–403b/**6**:466h–467a/ **6**:474c–475a/**6**:476g–477c/ **6**:484g–485a/ **11**:895b–897d *passim*/ **18**:261a–264h *passim*

	articles	article sections	other references
b. Religious literature and mythology		6:504e–h/ 6:921c–f/ 10:1088e–g	6:467e–f
c. Beliefs and doctrines		6:504h–506d	
i. The Egyptian gods		6:504h–506a	12:384a–b
ii. Cosmological myths		6:506b	
iii. Views about human nature and destiny		6:506c–d	
d. Major forms of Egyptian religion *with special attention to*		6:506d–508b	
i. The funerary religion		6:506d–g/ 16:202h–203b	6:463g–464b
ii. The state religion		6:506g–h/ 18:219e–g	6:477d–f/7:199c–h/ 14:1008f–g
iii. The role of the temple cult: priesthood and festivals		6:506h–508a/ 5:457d–g	6:317h–318b/6:478b/ 14:1008g–1009a
iv. Magic, divination, and popular religion		6:508a–b	6:478g–479a/14:951e–f
e. Religious symbolism and iconography		6:508c/ 19:255e–257h	19:250d–251b
4. Religions of the ancient peoples of Asia Minor	ASIA MINOR, RELIGIONS OF 2:189–193		
a. Early religious beliefs and practices: developments from the Neolithic Period to the period of Assyrian colonization		2:190b–g	
b. Beliefs and worship of the Hittites, Hattians, and Hurrians		2:190g–192f/ 5:227a–e	6:921g–922a/17:967c–e
c. Beliefs and worship of the peoples of the successor states		2:192f–193c	
i. Urartian religion		2:192g–h	
ii. Phrygian religion		2:192f–193c	
5. Syrian and Palestinian religions	SYRIAN AND PALESTINIAN RELIGIONS 17:966–969		
a. History of indigenous religion from prehistoric times to the Hellenistic Age [for biblical, Judaic, and Christian developments, see 826, 827]		17:967a–g	13:148g–149a
b. Polytheistic myths and legends; *e.g.*, theogonies, cosmogonies		17:967g–969c/ 17:938g–939c	2:908d–g
c. Practices and institutions		17:969d–g	14:1009d–e/15:63e–f
6. Religions in the Arabian Peninsula	ARABIAN RELIGIONS 1:1057–1059		
a. Historical development from the 1st millennium BC to the origin of Islām		1:1057f–h	9:927d–f
b. Polytheistic beliefs: the deities of the pre-Islāmic Arabian kingdoms		1:1057h–1058e	1:1045c–e
c. Practices and institutions		1:1058e–1059d	
B. Religions of the Iranian peoples	IRANIAN RELIGIONS 9:867–872		
1. General characteristics of the Iranian religions		9:867f–868d	
2. Early Indo-Iranian religion: nature-polytheism [see also 823.A.1.]		9:868d–g/ 12:288h–289b/ 19:1171d–f	
3. Religion of the Scythians, Sarmatians, and Alani [see F., below]			
4. The cult of Ahura Mazdā (Ormazd): its influence on the preaching of Zoroaster and the priestly institutions of the Magi	ZOROASTRIANISM AND PARSIISM 19:1171–1176		
a. Origin and development of Zoroastrianism		19:1171d–1172g	
i. Zoroaster's reform: ethical monotheism		19:1171f–g	19:1169g–h

	articles	article sections	other references
ii. The place of Ahura Mazdā in religion under the Achaemenids: the role of the Magi and the recurrence of polytheism		**19**:1171g–1172a/ **9**:837a–f	**9**:870a–b/**19**:1057d–f
iii. The effect of Hellenism on the religion of Ahura Mazdā during the Arsacid period		**19**:1172a–b	
iv. The establishment of Zoroastrianism as the state religion during the Sāsānian period; Mazdakism and post-Islāmic Iranian Zoroastrianism		**19**:1172b–f/ **9**:848d–849b	**2**:222g–h/**6**:329g–330b/ **9**:870c–d
v. History of Parsiism in India [see 823.D.3.a.ii.]			
b. Zoroastrian religious literature: the Avesta and other writings in Pahlavi and Persian		**19**:1172h–1173c	
c. Zoroastrian belief and thought		**19**:1173b–1174f/ **16**:165c/ **16**:204b–c	**1**:874g–875a/**5**:1067f–1068a/ **19**:1170a–f
d. Zoroastrian religious practices and institutions		**19**:1174f–1175h	**14**:953a–b/**15**:303e–g/ **15**:644g–645a/**16**:116d–e
e. Relation of Zoroastrianism to other ancient religions		**19**:1176a–c	
f. The Parsi version of Zoroastrianism [see 823.D.3.]			
5. Mithraism	MITHRAISM **12**:288–290		**9**:870b–c/**9**:871h–872a
6. Zurvanism		**9**:870e–871b/ **19**:1173f–h	
7. Manichaeism [see E.4., below]			
C. Greek religion	GREEK RELIGION **8**:406–410		
1. Historical development		**8**:407b–408a	
a. Developments through the 2nd millennium BC: the effects of the interaction of Indo-European elements with Mycenaean civilization and Minoan nature religion		**8**:407b–c/ **1**:122f–h	
b. Developments during the Archaic period, to the 6th century BC: agrarian cults; the relation of religious cult and practice to diverse political situations		**8**:407e–f/ **8**:333a–e	
c. Developments during the Classical and Hellenistic periods: rationalist challenges to traditional religion; popular religion and civic cults		**8**:407g–408c/ **12**:778g–780b	
2. Greek mythology and other religious literature	GREEK MYTHOLOGY **8**:402–406	**6**:906g–907g/ **6**:908g–909f	**6**:922g–923b/**8**:822c–e/ **8**:1017g–1021d *passim*/ **8**:1170h–1171f/**17**:15a–16c
3. Religious beliefs and speculation		**8**:408c–409b	
a. Greek gods and heroes: the pantheon		**8**:408c–f	**8**:403e–f/**8**:404h–405d/ **8**:823b–f/**18**:274b–c
b. Views of man and the universe: cosmogony, anthropology, and eschatology		**8**:408f–409b	**5**:1066g–1067c/**8**:404c–h/ **8**:405d–406b/**12**:779g–780b
4. Worship, practices, and institutions		**8**:409c–410b	
a. Sacred writings: hymns, oracles, and inscriptions		**8**:409b–c	**14**:951g–h
b. Sacred places: shrines and temples		**8**:409c–e	**13**:564h–566a/**18**:236f–h
c. Sacred institutions and times: the priesthood, festivals, and rites		**8**:409e–410b/ **2**:274f–275b/ **5**:457h–458d	**14**:1009f–g/**16**:134d–f/ **18**:580f–581a
5. Religious art and iconography		**8**:410c–e	**19**:284f–297e *passim*
D. Roman religion	ROMAN RELIGION **15**:1059–1066		
1. Historical development		**15**:1060c–1063a/ **5**:458e–g	
a. Early developments: the religion of the Latin and Sabine villagers; the influence of the Etruscans		**15**:1060c–1061e	**9**:1079e–1080c
b. Religion during the period of the Republic, 5th century–1st century BC: the influence of Greek thought, ritual, and architecture; astrological practices		**15**:1061e–1062b	**15**:1099a–b

	articles	article sections	other references
c. Religion during the imperial epoch, 1st century BC to the conversion of Constantine: patriotic cults; the place of the emperor in worship; the challenge to traditional paganism from Eastern cults		**15**:1062b–h/ **12**:780g–781d/ **15**:1109d–e/ **15**:1121d–f	
2. Roman gods, goddesses, numina, and genii: their place in family and civic religion		**15**:1063a–1065a/ **6**:909f–g	
3. Worship, practices, and institutions		**15**:1065a–h	**6**:923c–d/**15**:1086g–h
a. Sacred institutions: colleges of priests and other officials		**15**:1065a–d	**14**:1009g–1010a
b. Sacred places: shrines and temples		**15**:1065d–e	**19**:302h–303f
c. Sacred events: sacrifice and burial rites		**15**:1065f–h	**14**:951h–952b
4. Religious art: sculpture, metalwork, painting, and mosaic		**15**:1065h	
E. Religions of the Hellenistic world			
1. General characteristics of Hellenistic religions	HELLENISTIC RELIGIONS **8**:749–751	**8**:408b–c	**4**:536e–f/**8**:389a–b/ **12**:781d–f/**16**:120g–121a/ **16**:501h–502a
2. Mystery religions	MYSTERY RELIGIONS **12**:778–785		
a. Historical development		**12**:778g–781d	
i. Mystery religions of Hellenic origin: the mysteries of Dionysus, Eleusis, and Orpheus; secular mystery communities; groups influenced by philosophers		**12**:778g–780b	**5**:458b–c/**16**:115h–116b
ii. Characteristics of the syncretistic mystery religions of Greek and Oriental origins during the Hellenistic period; *e.g.*, Andania, Isis, Sarapis; the growth of older mysteries		**12**:780b–g/ **16**:202h–203b	**6**:484g–485a/**6**:508h–509c/ **8**:749g–h/**15**:1061g–h
iii. Developments during Roman imperial times: the cults of Mithra, Magna Mater, Atargatis, Attis, and Sol		**12**:780g–781d/ **12**:289d–f/ **15**:1064g–1065a	**8**:749h–750d/**15**:1121d–f
b. Beliefs and practices: rites and festivals, hymns and poems, theological and philosophical writings		**12**:781d–783f	**7**:199e–h
c. Art and iconography: architecture, statuary, reliefs, and painting		**12**:783f–784g	
3. Gnosticism	GNOSTICISM **8**:214–219		
a. Historical development: origins, growth, and decline of Gnostic movements, sects, and systems		**8**:215a–216d	
b. Basic doctrines and beliefs expressed in Gnostic mythology: cosmology, creation, redemption, and eschatology		**8**:216d–217e	**5**:1067d–f
c. Worship, practices, and institutions		**8**:217f–218d	
d. Influence of Gnosticism on other religions		**8**:218d–219b/ **13**:1079c–g	**2**:939g–940a/**4**:538b–d/ **4**:546b–c/**4**:553c–f/ **4**:711c–e/**11**:445b–c/ **13**:1080d–g
4. Manichaeism	MANICHAEISM **11**:442–447		
a. Historical development of Manichaeism: its origins in the teaching of Mani, expansion through intense missionary activity, and eventual decline as a result of persecution		**11**:443f–444h/ **9**:849d–f	
b. Beliefs, practices, and institutions: the Gnostic elements in Manichaean doctrine; the community of the elect and of the hearers; ritual and scriptures		**11**:444h–447f	**1**:873c–d
5. Hellenistic religious philosophies [see also 10/52.B.1.c.]			**2**:947e–g/**4**:536f–g/ **15**:134d–h/**18**:276h–277a
a. Neoplatonism		**14**:539h–542e	**14**:574c–e
b. Stoicism		**17**:698g–699h	**13**:952b–c/**15**:1061h–1062a
c. Epicureanism			**6**:912e–g/**6**:914g–915b
6. Quasi-scientific and magical cults; *e.g.*, numerology, astrology		**1**:433e–434a/ **2**:219h–220c/ **2**:221d–222e/ **11**:298f–h	**2**:947d–e/**15**:325f–g

	articles	article sections	other references
7. Judaism [see 826]			
8. Christianity [see 827]			
F. Religions of the early peoples of eastern and central Europe			
1. Scythian religion		**9**:868g–869g/ **16**:440d–441b	
2. Religions of the Sarmatians and associated peoples		**9**:869g–870a	
3. Religion of the pre-Christian Slavic peoples	SLAVIC RELIGION **16**:874–876		
a. The Slavic world view: myths and beliefs		**16**:874b–875c	
b. Practices and institutions		**16**:875d–876e	
G. Religions of the ancient Celtic and Germanic peoples			
1. Religion of the Celts	CELTIC RELIGION **3**:1068–1071		
a. Religious literature and mythology		**3**:1069b–1070f	
b. Religious beliefs, practices, and institutions		**3**:1070f–1071e	**3**:1072h–1073c/ **3**:1074g–1075b
2. Religion of the Germanic peoples	GERMANIC RELIGION AND MYTHOLOGY **8**:33–40		
a. Religious literature and mythology		**8**:34f–38h	
b. Religious beliefs, practices, and institutions		**8**:38h–39g	
H. Religions of the early peoples of northeastern Europe			
1. Religion of the Baltic peoples	BALTIC RELIGION **2**:664–667		
a. Myths and beliefs		**2**:664g–666d	
b. Practices, cults, and institutions		**2**:666d–667c	
2. Religion of the Finno-Ugric peoples	FINNO-UGRIC RELIGION **7**:310–313		
a. Myths and beliefs		**7**:311d–313b	
b. Practices, cults, and institutions		**7**:313b–g	
I. Religions of pre-Columbian American civilizations			
1. Inca religion	INCA RELIGION **9**:259–261		
a. The Inca gods		**9**:259h–260c	**1**:662a–c
b. Practices and institutions		**9**:260c–261g	**1**:842d–g/**6**:318h–319a
2. Mayan religion	MAYAN RELIGION **11**:719–722	**11**:946b–h	
a. Myths and beliefs		**11**:720d–721f	
b. Practices and institutions		**11**:721f–722e	**7**:200c
3. Aztec religion	AZTEC RELIGION **2**:548–552		
a. Myths and beliefs		**2**:550a–551b	**1**:661h–662a
b. Practices and institutions [for religions of other ancient peoples and civilizations, see 821, 823, 824, 825]		**2**:551b–552b/ **3**:610h–611d/ **11**:953h–954d	**1**:670f–671a/**16**:116f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AKHENATON **1**:401
ZOROASTER **19**:1163

Section 823. Hinduism and other religions of India

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 823 deal with four main subjects. The first three are concerned with Hinduism. Subject D is other religions in India, besides Buddhism (covered in Section 824).

The outline of subject A, the history of Hinduism, covers the major developments and periods from the prehistoric and protohistoric periods to contemporary Hinduism.

Subject B is the intellectual, spiritual, and imaginative expressions of Hinduism. The outline first deals with Hindu sacred literature: the primary Vedic scriptures, post-Vedic Sanskrit literature, and regional sacred literatures. Separate treatment is given to Hindu mythology and to the integral role of philosophy in Hinduism. Finally, the outline treats the characteristics, varieties, literature, and methods of Hindu mysticism.

Subject C is the beliefs, practices, and institutions of Hinduism. The outline first deals with common characteristics of Hindu belief about God or the sacred, about the universe, and about man. It next deals with the forms of Hinduism: Vedism and Brahmanism, Vaiṣṇavism, Śaivism, Tantrism, and Śāktism. It also treats folk Hinduism and its regional variations, and ethical, social, and nationalistic movements in modern Hinduism. The outline goes on to deal with sacrifice and worship, the sacred places and times of Hinduism, and the relationship between ritual practices and social status in Hinduism. The treatment of the cultural expressions of Hindu values and ideas covers the traditional religious function of Indian art generally and the characteristic symbolism and iconography expressed in the particular arts. Finally, the outline deals with the relations of Hinduism to other religions of Indian origin, to Islām, and to Christianity.

The outline of subject D covers Jainism, Sikhism, and Parsiism, including their history, beliefs, and practices and institutions.

articles	article sections	other references
A. History of Hinduism		
HINDUISM, HISTORY OF **8**:908–920	**9**:315a–316d	**9**:345d–e
1. The origins of Hinduism: Indo-European roots and other influences	**8**:908c–909c	**9**:345h–346c
2. The prehistoric and protohistoric periods, through the 2nd millennium BC: the religions of the indigenous prehistoric peoples and of the Indus Valley civilization	**8**:909c–f/ **9**:343g–344a	
3. The Vedic period (2nd millennium–7th century BC)	**8**:909g–911d/ **6**:319b–e/ **9**:316d–317a	**8**:923h–924d/**9**:346c–h/ **17**:151e–h
a. The religion of the Ṛgveda	**8**:909g–910e	**3**:984b–h/**9**:347e–g
b. The religion of the later Vedas and *Brāhmaṇas*	**8**:910f–h	**14**:1011a–b
c. The religion of the *Upaniṣads*	**8**:910h–911d	**14**:1011c–d
4. The heterodox period (7th–2nd century BC): challenges to Brahmanism by reformers and ascetic groups; *e.g.*, Jainism and Buddhism [see also D.1., below, and 824]	**8**:911d–912b/ **3**:404b–f/ **6**:319f–h	**9**:349e–g/**17**:185c–186e
5. The early Hindu period (2nd century BC–4th century AD): the rise of the major sects and other developments	**8**:912b–913g	**9**:356d–h/**17**:186e–192e/ **17**:252a–e
6. The Purāṇic period (4th–8th century)	**8**:913g–914c/ **6**:319h–320d/ **9**:478a–f	**9**:360b–f/**16**:222f–223b/ **17**:192e–194f
7. The rise of devotional Hinduism (8th–11th century): The Tamil hymnists and the *Bhāgavata-Purāṇa* after Hinduism	**8**:914d–h	**3**:683d–e/**9**:364d–f/ **17**:139g–144d *passim*/ **17**:175b–181c *passim*/ **17**:194f–197b
8. The age of *bhakti* (11th–19th century)	**8**:914h–917h	**3**:989g–990a/**8**:924f–925b/ **15**:499e–500a/**16**:812a–e/ **17**:154h–155c
9. The modern period (19th–20th century)	**8**:917h–919c/ **9**:333c–334b	**3**:987f–h/**3**:990a–e/ **9**:192e–g/**9**:413c–f/ **15**:536g–537c
10. Hinduism today: its current demographic and social aspects	**8**:919d–920c/ **8**:932d–f	**3**:990e–991b
B. Intellectual, spiritual, and imaginative expressions of Hinduism [see also C.4., below]		
1. Hindu sacred literature		**16**:127a–b
HINDU SACRED LITERATURE **8**:932–940		
a. Primary scriptures regarded as eternal revelations: the Veda	**8**:933g–934g/ **8**:936a–937a/ **8**:927c–f/ **9**:316d–317a/ **17**:133e–134a/ **17**:151e–152d	**8**:909g–911d/**8**:924b–d/ **9**:346c–h

	articles	article sections	other references
b. Post-Vedic Sanskrit literature; *e.g.*, epics, *Purāṇas*, *Tantras*		**8**:934g–935c/ **8**:937a–939e/ **8**:927f–h/ **9**:317g–318e/ **17**:134a–135a	**6**:907e–g
c. Sacred literature in Indian regional languages		**8**:935c–936a/ **8**:939e–940e	
2. Hindu mythology: varieties of myths; modes of representation and themes	HINDU MYTHOLOGY **8**:927–932	**16**:167g–h	
3. Hindu philosophy: the integral relation of philosophy and religion in Hinduism	INDIAN PHILOSOPHY **9**:313–317	**9**:317g–318e/ **9**:318h–322f/ **9**:324g–333a/ **8**:916a–e/ **15**:600b–f	**5**:1068a–b/**8**:910h–911d/ **8**:924c–925b/**9**:192e–g/ **15**:499e–500a/**16**:222f–223b
4. Hindu mysticism: its general characteristics, varieties, goals, and methods	HINDU MYSTICISM **8**:923–926		
C. Beliefs, practices, and institutions of Hinduism	HINDUISM **8**:888–907		
1. Common characteristics of Hindu belief		**8**:888g–890b/ **9**:316d–317a	**9**:314b–c
a. Views about God or the sacred		**8**:889b–d/ **13**:950d–951a	**5**:1068a–b/**9**:314g–315a/ **15**:600b–f/**18**:268f–269a
b. Views about the universe		**1**:433a–d/ **8**:928g–929f	**8**:930d–f
c. Views about man		**8**:889d–890b	**3**:983g–984a/**9**:318c–e
i. *Ahiṃsā*, the obligation to respect all living beings		**8**:889e/ **10**:10e–11c	
ii. The doctrines of *karman*, *saṃsāra*, and transmigration		**8**:889f–h/ **10**:10b–c/ **16**:203b–c	**1**:837a/**3**:988b–e/**6**:961a–b
iii. The three *mārgas*: the paths of duties, of knowledge, and of devotion		**8**:889h–890b/ **10**:10d–e	
2. The forms of Hinduism		**8**:890b–900f	
a. Vedism and Brahmanism		**8**:890c–891h/ **8**:936a–937a/ **9**:318h–321h	**8**:912h–913b
i. Views of nature, man, and the sacred		**8**:890e–g/ **8**:936g–937a	**8**:928g–929a/**8**:929g–930e/ **13**:950d–f
ii. Ritual practices		**8**:890g–891f/ **8**:909g–910h/ **17**:151e–152e	**5**:734c–e/**8**:923h–924e/ **8**:934a–e
iii. Ethical and social doctrines		**8**:891f–h	**3**:984b–985a/**3**:988b–c/ **15**:642d–g
b. Vaiṣṇavism		**8**:891h–893g/ **8**:912b–e/ **8**:939a–b	
i. Views of nature, man, and the sacred		**8**:892a–g/ **8**:924g–926e/ **8**:937a–938c/ **9**:330g–332e	**8**:914d–f/**8**:916a–c/ **8**:930e–931c/**15**:499e–500a
ii. Ritual practices		**8**:892g–893d	
iii. Ethical and social doctrines		**8**:893d–g	
c. Śaivism		**8**:893h–896a/ **8**:938g–939a	
i. Views of nature, man, and the sacred		**8**:894c–895f/ **9**:332e–333a	**8**:916c–e/**8**:925b–d/**8**:931c–g
ii. Ritual practices		**8**:895f–g	
iii. Ethical and social doctrines		**8**:895h–896a	**9**:479g–480d
d. Tantrism and Śāktism		**8**:896a–898b/ **8**:939b–d	**8**:913h–914a/**9**:364f–g
i. Views of nature, man, and the sacred		**8**:896g–897f	**8**:926e–g

	articles	article sections	other references
ii. Ritual and magical practices		8:897f–898b	
iii. Ethical and social doctrines		8:898b	
e. Folk Hinduism		8:898c–899f	
i. General characteristics		8:898c–h/ 8:917d–h/ 8:927h–928d/ 17:150c–g	
ii. Regional variations		8:898h–899f	17:129f–130b
f. Ethical, social, and nationalist movements in modern Hinduism		8:899g–900f/ 8:918a–920a/ 8:932d–f/ 9:412g–413e	7:876d–878a/13:850b–g/ 15:536g–537c/ 16:857h–858a/ 18:277e–278a
3. Rituals, social practices, and institutions		8:900g–905b	2:221c–d/2:222e–g
a. Sacrifice and worship		8:900g–902e	14:952b–d
i. Domestic worship: passage rites, daily offerings, and other private practices		8:900g–901f	
ii. Temple worship		8:901f–902e	3:985a–d/8:913b–c/ 8:915c–916a
b. Sacred times and places		8:902e–903e/ 3:606h–608d/ 8:932b–c	
c. The relationship between ritual practices and social status *with special attention to*		8:903e–904c	15:638f–g
i. The class hierarchy: the caste system	CASTE SYSTEMS 3:982–991	8:904a–c/ 5:734c–735a	1:837a/8:1164e–g/9:347e–h
ii. Religious orders, holy men, and the four stages of life		8:904d–905b/ 8:931h–932b/ 16:164h–165a	3:1042d–e/12:340e–341a/ 15:642d–g
4. Cultural expressions of Hindu values and ideas		8:905c–906f	
a. The traditional religious function of Indian art: symbols and images		8:905c–906a/ 1:161d–g	1:885a–886c/ 17:131c–132c *passim*/ 17:172f–g
i. Types of symbols: *yantras*, *maṇḍalas*, *liṅgas*, and *yonis*		8:905d–g	
ii. Icons: their role in expressing theological elements of Hinduism		8:905h–906a	
b. The religious expression of particular arts		8:906a–f	
i. The visual arts: sculpture, painting, architecture, and the decorative arts		8:906a–d/ 8:928f–g/ 17:184b–198d/ 17:270b–e	8:913b–c/8:915c–d/9:365a–b/ 17:175b–181c/ 17:201b–203h/ 17:265d–266d/ 17:268h–269c
ii. The performing arts: theatre and dance		8:906d–f	17:150c–158c *passim*/ 17:158g–159a
5. The place of Hinduism in Indian and world religions		8:906f–907f/ 8:913c–g	9:286g–287g
a. Hinduism and other religions of Indian origin		8:906f–h/ 3:397h–398c/ 16:744a–b	3:988f–989c/8:914f–h/ 8:917d–e/9:466h–467a/ 17:250c–251d *passim*/ 17:259e–263b *passim*
b. Hinduism and Islām		8:907a–c/ 9:333a–b	2:373c–f/8:917e–g/9:935c–g/ 12:341h–342b
c. Hinduism and Christianity		8:907c–f	
D. Other religions of India			
1. Jainism	JAINISM 10:8–14		
a. History of Jainism		10:8c–9c	
i. Early background: traditional accounts of Mahāvīra's predecessors		10:8c–d	8:911d–h/9:317a–c
ii. The life, work, and teachings of Vardhamāna Mahāvīra			9:349e–g/11:347d–348b
iii. Early development, 6th century BC–6th century AD		10:8d–h	

	articles	article sections	other references
iv. Later developments, 7th–20th century		**10**:8h–9c	
b. Myths about Jaina "great souls": Tīrthaṅkaras, ascetic and monastic figures, and lesser deities		**10**:9c–e	
c. Beliefs, practices, and institutions of Jainism		**10**:9e–14c	
i. Beliefs and doctrines: the nature of time and space; the dualistic character of reality; the defilement of *karman*		**10**:9e–10c	
ii. Ascetic and ethical concerns: the path to salvation; *ahiṃsā*, or noninjury		**10**:10d–h	
iii. Practices of monastic orders and of the laity		**10**:10h–11d	**12**:341a–c
iv. Sacred times and places		**10**:11d–12c	
v. Jaina literature: canonical texts; philosophical and literary works		**10**:12f–13b	
vi. Symbolism and iconography: sculpture and graphic arts		**10**:13b–h	
2. Sikhism	SIKHISM **16**:743–747		
a. History of Sikhism		**16**:744a–745a	
i. Islāmic and Hindu background, 11th–15th century [see also A., above and 828.A.]		**16**:744a–b	**8**:917d–e
ii. The origin of Sikhism in the life and work of Nānak, first of the ten Gurūs, 15th–16th century		**16**:744d–e	**12**:821e–g
iii. The establishment and growth of Sikhism under the nine succeeding Gurūs, and the establishment of Sikh militarism, 16th–18th century		**16**:744f–h	
iv. The condition of Sikhism during the Sikh empire, 18th–19th century		**16**:744h–745a	**9**:404f–405a
v. The condition of Sikhism under British rule, 19th–20th century		**16**:745a–e	
vi. Sikhism in independent India and Pakistan		**16**:745e–f/ **16**:747f–g	
b. Sikh religious literature		**16**:745f–746a	
i. Authoritative sacred scriptures: the centrality of the *Ādi Granth*		**16**:745f–g	
ii. Extra-canonical literature		**16**:745h–746a	
c. Beliefs, practices, and institutions of Sikhism		**16**:746a–747e	
i. Beliefs and doctrines		**16**:746a–e	**3**:988f–h
ii. Basic religious practices: veneration of the Gurū and recitation of hymns		**16**:746f–h	
iii. Sacred times and places		**16**:746h–747d	
iv. Sectarian variations		**16**:747d–e	**12**:339b–c/**12**:341f–g
3. Parsiism: Zoroastrianism in India	ZOROASTRIANISM AND PARSIISM **19**:1172–1175		
a. History of Parsiism			
i. The Persian background [see 822.B.4.a.]			
ii. From the settlement in India to the present time		**19**:1172f–g	
b. Sources of beliefs and doctrines in Zoroastrian literature [see 822.B.4.b.]			
c. Beliefs, practices, and institutions of the Parsis		**19**:1172h–1175h	
i. Beliefs and doctrines: monotheistic and dualistic elements; views of the origin and destiny of man		**19**:1173b–1174f/ **16**:165c/ **16**:204b–c	1:874g–875a
ii. Practices and institutions: purification rites and other ceremonies		**19**:1174f–1175h	**15**:303e–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

GANDHI, MAHATMA **7**:874
KĀLIDĀSA **10**:375
MAHĀVĪRA **11**:347
NĀNAK **12**:821
RĀMĀNUJA **15**:499
RAY, RAMMOHAN **15**:536
ŚAṄKARA **16**:222

Section 824. Buddhism

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 824 deal with three main subjects: A, the history of Buddhism; B, the intellectual, spiritual, and imaginative expressions of Buddhism; and C, the beliefs, practices, and institutions of Buddhism.

The outline of subject A begins with the cultural context for the origin of Buddhism and with the life, work, and teachings of the founder of Buddhism. The account of the development of Buddhism in India covers the early councils, early sectarian schisms, the period of expansion, and the decline of Buddhism in India. The outline next deals with the history of Buddhism in Central Asia and China; in Korea and Japan; in Tibet and the Himalayan kingdoms; and in Ceylon and Southeast Asia. It concludes with the response of Buddhism to Western colonialism and to the challenges of the modern age.

Subject B is the intellectual, spiritual, and imaginative expressions of Buddhism. Articles are referred to which separately treat Buddhist sacred literature—the religious texts and manuals of all major forms of Buddhism; Buddhist mythology, its religious roles, functions, types, and recurrent themes; the role in Buddhism of philosophy; and the universal characteristics, regional variations, goals, and techniques of Buddhist mysticism.

The outline of subject C begins with the traditional Buddhist beliefs and doctrines concerning the nature of reality, the path to salvation or release, Nirvāṇa as the goal of its Eightfold Path, the Threefold Refuge, and Buddhist views of the gods, spirits, and demons. It goes on to the doctrinal variations in the Theravāda and Mahāyāna versions of Buddhism and to various forms of esoteric Buddhism. The account of Buddhist religious practices and institutions covers those that are universal or widely prevalent, as well as the regional variations. The outline next treats the religious and cultural role of Buddhist art; the modes and canons of symbolic representation; and the specific characteristics of Buddhist architecture, sculpture, painting, and literature. Finally, the outline treats the relationship of Buddhism to other religions and its relationship to nationalist movements in the contemporary period.

articles	article sections	other references
BUDDHISM, HISTORY OF **3**:403–413		
A. History of Buddhism	**3**:404b–g	**8**:911d–h
1. The cultural context: its background in Hinduism; its geographical, ethnic, and cultural base [see also 823]	**3**:404g–405d/ **3**:375c–e/ **9**:317a–g	**3**:369d–373e/**9**:349e–g
2. The founding of Buddhism: the life, work, and teachings of Siddhārtha Gautama, 6th–5th century BC	**3**:405d–407h/ **3**:391d–g	**3**:415g–416a/**17**:173d–175b
3. Developments in India, 6th century BC–12th century AD	**3**:405h–406g/ **3**:1083g–h/ **6**:319f–h/ **9**:322f–323a	
a. Early Buddhist councils and the development of schisms between Theravādins and Mahāyānists	**3**:406h–407h	**2**:205c–g/**8**:914f–h/ **9**:352b–f/**9**:356d–f/ **9**:360b–f
b. Expansion and later decline of Buddhism in India	**3**:407h–409c	**3**:416b–c
4. Buddhism in Central Asia and China [see also 825.A.]	**3**:407h–408b/ **12**:373g–374b	**3**:1137c–1138b
a. Developments in Central Asian kingdoms	**3**:408b–409c/ **4**:319a–g/ **4**:328b–e/ **4**:418b–g	**4**:344a–c/**4**:423b–c/ **6**:321g–322b
b. Developments in China	**3**:409d–410h	
5. Buddhism in Korea and Japan [see also 825.D. and E.]	**3**:409d–f	**10**:531b–f
a. Developments in Korea		

	articles	article sections	other references
b. Developments in Japan		**3**:409f–410h/ **10**:111f–112h/ **16**:672d–g	**10**:110a–f
i. Introduction of Buddhism and developments to the 9th century		**3**:409f–410b/ **3**:416e–h/ **10**:59g–60c/ **10**:61b–62a/ **10**:101a–g/ **10**:102a–103a	
ii. Development from the 9th century to the modern period		**3**:410c–h/ **10**:103a–105a/ **10**:106e–h	**8**:1060c–g/**10**:63c–g/ **13**:65e–66d/**16**:671a–d
6. Buddhism in Tibet and the Himalayan kingdoms		**3**:410h–411e/ **3**:1128h–1130e	**3**:416c–e/ **3**:1140a–1143a *passim*/ **9**:364f–g/ **18**:378h–381h *passim*
7. Buddhism in Ceylon (Sri Lanka) and Southeast Asia to the mid-19th century		**3**:411e–413a	
a. Ceylon (Sri Lanka)		**3**:411e–412a/ **4**:2d–e/ **4**:5d–g	
b. Southeast Asia		**3**:412b–413a/ **9**:478f–479a	**3**:511f–h/**9**:479g–480d/ **9**:481e–f/**17**:250c–e
8. Buddhism in the late 19th and 20th centuries		**3**:413a–h/ **3**:338a–c/ **3**:399g–402c	**3**:513h–514c
B. Intellectual, spiritual, and imaginative expressions of Buddhism [see also C.4., below]			
1. Buddhist sacred literature	BUDDHIST SACRED LITERATURE **3**:431–441		**16**:127b–c/**17**:135a–e
a. Theravāda scriptures: the Pāli canon and its Asian translations		**3**:433b–435b/ **9**:318e–h	**3**:369b–374a *passim*
b. Noncanonical Hīnayāna texts in Pāli		**3**:435b–436b/ **3**:379c–e	
c. Mahāyāna texts		**3**:436b–437h	
d. Tantric and Tibetan texts		**3**:437h–439e	
2. Buddhist mythology: basic types, contents, and functions of myths	BUDDHIST MYTHOLOGY **3**:418–424		
3. Buddhist philosophy: the role and contribution of systematic reflective thought	BUDDHIST PHILOSOPHY **3**:425–431	**3**:436b–g/ **9**:317a–g/ **9**:318e–h/ **9**:322f–323a/ **9**:323h–324g/ **10**:101a–g/ **10**:102a–105a/ **10**:106f–h	**3**:375e–376e/**3**:376g–377g/ **3**:380d–386h/**3**:434g–h/ **12**:808e–809b
4. Buddhist mysticism: universal characteristics, regional and historical variations; goals, techniques, and approaches	BUDDHIST MYSTICISM **3**:414–418	**4**:418b–g	**3**:378b–d
C. Beliefs, practices, and institutions of Buddhism	BUDDHISM **3**:374–402		
1. Traditional beliefs and doctrines		**3**:375d–376e/ **3**:425c–428g	**9**:317c–g/**15**:599e–h/ **18**:269a–b
a. Views of the nature of reality; *e.g.*, the impermanence of all existence, the absence of self, the underlying state of suffering and its causes		**3**:425c–427f/ **9**:318e–h	**3**:375e–376b
b. The Eightfold Path to salvation or release		**3**:414h–415g	**3**:417g–418a
c. The goal of the Eightfold Path: Nirvāṇa		**16**:203c–e	**3**:418e–g/**3**:427g–428b/ **6**:960g–961a
d. The Threefold Refuge—in the Buddha, the doctrine, and the community		**3**:419c–422d	**3**:369b–374a *passim*/ **3**:428b–e
e. Views of the gods, spirits, and demons: the role of miraculous powers		**3**:422d–423h	**3**:370h–371b/**4**:413g–h/ **12**:272c–d

	articles	article sections	other references
2. The main forms of Buddhism		3:376f–390c	
a. The Theravāda school and other ancient schools		3:376g–380d	
i. Views of the nature of things: cosmology; the classification of *dharmas*		3:376g–377g	
ii. The emphasis on self-cultivation and self-salvation: the stages leading to *arhat*ship; the levels of meditation		3:377h/ 3:378b–d	3:416h–417b/3:433d–f/ 16:164d–e
iii. Doctrines concerning Buddha and Buddhahood		3:378a/ 3:433f–h	
iv. Characteristics of the individual ancient and transitional schools		3:378d–380c/ 3:411e–413a/ 17:168b–h	17:250c–255d *passim*
b. The Mahāyāna version		3:380d–386h	
i. Views of the nature of absolute reality: the ultimate realization of the meditative quest		3:380d–f/ 3:436b–g/ 9:322f–323a/ 13:951a–c	3:417b–e/10:103e–104a/ 16:164e–g
ii. Views of the transcendence of the Buddha: the three aspects of the Buddha; the *bodhisattva* ideal		3:380f–381e/ 3:436g–437b	
iii. Characteristics of the individual Mahāyāna schools; *e.g.*, Mādhyamika, Yogācāra, Avataṃsaka, Zen, and devotional schools		3:381f–386h/ 3:408b–411e/ 3:437b–e/ 4:418b–g/ 10:103a–105a/ 10:111f–112h	8:1060c–g/10:102d–f/ 10:110a–f/10:533b–c/ 13:65e–66d/15:643b–d/ 16:671a–d
c. Esoteric Buddhism		3:386h–390c	
i. Tantrism		3:386h–387h/ 3:438a–e	3:417e–418e/9:364f–g
ii. Tibetan Buddhism		3:387h–389e/ 3:438e–440e	18:374g–h/18:378a–c/ 18:378h–381h *passim*
iii. Shingon		3:389e–390c	10:102f–103a
3. Practices and institutions		3:390d–395b	
a. Universal or prevalent ethical and religious practices		3:390d–391c/ 3:428e–430d/ 5:735a–c	3:417g–418a/3:988h–989c
b. Monastic institutions: the characteristics and role of the *saṅgha*		3:391c–393c/ 10:102a–c/ 14:1011d–g	12:341c–f/15:642g–643e/ 17:225c–d
c. Ceremonies and festivals: the religious year; popular traditions; passage rites		3:393d–395b/ 15:638g–639c	
d. Regional variations in practices		3:423h–424c/ 10:101a–102a	14:1011g–1012a/17:225a–e/ 18:376g–h
4. The religious and cultural role of Buddhist art		3:395c–397g/ 10:113f–114e	3:418c–e
a. Symbolism and iconography		3:395c–397b/ 3:440g–441b	3:1140a–1143a *passim*/ 17:255d–g/ 19:219e–236h *passim*
i. The symbolism and forms of the Buddha and of *bodhisattva* images: historical and regional variations		3:395c–h/ 3:420c–h/ 3:422b–d	3:1137c–1138b/ 19:188h–189b
ii. Architectural forms; *e.g.*, *stūpa* (commemorative relic mound), *caitya* (temple), *vihāra* (monastery)		3:396a–e/ 17:205f–206c	17:173d–175b/ 17:250c–255e *passim*/ 17:257g–258c/ 17:266d–268h/19:184g–h
iii. Supports of worship: verbal (*dhāraṇī* and *mantra*), gestural (*mudrā*), and visual (*maṇḍala*)		3:396e–397b	
b. Religious expression in particular arts			
i. The visual arts: sculpture, painting, and the decorative arts		17:206c–e	17:257a–g/19:185a–186f/ 19:193g–194c/19:198c–d
ii. The performing arts: music, dance, and theatre as cultic activity		3:1126h–1127b/ 3:1128h–1130e/ 10:114a–b/ 12:683h–684a	5:474a–477d *passim*

	articles	article sections	other references
iii. The literary arts: themes and forms		3:421a–422b	3:418a–c/ 17:233h–235f *passim*
5. The relation of Buddhism to other religions *with special attention to*		3:397h–399g	3:1137c–1138b
a. Hinduism		3:397h–398c	8:914f–h
b. Islām		3:398d–e	
c. Chinese religions		3:398e–399a/ 17:1047f–1048a	17:1040f/17:1043b–c
d. Tibetan religion		3:399a–c	
e. Japanese religions		3:399c–g/ 16:672d–g	
6. The relationship of Buddhism to nationalist movements: its contemporary situation; its prospects for the future		3:399g–402c/ 3:413a–h	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AŚOKA 2:205
BUDDHA 3:369
HŌNEN 8:1060
NĀGĀRJUNA 12:808
NICHIREN 13:65
SHINRAN 16:670

Section 825. Indigenous religions of East Asia: religions of China, Korea, and Japan

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 825 deal with five main subjects: A, the characteristics and development of Chinese religion; B, Confucianism; C, Taoism; D, the religions of Korea; and E, the religions of Japan

The outline of subject A begins with the distinction between and relationship of the folk religions and the literate religions in China. It goes on to treat the history of religion in China, after which it covers traditional concepts concerning the relation of the individual to the cosmos and to society. The account of ritualistic practices and institutions covers rites of passage in family religion, rites connected with shrines and temples, the rites of Imperial worship and state religion, and the practices of sects and secret societies. Finally, the outline treats Chinese religious symbolism and mythology.

The outline of subject B first deals with the history of Confucianism, from its origin in the life and teachings of Confucius to its current demographic and social aspects. It goes on to the Confucian Classics, covering divination and poetic texts; basic texts on Confucius and Mencius; history texts; and texts on rites. The outline further treats the basic beliefs and doctrines of Confucianism; its influence on all aspects of Chinese culture; and its relation to non-Chinese religions and philosophical schools.

The outline of subject C, Taoism, first deals with the history of Taoism, from the teachings of Lao-tzu and Chuang-tzu in *c.* 4th–3rd century BC to the present. After dealing with Taoist literature, the outline treats the basic doctrines of philosophical Taoism; the basic beliefs, practices, and institutions of religious Taoism; variations in belief and practice in folk Taoism; and the contribution of Taoism to science and the arts.

The outline of subject D begins with the history of Korean religion from prehistoric times to the present, including the influence of Chinese, Japanese, and Western religions. It goes on to treat religious literature and mythology, general beliefs and doctrines, and the practices and institutions of Korean religion.

The outline of subject E, the religions of Japan, begins with the nature and types of Japanese religion and with the broad history of Japanese religion. It then treats separately the indigenous Shintō religion and the traditional and modern roles of Buddhism, Confucianism, and Christianity in Japan. Finally, it treats Japanese religious art and symbolism; Japanese mythology; the political and social roles of religion in modern Japan; and the place of Japan in world religion.

	articles	article sections	other references
A. Characteristics and development of Chinese religion	CHINESE RELIGION 4:422–428	4:415c–h	
1. The distinction and relationship between the folk religions and the literate religions in China		4:422a–e/ 17:1034f–1035a/ 17:1042c–e/ 17:1051a–e	17:1044g–1045c
2. History of religion in China		4:422e–423g	
a. The emergence of Chinese religion: ancestor worship, early cosmological beliefs		4:422e–f	4:410g–411a/4:415c–d
b. The formulation of the Great Tradition: the development of the Confucian and Taoist ways, 6th–1st century BC		4:422f–423a/ 3:1083e–f/ 4:415h–417g/ 17:1045f–1046f	4:411a–b/4:1109b–f/ 10:679f–680e/12:577b–f

	articles	article sections	other references
c. The dominance of the Buddhist Way and the rise of Taoist-inspired cults, 1st–16th century		**4**:423a–d/ **3**:408b–409c/ **4**:317f–319g/ **4**:328b–f/ **4**:1101d–g/ **17**:1046f–1050f	**3**:439g–440c/**4**:315b–d/ **4**:343g–344f/**4**:411c–e/ **4**:417h–418g/**4**:1096f–1097a/ **6**:321g–322b/**11**:444d–e/ **15**:643b–d
d. The modern period: the impact of Western religions and the effect of nationalism and secularism on familial and social systems		**4**:423d–g/ **4**:352g–353a/ **4**:1097b–e/ **17**:1050f–g	**4**:345f–346a/**4**:356b/ **4**:360f–h/**4**:361e–f/ **15**:1014b–d
3. Traditional concepts in Chinese religious thought		**4**:423h–424e	**4**:410e–415a *passim*/ **6**:127b–e
a. The relation of the individual to the cosmos		**4**:423h–424d	**8**:823h–824a/**15**:599h–600a/ **17**:1035b–d
b. The relation of the individual to society		**4**:424d–e/ **4**:1097e–1098a/ **5**:735c–g	**15**:643f–g
4. Ritual practices and institutions		**4**:424f–426g/ **15**:639c–e	
a. Rites of passage in family religion: ceremonies and customs connected with birth, marriage, and death		**4**:424f–425h	**1**:836f–g
b. Rites connected with shrines and temples		**4**:425h–426c	
c. Rites of Imperial worship and state religion		**4**:426c–d	
d. Practices involving other supernatural elements; *e.g.*, astrology, alchemy		**4**:426d–f	
e. Practices of sects and secret societies		**4**:426f–h	**4**:357b–c/**15**:67e–f
5. Chinese religious symbolism		**4**:426h–428a	
a. Religious use of vessels, images, and other decorations		**4**:426h–427b	**3**:397d–g/**19**:178d–g/ **19**:181a–b
b. Religious significance of the arts		**4**:427c–428a	**19**:175g–176a
6. Chinese mythology	CHINESE MYTHOLOGY **4**:410–415		**17**:1036e–f
B. Confucianism			
1. History of Confucianism	CONFUCIANISM, HISTORY OF **4**:1099–1103	**3**:1083e–f	
a. Background in the institutions of the predynastic sage-emperors and the founders of the first three dynasties		**4**:1099g–1100a	
b. Origin in the life and teachings of Confucius, 551–479 BC, the first Sage		**4**:1100b/ **4**:1092c–1093d	**4**:416a/**4**:1108d–1109f
c. The Confucian school and its various forms: the teachings of Mencius, the second Sage and of Hsün-tzu, *c.* 5th–3rd century BC		**4**:1100c–f/ **4**:408a–e/ **4**:1093d–1094g	**4**:416b–f/**8**:1127g–1128d/ **11**:898a–d
d. Establishment of Confucianism as the state orthodoxy of the Han Empire: eclectic tendencies, skeptical and rationalistic reactions, 2nd century BC–3rd century AD		**4**:1100g–1101d/ **4**:1094g–1095h	
e. Introduction of Confucianism into Korea and Japan, 1st and 4th centuries AD [see D. and E., below]			
f. Confucianism during the time of Buddhist ascendancy: its continued role in the family system, the government bureaucracy, and the examination system; textual studies		**4**:1101d–g	**4**:337a–c/**4**:338d–e
g. The emergence and development of Neo-Confucianism, 11th–20th century: metaphysical and humanistic emphases; the teaching of Chu Hsi; the development of Neo-Confucian schools		**4**:1101g–1102h/ **4**:339b–g/ **4**:418h–420e/ **4**:1095h–1097b/ **16**:672g–h	**4**:344d–f/**4**:586c–e
h. Varied responses to intellectual and material challenges of the West and to other developments: reformist and conservative movements; the effect of political developments on Confucian ideology and scholarship		**4**:1102h–1103f/ **4**:1097b–e	**4**:420g–h/**4**:421e–f

i. Confucianism today: its current demographic and social aspects

2. Confucian Classics

a. Divination and poetic texts: *I Ching*, *Shih Ching*

b. Basic texts on Confucius and Mencius: *Lun yü*, *Hsiao Ching*, *Meng-tzu*

c. History texts: *Shu Ching*, *Ch'un Ch'iu*, commentaries on the *Ch'un Ch'iu*

d. Ritual texts: *Li chi* and other texts

3. Confucianism as a religion and as a philosophy

a. Beliefs and doctrines: the concept of Tao as a way of action, the ideal relationships between the individual and society

b. The place of Confucianism in Chinese culture: its influence on the visual arts and on literature

c. The relation of Confucianism to non-Chinese religions and philosophical schools, especially Buḍdhism, Shintō, Islām, and Christianity

C. Taoism

1. History of Taoism

a. Origin and early developments: the first evidence of the teachings of *Lao-tzu* and *Chuang-tzu*, *c.* 4th–3rd century BC

b. Developments during the Ch'in and Han periods, 3rd century BC–3rd century AD: esoteric traditions; the Huang-Lao tradition; revolutionary messianism; developments in philosophy

c. Developments from the 2nd to the 6th century: brief recognition of Taoism as the state religion; interaction with Buddhism; ceremonial, alchemical, and scriptural traditions

d. Developments under the T'ang, Sung, and later dynasties: internal developments; the role of alchemy; syncretistic tendencies

e. The later development of philosophical and religious Taoism, from the 14th century to the present time

2. Taoist literature

a. Texts of speculative Taoism; *e.g.*, the *Tao-te Ching*, *Chuang-tzu*

b. The literature of Taoist esoterism; *e.g.*, hagiography, doctrinal texts

3. Taoism as a religion and as a philosophy

a. Basic concepts of Taoism: philosophical, ethical, and ritual approaches to the understanding of the integral unity of mankind and the natural order

b. Doctrines of philosophical Taoism: the teachings of Lao-tzu, Chuang-tzu, and later teachers

c. Beliefs and practices of religious Taoism: techniques for attaining longevity; priestly and monastic institutions

d. Folk Taoism and other variations in belief and practice: the deities of the popular pantheon; magical rituals and exorcism rites; secret societies

articles	article sections	other references
	4:1103f–g	
CONFUCIAN TEXTS, CLASSICAL **4**:1104–1107	**4**:1094e–g	
	4:1105c–h	
	4:1105h–1106d	
	4:1106d–1107a	
	4:1107a–g	
CONFUCIANISM **4**:1091–1099		
	4:1097e–1098g	**10**:532f–533a/**11**:898a–d/ **16**:163h–164b
	4:1098g–1099b/ **4**:1107g–h	**1**:160g–161a/**15**:643f–g/ **17**:1043d–e
	4:1099b–e/ **3**:398e–399a/ **4**:1102h–1103b/ **10**:101h–102a/ **10**:105c–106d	**4**:1102h–1103b
TAOISM, HISTORY OF **17**:1044–1050		**17**:1051a–c
	17:1045f–1046b	**4**:416f–417a/**4**:584d–585c/ **10**:679f–680e/**17**:1051e–f
	17:1046b–g/ **4**:317f–318c/ **4**:417h–418b/ **17**:1052b–1053e	
	17:1046h–1049g/ **4**:318c–319a/ **17**:1038g–1039a/ **17**:1053e–1054c	
	17:1049g–1050f/ **17**:1054c–e	
	17:1050f–g/ **17**:1042e–f	
TAOIST LITERATURE **17**:1051–1055		
	17:1051e–1052e/ **17**:1036h–1038c/ **17**:1045f–1046b	
	17:1052e–1054e	**10**:1053h–1054a
TAOISM **17**:1034–1044		
	17:1035b–1036f/ **17**:1044g–1045c	
	17:1036g–1039a	
	17:1039b–1042c/ **1**:432d–433a/ **17**:1052g–1054e	**17**:1048b–d
	17:1042c–1043b	**4**:413e–f/**4**:318g–319a

	articles	article sections	other references
e. Relation of Taoism to other religions, especially Confucianism, Buddhism, and the Western religions [see also B.3., above]		**17**:1043b–g/ **3**:398e–399a/ **17**:1047f–1048a	**17**:1050e–f
f. Contribution of Taoism to science and to the arts		**17**:1043h–1044d/ **17**:1054e–1055b	
D. The religions of Korea	KOREAN RELIGION **10**:530–534		
1. History of Korean religion from prehistoric times to the present: the influence of Chinese, Japanese, and Western religions		**10**:530g–532c/ **3**:409d–f	**10**:533f–g
2. Religious literature and mythology		**10**:532c–e	**10**:1059e–1064g *passim*
3. Beliefs and doctrines		**10**:532e–533c	
4. Practices and institutions		**10**:533c–534b/ **12**:678b–f	**5**:474a–475g *passim*
E. The religions of Japan	JAPANESE RELIGION **10**:109–115		
1. The nature and types of Japanese religion: the simultaneous participation in several religious traditions—"dual adherence" or "plural belonging"		**10**:109d–h/ **3**:399c–g/ **16**:671g–h	**1**:836h/**10**:44c–f/**10**:113d–f/ **15**:600a–b/**17**:1042h–1043b
2. History of Japanese religion		**10**:109h–111a/ **3**:409f–410h/ **16**:671h–673c	
a. Early clan religion, before the 6th century AD		**10**:111b–f/ **16**:672a–b	**10**:97d–98a/**10**:109h–110a
b. Early historic and medieval periods, 6th–16th century: the introduction of Buddhism; the impact of Chinese influences on Shintō; other developments		**10**:111f–112h/ **10**:59g–60c/ **10**:61b–62a/ **16**:672c–g	**3**:440c–e/**5**:735h–736c/ **8**:1060c–g/**10**:63c–g/ **10**:69f–70a/ **10**:101a–105c *passim*/ **10**:110a–f/**13**:65e–66d/ **16**:671a–d
c. The Tokugawa era, 1603–1867: Neo-Confucian Shintō, Sect Shintō, and other developments		**10**:112h–113d/ **10**:105c–107e/ **16**:672g–673b	**6**:342h–343b/**10**:110f–h
d. The Meiji era and after, 1868 to the present: new religious movements		**10**:110h–111a/ **3**:401e–g/ **16**:673b–c/ **16**:675h–676c	
3. Shintō: the Way of the Gods	SHINTŌ **16**:671–676	**10**:111b–f	
a. History of Shintō [see E.2., above]			
b. Characteristics of primitive Shintō: the role of guardian shrines and shamans		**16**:671g–h/ **13**:1047d–f	
c. Shintō literature and mythology: the form and content of the *Koji-ki*, *Nihon-gi*, and other writings		**16**:673c–f	**10**:98b–d
d. Basic beliefs and doctrines: concepts of man and the sacred and related precepts and principles		**16**:673f–674c	
e. Ritual practices and institutions		**16**:674c–675c	**10**:98d–e/**15**:639e–f/ **15**:643g–644a
4. The traditional and modern roles of Buddhism, Confucianism, and Christianity in Japan		**10**:111f–113f/ **3**:383a–386h/ **3**:389e–390c	**12**:689f–g
5. Japanese religious art and symbolism		**10**:113g–114e/ **15**:639e–g/ **16**:675d–g	
a. The visual arts: architecture, painting, sculpture, and the decorative arts		**10**:113g–114a/ **19**:215d–243d	**3**:397d–g/**16**:675d–f
b. The performing arts: music, dance, theatre, and festivals		**10**:114a–e/ **12**:683e–g	**5**:475g–477d *passim*/ **13**:270h–273h *passim*/ **16**:675f–h
6. Japanese mythology	JAPANESE MYTHOLOGY **10**:97–100		**16**:673d–f

	articles	article sections	other references
7. Political and social roles of religion in modern Japan		**10**:114f–115a/ **5**:735g–736d	**10**:100d–f/**16**:675h–676c
8. Place of Japanese religion in world religion		**10**:115a–c/ **16**:672c–e	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CHUANG-TZU **4**:584
CHU HSI **4**:585
CONFUCIUS **4**:1108
HAN-FEI-TZU **8**:625
HŌNEN **8**:1060
HSÜAN-TSANG **8**:1126
HSÜN-TZU **8**:1127
LAO-TZU **10**:679
MENCIUS **11**:897
MO-TZU **12**:577
NICHIREN **13**:65
SHINRAN **16**:670
WANG YANG-MING **19**:537

Section 826. Judaism

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 826 deal with three main subjects: A, the history of Judaism; B, the intellectual, spiritual, and imaginative expressions of Judaism; and C, the beliefs, practices, and institutions of Judaism.

The outline of subject A begins with the biblical era, from the pre-Mosaic period to the Persian period of return and restoration, 6th–4th century BC. It goes on to the Greek and Roman periods in the Hellenistic era and to the Talmudic era in Palestine and Babylonia, witnessing the foundations of rabbinic Judaism. It then treats the European and Islāmic phases of rabbinic Judaism in the medieval era. Finally, it covers the modern era, from about mid-18th century to contemporary Judaism.

The outline of subject B first deals with the biblical literature. It then treats the Qumrān literature (Dead Sea Scrolls) and the Talmud and Midrash, ancient commentaries and interpretive writings regarded as sacred or normative. Articles are then referred to that separately treat Judaic exegesis and hermeneutics, the literature of Jewish mysticism, Jewish philosophy, and biblical, Talmudic, and folk myth and legend.

The outline of subject C begins with basic Judaic beliefs and doctrines concerning God, concerning the Jewish people and the divine convenant with it, concerning man in relation to God and God's world, and concerning the future age of mankind and the world. The treatment of basic practices and institutions covers individual and familial practices; synagogue and other public institutional practices; the roles of the rabbinate and of general councils and conferences; sacred times and the cycle of the religious year; sacred places—the land of Israel and Jerusalem; and the sacred language—Hebrew. After treating present-day forms of Judaism, the outline deals with Judaic art and iconography; the influence and modification of the traditional anti-iconic principle; the uses of ceremonial objects and symbols; and the characteristics of Jewish architecture, painting, music, and literature. It then treats the relation of Judaism to religions of non-biblical origin and to Christianity and Islām, and the influence of Judaism on Western culture and civilization.

	articles	article sections	other references
A. History of Judaism	JUDAISM, HISTORY OF **10**:302–328		
1. The biblical era		**10**:303a–310a/ **2**:895g–898c/ **6**:322b–f	**10**:199f–h/**14**:1010b–c/ **15**:303b–c/**15**:635b–c
a. The pre-Mosaic period: the patriarchal traditions, *c.* 19th–13th century BC		**10**:303d–304b/ **2**:895h–896a	**1**:11e–13d/**2**:900a–d/ **17**:939f–940b
b. The Mosaic period: the foundations of the Israelite religion, *c.* 13th century BC		**10**:304b–305a/ **5**:227f–228d	**2**:900d–906d *passim*/ **12**:487d–490d
c. The conquest and settlement of Canaan: development of the convenanted confederacy and the period of the united monarchy, *c.* 12th–10th century BC		**10**:305a–306g/ **2**:896a–h/ **5**:228d–229a	**2**:907b–913h *passim*/ **3**:599h–600a/**5**:517f–518h/ **10**:136b–e/ **16**:207g–208e *passim*/ **16**:281f–282c/ **16**:1044d–1045d/ **17**:940b–941a/ **17**:944h–945h
d. The prophetic period: developments during the period of the divided kingdom and the Babylonian Exile, *c.* 9th–6th century BC		**10**:306g–309d/ **2**:896h–897f	**2**:913h–922b *passim*/**5**:229b/ **6**:961f–g/**9**:909b–910e/ **10**:134d–135h/**15**:63g–64f/ **17**:945h–946g
e. The Persian period: return and restoration, 6th–4th century BC		**10**:309d–310a/ **2**:897g–898c/ **5**:229c–d/ **10**:192e–h	**7**:128b–d
2. The Hellenistic era [see also 822.E.]		**10**:310a–316a/ **7**:65c–g/ **10**:192h–193d	**2**:887b–d/**3**:600b–d/ **8**:749a–750a *passim*/ **11**:1018d–f/**14**:1010d–e/ **15**:65b–d

	articles	article sections	other references
a. The Greek period, 4th–1st century BC		10:310a–314f/ 2:934d–f/ 17:948d–950b	2:931g–932a/11:224g–226a
b. The Roman period, 1st century BC–2nd century AD		10:314f–316a/ 4:533e–534c/ 10:208d–f	10:146f–148g/10:184b–e/ 10:229d–h/14:245d–247b/ 17:950g–951b/17:1012a–c
3. The Talmudic era in Palestine and Babylonia: the foundations of rabbinic Judaism [see also B.3., below]		10:316a–319d/ 10:218e–h	15:644b–d
a. The ancient background of Talmudic lore and learning [see A.1.e. and 2.a., above]			
b. The ages of the *tannaim* and of the *amoraim:* the making of the Talmud in the schools of Palestine and Babylonia, 2nd–6th century AD		10:316a–318c/ 10:203b–g/ 17:1007d–1008b	1:403g–h/10:184e–185a/ 17:1012d–e
c. The age of the *geonim:* the continuance of Talmudic compilation and scholarship in the Babylonian academies, 7th–11th century		10:318d–319d	7:65g–h/16:111b–h
4. The medieval era: the European and Islāmic phases of rabbinic Judaism, 7th–18th century		10:319e–322c	10:199h–200b
a. The Talmudic base of Jewish society and culture [see also B.3., below]			15:527b–e/15:644d–e/ 17:1006c–f
b. Sefardic developments: achievements in literature, religious philosophy, and biblical exegesis; the Arabic–Islāmic milieu [see also B.6., below]		10:319f–320c/ 10:208g–215e	9:145g–146h/10:194b–g/ 10:203g–204c/10:1126a–c/ 11:353c–e/17:422d–423e
c. Ashkenazic developments: patterns of Jewish religious life in the midst of medieval and Renaissance Christendom		10:320d–g/ 4:467b–d	2:886e–g/10:194g–195a/ 10:204d–f/10:206g–207a/ 10:1125g–1126a/ 15:1006h–1007b
d. The flowering of Jewish mysticism [see also B.5., below]		10:320h–321c/ 10:185b–189e	11:187d–188b
e. Anti-Talmudic and messianic movements challenging orthodox rabbinic Judaism		10:321c–322b	2:552g–553b/10:195b–c
5. The modern era, from *c.* mid-18th century: developments in modern Judaism		10:322c–327b	
a. The Haskala (Enlightenment)		10:322f–323e	
b. Religious reform movements		10:323e–324b	10:189e–h
c. The continuance and renewal of Orthodox Judaism		10:324b–g	6:717h–718f
d. The development of modern Jewish religious scholarship and philosophy		10:324g–325e/ 7:66b–d/ 10:215e–216h/ 17:1013f–g	2:892b–d/10:190f–g/ 15:644e–g
e. Jewish–Gentile relations: anti-Semitic discrimination, persecution, and extermination; the central event of the Holocaust; recent ecumenical developments		10:325f–326a	2:581d–f
f. The origin and development of modern Zionism and the establishment and development of the State of Israel		10:326a–b	3:359c–h/8:829d–830a/ 19:737b–g
g. Developments in particular areas		10:326b–327b	6:429e–g
6. Judaism today: its current demographic and social aspects		10:327d–328b/ 10:222a–d/ 10:300g–301a/ 17:1013d–f	9:1061f–g/10:190d–e
B. Intellectual, spiritual, and imaginative expressions of Judaism [see also C.4., below]			
1. Biblical literature	BIBLICAL LITERATURE 2:879–938	10:1088h–1089b	
a. Canons, texts, and vernacular versions of the Bible; *e.g.,* Septuagint, Targum		2:884a–895g/ 2:931d–g	
b. Ta NaKh, the Hebrew Bible		2:881g–931a/ 7:64h–65c	7:61c–e/7:136d–e/ 10:191e–192c
i. Torah, or Law		2:898c–906d	1:3b–e/1:11e–13d *passim*/ 10:286e–h/12:487d–h/ 17:939a–c
ii. Nevi'im, or Prophets		2:906d–922b	7:127a–d/10:135e–h/ 16:207g–208e

	articles	article sections	other references
iii. Ketuvim, or Writings		**2**:922b–931a/ **10**:208c–d	**12**:200h–201c
c. Noncanonical literature: Apocrypha and Pseudepigrapha		**2**:931b–938a	**10**:193b–d
2. Qumrān literature (Dead Sea Scrolls)		**2**:883a–b/ **2**:885h–886a/ **2**:938a–g	
3. Talmud and Midrash	TALMUD AND MIDRASH **17**:1006–1013	**3**:1084a–c/ **10**:1089c–d	**15**:644b–g
a. Mishna, Tosefta, and Talmud		**17**:1008c–g/ **10**:316e–g	**8**:873b–e/**10**:286h–287a/ **10**:716e–f
b. Midrashic literature		**17**:1008g–1009b	**7**:65e–g/**10**:193e–h
c. Talmudic codifications and commentaries		**17**:1009b–h	**15**:527b–f
4. Judaic exegesis and hermeneutics	EXEGESIS AND HERMENEUTICS, BIBLICAL **7**:60–66	**2**:884a–885d	**10**:192c–e
5. Mystical and devotional writings	JEWISH MYSTICISM **10**:183–190		**7**:65h–66a/**10**:320h–321c/ **11**:187g–h
6. Philosophical writings: the role of philosophy in Judaism; the major schools of Judaic philosophy	JEWISH PHILOSOPHY **10**:208–216	**10**:325b–e/ **14**:542f–g	**1**:1158c–e/**3**:359h–360f/ **9**:146f–h/**10**:322f–323a/ **14**:246a–c/**14**:258g–h/ **16**:111f–h
7. Myth and legend: their characteristics and functions in the Bible, Talmud, and Midrash, and other Jewish literature; the special problems and various interpretations of myth in Judaism	JEWISH MYTH AND LEGEND **10**:191–195	**15**:64h–65a/ **17**:1011f–g	
C. Beliefs, practices, and institutions of Judaism	JUDAISM **10**:284–301		
1. Basic beliefs and doctrines		**10**:285d–294a/ **17**:1010d–1011e	**10**:208b–216h *passim*
a. Doctrines concerning God		**10**:285d–286e	**12**:383d–f
b. Doctrines concerning the Jewish people: the concept of Covenant [see also 811.B.2.h.viii]		**10**:287d–289a/ **16**:203e–g	**12**:489e–490a
c. Doctrines concerning man		**10**:289a–292a/ **17**:1011c–e	**3**:1042g–h
i. Man as the image of God: man's relationship to God		**10**:289a–b/ **15**:785c–d/ **16**:165d–e	**2**:904g–905b/ **10**:183d–190g *passim*/ **15**:784d–e
ii. Man as an earthly spiritual creature; his ethical obligations		**10**:289b–292a	**2**:901b–h/**2**:905c–906d/ **15**:282a–c
d. Doctrines concerning the universe		**10**:292b–h/ **17**:1011g–1012a	
i. Man's place in God's world: creation and providence		**10**:292b–f	**12**:272e–g
ii. Intermediary beings: angels and demons [see also 811.B.2.e.v.]		**10**:292g–h	**1**:875a–b/**2**:932h–933c/ **5**:1068d–f
e. Eschatology: views about the future age of mankind and the world; the King-Messiah and his reign [see also 811.B.2.h.ix., 827.F.2.a.iv., 829.A.]	MESSIAH AND MESSIANIC MOVEMENTS **11**:1017–1018	**10**:293a–294a/ **2**:932a–b/ **2**:936b–937g/ **10**:189c–e/ **15**:64d–65a	**6**:961d–g/**12**:200h–201c
2. Basic practices and institutions		**10**:294b–298e	
a. Individual and familial practices		**10**:294d–295b/ **5**:732a–733b	**1**:441g–h/**10**:219g–220b/ **14**:952e
b. Synagogue practices and other public institutions: the role of the rabbi, chief rabbinates, and general councils and conferences		**10**:295c–296b/ **10**:297e–298e/ **2**:974a–c/ **10**:220b–222a/ **15**:635b–h/ **17**:1012e–1013d	**16**:134g–h
c. Sacred times: the sabbath and the Jewish holidays	JEWISH RELIGIOUS YEAR **10**:217–222	**10**:296b–h/ **3**:599a–600e/ **4**:601a–c	

	articles	article sections	other references
d. Sacred places: the land of Israel and Jerusalem		10:297a–c	5:519a–f
e. The sacred language: Hebrew		10:297c–e	10:184g–h
3. Present-day forms of Judaism		10:301a–f	
a. Orthodox Judaism		10:301a–b	
b. Reform, or Liberal, Judaism		10:301b–c	
c. Conservative Judaism		10:301c–d	
d. Other variations in belief and practices: Reconstructionism; Ḥasidism; regional or ethnic groups		10:301d–f/ 10:189e–190c/ 12:943e–g	5:732f–733b
4. Art and iconography		10:298e–299e	
a. The anti-iconic principle: the influence of the biblical prohibition against idolatry		10:298e–g	10:202e–g
b. Uses of the visual arts in ceremony and ritual: ceremonial objects, synagogue architecture, paintings, and manuscript illumination		10:298g–299c/ 10:202h–205g	
c. Music: Jewish liturgical modes; the influence of folk traditions; vocal and instrumental music		10:299c–d/ 10:205g–207e	12:296e–g
d. Literature: traditional legends and poetic exegesis; later religious poetry and tales		10:299d–e/ 2:931b–932b/ 10:1125f–1126d	9:146c–f/ 10:196c–199e *passim*
5. The relation of Judaism to other religions		10:299f–300e	10:193h–194c/10:327d–e
a. The ethnic and universalist emphases in Judaism: exclusiveness and proselytization		10:299f–h	
b. The relation of Judaism to Christianity		10:299h–300b/ 4:466a–467h/ 10:315b–f/ 10:325f–326a	10:145e–f/10:190e–f
c. The relation of Judaism to Islām		10:300b–d/ 10:185b–c/ 10:209a–210a	9:926a–d
d. The relation of Judaism to other ancient and modern religions		10:300d–e/ 12:917f–918a	19:1176a–c
6. The influence of Judaism on Western culture and civilization		10:300e–301a/ 2:881b–g	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AARON 1:2
ABRAHAM 1:11
AKIBA BEN JOSEPH 1:403
BAʿAL SHEM TOV 2:552
BAECK, LEO 2:580
BUBER, MARTIN 3:358
DAVID 5:517
ELIJAH BEN SOLOMON 6:717
EZEKIEL 7:126
EZRA 7:127
HERZL, THEODOR 8:828
HILLEL 8:873
IBN GABIROL 9:145
ISAIAH 9:908
JEREMIAH 10:134
JOHANAN BEN ZAKKAI 10:229
JUDAH HA-LEVI 10:282
LURIA, ISAAC BEN SOLOMON 11:187
MACCABEES 11:224
MAIMONIDES, MOSES 11:352
MOSES 12:487
PHILO OF ALEXANDRIA 14:245
RASHI 15:527
ROSENZWEIG, FRANZ 15:1154
SAʿADIA BEN JOSEPH 16:111
SAMUEL 16:207
SAUL 16:281
SOLOMON 16:1044

Section 827. Christianity

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 827 deal with ten main subjects. The first group of four subjects covers the history of Christianity: A, the history of Christianity to the schism of 1054; B, the history of the Eastern Orthodox Church from the schism of 1054 to the present; C, the history of the Roman Catholic Church from the schism of 1054 to the present; and D, the history of Protestantism. The next group of two subjects concerns things common or predominant among the various traditional forms of Christianity; E, intellectual, spiritual, and imaginative expressions of Christianity; and F, the beliefs, practices, and institutions of Christianity. The last group of four subjects concerns the differences among the forms of the Christian religion: G, the major traditional forms of Christianity: Eastern Orthodoxy, Roman Catholicism, and Protestantism; H, the major forms of Protestantism; I, ecumenism; and J, variations of the traditional forms of Christianity.

The outline of subject E treats the biblical literature and its interpretation; ante-Nicene and post-Nicene patristic literature; creeds and confessions of faith; writings of post-patristic theologians, reformers, and church leaders; Christian mystical literature; Christian philosophy and anti-philosophy; and Christian myths and legends.

Subject F is the beliefs, practices, and institutions of Christianity. The outline begins with general issues—about the right way of understanding the essential nature of Christianity, and about the nature of and criteria for the unity of the church. In dealing with beliefs or doctrines common or predominant among the various traditional forms of Christianity, as it does next, the out-

line first treats doctrines concerning God, dealing with such matters as the nature of God, the self-revelation of God, Christology, eschatology, the role of the Holy Spirit in the church, and the Trinity. The outline then goes on to treat doctrines concerning intermediary beings, powers, or principles; doctrines concerning the physical world; doctrines concerning man; and doctrines concerning the church and the normative role of Scripture, tradition, creeds, and confessions. The outline next deals with various approaches to church polity and with the significance of discipline and canon law in the organizational development of the church. Considering the church as a worshipping community, the outline covers such topics as the importance, forms, and variations of the eucharistic liturgy; the sacraments; and the liturgical year. It goes on to monasticism; the saintly life; the major eras, regions, and schools of Christian art; and the expression of Christian faith and themes in particular arts. Dealing with attitudes concerning the relation of the Christian community and the individual Christian to the world, the outline first treats the relations of the church to the political, socioeconomic, intellectual, educational, and cultural orders. It then treats diverse tendencies in the understanding of marriage and the family; diverse approaches to the understanding of Christian personal and social ethics; and attitudes toward the religions of pagan antiquity, toward Judaism, toward Islām, toward the religions of Asia, and toward modern primitive religions. Finally, the outline deals with other tendencies affecting traditional institutional Christianity: the esoteric tradition involving arcane disciplines and Gnostic groups; and recent trends toward secularization.

Subject G is the major traditional forms of Christianity. The articles referred to separately treat the major differentiating beliefs, practices, and institutions of Eastern Orthodoxy; of Roman Catholicism, including the Eastern rite churches in communion with Rome; and of Protestantism.

Subject H is the major forms of Protestantism. The articles first referred to separately treat the distinctive creedal statements, practices, and institutions of Lutheran churches, of Reformed and Presbyterian churches, and of the Anglican Communion. The outline goes on to the characteristics that have traditionally distinguished the Free churches from Lutheran, Reformed, and Anglican churches. Articles referred to then give separate treatment to the major Free churches: Baptists, Disciples of Christ, Congregationalists, Methodists, Friends, and Unitarians and Universalists.

The outline of subject I deals first with the nature and history of the ecumenical tradition in Christianity—the varying relations of particular forms of Christianity toward one another at different times. It then treats current ecumenical associations and agencies and the controversy about them.

Subject J is variations of the traditional forms of Christianity and special new forms. The outline first deals with traditional Eastern churches separated from the Orthodox Eastern Church —the Syrian, East Syrian, Armenian, Coptic, and Ethiopian churches—and with other deviant or eclectic churches in the East. It next treats the Eastern rite churches within the jurisdiction of the Roman Catholic Church and various kinds of separatist churches, especially the several kinds of so-called Old Catholic churches. The outline next deals with variants of Protestantism, treating separately Holiness churches; Pentecostal churches; millenarian churches, such as Adventists and Jehovah's Witnesses; old-line Protestant sects, such as the Mennonites, the Moravians, and the Brethren; various Fundamentalist and evangelical churches; and Negro versions of traditional Protestantism. The outline concludes with new forms that are tangentially related to traditional Christianity, such as New Thought, Christian Science, and Mormonism.

	articles	article sections	other references
A. History of Christianity before the schism of 1054	CHRISTIANITY BEFORE THE SCHISM OF 1054 **4**:533–545		
1. The development of the Christian Church from the time of Jesus to the reign of Constantine		**4**:533e–540b/ **15**:986h–987b	**4**:508h–509c/**12**:272h–273b
a. The origins and growth of the primitive church, *c.* AD 30–70		**4**:533e–536g/ **4**:490g–491d	
i. The relation of the early church to late Judaism [see also 826.A.]		**4**:533e–534c/ **2**:945g–947c/ **4**:481d–482c/ **10**:315b–f	**10**:146f–148g/**10**:242e–243b
ii. The relation of the early church to the life, work, and teachings of Jesus of Nazareth, *c.* 6 BC–*c.* AD 30		**4**:534d–535e/ **2**:948a–d/ **5**:229d–h	**10**:148g–154a/ **11**:1018h–1019a/ **14**:154e–155b/ **15**:65f–h
iii. The mission of the Apostles in Palestine and in the Gentile world		**4**:535e–536a/ **2**:947c–948a/ **2**:948d–h	**2**:956f–973a *passim*/**4**:546a–c/ **10**:241a–e/**11**:177e–178c/ **13**:1091a–1093h/ **14**:153d–155h/**15**:65h–66a
iv. Organization, worship, and doctrine in the primitive Christian churches: the influence of contemporary, social, religious, and intellectual patterns [see also 822.E. and 826.A.]		**4**:536a–g/ **4**:485a–e	**4**:601c–e/**6**:961h–962c/ **8**:749a–750d *passim*/ **14**:1010e–h
b. Post-apostolic developments in the early Christian Church, *c.* AD 70–325		**4**:536h–540b	
i. The development of church polity and institutions: variations in practice in different areas; the teaching of the Apostolic Fathers on the nature and practice of ecclesiastical authority [see also E.2.a., below]	PAPACY **13**:955–956	**4**:536h–537e/ **13**:960e–f/ **13**:1078f–1079c	**1**:199f–200g/**4**:460a–c/ **4**:493d–g
ii. The development of the New Testament canon		**4**:537e–538a/ **2**:938g–941a/ **2**:973a–e	**2**:883c–e
iii. The liturgical origins and theological function of the early creeds		**4**:538a–b	**5**:244e–g

	articles	article sections	other references
iv. Early heretical movements; *e.g.*, Gnosticism, Montanism		**4**:538b-d/ **8**:215d-216b	**4**:553c-f/**4**:601c-e/ **9**:889d-890a/**11**:443h-444b/ **12**:201f-h/**13**:1079c-g/ **15**:66b
v. The relationship between Christianity and the Roman government: the challenges facing the church in a pagan state		**4**:538d-g/ **9**:849b-c/ **15**:1121f-1122b	**5**:400h-401g/**6**:329c-e/ **13**:153a-b/**15**:1125g-1126a
vi. The relationship between Christianity and classical culture: pagan philosophy and the mystery religions; attempts of the early Christian apologists to resolve the problem [see also E.2.a., below]		**4**:538g-539e/ **4**:485e-g/ **6**:333f-h/ **13**:1079h-1080g	**4**:467h-468d/**4**:552g-553c/ **8**:1173e-1174a/**13**:848a-d/ **14**:542g-543b/**17**:700a-c
vii. The further development of liturgical practices: the role of music, art, and literature in early Christianity; early monastic institutions; the rise of catechetical and theological schools at Antioch, Alexandria, and other places		**4**:539e-540b/ **4**:480h-481a/ **13**:1080g-1081h	**3**:1042h-1043b/**4**:502b-c/ **4**:601e-g/**4**:710d-711g/ **13**:735c-736e/**15**:645a-b/ **18**:160g-161c/**19**:319b-d
2. The early Christian Church, from the reign of Constantine to the pontificate of Gregory I, the Great, *c.* 4th-6th century		**4**:540c-542f/ **15**:1131b-e	
a. The establishment of Christianity as the state religion of the Roman Empire: the problem of the alliance between church and empire; the increasingly important role played by the bishop of Rome as pope		**4**:540c-g/ **3**:1085c-e/ **4**:511b-h/ **4**:590c-591a/ **13**:956b-f	**4**:583g-584a/**5**:71g-73f/ **8**:44b-e/**8**:415f-416f/ **9**:1124c-g/**10**:333c-f/ **15**:1126d-g/**15**:1129d-f/ **17**:951f-g/**18**:273c-d
b. Doctrinal controversies that occasioned the further development of Christian theology		**4**:540h-541e/ **6**:139d-f	**4**:460c-e/**4**:558d-e/ **5**:244g-245b/**13**:736e-h
i. Reactions to the teaching of Novatian, Donatus, and Pelagius: the role of St. Augustine in shaping the tradition of the West		**4**:540h-541a/ **14**:687d-g	**2**:366a-368c/**4**:558d-e/ **10**:716f-g/**12**:201h-202c/ **13**:153b-g/**13**:848d-f/ **13**:1085e-g/ **13**:1085h-1086b/**14**:257b-d/ **14**:543d-h
ii. The Arian controversy and the councils of Nicaea (AD 325) and Constantinople (AD 381): the role of the theological schools in the East		**4**:541b-c/ **13**:1082c-1083a/ **13**:1083d-1084a	**2**:257g-258f/**2**:747c-f/ **4**:485h-486d/ **6**:1130g-1131b/**18**:272f-h
iii. Christological controversies and the councils of Ephesus (AD 431) and Chalcedon (AD 451)		**4**:541c-e/ **3**:550f-551b/ **4**:481b-d/ **6**:136f-137c/ **6**:138c-e/ **6**:140c-e/ **13**:1084c-1085e	**10**:364h-365d/ **12**:1057g-1058c
c. The relation of the Christian religion to the culture of the late empire		**4**:541e-542f	
i. Popular religious practices; *e.g.*, the cult of saints, the use of relics; the development of canon law as a means of regulating practices and institutions [see also F.3.a.i., below]		**4**:541e-f/ **3**:773g-775h/ **11**:828a-c	**4**:482h-483a/**4**:500e-h
ii. Refinements in the Christian use of the visual arts; *e.g.*, architectural forms, mosaics		**12**:468a-469f/ **19**:319d-324e/ **19**:325f-330g	**19**:345d-349c *passim*
iii. The further development of liturgical practices and of sacred music		**4**:541g-h/ **12**:740h-741c	
iv. The literary expression of Christian thought and practice; *e.g.*, hagiography, church history, theological and monastic literature		**4**:542c-f/ **6**:333h-334g/ **8**:947h-948h/ **10**:1126d-f/ **13**:1083b-d	**4**:546d-g/**4**:580a-d/**8**:422b-f/ **10**:1100a-f/**10**:1124f-1125a/ **13**:1086d-e
v. The growth of the church in particular areas within the empire		**3**:229f-h/ **3**:233f-h/ **3**:284g-285d/ **3**:554f-555g/ **11**:933a-h	**1**:887d-f/**2**:834h-835e/ **17**:406f-g
3. The growing division between Eastern and Western Christianity		**4**:542g-545a/ **6**:152e-154a	
a. The political and religious bases of increasing tensions between Rome and Constantinople		**4**:542g-543d/ **9**:1121b-1122b/ **13**:956f-957b	**3**:556g-557b/**4**:591f-592a

	articles	article sections	other references
b. The relation of Christianity to the Western and Byzantine cultures, 7th–11th century		**4**:543d–g	
i. Developments in the Christian use of architecture, painting, music, and the theatrical arts		**3**:559d–560e/ **12**:469f–470g/ **12**:704g–705a/ **18**:221c–d/ **19**:341b–342d	**3**:653e–656a *passim*/ **4**:503e–504a/**10**:809c–e/ **19**:330g–336f *passim*/ **19**:349d–355h *passim*
ii. Diverse attempts to promote scholarship and literary activity		**3**:200e–h/ **6**:330b–331a/ **6**:334c–335h/ **8**:1174a–1175b	**1**:486d–g/**8**:948h–949c/ **10**:1100f–h/**14**:257f–258a
c. Developments affecting institutions and practices in the East and the West		**4**:543g–544h	
i. The further expansion of Christianity in the West: developments in particular areas		**3**:200a–e/ **3**:201g–202a/ **3**:203e–g/ **8**:39g–40c/ **8**:73b–e	**3**:31g–32b/**3**:1043b–d/ **4**:509g–510a/ **9**:1124g–1125a/ **10**:804g–805b/ **16**:306h–307f *passim*/ **17**:899d–h
ii. Developments in Eastern Christianity: the rise of the independent churches		**6**:137c–f	**3**:561d–e/**6**:138e–139a/ **6**:139f–h/**6**:140f–g
d. The Photian schism and the beginnings of the great East–West schism		**4**:544h–545a/ **6**:142h–143c	**3**:562c–d/**10**:805c–e/ **14**:290h–291c
B. History of Eastern Orthodoxy from the schism of 1054 to the present day	EASTERN ORTHODOXY, HISTORY OF **6**:152–162		
1. The church of imperial Byzantium		**6**:152e–155g	**4**:591d–f/**6**:294c–f
a. Effects of the Crusades and other invasions (to 1261)		**6**:154a–e	**3**:565a–e
b. Developments in the Eastern churches from 1261 to 1453; *e.g.*, relations with the Western Church; the theological and monastic renaissance		**6**:154e–155g/ **3**:568e–h/ **12**:471g–472g/ **19**:336g–339g	**12**:96h–97b/**13**:905f–906a
2. Developments from the fall of Constantinople (1453) to the early 19th century		**6**:155h–158b/ **6**:294f–295d	**6**:150d–g
a. Orthodoxy under the Ottomans (1453–1821)		**6**:155h–156g	
b. The Church of Russia (to 1800)		**6**:156g–158b/ **6**:331d–332a/ **19**:339h–341b	**6**:150d–e/**13**:101h–102d/ **16**:50h–51b
3. The Orthodox churches in the 19th century: developments in various areas		**6**:158c–159g	**10**:453a–b
4. The Orthodox Church since World War I		**6**:159g–162a	
a. Developments in various countries and regions; *e.g.*, in the Soviet Union, the Balkan states, the Middle East, and the United States		**6**:159g–161g	
b. Missionary, theological, and ecumenical developments		**6**:161g–162a/ **6**:150g–151a/ **6**:296d–f	**6**:145e–146a/**6**:295f–g
5. The Eastern Church today: its current demographic and social aspects		**6**:142f–h/ **6**:151g–152a	
C. History of the Roman Catholic Church from the schism of 1054 to the present day	ROMAN CATHOLICISM, HISTORY OF **15**:1002–1019		
1. The medieval and Renaissance eras, *c.* 11th–16th century		**15**:1002e–1009d	**15**:987d–e
a. Development of the papacy as the chief spiritual and temporal power in the West	PAPACY **13**:957–959	**13**:960g–961a/ **4**:592a–e/ **5**:810e–811c/ **12**:143d–g	**14**:1010h–1011a/ **15**:1069g–1070e
i. The reforms of Leo IX, Nicholas II, and Gregory VII (Hildebrand); the Investiture Controversy; the involvement of 12th- and 13th-century popes in international political matters		**13**:957c–958c/ **15**:1002e–1003b/ **15**:1003d–1004g/ **15**:1005c–d/ **15**:1005g–1006a/ **3**:205e–g/ **3**:208c–f	**1**:467b–g/**2**:787b–h/**3**:206c–e/ **3**:209d–h/**8**:74a–75e *passim*/ **8**:417h–418g/**8**:419d–h/ **8**:761f–762b/**9**:605c–606c/ **9**:607b–h/**9**:1129a–1130d

	articles	article sections	other references
ii. The papacy in the Late Middle Ages: Boniface VII to the Council of Trent (1545–63)		**13**:958d–959a/ **15**:1007c–e/ **15**:1007h–1008e/ **9**:1142e–h	**1**:937h–938e/**2**:1188c–h/ **3**:32g–33f/**3**:237g–h/ **7**:618e–g/**8**:79h–80b/ **9**:1137h–1138b/**9**:1139e–g/ **10**:233f–234a/**11**:117c–f/ **14**:481d–g/ **14**:224b–225a
b. Religious and cultural characteristics of Latin Christianity		**6**:335h–336g/ **10**:1103e–h/ **12**:470g–471g	**6**:294c–f/**7**:137a–f/ **10**:1100h–1101e/ **17**:410c–f/ **19**:355h–379b *passim*
i. The church and the social order: the role and development of canon law [see also F.3.a.i., below]		**15**:1002e–1003b/ **15**:1006f–1007b/ **3**:776a–h/ **12**:145e–146f/ **12**:154c–156c	**3**:231e–f/**3**:235b–d/**4**:510a–b/ **5**:93f–h/**6**:1116e–f/**9**:606e–f/ **13**:848a–h/**14**:640g–641a/ **15**:1007f–h
ii. Popular Christianity: the religion of the layman		**15**:1003b–d/ **4**:553h–554e/ **5**:458h–459b/ **11**:298h–299c/ **18**:221g–222e/ **18**:242e–g	**8**:86f–h/**9**:1134e–h/ **12**:161f–162a/**15**:645b–d/ **19**:898d–h
iii. The Crusades		**15**:1004d–g	**3**:565a–e/**5**:298d–299e/ **5**:303f–h/**5**:310c–f/ **6**:154a–d/**9**:606c–d/ **11**:119c–f/**12**:338e–g/ **16**:117f–h
iv. Developments in theology and philosophy: the role of Scholasticism [see also 10/52.B.2. and 10/53.A.1.j.]		**15**:1004g–1005a/ **15**:1006a–f/ **3**:1085g–1086b/ **7**:67a–d/ **8**:1175b–f/ **12**:163f–164a/ **12**:864b–f/ **14**:258a–261d/ **14**:687h–688d/ **16**:354e–356f/ **16**:367f–h	**1**:10c–11c *passim*/**1**:430a–c/ **1**:1159a–g/**5**:1084a–e/ **7**:622d–e/**10**:716h–717a/ **13**:504h–505c/ **18**:346b–348b
v. Monasticism: reforms in the monasteries and the rise of the mendicant orders		**15**:1005a–b/ **15**:1006b–d/ **15**:1009a–d/ **12**:155d–g	**4**:345f–346a/**5**:942c–943b/ **7**:612e–g/**8**:1114d–f/ **10**:857e–858a/**12**:338e–g/ **13**:505d–g
vi. Medieval heresies and other revivalist, prophetic, and reform movements		**15**:1005e–g/ **15**:1008e–1009a/ **3**:215a–c/ **8**:83b–84b	**2**:889h–890a/**4**:529g–530a/ **7**:621f–622c/**7**:682c–683d/ **9**:64f–66a/**10**:225b–e/ **11**:444g–h/**12**:162a–c/ **19**:1050f–1051d
vii. The treatment of the Jews in the West: *e.g.*, forced conversions and periodic massacres; religious, social, and economic explanations for such persecution		**15**:1006h–1007b	**10**:321e–f/**17**:422d–423e
viii. Mysticism [see also E.5., below]			**4**:547a–f/**6**:187f–188b/ **15**:669a–d
ix. Humanism [see also 10/42.A.2.]		**14**:688d–f/ **15**:665a–c	**5**:483a–485f *passim*/ **6**:343c–345h *passim*/ **6**:887f–888a/**6**:952a–954a/ **10**:334c–h/**11**:141b–e/ **12**:97h–102b/**13**:67a–c/ **14**:161h–163d *passim*/ **15**:668f–669a/**16**:981a–d/ **19**:379b–412e *passim*
2. The era of the Reformations and the wars of religion: from Luther's reform to the Peace of Westphalia, 16th–17th century			
a. Background of the Protestant Reformation in late medieval and Renaissance Catholicism [see D.1.a., below]			
b. The Protestant Reformation [see D.1., below]			
c. The Catholic Reformation and Counter-Reformation		**15**:1009d–1013a	**3**:777a–d/**15**:555a–b/ **15**:987f–h

	articles	article sections	other references
i. The Catholic Reformation: attempts to reform the church from within; the formation of new orders and the reformation of old orders; the Council of Trent (1545–63)		**15**:1010a–1011g/ **13**:959a–b	**3**:777b–d/**10**:222h–223c/ **10**:806c–807a/ **11**:166h–167b/ **12**:707h–708b/ **13**:1041e–1042g/ **13**:1087f–1088e/**15**:669d–e/ **17**:422g–423e/**17**:426g–427a
ii. The Counter-Reformation: religious and political approaches directed against the Protestant movements; developments in various places		**15**:1011g–1013a/ **3**:1086b–f/ **6**:348a–c/ **8**:91a–g/ **16**:831e–f	**2**:454c–g/**2**:1191a–1192b/ **3**:1087a–f/**9**:1148h–1149b/ **9**:1151d–e/**11**:141d–f/ **14**:481h–482e/ **14**:644h–645b
d. The wars of religion [see D.1.h., below]			
e. Missionary endeavours in other areas: the role of the church in the explorations and colonial policies of the European powers			
i. In the Americas		**15**:1017f–g	**10**:695b–e/**10**:697f–698e/ **18**:701c–e
ii. In Africa			**3**:1093d–f/**6**:1009e–g
iii. In Asia			**9**:392f–393b/**10**:381d–f/ **15**:826c–g/**19**:1055d–h
3. The transition era: from the Peace of Westphalia to the French Revolution, 17th–18th century		**15**:1013a–1014g	
a. The effect of changing conditions on the papacy: the struggle between Ultramontanism and the claims of Conciliarism and later of Gallicanism		**15**:1013a–f/ **7**:631b–g	**3**:54b–55b/**13**:961b–d/ **15**:833h–834a
b. Developments in theology and mysticism: Jansenism, Quietism, and other movements		**15**:1013f–1014b	**3**:968f–969d/**6**:350g–351a/ **10**:33g–34c
c. Controversies concerning, and suppression of, the Society of Jesus		**15**:1014b–e/ **18**:224a–c	**6**:350f–g/**17**:435d–h
d. The influence of religious life on culture and the arts		**15**:1014e–g/ **6**:1128b–d	
e. The expansion of missions in the Americas, Africa, and Asia			**3**:777d–e/**3**:1093f–h/ **10**:510a–b/**14**:241e–f/ **19**:124g–125b
f. Developments in the Americas			**6**:356f–g/**18**:701e–f
g. The challenge of rationalism, Deism, and the Enlightenment		**16**:372d–e	**5**:563a–b/ **6**:888f–890h *passim*/ **10**:1170c–1171h *passim*
4. The modern age: from the French Revolution to World War I, 18th–20th century		**15**:1014g–1016g	
a. The effects of the French Revolution and the Napoleonic era		**15**:1014g–1015g/ **4**:594c–e/ **13**:959c–f	**7**:651e–g/**7**:654g–h
b. The reign of Pius IX (1846–78): the increase in papal authority and the assertion of papal supremacy; protests from schismatic groups and national governments [see also J.2.b., below]		**15**:1015g–1016d	**8**:113a–b/**13**:1g–2b/ **13**:552g–553b/**14**:484e–485f
c. The reign of Leo XIII (1878–1903): developments in scholarship and social thought		**15**:1016d–g	**10**:807h–808d/**14**:694e–f
d. Developments in particular areas		**15**:1018c–e/ **15**:1018g–h	**10**:510b–c/**10**:531g–h/ **18**:701f–h/**19**:125b–d
5. Developments in the 20th century		**15**:1016g–1017d/ **15**:988b–c	
a. The reign of Pius X: condemnation of Modernism, the revision and codification of canon law, and the beginnings of the liturgical movement		**15**:1016g–h	**3**:777e–778a
b. The relations of the church with democratic, Fascist, and Communist regimes during the periods of the world wars: its response to new ideologies and to secular culture		**15**:1016h–1017b	**14**:486g–487b

	articles	article sections	other references
c. Developments leading up to and following the second Vatican Council: Catholic ecumenism and inner renewal [see also I., below]		**15**:1017c-d/ **3**:778b-779f/ **4**:606e-g/ **6**:296c-d/ **13**:960a-c/ **13**:962f-963a/ **15**:1001f-1002a	**3**:1043d-f/**10**:235f-236d/ **13**:961d-f/**13**:1089b-g
d. Developments in the United States, Canada, Latin America, and other American countries		**15**:1018a-c	**6**:428c-d/**13**:248b-c
e. Developments in the non-Western world		**15**:1019c-f	
6. Roman Catholicism today: its current demographic and social aspects		**6**:165a-b/ **15**:986e-g	**1**:630e-f/**11**:853h-854a
D. History of Protestantism	PROTESTANTISM, HISTORY OF **15**:108-120		
1. The Protestant Reformation and its aftermath, to the Peace of Westphalia, 16th-17th century	REFORMATION **15**:547-556	**15**:109b-112d/ **4**:460e-h/ **15**:99e-100d	**8**:953d-954c/**10**:858d-h
a. Its background in European Roman Catholic Christendom			
i. The institutional patterns of late medieval and Renaissance Catholicism		**15**:547g-548g/ **15**:1009d-1010a	**3**:238c-e/**4**:510a-b/**7**:627e-f/ **8**:86f-h
ii. Calls for reform within the church: forerunners of the Reformers		**15**:548h-549b/ **3**:215a-c/ **8**:83b-84b/ **12**:435f-436a/ **15**:1008e-1009a	**9**:64f-66a/**19**:1050f-1051d
iii. The political, economic, and cultural situation in the early 16th century [see 961.A.]			
b. Luther and the German Reformation		**15**:549c-552a/ **8**:87g-88g/ **11**:197a-e/ **15**:109b-d	**2**:1202e-1203a/**3**:361f-362b/ **6**:294f-g/**6**:346b-e/ **10**:807a-b/**10**:1143b-d/ **11**:190f-195f/**11**:863f-864e/ **15**:558c-d
c. The Reformation in Switzerland, France, and the Low Countries		**15**:110c-f/ **15**:552a-554c/ **15**:557d-558f	
i. The Swiss Reformation		**6**:347g-348a/ **17**:882d-883e	**3**:671f-674f/**7**:1011c-d/ **15**:557e-h/**19**:1179b-h
ii. The French Reformation		**15**:553e-554c/ **7**:629d-h	**3**:674b-c/**15**:557h-558b
iii. The Dutch Reformation			**11**:146a-d/**13**:556b-e/ **15**:558d-f/ **19**:833f-836a *passim*
d. The English, Scottish, and Irish reformations	PURITANISM **15**:304-306	**15**:110f-h/ **15**:111c-g/ **15**:554c-555e/ **2**:713e-714a/ **3**:222g-224e/ **3**:242g-243a/ **3**:286g-287a/ **4**:593d-594c	**2**:890b-891e/**3**:238e-239b/ **3**:239f-245f *passim*/ **3**:1036g-h/**5**:237c-238b/ **5**:296c-f/**6**:346f-h/ **8**:770g-771f/**8**:1065g-1066f/ **10**:495a-497b/**10**:708d-h/ **12**:439f-h/**15**:558f-559b
e. Expansion of the Reformation to Scandinavia, the Baltic states, and eastern, central, and southern Europe		**15**:555f-556c/ **16**:319e-g	**2**:454b-d/**2**:1191a-1192b/ **14**:643f-g/**15**:559c-e/ **18**:860c-e
f. Radical reform movements		**15**:110h-111c/ **15**:551f-552a/ **15**:552c-f/ **7**:710d-h	**12**:619e-620c/**15**:105e-h
i. In Germany and the Low Countries		**8**:88g-89a/ **11**:904c-e	**11**:141e-g/**11**:193f-194b/ **11**:906d-g
ii. In eastern Europe		**12**:436a-c	
g. The Catholic Reformation and Counter-Reformation [see C.2.c., above]			

	articles	article sections	other references
h. The wars of religion: church–state relations and the gradual development, during the 16th–17th century, of the concept of religious liberty		**15**:111g–112d/ **15**:556c–h/ **2**:454e–h/ **4**:592h–593b	**4**:492c–e/**4**:510c–d
i. The war between Charles V, Holy Roman emperor, and the German Protestant princes		**8**:89b–90h	**3**:362b–c/**4**:50a–c/ **6**:1085g–1086a/ **6**:1086h–1087e/ **14**:230e–231d
ii. The wars between French Protestants, or Huguenots, and Catholics		**15**:554a–c/ **6**:1089a–b/ **7**:629h–631b/ **17**:883f–884b	
iii. The Thirty Years' War		**18**:336g–337f	**9**:34h–35c
2. The transition era: from the Peace of Westphalia to the French Revolution, 17th–18th century		**15**:112d–114e	**12**:202e–h/**15**:100e–h
a. Political developments affecting the continental Protestant churches		**15**:112d–h	
b. Developments in German Protestantism	PIETISM **14**:455–457	**15**:112h–113d/ **6**:352g–353g	**3**:156h–157c/**8**:100d–h/ **11**:197e–h/**15**:105c–e
c. The challenge of Rationalism, Deism, and the Enlightenment: the Protestant response		**15**:113d–h/ **5**:562b–563e/ **6**:348g–349b	**5**:93h–94c/ **6**:888f–890h *passim*/ **11**:197g–h
d. Developments in English Protestantism	PURITANISM **15**:306	**15**:113h–114c/ **3**:262c–g	**2**:714a–c/ **3**:245g–249c *passim*/ **3**:289c–g/**4**:1127h–1128e/ **5**:292c–d/**6**:294g–295a/ **7**:580a–e/**7**:743d–e/ **12**:60c–f/**18**:860f–g/ **19**:898h–899a
e. Developments in American Protestantism during the Colonial period		**15**:114c–e	**6**:357b–d/**12**:937e–h/ **15**:560d–e
i. Developments in Protestant churches of British origin	PURITANISM **15**:306–308	**7**:743f–744a	**2**:714d–715a/**3**:481f–482h/ **4**:1129a–d/**6**:440h–442c/ **11**:696f–698b *passim*
ii. Developments in Protestant churches of German and eastern European origin			**3**:157c–e/**11**:904g–h/ **14**:458g–h
f. Developments in the Dutch Reformed churches		**11**:149a–d	
g. Developments in other continental European churches		**12**:436c–f	**11**:904e–g/**14**:458c–f/ **19**:1155c–1156a
3. The modern age: from the American and French revolutions to World War I, 18th–20th century		**15**:114e–118c	
a. Developments in continental Europe		**15**:114e–115c/ **12**:436f–h	**2**:716a–c/**11**:197h–198b/ **14**:458h–459h
b. Developments in the United States		**15**:115c–h/ **5**:834d–835a/ **7**:744a–e/ **7**:777f–778f/ **8**:994a–995c/ **10**:131e–h	**1**:101g–102d/**2**:715b–f/ **3**:157e–g/**4**:1129d–e/ **10**:120e–g/**12**:61b–c/ **12**:202h–203a/**12**:937h–938f/ **13**:14h–15a/**14**:459h–460b/ **15**:560f–g/**18**:701h–702e/ **18**:861b–e
c. Developments in the British Isles		**3**:269a–g	
i. Anglicanism			**1**:888a–d/**2**:891e–g/**13**:1c–g
ii. Free churches		**4**:1128f–1129a	**12**:60g–61a/**18**:860g–861b
d. General trends affecting Protestantism throughout the world: expansion, revivalism, and the response to social and intellectual challenges		**15**:115h–118c	**7**:67e–g/**8**:656g–657b/ **13**:445c–g/**16**:374d–h
4. Developments in Protestantism after World War I		**15**:118c–120a	
a. The response of European Protestantism to war and to the new totalitarian governments		**15**:118c–119a	**2**:726b–e/**3**:30h–31c/ **11**:198c–d
b. New theological developments		**15**:119b–d/ **4**:461f–g	**2**:726d–g/**2**:892a–b/**3**:479c–f/ **7**:67h–68b/**12**:274b–c
c. The foreign activities of the Protestant churches		**12**:61f–h/ **18**:702h–703h	
d. The Protestant ecumenical movement [see also I., below]		**15**:119e–120a	**6**:295d–f/**6**:296a–c

	articles	article sections	other references
e. The confrontation and interchange between Protestantism and secular culture and society		**15**:101a–c	
f. Developments in the United States		**5**:835a–836a/ **7**:778f–780c/ **7**:996a–e/ **12**:938g–940a/ **14**:31c–34a	**6**:429c–d/**13**:74e–g/ **15**:560g–h
5. Protestantism today: its current demographic and social aspects		**4**:1130g–1131a/ **11**:905a–b/ **14**:30e–f/ **14**:34a–f/ **15**:108a–d	**1**:102g–h/**1**:887a–c/**2**:713d–e/ **8**:55b–d/**18**:859h–860a
E. Intellectual, spiritual, and imaginative expressions of Christianity [see also F.4., below]			
1. Sacred Scriptures: biblical literature	BIBLICAL LITERATURE **2**:879–975	**7**:61c–f	
a. The Old Testament		**2**:881g–931a/ **10**:208c–d	**1**:3b–e/**1**:11e–13d *passim*/ **4**:466a–e/**4**:537e–f/ **7**:64h–65c/**7**:136d–e/ **9**:910e–g/**10**:135e–h/ **10**:191e–192c/**12**:200h–201c
b. Old Testament Apocrypha		**2**:931b–935b	**10**:193b–h/**12**:201d–f
c. The New Testament		**2**:938g–973a	**4**:537g–538a/**7**:66d–f/ **10**:145g–146f/**10**:241h–242e/ **11**:178d–f/**11**:560g–561b/ **13**:1091a–1094c *passim*
d. New Testament Apocrypha		**2**:973a–974a/ **8**:217f–g	**4**:553g–h/**14**:157a–c
e. The interpretation of Sacred Scriptures	EXEGESIS AND HERMENEUTICS, BIBLICAL **7**:60–68	**2**:884a–885d/ **2**:941a–942g/ **2**:949d–951c/ **7**:778f–779e	**3**:479c–f/**4**:498e–499b/ **8**:734a–c/**8**:1177f–g/ **10**:192c–e/**12**:487d–h
2. Patristic literature	PATRISTIC LITERATURE **13**:1077–1086		
a. Ante-Nicene literature		**13**:1078f–1081h/ **4**:539c–e	**1**:200a–g/**4**:537a–b/ **4**:552g–553c/**4**:710d–711g/ **7**:66g/**9**:889g–890a/ **13**:735c–g/**18**:160g–161b
b. Post-Nicene literature		**13**:1081h–1086f	**1**:657g–658a/**2**:257h–258f/ **2**:366a–368c/**2**:747f–g/ **4**:542c–f/**6**:1130d–g/ **7**:66h–67a/**8**:421f–h/ **10**:138a–e/**14**:257b–g
3. Formal, official statements of beliefs and doctrines; *e.g.*, creeds, dogmas, confessions of faith		**4**:460e–h/ **4**:492f–493d/ **5**:244e–246b	**5**:928a–e/**6**:143e–g/**6**:156e–g
4. Writings of the post-patristic theologians, reformers, and church leaders		**7**:67a–68b/ **15**:623h–624g/ **18**:275g–276b	**2**:861d–862a/**3**:54b–55b/ **3**:482b–g/**4**:518h–519a/ **6**:952a–954a/**8**:422g–423a/ **8**:656g–657b/ **10**:1081h–1082d/ **10**:1134d–1135a/ **10**:1143b–d/**13**:74e–g/ **13**:1041h–1042g/ **14**:257g–261d *passim*/ **15**:863c–d/**17**:856c–e
5. Writings of the great mystics	CHRISTIAN MYSTICISM **4**:545–550		**2**:1202e–1203a/**6**:187f–188a/ **10**:225b–e/**13**:905f–h/ **15**:1014a–b/**18**:277b–d
6. The relation of philosophy to Christian thought and statement: Christian philosophy and anti-philosophy	CHRISTIAN PHILOSOPHY **4**:555–562	**12**:24d–g/ **14**:256h–261d/ **14**:542g–544d/ **14**:687d–688f/ **14**:689b–690a/ **16**:352g–353d/ **16**:357a–f	**1**:984d–e/**18**:346f–347b

	articles	article sections	other references
7. Myth and legend: biblical folk, and nonbiblical literature; the role of myth in Christianity; "demythologization"	CHRISTIAN MYTH AND LEGEND **4**:550–554		**7**:132g–139a *passim*
F. Beliefs, practices, and institutions of Christianity	CHRISTIANITY **4**:459–532		
1. General considerations		**4**:459g–476a	
a. Views of the nature of Christianity: theological, ethical, ecumenical, eschatological, and historical approaches to the understanding of the "essence of Christianity"		**4**:459g–461g	
b. The problem of the nature of and criteria for the unity of the church: religious and political factors affecting the concept and implementation of unity; tendencies toward organizational, national, and tribal multiformity		**4**:462h–476a/ **6**:293d–h/ **15**:992d–993d/ **15**:107b–h	
2. Beliefs or doctrines common or predominant among the various traditional forms of Christianity		**4**:476a–490g	
a. Doctrines concerning the nature and activity of God		**4**:477e–479d/ **4**:480g–486g	
i. The nature of God: the oneness of God; the transcendence of God; God as Father		**4**:477e–478e/ **6**:145d–e/ **18**:265e–g	**4**:549h–550b/**10**:150h–153c/ **12**:383f–g
ii. The self-revelation of God: the understanding of God as Creator, Sustainer, and Judge		**4**:478e–479b/ **4**:556g–557c/ **8**:962a–c/ **15**:993d–994b	**12**:272h–273c/**15**:134h–135a/ **15**:784f–g
iii. Christology: teachings concerning the person of Jesus Christ [see also 826.C.1.e.]		**4**:480g–481d/ **2**:948h–956f/ **4**:534d–535e/ **4**:540h–541e/ **5**:229d–230b/ **6**:144c–g/ **11**:1018h–1019g	**4**:495c–e/**4**:534d–535e/ **4**:535h–536a/**4**:549e–h/ **4**:552e–g/**10**:154b–155b/ **11**:561c–562b/ **13**:1084f–1085a/**18**:860a–c
iv. Eschatology: political and apocalyptic messianic concepts; expectation of the Kingdom of God		**4**:481d–482c/ **4**:505h–508e/ **6**:959b–960c/ **6**:961h–962f	**11**:1019c–g
v. The role of the Holy Spirit in the church: the tensions between continuity and revolution, institutional authority and charismatic activity, and order and freedom		**4**:483c–485a/ **6**:144g–145a	
vi. The doctrine of the Holy Trinity		**4**:485a–486g/ **6**:145a–c	
b. Doctrines concerning intermediary beings, powers, or principles; *e.g.*, the angels, Satan [see also 811.B.2.e.v.]		**4**:479d–480g/ **19**:898b–899b	**1**:875c–e
c. Doctrines concerning the physical world		**4**:520h–522e/ **7**:134h–135c	
d. Doctrines concerning man		**4**:486g–490g	
i. Man as a creature and as the image of God: diverse emphases on his solidarity with and superiority to nature; his freedom and sinfulness; the nature of his redemption; the problem of suffering		**4**:486h–488c/ **4**:557d–558b/ **6**:143h–144c	**1**:977c–e/**2**:137e–f/ **2**:367b–368a/**15**:595g–596a/ **18**:347f–348a
ii. The relation of man to the work of Jesus Christ: the resurrection of man; the experience of salvation as justification, newness, rebirth, liberation, and perfection		**4**:488c–490g/ **16**:165e–f/ **16**:203g–204a	**4**:548d–g/**5**:527b–c/ **14**:460c–d/**15**:101c–102e/ **15**:995g–996a
e. Doctrines concerning the church: Scripture, tradition, creeds, and confessions as normative expressions of Christian belief; the nature and role of doctrine and dogma		**4**:462h–463d/ **4**:476a–477e/ **4**:490g–493d/ **4**:497b–499d/ **4**:536h–538a/ **6**:143e–h/ **15**:988c–989c/ **15**:994c–995f	**1**:888d–f/**15**:103a–g/ **15**:109d–f
3. Practices and institutions common or predominant among the various traditional forms of Christianity		**4**:493d–501h	
a. The structure of church institutions		**4**:463d–h/ **4**:493d–495c/ **4**:850b–d/ **15**:606c–f	

	articles	article sections	other references
i. The significance of church discipline in the organizational development of the church; the role of canon law	CANON LAW **3**:773–780	**4**:493d–494b/ **6**:146b–c/ **15**:992c–d	
ii. Church polity: episcopal, presbyterian, and congregational approaches to structure		**4**:494b–495c/ **6**:146d–147a/ **13**:552e–g/ **15**:989d–991b	**1**:886h–887c/**15**:102e–103a/ **15**:110c–111g/**15**:562d–e
b. The role and characteristics of the liturgy: the church as a worshipping community		**4**:495c–500c	**15**:104g–105b
i. The importance, development, forms, and variations of the eucharistic liturgy		**4**:495c–496f/ **6**:147d–148b/ **14**:1012b–c/ **15**:996b–d	**1**:888f–g/**16**:134h–135b
ii. Liturgical gestures and vestments		**4**:496f–h	**15**:635h–637h
iii. Diverse views of the number and role of the sacraments		**4**:496h–497b/ **4**:518d–g/ **6**:148f–149d/ **15**:996g–999e/ **16**:116h–118c	**5**:733e–734a/**15**:103h–104c
iv. The Christian liturgical year	CHURCH YEAR **4**:600–607	**3**:602c–603h/ **4**:499b–500c/ **6**:148c–f	
v. The liturgical use of the sung and spoken word: hymns, chants, Bible readings, and preaching		**4**:474b–d/ **2**:974d–975e/ **15**:996d–e	**10**:120e–g/**13**:642g–h/ **14**:952f–g/**19**:497g–498a
c. Forms of Christian life		**4**:500d–501h	
i. Monasticism		**4**:500d–501b/ **6**:147b–d/ **15**:991b–h/ **15**:1005a–b/ **15**:1006b–d	**2**:834h–835e/**4**:543h–544d/ **12**:342e–g
ii. The saintly life		**4**:484c–g/ **4**:501b–h/ **15**:999g–1000b/ **16**:165e–f	
4. Art and iconography			
a. Major eras, regions, and schools of Christian art		**4**:501h–504a/ **4**:519c–520b/ **10**:1099c–1100a/ **19**:318g–319a/ **19**:324e–325g/ **19**:330g–331c/ **19**:341b–c/ **19**:344a–e	
b. The expression of Christian faith and themes in the visual arts		**6**:149d–150b	**19**:318g–432e *passim*
i. Architecture		**8**:1173e–1174a/ **19**:319b–321g/ **19**:339h–340g/ **19**:341c–342a/ **19**:354e–360b	**7**:422a–423a/**15**:1081c–1083c/ **19**:325g–327e/**19**:331c–g/ **19**:336g–337b/**19**:342f–h/ **19**:349e–350c/**19**:351c–e
ii. Sculpture and reliefs		**19**:322f–323a/ **19**:342h–343c/ **19**:360c–f	**5**:538a–b/**19**:327e–f/ **19**:351f–352d
iii. Paintings, mosaics, and stained glass		**12**:468a–472g/ **19**:321g–322d/ **19**:323a–g/ **19**:340h–341b	**12**:464c–h/**13**:885e–g/ **17**:566h–576d *passim*/ **19**:327f–328d/**19**:331h–332f/ **19**:337f–339b/**19**:343c–h
iv. Manuscript illumination and illustration		**19**:342c–d	**3**:653e–656a *passim*/ **19**:330c–f/**19**:332g–333d/ **19**:339b–f/**19**:350d–e/ **19**:352f–353h/**19**:361a–362e
v. The sumptuary arts: jewelry, tapestry, and glass		**19**:323h–324e/ **19**:362e–363d	**10**:171c–e/**19**:328d–330c/ **19**:333d–335e/**19**:350e–f
vi. Cult objects			**7**:474e–475g/ **11**:1094h–1095a/ **11**:1097h–1098b
c. The expression of Christian faith and themes in other arts			

	articles	article sections	other references
i. Music: liturgical and nonliturgical		**4**:443c–445d/ **5**:458g–459a/ **12**:296g–297h/ **12**:716e–717e	**12**:663f-g/**12**:689f-g/ **12**:706d-e/**12**:707h–708b/ **14**:59c-g/**19**:497g–498a
ii. Drama; *e.g.*, mystery plays		**10**:1103e-h/ **18**:242e-g	**18**:582h–583a
iii. Literature: Christian themes in imaginative literature		**7**:134h–135c/ **7**:135h–136e/ **10**:1038f-g/ **10**:1100a–1101e	**1**:241d-f/**4**:550f–554g *passim*/ **5**:485b-f/**7**:137a-h/ **10**:1124e–1125a/ **12**:205d–208c
5. Attitudes concerning the relation of the Christian community and the individual Christian to the world		**4**:469h–471d/ **4**:508f–526d	
a. The relationship between the church and the political orders: problems associated with the exercise of power; diverse approaches to and views of the forms of political institutions		**4**:463h–464e/ **4**:468g–469h/ **4**:508f–512f/ **4**:538d-g/ **15**:107b-c/ **15**:1000h–1001a/ **15**:1003g–1004d	**4**:540c-e/ **12**:142f–143g *passim*/ **15**:104d-e/**15**:106d-e
b. The relationship between the church and the socioeconomic order		**4**:512f–514a/ **15**:117d-f/ **15**:1001b-c	
c. The involvement of the church in intellectual and educational pursuits: forms of Christian education		**4**:514b–516d/ **15**:117g–118c/ **15**:1000e-g	**15**:645a-f
d. The concern of the church for the sick and for others in need		**4**:516d–517a/ **15**:998g–999a/ **15**:1000g-h	**8**:1114d-f/**13**:395h–396a
e. The influence of the church on culture: diverse effects of the status of the church as a majority religion or as a minority religion in different places		**4**:464e–465b/ **4**:519b–520h/ **6**:155h–156c	**4**:551a-c/**6**:1123c-f
f. Diverse tendencies in the understanding of marriage and the family: biblical, theological, and ethical approaches		**4**:522e–524g/ **15**:556g-h/ **15**:999a-c/ **15**:1001d-e	**16**:599a-d
g. Diverse approaches to the understanding of Christian ethics: the commandment to love God and neighbour; personal and social ethics		**4**:524g–526d/ **3**:1042h–1043f	**1**:449g–450a/**7**:63f-h/ **15**:282c-g/**15**:595g–596a
6. The relation of Christianity to other religions			
a. Basic attitudes toward non-Christian religions: traditional approaches and recent developments; missionary activity; apologetics		**4**:491h–492e/ **4**:504a–505h/ **4**:526d–529c/ **6**:150c-f/ **15**:615e–616c/ **15**:1000c-e	**3**:777d-e/**15**:624g–625a
b. Attitudes toward and relations with other religions			
i. The religions of pagan antiquity		**4**:538g–539e/ **4**:541e-f/ **8**:218d–219b/ **10**:1038f-g/ **12**:784h–785g	**4**:467h–468d/**4**:551e–552b/ **5**:73d-f/**6**:329c-e/**6**:887d-e/ **13**:1079h–1080c/ **14**:542g–543b
ii. Judaism		**4**:466a–467h/ **2**:880d-e/ **4**:533f–534c/ **7**:63f–64b/ **7**:66d-f/ **10**:299h–300b/ **10**:315b-f/ **10**:325f–326a	**2**:962f–963c/**4**:497d-h
iii. Islām		**6**:155h–156c	**2**:621h–622a/**9**:926a-d/ **17**:426g–427a
iv. The religions of India		**8**:907c-f	
v. East Asian religions			**4**:356b/**4**:361e-f/ **10**:531g–532a/**15**:1014b-c
vi. Modern primitive religions		**4**:471h–472g/ **6**:1065c-d	**18**:697f–705b *passim*
7. Other tendencies affecting traditional institutional Christianity		**4**:529c–532b	

	articles	article sections	other references
a. The esoteric tradition in Christianity: arcane disciplines; gnostic groups; the influence of such tendencies in monasticism and mysticism		**4**:529c–530e	
b. The trend toward secularization: recent tendencies limiting the cultural and religious role of Christianity		**4**:530e–532b	
G. The major traditional forms of Christianity			
1. Eastern Orthodoxy [see also J.1., below]	EASTERN ORTHODOXY **6**:142–152		
a. The Orthodox Church: general characteristics deriving from its historical development		**6**:142c–143e/ **4**:546d–547a	**4**:469d–h/**4**:491d–f/ **4**:502e–503e/**10**:453a–b
b. Teachings, forms of worship, and principles of organization that distinguish Eastern Orthodoxy from Protestantism and Roman Catholicism		**6**:143e–150b/ **2**:974d–g	**4**:504f–505a/**4**:602b–c/ **13**:961g–962a/ **15**:636h–637b
c. The relationship of Eastern Orthodoxy to recent social movements and to other religious traditions		**6**:150c–152a/ **4**:509d–f	**6**:296d–f
2. Roman Catholicism	ROMAN CATHOLICISM **15**:985–1002		
a. The Roman Catholic Church: general characteristics deriving from its historical development and cultural importance; its differentiating beliefs and doctrines		**15**:986a–996a/ **4**:457a–g/ **9**:1124c–1125a/ **13**:960d–963a	**2**:1071a–f/**4**:473c–e/ **4**:491g–h/**4**:555g–h/ **6**:373e–f/**11**:561c–563a/ **14**:694e–f
b. Forms of worship and principles of organization distinguishing the Catholic tradition from that of Eastern Orthodoxy and Protestantism		**15**:996b–1000h/ **2**:975c–e/ **3**:778f–779c/ **3**:1042h–1043f/ **5**:810e–811c/ **6**:296c–d/ **13**:954h–955g/ **15**:636a–h/ **15**:637e–h	**4**:505a–d/**4**:602e–g/**4**:606e–g/ **7**:474e–h/**13**:395h–396a
c. The attitude of Roman Catholicism toward social and political developments: traditional views; recent trends		**15**:1000h–1002a	**4**:509f–510b
d. The Eastern rite churches: their history, special organization, practices, and discipline	EASTERN RITE CHURCHES **6**:162–165		**3**:778c–e
i. Byzantine rite		**6**:162g–163c	
ii. Alexandrian rite		**6**:163c–f	
iii. Antiochene rite		**6**:163g–164c	
iv. Chaldean rite		**6**:164c–f	
v. Armenian rite		**6**:164f–165a	
3. Protestantism	PROTESTANTISM **15**:99–108	**15**:108h–109b	
a. The Reformation heritage: its origins in the magisterial and radical reformers and its historical development		**15**:99e–101c/ **4**:461c–g/ **4**:592f–h/ **5**:229h–230b/ **7**:710d–h	**4**:473f–g/**4**:492h–493b/ **4**:498h–499b/**13**:849g–850a/ **15**:109d–120a *passim*/ **18**:860c–e
b. Teachings, forms of worship, and principles of organization distinguishing the Protestant heritage from that of Eastern Orthodoxy and of Roman Catholicism		**15**:101c–107b/ **2**:974g–975c/ **4**:547g–548d/ **6**:296a–c	**4**:505b–g/**4**:518f–519a/ **4**:526h–527b/**4**:555h–556a/ **4**:602g–h/**5**:245b–f/ **13**:962a–d/**15**:637b–e
c. The influence of the Protestant heritage on modern political and social thought		**15**:107b–h/ **6**:223h–224f	**4**:492c–e/**4**:510c–511a/ **4**:511h–512e/**15**:610b–h/ **19**:715h–716b
H. Major forms of Protestantism			
1. Lutheran churches	LUTHERAN CHURCHES **11**:196–201		
a. Historical development		**11**:197a–199a/ **15**:109b–e/ **15**:549c–552a	**2**:893c–d/**3**:361f–362b/ **6**:346b–e/**10**:807a–b/ **10**:1143b–d/**11**:190f–195f/ **11**:863f–864e/**14**:456b–457e/ **14**:459a–h/**15**:555f–g

	articles	article sections	other references
b. Distinctive Lutheran teachings: creedal statements and doctrines		**11**:199a–200d	**5**:245e–d
c. Lutheran worship and institutions		**11**:200d–201b	
d. Organization: the major Lutheran bodies		**11**:201b–d	
2. Reformed and Presbyterian churches: Calvinism	REFORMED AND PRESBYTERIAN CHURCHES **15**:557–563		
a. Historical development		**15**:557d–561e/ **6**:224a–d/ **15**:304e–306h	
i. The Reformation period		**15**:557d–559f/ **6**:347g–348a	**3**:238e–239b/**3**:361f–362b/ **3**:671f–674f/**7**:1011c–d/ **10**:495a–497b/ **11**:141h–142b/**15**:110c–f/ **15**:552a–554c/ **15**:554h–555a/**17**:883d–e
ii. Later developments in Europe		**15**:559f–560d	**3**:239f–249c *passim*/ **11**:146a–d/**13**:556b–e
iii. Developments in America		**15**:560d–h	
iv. Missionary and ecumenical endeavours		**15**:560h–561e	
b. Distinctive Reformed and Presbyterian teachings: creedal statements and doctrines		**15**:559e–f/ **15**:561e–562c/ **5**:229h–230b	**5**:245d–e/**19**:715h–716b
c. Reformed and Presbyterian institutions: worship and organization		**15**:562d–563b	**4**:494f–g
3. The Anglican Communion	ANGLICAN COMMUNION **1**:886–890		
a. Historical development		**1**:887d–888d	
i. The Reformation period		**3**:222g–224e/ **15**:554c–h	**2**:890b–891b/**5**:237c–238b/ **5**:296c–f/**8**:770g–771f/ **8**:1066a–f/**10**:495a–g/ **15**:304e–305d
ii. The 17th and 18th centuries		**4**:593d–594c/ **14**:689g–690a/ **15**:305d–306h	**2**:891c–e/**3**:239f–249c *passim*/ **6**:294g–295a/**10**:708d–h
iii. The 19th and 20th centuries		**1**:888a–d	**2**:891e–g/**3**:269a–e
b. Distinctive Anglican teachings: creedal statements and doctrines		**1**:888d–f	**2**:883g–h
c. Anglican worship and institutions		**1**:888f–g	
d. Organization: the authority and structure of the Anglican Communion		**1**:888h–890a	**3**:779g–780a/**4**:494b–c/ **13**:554h–555a
4. The Free churches	FREE CHURCHES **7**:710–711		
a. Historical development		**7**:710d–h/ **2**:713e–716c/ **4**:1127h–1129g/ **7**:743d–744f/ **12**:60c–61h/ **15**:304e–307f/ **15**:552c–f	**3**:269e–g/**15**:110h–111g/ **15**:555b–d
b. Teachings and practices that have traditionally distinguished the Free churches from Lutheran, Reformed, and Anglican churches		**7**:710h–711g	**4**:494h–495c
c. The major Free churches *with special attention to*			
i. Baptists	BAPTISTS **2**:713–717		**12**:940b–c
ii. Disciples of Christ	DISCIPLES OF CHRIST **5**:834–837		
iii. Congregationalists	CONGREGATIONALISTS **4**:1127–1131		**4**:494h–495b/**6**:440h–442c/ **10**:708d–h

	articles	article sections	other references
iv. Methodists	METHODISTS **12**:60–62	**8**:994a–d/ **15**:113h–114c	**3**:262d–f/**12**:940c–d/ **19**:759h–760g
v. Friends	FRIENDS **7**:743–745		**7**:580a–e
vi. Unitarians and Universalists	UNITARIANS AND UNIVERSALISTS **18**:859–862		
d. Free church associations and councils			**4**:1129f–g/**5**:835b–f
I. Ecumenical, interdenominational, and intradenominational associations	ECUMENISM **6**:293–296	**15**:608b–e	
1. The nature and history of the ecumenical tradition in Christianity: the varying attitudes and relations of particular forms of Christianity toward one another at different times		**6**:293d–296a/ **6**:150f–151a/ **6**:156c–g/ **6**:161g–162a/ **6**:162c–g/ **14**:35c–d/ **15**:107f–h/ **15**:993b–d/ **16**:831e–f	**6**:154e–155c/**13**:554g–555a/ **13**:961g–962d
2. The World Council of Churches and other interdenominational movements		**6**:296a–b/ **15**:561c–e	**1**:889f–h/**4**:461e–f/ **15**:119e–h
3. Intradenominational ecumenical agencies		**6**:296b–f	**4**:1129f–g
4. Criticism of ecumenism based on theological or procedural grounds		**6**:296f–h	
J. Variations of the traditional forms of Christianity and special new forms			
1. In Eastern Christianity	EASTERN CHRISTIANITY, INDEPENDENT CHURCHES OF **6**:136–141	**3**:550f–551b	**3**:774d–g/**4**:541c–e/**4**:602d–e/ **6**:162b–165b *passim*/ **6**:1011f–g/**12**:1058e–f
a. Syrian Orthodox Church of Antioch		**6**:136f–138b	
b. East Syrian Church		**6**:138c–139c	
c. Armenian Church		**6**:139d–140c	
d. Coptic Church		**6**:140c–141b/ **10**:1126d–f	
e. Ethiopian Church		**6**:141b–h	**6**:1001b–e/ **6**:1007e–1011g *passim*/ **6**:1015g–h/**10**:1126g–1127a
2. In Roman Catholicism			
a. Ritual and other variations within the jurisdiction of the Roman Catholic Church [see G.2.d., above]			
b. Old Catholic churches	OLD CATHOLIC CHURCHES **13**:552–555		
i. Churches united in the Union of Utrecht		**13**:552g–553d/ **13**:554e–555b	
ii. National Catholic churches; *e.g.*, Polish National Catholic Church of America, Philippine National Church		**13**:553d–g	
iii. Churches headed by *episcopi vagantes*		**13**:553g–554e	
3. In Protestantism			
a. Holiness churches	HOLINESS CHURCHES **8**:993–996	**12**:940f–941a	**15**:116b–d
b. Pentecostal churches	PENTECOSTAL CHURCHES **14**:30–35		
c. Millenarian churches *with special attention to*	MILLENNIALISM **12**:200–203	**6**:959g–960a/ **7**:777f–778f/ **15**:66c–d	**4**:551h–552e/**11**:1019c–g/ **15**:116e–g/ **18**:697f–705b *passim*

	articles	article sections	other references
i. Adventists	ADVENTISTS **1**:100–103		
ii. Jehovah's Witnesses	JEHOVAH'S WITNESSES **10**:131–132		
d. Old-line Protestant sects and their derivations *with special attention to*			
i. Mennonites, including Amish and Hutterites	MENNONITES **11**:904–905	**15**:552c–f	**11**:906d–g
ii. The Moravian Church	MORAVIAN CHURCH **12**:435–437		**14**:457e–g/**15**:110h–111c/ **19**:1155c–1156a
iii. Brethren	BRETHREN **3**:156–158		
e. Other independent churches: various Fundamentalist, evangelical, and other sectarian groups	FUNDAMENTALIST AND EVANGELICAL CHURCHES **7**:777–780		
f. The Negro churches: Negro versions of traditional Protestant faiths; new Negro churches; *e.g.*, Church of God in Christ	NEGRO CHURCHES (IN THE UNITED STATES) **12**:936–942		**10**:120e–g
4. Special new forms tangentially related to traditional Christianity *with special attention to*			
a. New Thought: Unity and other groups	NEW THOUGHT **13**:14–16		
b. Christian Science	CHRISTIAN SCIENCE **4**:562–564		
c. Mormonism	MORMONISM **12**:442–444		**18**:1101h–1102e

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ABELARD, PETER **1**:10
ALBERTUS MAGNUS, SAINT **1**:429
AMBROSE, SAINT **1**:657
ANSELM OF CANTERBURY, SAINT **1**:937
ATHANASIUS, SAINT **2**:257
AUGUSTINE OF HIPPO, SAINT **2**:364
BARTH, KARL **2**:725
BASIL THE GREAT, SAINT **2**:747
BECKET, THOMAS **2**:786
BENEDICT OF NURSIA, SAINT **2**:834
BERNARD OF CLAIRVAUX, SAINT **2**:860
BÖHME, JAKOB **2**:1202
BONAVENTURE, SAINT **3**:17
BONHOEFFER, DIETRICH **3**:30
BONIFACE, SAINT **3**:31
BONIFACE VIII, POPE **3**:32
BUCER, MARTIN **3**:361
BULTMANN, RUDOLF **3**:479
BUNYAN, JOHN **3**:480
CALVIN, JOHN **3**:671
CHRYSOSTOM, SAINT JOHN **4**:583
CLEMENT OF ALEXANDRIA, SAINT **4**:710
CYPRIAN, SAINT **5**:400
DOMINIC, SAINT **5**:942
DUNS SCOTUS, JOHN **5**:1083
ECKEHART, MEISTER **6**:187
EDWARDS, JONATHAN **6**:440
ERASMUS, DESIDERIUS **6**:951
EUSEBIUS OF CAESAREA **6**:1130
FOX, GEORGE **7**:579
FRANCIS OF ASSISI, SAINT **7**:682
GREGORY I, SAINT AND POPE **8**:415
GREGORY VII, SAINT AND POPE **8**:417
GREGORY OF NAZIANZUS, SAINT **8**:420
GREGORY OF NYSSA, SAINT **8**:421
GREGORY OF TOURS, SAINT **8**:422
HARNACK, ADOLF VON **8**:656
HOOKER, RICHARD **8**:1065
HUS, JAN **9**:64
IGNATIUS OF ANTIOCH, SAINT **9**:199
INNOCENT III, POPE **9**:604
IRENAEUS, SAINT **9**:889
JANSEN, CORNELIUS OTTO **10**:33
JEROME, SAINT **10**:137
JESUS CHRIST **10**:145
JOACHIM OF FIORE **10**:225
JOHN XXII, POPE **10**:233
JOHN XXIII, POPE **10**:234
JOHN THE APOSTLE, SAINT **10**:241
JOHN THE BAPTIST, SAINT **10**:241
KHOMYAKOV, ALEKSEY STEPANOVICH **10**:452
KNOX, JOHN **10**:494
LEO IX, SAINT AND POPE **10**:804
LEO X, POPE **10**:805
LEO XIII, POPE **10**:807
LOYOLA, SAINT IGNATIUS OF **11**:165
LUKE, SAINT **11**:177
LUTHER, MARTIN **11**:188
MARY **11**:560
MATHER FAMILY **11**:696
MELANCHTHON, PHILIPP **11**:863
MENNO SIMONS **11**:906
MÜNTZER, THOMAS **12**:618
NESTORIUS **12**:1057
NEWMAN, JOHN HENRY **13**:1
NICHOLAS V, POPE **13**:66
NIEBUHR, REINHOLD **13**:74
ORIGEN **13**:734
OTTO, RUDOLF **13**:769
PALAMAS, SAINT GREGORY **13**:905
PASCAL, BLAISE **13**:1041
PATRICK, SAINT **13**:1076
PAUL VI, POPE **13**:1088
PAUL THE APOSTLE, SAINT **13**:1090
PETER THE APOSTLE, SAINT **14**:153
PHOTIUS **14**:290
PIUS II, POPE **14**:481
PIUS V, SAINT AND POPE **14**:481
PIUS IX, POPE **14**:482
PIUS XII, POPE **14**:486
RENAN, ERNEST **15**:671
RITSCHL, ALBRECHT **15**:862
SCHLEIERMACHER, FRIEDRICH **16**:345
SYLVESTER II, POPE **17**:898
TERTULLIAN **18**:160
THOMAS AQUINAS, SAINT **18**:345
TILLICH, PAUL **18**:407
TROELTSCH, ERNST **18**:715
WESLEY FAMILY **19**:759
WYCLIFFE, JOHN **19**:1050
XAVIER, SAINT FRANCIS **19**:1055
ZINZENDORF, NIKOLAUS LUDWIG, GRAF VON **19**:1155
ZWINGLI, HULDRYCH **19**:1178

Section 828. Islām

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 828 deal with three main subjects: A, the history of Islām; B, intellectual, spiritual, and imaginative expressions of Islām; and C, the beliefs, practices, and institutions of Islām.

The outline of subject A begins with the pre-Islāmic setting in Arabia; the origin of Islām in the life and teachings of the Prophet Muḥammad; the foundations of the Islāmic community; and the early expansion of Islām beyond Arabia. It goes on to the development of Islāmic religion, culture, and society during the first centuries of the caliphate of the ʿAbbāsids, from the 8th to 11th century. It next deals with the Middle Ages of Islām, from the 11th to the 18th century, covering such topics as the emergence of independent dynasties in the Muslim West; developments in Islāmic theology, philosophy, and mysticism; the further expansion of Islām to the east and south; and the rise of the Ottoman Turks to the leading role in Islām. The treatment of Islām in the modern world covers the development of fundamentalist reform movements and syncretistic sects; modernist religious and political responses to the inroads of Western secular culture; developments in particular areas of the Muslim world; and current demographic and social aspects of Islām.

A. History of Islām

1. The pre-Islāmic setting in Arabia
[see also 822.A.6.]

2. The origin of Islām in the life and teachings of the Prophet Muḥammad, the Messenger of Allāh, 6th–7th century AD

3. The foundations of the Islāmic community and the early expansion of Islām beyond Arabia, 7th and 8th century

   a. The caliphate of the Companions, or the first four caliphs (successors)

   b. The caliphate of the Umayyads

4. The development of Islāmic religion, culture, and society during the first centuries of the caliphate of the ʿAbbāsids, 8th–11th century

   a. The relation of the caliphate to the religious community

   b. The development and consolidation of Sunnite law and theology

   c. Challenges to and disruption of the unity of the community: the role of the Shīʿah and other sectarian movements

5. The Middle Ages of Islām: developments in theology, law, and culture, 11th–18th century

The outline of subject B deals with the origin, form, and contents of the Qur'ān (Koran) and with interpretations or translations of it. Articles are then referred to that separately treat the Ḥadīth, the oral tradition; Islāmic law; Islāmic theology and philosophy; Islāmic mysticism; and Islāmic myth and legend.

The outline of subject C deals first with basic Islāmic beliefs and doctrines—doctrines concerning God, the universe, and man; doctrines concerning Satan and other intermediate beings, powers, or principles; doctrines concerning Muḥammad and the nature of prophecy; eschatological doctrines; and social and ethical doctrines. After dealing with the forms of Islām, the orthodox community and its variations, the outline goes on to Islāmic practices and institutions. It covers such topics as the Five Pillars of Islām; the role of the mosque and of festivals in public worship; the religious role of the family; the religious role of law; the joining of religious with political activities and institutions; and the national and regional variations of practices and institutions. The outline next deals with Islāmic art and iconography. Finally, it treats reform and modernist tendencies in contemporary Islām and the relation of Islām to Judaism, Christianity, and the religions of Iran, India, and East Asia.

articles	article sections	other references
ISLĀM, HISTORY OF **9**:926–937		
	9:927d–f/ **1**:1043a–1046e/ **1**:1057h–1059g	
	9:927g–928e/ **3**:624a–625a/ **8**:536f–g/ **15**:343d–f	**1**:1046g–1047a/ **12**:606b–609b/**15**:66e–g
	9:928e–929h/ **8**:536h–537b/ **9**:938e–f/ **11**:990h–991h	**1**:1047a–f/**4**:580e–581a/ **9**:852d–853a/**13**:110a–c
	9:928f–929d/ **3**:625a–626h/ **9**:958e–g	**1**:573f–h/**4**:580e–581a
	9:929d–h/ **9**:958g–959b/ **9**:1013e–1014a	**1**:5b–h/**3**:626h–635a *passim*/ **8**:664h–665b/**9**:985c–987b/ **10**:6b–f/**12**:605c–g/ **13**:156a–c
	9:929h–930h/ **9**:959c–961a/ **9**:987b–988d/ **9**:1018e–1021a	**1**:1047g–1048b
	9:929h–930c/ **3**:635a–639a	**11**:991h–992g
	9:930c–d/ **3**:643c–644g/ **8**:537b–c/ **9**:921h–922e/ **9**:938f–939c/ **9**:1012g–1013e/ **9**:1015f–1016h	**1**:18c–e/**1**:368a–g/ **3**:663f–664b/**15**:344b–e
	9:930e–h/ **1**:434a–e/ **3**:639a–f/ **7**:193b–194c/ **9**:853b–g/ **9**:943d–h/ **9**:1014a–1015f/ **9**:1016h–1018e/ **17**:414a–416g	**3**:635f–g/**3**:643e–f/ **8**:555f–556b/**12**:611g–612c/ **13**:156d–157e
	9:930h–936d/ **1**:1048b–1049e	

	articles	article sections	other references
a. The rise of the Ghaznavid and Seljuq Turks in the Muslim East		**9**:930h–931d/ **3**:639f–640a/ **3**:640f–h/ **9**:994h–999g	**9**:854g–856g *passim*/ **9**:962d–963f/**13**:135g–136a/ **16**:503g–506f *passim*
b. The emergence of independent dynasties in the Muslim west: the regimes of the Fāṭimids, Almoravids, Ḥammādids, and Almohads in North Africa and Spain		**9**:931e–932f/ **3**:640a–e/ **7**:193e–195b/ **9**:961a–962c/ **9**:993f–994h/ **9**:999g–1001e/ **13**:157c–159b/ **17**:416g–419b	**6**:489f–h/**16**:177d–h
c. Developments in Islāmic theology and philosophy [see also B.4., below]		**6**:332c–333e/ **9**:1021a–1025a/ **16**:368a–c	**3**:664b–g/**7**:144g–h/ **9**:143f–144a/**9**:151c–f/ **9**:961c–g
d. The development of Ṣūfism, Islāmic mysticism [see also B.5., below]		**9**:917h–918b/ **9**:943h–944e/ **10**:185b–c	**9**:483c–g/**9**:922f–g/ **9**:963f–964b/**10**:14h–15e
e. Developments in the later Middle Ages: the rise of the Mongols and later the Timurids in the East and the Mamlūks in the West: the 14th-century cultural renaissance; further expansion of Islām to the east and south		**9**:932h–934f/ **9**:482d–483g/ **9**:964b–966e/ **9**:1001e–1004h/ **13**:110h–111d/ **17**:154f–155c	**6**:491d–g/**11**:365h–366a/ **11**:399f–401c *passim*/ **19**:772b–d
f. The rise of the Ottoman Turks to the leading role in Islām, and the sultanate's assumption of the caliphate		**9**:934f–935b/ **9**:935h–936b/ **9**:968f–969b/ **9**:1005d–1007a	**13**:771d–784h *passim*
g. The rise of other dynasties; *e.g.*, the Ṣafavids in Iran and the Mughal Empire in India		**9**:934h–935g/ **9**:936b–c/ **9**:384f–385b/ **9**:967b–968f/ **9**:1007a–1008e	**2**:373c–f/**9**:382c–f/ **17**:181d–183g/ **17**:198d–201b
6. Islām in the modern world, 18th–20th century		**9**:936d–937e	
a. The development of reform movements: rigorous puritan groups, anti-Ṣūfī trends, attempts to renew Shīʿism and Sunnism, and the emergence of syncretistic sects		**9**:936d–f/ **13**:112g–113e	**1**:8h–9d/**1**:369c–e/ **1**:1049e–1050a/**2**:588b–f/ **9**:924f–h/**10**:20a–g/ **11**:348e–349b/ **18**:1100c–1101b/ **19**:772d–774b *passim*
b. Modernist religious and political responses to the inroads of Western secular culture		**9**:936f–h/ **9**:1025b–g	**9**:820b–h/**9**:924h–925g/ **9**:969b–971c *passim*/ **15**:344e–345a
c. Religious and political developments in particular areas of the Muslim world		**9**:937a–e/ **6**:428e–h/ **9**:941b–942g	**4**:360f–h/**9**:150c/ **9**:487g–488d/ **13**:162f–172h *passim*
7. Islām today: its current demographic and social aspects		**9**:937e–g/ **9**:948a–c	**1**:829d–e/**2**:690g–h
B. Intellectual, spiritual, and imaginative expressions of Islām [see also C.4., below]			
1. The Qur'ān: its form and contents; views about its origin; interpretations or translations	QUR'ĀN **15**:341–345	**15**:66g–h	
2. The Ḥadīth: the oral tradition	ḤADĪTH **8**:536–538		
3. Islāmic law: Sharīʿan and *fiqh*	ISLĀMIC LAW **9**:938–942	**5**:733c–e/ **9**:920f–921d	**1**:18c–e/**1**:368e–g
4. Islāmic theology and philosophy: philosophic and anti-philosophic trends in Islām; the major schools of Islāmic philosophy	ISLĀMIC THEOLOGY AND PHILOSOPHY **9**:1012–1025	**2**:539c–540c/ **9**:333a–b/ **9**:915e–916g/ **15**:66h–67b	**2**:143g–144b/**7**:144g–h/ **8**:146a–c/**8**:664h–665b/ **9**:147d–e/**9**:151c–f/ **9**:961c–g/**15**:600g–601a
5. The mystical path: Ṣūfism	ISLĀMIC MYSTICISM **9**:943–948	**9**:917h–918b/ **9**:922f–923a/ **9**:1022d–1025a	**8**:555f–556b/**9**:963f–964b/ **9**:1020g–1021a/**10**:14h–15e/ **12**:611g–612c
6. Myth: mythical elements and elaborations of Islāmic beliefs and doctrines	ISLĀMIC MYTH AND LEGEND **9**:949–952		

	articles	article sections	other references
C. Beliefs, practices, and institutions of Islām	ISLĀM **9**:911–926		
1. Beliefs and doctrines		**9**:912h–915a	**15**:600g–601a
a. Doctrines concerning God		**9**:913c–d	**9**:1014b–f/**12**:383h–384a/ **15**:342f–343a/**15**:784h–785a
b. Doctrines concerning the universe		**9**:913d–e	**9**:1014h–1015a/**12**:273c–e
c. Doctrines concerning man		**9**:913e–g/ **5**:230b–d	
d. Doctrines concerning Satan and other intermediate beings, powers, or principles [see also 811.B.2.e.v.]		**9**:913g–914a	
e. Doctrines concerning Muḥammad and the nature of prophecy		**9**:914a–c/ **8**:536b–537c/ **15**:66d–67d/ **15**:343d–f	**9**:950e–h
f. Eschatological doctrines		**9**:914c–d	**9**:1023d–f/**11**:1020e–f
g. Social and ethical doctrines		**9**:914d–915a	**9**:1014f–h/**15**:343b–c
2. The forms of Islām: the orthodox community and its variations		**9**:915b–918e	
a. Khārijism: the doctrines of the Khārijīs and Ibāḍīs		**9**:915b–d	**9**:852d–g
b. Muʿtazilism: the rationalist and dualist tendencies of the Muʿtazilah		**9**:915e–916a/ **9**:1013e–1015f	
c. Sunnism: the way of "the consolidated majority;" the schools of Sunnī orthodoxy		**9**:916a–g	
d. Shīʿism and its subsects: the Ismāʿīlīs and other Ismāʿīlī sects		**9**:916g–917g/ **8**:538c–d/ **9**:856e–g/ **9**:858c–859a/ **9**:1016h–1018e/ **9**:1023h–1025a	**7**:193b–195d *passim*/ **9**:852d–f/**9**:866d–e/ **9**:934h–935c/**9**:936b–c/ **10**:6b–f
e. Religious groups of Islāmic origin, now considered non-Islāmic; *e.g.*, Druzes, Bahāʾī faith [see 829.E.]			
f. Variations among the urban and rustic Ṣūfī orders		**9**:917h–918b/ **9**:922f–923a/ **9**:947b–948c	**12**:169a–b/**12**:338h–339a/ **12**:342c–e/**15**:638d–e
3. Practices and institutions		**9**:918e–923e	
a. The Five Pillars of Islām: the profession of faith, the five daily prayers, the obligatory tax (*zabāt*), fasting, and the pilgrimage to Mecca		**9**:918e–919h	**14**:952h–953a
b. Sacred places and days: the mosque and festivals in public worship		**9**:919h–920c	**9**:983h–984c/**15**:645h–646b
c. The family: Islāmic teaching regarding marriage, divorce, chastity, and inheritance		**9**:920c–f/ **5**:733c–e/ **9**:939h–940f	**11**:575b–e
d. The Sharīʿah: law and jurisprudence; the schools of law		**9**:920f–921d/ **9**:938b–939e/ **9**:941b–942g	**9**:1019d–f
e. The juncture of religious and political activities and institutions: the state in Islām		**9**:921d–h/ **4**:591a–b	
f. Educational institutions		**9**:921h–922e/ **6**:339d–340c	**15**:645g–646b
g. Folk Islām: the veneration or worship of saints; other disputed nontraditional practices		**9**:922f–923a/ **11**:576a–577d/ **16**:165g–166a	**2**:222h–223a/**9**:945d–f/ **9**:951a–b
h. Cultural diversity: national and regional variations of practices and institutions		**9**:923a–e/ **1**:827d–f/ **3**:600e–h/ **9**:333a–b/ **9**:951e–f/ **11**:296e–297a	**3**:989d–g/**3**:1121e–g/ **6**:1015h–1016b/ **9**:466h–467c/**9**:866d–g/ **13**:897h–898c/**15**:638a–e/ **17**:227a–c/ **19**:772b–774b *passim*
4. Art and iconography		**9**:923e–924e/ **9**:952c–954a/ **9**:982e–1010c	**3**:645a–c

	articles	article sections	other references
a. The religious and cultural context of Islāmic art and iconography: the effect of the anti-iconic principle on representational art		**9**:923e–h/ **9**:951g–h/ **9**:982e–984h	
b. Music, dance, and theatre		**9**:923h–924a/ **9**:973g–974a/ **9**:977b–980h/ **17**:154f–155c	
c. Literature: Islāmic themes in imaginative literature		**9**:924b–c	**9**:954b–973a *passim*/ **17**:144d–146f *passim*
d. Architecture and architectural decoration		**9**:924c–e/ **9**:985c–991h	**9**:993g–994g/**9**:995c–998d/ **9**:999g–1001d/ **9**:1001g–1002g/ **9**:1003d–1004a/ **9**:1005h–1006f/**9**:1007c–g/ **9**:1008c–d/**17**:181d–183g
e. The decorative arts; *e.g.*, calligraphy, pottery, tapestry, glass, jewelry		**3**:663c–665a/ **8**:183f–184e/ **9**:991h–992g	**10**:171e–g/**17**:198d–201b/ **17**:204d–205c
5. Modernistic reform movements: the reinterpretation of Islām to accommodate modern ideas and viewpoints; reforms in theology, politics, and social institutions; nationalism, secularism, and socialism in Islāmic contexts		**9**:924f–925g/ **9**:936d–937e	**1**:829d–e/**9**:820b–h
6. The relation of Islām to other religions		**9**:925g–926d/ **9**:1012g–1013e	**6**:1008a–b/**9**:1019f–g/ **9**:1020b–1025a *passim*
a. The special relation to Jews and Judaism		**10**:209a–210a/ **10**:300b–d	
b. The relation to Christianity		**6**:155h–156c	**2**:621h–622a/**6**:491d–g/ **17**:426g–427a
c. The relation to the religions of Iran, India, and East Asia		**3**:398d–e/ **9**:384f–385b/ **16**:744a–b/ **17**:154f–155c	**2**:373c–f/**4**:360f–h/**9**:333a–b/ **9**:382c–f/**9**:923a–d/ **9**:935c–g/**10**:14b–c/ **17**:224b–c

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ABŪ ḤANĪFAH **1**:18
AḤMAD IBN ḤANBAL **1**:367
AHMAD KHAN, SIR SAYYID **1**:369
ASHʿARĪ, AL- **2**:143
FAKHR AD-DĪN AR-RĀZĪ **7**:144
GHAZĀLĪ, AL- **8**:145
ḤALLĀJ, AL- **8**:555
ḤASAN AL-BAṢRĪ, AL- **8**:664
IBN AL-ʿARABĪ **9**:143
IBN BAṬṬŪṬAH **9**:144
IBN ḤAZM **9**:147
IBN TAYMĪYAH **9**:150
IQBĀL, MUḤAMMAD **9**:820
JAʿFAR IBN MUḤAMMAD **10**:6
JALĀL AD-DĪN AR-RŪMĪ **10**:14
JAMĀL AD-DĪN AL-AFGHĀNĪ **10**:20
MAHDĪ, AL- **11**:348
MUḤAMMAD **12**:605
MUḤĀSIBĪ, AL- **12**:611
ṬABARĪ, AṬ- **17**:980

Section 829. Other religions and religious movements in the modern world

[for Part Eight headnote see page 501
for Division II headnote see page 517]

The articles and parts of articles referred to in Section 829 deal with six main subjects.

Subject A is new religious movements among tribal peoples—movements arising from the encounter of such peoples in modern times with large, powerful, highly organized, literate societies. The outline first deals with the general causative factors for these religious developments and their characteristic features. It then treats the history of new movements in various parts of the world.

Subject B is Negro cults in Western cultures, such as Black Muslims and Black Jewish cults.

Subject C is theosophical movements and groups.

Subject D is spiritualistic groups, variously organized around believed communications with departed spirits.

Subject E is religious movements of Islāmic origin or influenced by Islām. The articles referred to deal separately with the Bahā' ī faith; the Druze religion; and with the Nation of Islām or Black Muslims.

Subject F is residues or revivals of ancient and primitive religious beliefs and practices in modern civilizations. The outline covers witchcraft, black magic, and Satanism; prophecy, divination, and astrology; healing cults or practices; and pharmacological cults or practices.

	articles	article sections	other references
A. New religious movements reflecting the impact of dominant cultures and religions	TRIBAL RELIGIOUS MOVEMENTS, NEW **18**:697–705		
1. The causes, nature, and significance of new religious movements: their variations and characteristic features		**18**:697g–701b/ **11**:1020b–e	**4**:850a–b/**6**:960f
2. The history of new movements		**18**:701b–704h/ **15**:67g–68a	
a. In Latin America and the Caribbean		**18**:701b–h/ **2**:549h–550a	**3**:905h–906a/**12**:165e–g/ **13**:248b–c/**14**:202a–c/ **17**:125c–e
b. In the United States, Canada, and Greenland		**18**:701h–702h	**13**:207d–e
c. In Africa		**18**:702h–703h/ **6**:115d–e	**17**:283g–h
d. In Asia		**18**:703h–704e	**9**:44a–g
e. In Oceania and Australia		**18**:704e–h/ **13**:451f–453a	**11**:869h–870a
B. Negro cults in Western cultures	NEGRO CULTS (IN THE UNITED STATES) **12**:942–944		
1. The Nation of Islām, or Black Muslims [see E.3., below]			
2. Black Jewish cults; *e.g.*, the Church of God; the Commandment Keepers, or Black Jews; the Church of God and Saints of Christ		**12**:943e–g	
C. Theosophical groups	THEOSOPHY **18**:277–278	**8**:216c–d	
D. Spiritualist groups	SPIRITUALIST GROUPS **17**:511–513	**12**:942h–943a	
E. Religions and religious movements of Islāmic origin or influenced by Islām			
1. The Bahā'ī faith	BAHĀ'Ī FAITH **2**:587–589		
2. The Druze religion	DRUZES **5**:1060–1062		
3. The Nation of Islām, or Black Muslims	BLACK MUSLIMS **2**:1093–1096	**5**:733b–c	
F. Residues or revivals of ancient and primitive religious beliefs and practices in modern civilizations			
1. Witchcraft, black magic, and Satanism [see also 812.D.6.]		**19**:899b–e	
2. Prophecy, divination, and astrology		**3**:901e–902a/ **5**:920a–b	**2**:223d–f/**16**:640h–641d
3. Healing cults or practices	HEALING CULTS **8**:685–687	**4**:562d–g	
4. Pharmacological cults or practices	PHARMACOLOGICAL CULTS **14**:199–203		**5**:1048h–1049c/**17**:124a–b

Introduction to Part Nine:

The point and pleasure of reading history

by Jacques Barzun

Everything that we call the arts and the humanities comes out of some natural desire and acquires value by satisfying it. Painting and music and literature are important not because there are museums and concert halls and libraries to be kept supplied but because human beings want to draw and sing and tell stories as well as enjoy seeing others fulfill these native and universal impulses.

Among the humanities, history holds a special place in that its origin within each of us is not even dependent on impulse. A person may lack altogether the wish to sing or the knack of telling a story, but everybody without exception finds occasion to say: "I was there; I saw it; I remember it very well." In saying (or even thinking) these words, every man is a historian. History is inescapably a part of consciousness. The Greeks expressed this truth by describing Clio, the muse of history, as the daughter of memory.

Without going into the subtleties of how we are able to remember and what the contents of memory actually are, it is clear that as soon as we take thought about our experiences, whether the farthest back or the nearest and most immediate, we are dealing with what is past. The so-called present vanishes in the very act of reflecting upon it, and the future is all surmise and imagination. Hence the greater our interest in the facts and truths of human existence—our own existence included—the greater, necessarily, is our concern with the past. "To live in the past" ought not, therefore, to be the phrase of reproach that it commonly is. The larger part of the thoughtful life that one leads during the intervals of action cannot be anything but some form of living in the past. If this part of our lives is to be criticized, it should be in words different from the cliché. One should ask, *How* does he or she live in the past? and *What past* does he or she recall, prefer, imagine?

It is at this point that history as the organized story of the whole human past comes in to contribute its pleasures and its illumination to the thoughtful life. A person who remembered only his own past would be pretty poor indeed—living on a starvation diet. Actually, it is a question whether such a life is not an impossible supposition. Everybody remembers pieces of other people's pasts; everybody, whether he means to or not, finds that he has learned about his country, his town, his street, his business office, or his factory many things that came to pass well before his time. To possess that information, if it is accurate, is in essence a knowledge of history. It differs in extent but not in kind from a knowledge of how Rome rose and fell. And this relation tells us what reading history affords in the first instance. Just as knowing about our neighbours' and friends' histories adds to our sense of reality, so does reading history: it gives us vicarious experience.

If we add to the habitual, unconscious intake of personal and local history the daily filling of the mind by news reports—which is contemporary history and which usually brings with it fragments of a remoter past—we begin to see that every man who lives in a modern, communicative society is forced to become in some sense a conscious historian. His interest begins with himself and his environment, but it is soon stretched out, haphazardly, into such domains of history as chance or special interests have developed. And special interests need not mean explicitly intellectual ones; baseball and chess, model trains and furniture, pottery and boatbuilding have their heroes and revolutions too, and whoever cares about these activities or artifacts for themselves inevitably becomes engrossed in their histories.

It is of course true that when we ordinarily speak of someone having an interest in history we mean the political, social, or cultural history of great civilizations; and for a long time history was arbitrarily taken to mean the sequence that leads from the ancient civilizations of the eastern Mediterranean to the modern ones of the West. It is a tremendous spectacle, even though concentrated on a relatively small territory. But now that certain dynamic elements of Western civilization have aroused the rest of the world to both imitation and resistance, it has become imperative to widen the panorama and see behind the vast and confused modern scene the several histories of the great Eastern civilizations as well as the traditions and vicissitudes of the African societies.

Two questions readily occur at the mere thought of so much to know. Can a reader who is not a professional historian find his way in this huge maze of names, dates, and facts? And if he can, why should he? The answer to the first question is the old reply of the mathematician to the nervous student: "What one fool can do, another can." A real compliment is concealed in this gruff retort, for what it implies is that given an interest, a motive, any man can inform himself about any part of world history through secondary accounts such as are digested in an encyclopaedia. There is no obligation to master every detail, to dispute or criticize sources—in a word, to ape the professional, who, for the best of reasons, limits himself to a small segment of the whole. A *reader* of history is one who follows with his mind the steps another took on his voyage of discovery; and this is easier in history than in mathematics, for history is told in plain words and deals with ordinary human relationships.

So the main difficulty lies in the second question: Why embark on the journey? The answers are numerous and varied, for temperaments differ, as do "special interests" in the sense referred to above. But there is one answer that covers the rest; it is the answer suggested by what was said earlier about every man's unconscious absorption of haphazard fragments of history. The best motive for reading history deliberately is curiosity about the portions missing from one's own picture of the past. Curiosity: How did things come to be as they are? How was it when they were different? Is it true that once upon a time men did thus and so? History deals with particulars, and most recorded particulars contain puzzles, contradictions, enormities, all of them spurs to curiosity: the Hudson River in the state of New York was named after the navigator often called Hendrik Hudson, who first sailed up the stream. But why Hendrik and not Henry? Well, Henry was his baptismal name; how did he acquire the other and why? The full answer leads really to a comprehensive view of exploration and colonization by the national states at the dawn of the modern age—the aims, drives, desires, errors, follies, cruelties, and incalculable consequences of a great movement that occupies two and a half centuries and that has continued in different forms down to the landings on the Moon.

The most striking feature of history is its fusion of purposeful direction and unexpected drift. For example, read about

Plato, Aristotle, and the ancient mathematicians, and you will discover how their speculations and discoveries have been transformed and amplified into the methods and systems that we still work with. But you will also be told how at various times these same streams of thought or belief generated entirely new and remote, strange and absurd consequences. Again, ancient astrology led to the science of astronomy, and science (as we think) replaced superstition. Yet astrology fills columns in 20th-century newspapers and the minds of their millions of readers. What is the explanation? We lack the pythoness of Delphi, in whom Socrates believed or affected to believe, and we have no official college of augurs to scan the entrails of birds as a guide to future political action, but fortune-tellers are never out of business and we do have Gallup polls. Truly, the wonders of cultural history are infinite.

To conjure up these beliefs and institutions in this comparative fashion is not to equate them with one another or across the centuries; it is rather to stress the identity in diversity that is the principle of human affairs and that makes human history accessible to any willing reader. In different times and places, men are the same and also different. The differences are due to the varying emphases given by one people at one time to some element of life and feeling or to some form of its expression. This is most easily seen in the plastic arts. Think of the representations of the human body in Egypt, Greece, medieval Europe, the west coast of Africa, pre-Columbian America, and the art galleries of world capitals in the second half of the 20th century: is it the same human body or different? The question is really idle, for it is both and neither. In paint or marble there is strictly no human body, only a view of it, a feeling about it. Similarly, what we see in history is not so much Man distorted in one way or another as *men* who existed *only as we see them;* that is, in their society and culture, under their skies and gods, never staying put for more than a short time, never to be reduplicated elsewhere or at a later time, even when the effort to imitate is strong and shrewd—as in the Italian Renaissance, which tried to restore the ancient culture of Greece and Rome.

Despite this irreducible plasticity, diversity, and restlessness, we draw historical parallels, we make comparisons. That we can do so is what persuades us of the unity and continuity of history. When we find the Celtic druids and the Aztecs making human sacrifices to their gods we say we recognize a human tendency, though we profess to abhor it. Yet some future reader of history might be tempted to compare with those ancient peoples our contemporary revolutionists, who sacrifice 400,000 kulaks (or some other hapless group) for the good of the tribe and its eternal prosperity. But we also notice a strange difference: we know that fanatical faith presides over each type of human sacrifice, ancient and modern, but even as we condemn we think we understand the modern more readily: we know its background, have heard its advocates. It is one of the illuminations of history, not merely to know abstractly, but, by learning the local shape of things, to feel how the reality of each time and place differs; how the faiths diverge in contents and origins and thus in persuasiveness. We may now lump together the Celts and the Aztecs, but they were far apart in thought and character: in short, nothing is truly comparable; in history everything is *sui generis*.

The wise reader of history keeps his equilibrium between these two extremes of likeness and difference. He tries to see the unfamiliar in the familiar, and vice versa. He stands away from his own prejudices and satisfies his curiosity by trying to sympathize with what is farthest away or most alien. This is very hard to do when what is before us is a bloody sacrifice, a massacre, a piece of treachery or cynical greed that violates our sensibilities as well as our moral principles. But to sympathize is not to condone or approve, it is only to acknowledge in oneself the ever-present possibility of the same feeling or action. Certainly the enlightened 20th century has no warrant for looking down on times and places where treachery and massacre were commonplace. And it is a sobering observation to find in both past and present the evidence that inhumanities have been and are being committed by the brutish and civilized alike, the ignorant and the educated, the cynical and the devout, the selfish and the heroic.

A principal good derived from history is thus an increase in self-knowledge, through a fellow-feeling with men singly and in groups as history tells about them. That self-knowledge in turn makes the reader of history less ready to find "monsters of error" in his own time and place. Let it be said again, he need not condone or accept with indifference, but he is spared one of the very errors that perpetuates man's inhumanity to man—fanatical self-righteousness.

On the constructive side, what history tells is the long series of efforts to overcome the constraints of nature and the difficulties of living in society. Those efforts we call civilizations. They start small. In the West they first take the form of city-states. They clash, with one another or with the barbarians "outside." Trade and war, war and trade expand the scope of power, government, and law. Great men introduce broader conceptions of citizenship, morals, and religion. Others invent practical devices of administration, manufacture, and—again—war. Still others discover the workings of nature, create mathematics or art or systems of philosophy. A concentration of such activities over a given territory is what is meant by a high civilization—Egypt, Greece, the Hellenistic Age, Rome, the Saracens, the High Middle Ages, the Renaissance. And also China, Japan, the Khmers, India, the Mayas, the Incas, and so on.

Along this hazardous and always violent course, innumerable characters rise and play their parts. Their fates provide stories within the story. Visibly, biographies are the bricks of which history is made, for the story of mankind can only be the stories of men. But by a paradox of man's social existence, the life of communities is not a simple sum of individual lives. The reader of history must therefore imagine from the printed page characteristic acts, moods, errors, disasters, achievements that are nobody's doing and everybody's doing. This imagining is another important good bestowed by historical reading, for it dispels the illusion that H.G. Wells called the "governess view" of history: They (the bad people) are doing this terrible thing to Us (the good people). The fallacy in it is to suppose that any large group acts as with one mind, clear in purpose and aware of consequences. Such a projection of the single ego upon whole masses is a form of provincialism that is encountered in most political discussions and certainly in all social prejudices: "If the President would only act . . . if those people would only see reason. . . ." A reader of history is cured of this simple-mindedness by developing a new sense—the historical sense—of how mankind in the mass behaves, neither free

nor fatally pushed, and in its clearest actions mysterious even to itself.

It is this peculiarity that, while marking the difference between history and biography (where acts can be deemed individual and responsible), has led many minds to postulate a meaning in history, a meaning discoverable but obscured by the multiplicity and confusion of facts. A famous passage in Cardinal Newman's *Apologia* records in admirable prose the feelings that lead to the elaboration of philosophies of history; for Newman it is of course the traditional Christian interpretation that unifies the multiplicity and resolves the confusion:

> To consider the world in its length and breadth, its various history, the many races of man, their starts, their fortunes, their mutual alienation, their conflicts; and then their ways, habits, governments, forms of worship; their enterprises, their aimless courses, their random achievements and acquirements, the impotent conclusion of long-standing facts, the tokens so faint and broken, of a superintending design, the blind evolution of what turn out to be great powers or truths, the progress of things, as if from unreasoning elements, not towards final causes, the greatness and littleness of man, his far-reaching aims, his short duration, the curtain hung over his futurity, the disappointments of life, the defeat of good, the success of evil, physical pain, mental anguish, the prevalence and intensity of sin, the pervading idolatries, the corruptions, the dreary hopeless irreligion, that condition of the whole race, so fearfully yet exactly described in the Apostle's words, "having no hope and without God in the world,"—all this is a vision to dizzy and appal; and inflicts upon the mind the sense of a profound mystery, which is absolutely beyond human solution.

Other famous philosophies, from Vico's and Hegel's to Marx's and Spengler's, discover a direction in history, or a principle of action, and often a goal or terminus (as in Marx), after which history as we know it shall cease and a kind of second Eden be restored.

To the practical writer or reader of history these philosophies appeal mainly by their suggestiveness; they are valued for their scattered insights and analogies. As systems they negate the very spirit of history, which seeks the concrete and particular, the opposite of system and abstraction. True, there have been historians who took a middle course and attempted to find empirical regularities in history—again with occasionally suggestive results—but very soon their methods begin to do violence to the facts in order to group them and count them and treat them like identities in physical science. When the physical world itself has not yet been fully systematized, to assume or "find" a system in history without the means and the liberties that science uses is to think like neither a scientist nor a historian. It is in fact an attempt to remove the difficulty of history at the cost of destroying its unique merit and interest.

By the "liberties" that science takes is meant the experimenter's elimination of all but a very few components in a given trial, so as to ascertain precisely the nature and amount of a given effect. When this is done, the result is usually stated in causal terms—so much of this, under such and such conditions, will produce so much of that. Hardly anyone needs to be told that history defies a similar treatment. Its elements cannot be exactly measured, and although each historical situation presents to the discerning eye a variety of clear conditions or factors, the isolating of *a* cause for what happens is beyond reach.

That is but another way of saying that history is and must remain a story. And a story, if properly told, is a whole, to be understood as a whole—synthetically, not analytically. History in this regard resembles the arts. We say we "analyze" a work of art, but that is to speak metaphorically. We can enjoy and understand the products of art only as wholes. In history, the artful story is offered as a true story, and great pains are taken to see that it is true. But except in the broadest sense, the historical wholes are not given as such in the record; they are devised by the historian, to make the welter of facts intelligible and hence able to be remembered. Clio was not only the muse of history but also of eloquence, by which the Greeks meant good, intelligible prose, to be spoken before an audience unused to books. The same requirements still hold: written history must be readable with pleasure, or Clio is defeated.

But, it will be said, from many diverse writers will come divergent stories, rival interpretations. That is true, for only a divine mind could know "how it actually happened." But this limitation of history is also a merit, for it can thereby be written and read over and over again in as many versions as are plausible or accessible. There is and will be no final statement; the perspective forever changes, and with it the interest of history renews itself into infinity. As the philosopher William James once remarked, "What has been concluded that we should conclude about it?"

Part Nine. The history of mankind

The outlines, and the articles and parts of articles referred to, in the thirty-nine sections, in seven divisions, of Part Nine deal with the history of the peoples and civilizations of the world.

Certain points should be noted about Part Nine.

History, like philosophy, has developed methods applicable to the subject matter of other disciplines. The results of these applications are set forth in other parts. The articles referred to in each of the nine sections of Division II of Part Six include a historical treatment of each of the arts. Similarly, the articles referred to in each of the nine sections of Division II of Part Eight include a historical treatment of each of the particular religions dealt with. Articles referred to in certain sections of the five divisions of Part Ten set forth the history of logic and mathematics; the history of science generally; the history of each of the natural and social sciences; the history of medicine; the history of technology; the history of philosophy; the history of humanistic scholarship; and the history of historiography and of the study of history itself.

The topical breakdown of the history of mankind into seven divisions and thirty-nine sections reflects more or less traditional judgments—judgments regarding the regional divisions of world history; the identification of peoples and civilizations; the temporal periodization in historical accounts of particular civilizations; and the periods of relative isolation and of relative confluence of different civilizations.

The titles of the seven divisions in this part indicate the regional and temporal divisions used. Introductory headnotes for each of the seven divisions indicate the temporal periodizations used in the accounts of particular civilizations.

Division I. Peoples and civilizations of ancient Southwest Asia, North Africa, and Europe 563
II. Peoples and civilizations of medieval Europe, North Africa, and Southwest Asia 578
III. Peoples and traditional civilizations of East, Central, South, and Southeast Asia 595
IV. Peoples and civilizations of sub-Saharan Africa to 1885 610
V. Peoples and civilizations of pre-Columbian America 615
VI. The modern world to 1920 618
VII. The world since 1920 662

Division I. Peoples and civilizations of ancient Southwest Asia, North Africa, and Europe

The articles and parts of articles referred to in Section 911 first treat the geography of the regions covered in the section, the sources for the history of the peoples in these regions, and the character and achievements of ancient Near Eastern, Aegean, and North African civilizations. They then deal separately with the history of each of the peoples in these regions in ancient times.

The outline in Section 912 begins with the history of the peoples of non-Classical ancient Europe. It then deals with the whole course of the Classical Greco-Roman civilization, extending from the emergence of Classical Greece from Archaic Greece, through the Hellenistic Age and the history of republican Rome, to the history of the Roman Empire up to AD 395.

Section 911. Early peoples and civilizations of Southwest Asia and Egypt, the Aegean, and North Africa 563
912. Peoples of ancient Europe and the Classical civilizations of the ancient Mediterranean world to AD 395 570

Section 911. Early peoples and civilizations of Southwest Asia and Egypt, the Aegean, and North Africa

The articles and parts of articles referred to at A in the outline of Section 911 treat the geography of the regions covered in this section, the sources for the history of the peoples in these regions, and the character and achievements of their civilizations.

The remaining articles and parts of articles referred to in Section 911 deal separately with the history of the peoples in these

regions: B, Mesopotamia and Iran to *c.* 1600 BC; C, emergence of river valley civilization in Egypt (to *c.* 1600 BC); D, early civilizations in Syria and Palestine, Anatolia, and the Aegean (to *c.* 1600 BC); E, the era of the Egyptian and Hittite empires (*c.* 1600–1050 BC): the expansion of the Indo-Europeans; F, the era of the new states of Southwest Asia: the beginning of the Iron Age (*c.* 1050–700 BC); G, the era of the Assyrian and Neo-Babylonian empires, and the Achaemenid Persian Empire (746–250 BC); H, the Parthian and Sāsānian empires (*c.* 250 BC–AD 651): Armenia; and I, the Nilotic Sudan to *c.* AD 550, South Arabia, and Ethiopia until *c.* AD 650, and North Africa until the Roman conquest (from 146 BC).

	articles	article sections	other references
A. Introduction: the character and achievements of ancient Near Eastern, Aegean, and North African civilizations; the geography of these regions; archaeological and documentary historical sources; historiographic problems	NEAR EAST, ANCIENT **12**:913–915	**1**:1057c–f/ **3**:604f–606h/ **4**:575d–578c/ **6**:460d–463d/ **6**:504c–h/ **6**:915h–918b/ **8**:324a–325g/ **9**:829g–831a/ **11**:1001h–1002g/ **12**:916b–921g/ **13**:145e–146d/ **17**:966d–967a/ **19**:257h–258e	**1**:1052a–1054e/**2**:189h–190b/ **5**:524e–f/**6**:445e–451f/ **7**:850d–851a/**9**:702h–704c/ **9**:821d–824h/**9**:873a–876g/ **9**:1059c–1062e/**10**:548a–f/ **10**:875h–879a/ **12**:445a–449a/**15**:544f–545b/ **16**:275h–277f/**16**:779a–h/ **17**:756a–762e/**17**:920a–923a/ **18**:402b–406c *passim*/ **18**:745d–747f/**18**:782d–788a/ **19**:1079e–1080h/ **19**:1084g–1085g
B. Mesopotamia and Iran to *c.* 1600 BC			
1. Development of river valley civilization in Mesopotamia	MESOPOTAMIA AND IRAQ, HISTORY OF **11**:963–979	**12**:913e–914a	**6**:318b–c/**18**:1074g–1075a
a. Character and achievements of ancient Mesopotamia: classical and medieval views; modern archaeological excavations		**11**:964e–967b/ **12**:913e–h	
b. The Late Neolithic, Chalcolithic, and protohistoric (pre-urban) periods		**11**:967c–969e/ **5**:1017h–1018c	**12**:913h–914a/**19**:258e–g
c. The Sumerians from their origins to the end of the Early Dynastic Period (*c.* 2350 BC)		**11**:969f–972g	**12**:913h–914a/**16**:119f–h
i. Their conjectured origins: literary and other historical sources (king lists and invention of cuneiform writing); early kings and legendary figures (Gilgamesh)		**11**:969f–971d/ **5**:369g–370g/ **6**:920e–921b/ **10**:1088b–e/ **11**:1007a–1009a	
ii. Foundation of city-states *e.g.*, Kish, Ur, Uruk, Lagash, Mari, Umma): rivalry among the cities; the temple city and theocracy; social and economic organization; contacts with Egyptian and Indus Valley civilizations; Sumerian culture		**11**:971d–972g/ **11**:1002h–1003b/ **18**:219d–e/ **18**:649e–h/ **18**:1021e–g/ **19**:258g–260h	1:326c–e/**11**:1061c–f/ **17**:797c/**19**:521a–b
d. Sumer and Akkad from *c.* 2350 to 2000 BC		**11**:972g–975h/ **19**:261b–262c	
i. The ascendancy of the Semitic Akkadians under Sargon I of Akkad and his successors; invasions and the fall of the dynasty		**11**:972g–974d	**16**:247g–248d/**17**:797d–g
ii. The unification of Sumer, Akkad, and Elam under the 3rd dynasty of Ur (*c.* 2112–2004 BC): administration and composition of the empire; Ur in decline	UR **18**:1021–1022	**11**:974d–975h	
e. The Old Babylonian Period and the early history of Assyria		**11**:975h–979e/ **19**:262c–h	
i. Isin and Larsa: rivalry and political fragmentation; literary texts; decentralization		**11**:975h–977d	**18**:1022b–c
ii. Early Assyria: Ashur, Nineveh, and Urbilum; Akkadian inscriptions and language; the economy; the reign of Shamshi-Adad I (*c.* 1813–1781 BC)		**11**:977d–978a	**6**:916d–e
iii. Establishment of the Old Babylonian Empire under the dynasty of Hammurabi (*c.* 1792–1750 BC): law, society, and literature		**11**:978b–979e/ **5**:1018c–e	**5**:369e–f/**8**:598g–599e
f. Hurrian expansion to *c.* 1600 BC and the decline of the Old Babylonian Empire after *c.* 1750 BC		**11**:979e–g	
2. Early Elam (Iran): cultural ties and political and military interaction with Mesopotamia	IRAN, HISTORY OF **9**:831	**12**:288h–289b/ **19**:267g–268g	

	articles	article sections	other references
C. Emergence of river valley civilization in Egypt (to *c.* 1600 BC)	EGYPT, HISTORY OF **6**:460–471	**6**:921b–g	**6**:318a–b
		6:463d–465b/ **6**:508d–e/ **19**:249d–g	**1**:326e–g/**11**:895b–d
1. The Predynastic Period (to *c.* 3100 BC) and the Early Dynastic Period (1st and 2nd dynasties, *c.* 3100–*c.* 2686 BC): unification of Upper and Lower Egypt under King Menes (Narmer); capital at Memphis		**6**:465b–469b	**8**:853a–856d *passim*
2. The Old Kingdom (*c.* 2686–2160 BC) and the First Intermediate Period (*c.* 2160–*c.* 2040 BC)			
a. The Old Kingdom (3rd–6th dynasties, *c.* 2686–*c.* 2181 BC): divine kingship; the building of the great pyramids near Memphis; centralized government; class structure; agriculture, manufactures, and foreign trade; hieroglyphic writing, science, and technology; the arts	MEMPHIS (EGYPT) **11**:895	**6**:465b–468d/ **5**:1016e–1017g/ **10**:1088e–g/ **18**:219e–g/ **19**:249h–252g	**19**:728b–e
b. The First Intermediate Period (7th–11th dynasties, *c.* 2181–1991 BC): governmental decentralization; collapse of the Old Kingdom and ensuing disunity and foreign raids; reunification by Mentuhotep II under the 11th dynasty, ruling from Thebes		**6**:468d–469b	
3. The Middle Kingdom (*c.* 2040–1786 BC) and the Second Intermediate Period (1786–1567 BC)		**6**:469b–471f	**11**:895h–896c/**13**:108h–109e
a. The Middle Kingdom (12th dynasty, 1991–1786 BC) the cult of Amon; developments in the monarchical institutions; the conquest of Nubia, trade, and exploration; the arts		**6**:469b–470e/ **19**:252h–253g	
b. The Second Intermediate Period (13th–17th dynasties, 1786–1567 BC): internal decentralization and the Asiatic Hyksos occupation		**6**:470f–471f	
D. Early civilizations in Syria and Palestine, Anatolia, and the Aegean to *c.* 1600 BC			
1. Emergence of civilization in Syria and Palestine	SYRIA AND PALESTINE, HISTORY OF **17**:927–934		
a. The Stone Age cultures and their transition from the Neolithic to the Early Bronze Age until *c.* 2300 BC; agricultural and technological developments; Proto-Urban settlements; Jericho	JERICHO **10**:136	**17**:927b–932a/ **17**:967a–b	
i. Paleolithic and Mesolithic periods: development of horticulture and the domestication of animals		**17**:927b–928b	
ii. Pre-Pottery Neolithic areas; grouped houses and town walls; arrival of new peoples and their rectangular architecture; Pottery Neolithic areas; molded plaster vessels; dark-faced burnished ware and the spread of its associated culture		**17**:928d–930a	
iii. The Chalcolithic Period and the Early Bronze Age: migrations and spread of Ḥalafian culture; development of trade; beginnings of urbanization; Early Bronze Age cities		**17**:930a–932a	
b. The Intermediate Period (*c.* 2300–*c.* 1900 BC) and the Middle Bronze Age (*c.* 1900–*c.* 1525 BC): revival of trade and connecting link between the greater states; *e.g.*, Aleppo, Byblos, Alalakh in Syria	ALEPPO **1**:465	**17**:932a–934b	**17**:967b–d
i. The Amorite invasion: breakup of settled areas by nomadic peoples; bronze weapons and votive objects		**17**:932a–g	
ii. Reappearance of urban civilization in the Middle Bronze Age: hieroglyphics; clay tablets; development of new pottery in Canaan		**17**:932h–934b	
2. Emergence of civilizations in Anatolia, Cyprus, and the Aegean			**2**:190b–g
a. Anatolia: the Neolithic, Chalcolithic, and Bronze ages; settlement by the Hittites	ANATOLIA, ANCIENT **1**:813–818	**1**:830d–g	
i. Neolithic farming communities: house styles, tools and weapons, pottery, and foodstuffs		**1**:814a–e	**19**:266b–c

	articles	article sections	other references
ii. Appearance of painted pottery in the Chalcolithic Period; uses of metal		1:814e–g	
iii. Bronze Age culture; *e.g.*, Troy, Alaca Hüyük: jewelry, pottery, burial customs, metalworking, weaponry, migrations		1:814h–816b	19:266d–g
iv. The Hittite occupation of Anatolia and establishment of the Old Hittite Kingdom (*c.* 1700–*c.* 1500 BC): expansion into northern Mesopotamia and Syria under Hattusilis and Mursilis; the Hurrian invasions; the Middle Kingdom		1:816c–818c/ 5:226g–227e/ 19:266h–267c	
b. The Late Neolithic, Chalcolithic, and Bronze ages in Cyprus	CYPRUS, HISTORY OF 5:406		
c. The early Aegean civilizations (to *c.* 1450 BC)	AEGEAN CIVILIZATIONS 1:111–122	19:273f–275e	
i. The Paleolithic, Neolithic, and Chalcolithic ages in Greece, Crete, and the Aegean islands; the pre-Greek (Early Bronze or Helladic) population of Greece from *c.* 3000 BC; the Early Bronze or Cycladic Age in the Aegean islands; the shaft grave period on the mainland		1:113b–116h/ 14:897g–898a	
ii. The Minoan civilization on Crete: the period of the Early Palaces (*c.* 2200–1700 BC); cultural efflorescence; Kamáres ware; commerce; Knossos; Middle Cycladic culture; period of the Later Palaces (*c.* 1700–*c.* 1450 BC) on Crete; the arts; Linear A tablets		1:116h–119c/ 5:1020f–1021b/ 14:898a–f	6:473d–f
E. The era of the Egyptian and Hittite empires (*c.* 1600–1050 BC): the expansion of the Indo-Europeans			
1. The New Kingdom of Egypt (18th–20th dynasties, 1567–1085 BC)			
a. The 18th dynasty (1567–1320 BC): the emergence of strong centralized administration; territorial expansion; religious and cultural developments	EGYPT, HISTORY OF 6:471–479		11:896c–f
i. Expulsion of the Hyksos from Egypt under Ahmose (1570–1546 BC) cult of Amon-Re; expansion into Syria and Palestine; contacts with the Aegean and its arts		6:471f–475d/ 6:502e–503c	
ii. Egyptian culture and prosperity in the reigns of Amenhotep III (1417–1379 BC) and Akhenaton (Amenhotep IV): domination over Nubia; erection of new temples at Thebes; cult of the god Aton; subsequent eclipse of the dynasty	THEBES (EGYPT) 18:261–264	6:471g–473g/ 1:818a–c/ 19:253g–254d	1:401f–402a/17:934d–g/ 18:366a–367c
b. The 19th and 20th dynasties (1320–1085 BC): political shift to the north; new construction; foreign policies		6:473g–475d	1:402a–403d/6:508e–g/ 19:254d–255c
i. Reassertion of Egyptian power: campaigns against the Hittites and Libyans; succession disputes		6:475d–477d	
ii. The reign of Ramses III (1198–1166 BC) and subsequent decline of the 20th dynasty; campaigns against the Sea Peoples; growth of influence of the priests of Amon-Re		6:475d–476b	1:819a–c/12:488f–489b/ 15:501g–503b
c. Society and culture in the New Kingdom: the king as the embodiment of the state; the civil service; the military; the priesthood; the artisans, common people, and slaves; trade and commerce		6:476c–477d/ 17:941a–e	
2. The Hittite Empire and its conflict with Egypt; Syria and Palestine under Egyptian and Hittite domination; the period of the migrations of new peoples		6:477d–479a/ 19:255c–256f	16:119a–121a *passim*
a. The Hittite Empire (*c.* 1525–1190 BC)			12:914b–d
i. Expansion of the Hittite Empire under Suppiluliumas I into Syria (*c.* 1365 BC): reduction of the Mitannian state; ensuing conflicts and treaties with Egypt; relations with neighbouring states		1:818c–819e	
			1:818c–819c/6:475f–h

ii. The capital of the Hittite Empire at Hattusa (Boğazköy): geographical position; architecture; invasions from the West; fall of the empire and destruction of the capital (*c.* 1190 BC): emergence of the Indo-European Phrygians as the chief Anatolian power

b. Syria and Palestine under Egyptian, Mitannian, and Hittite domination, and the period of the migrations of new peoples (*c.* 1550–1200 BC)

i. The development of Levantine seafaring trade: the Levantine city-states (*e.g.*, Ugarit); political organization; economy; culture; development of the linear alphabet by the Canaanites and the spread of its use

ii. The origins of the Hebrews in the patriarchal age, and their sojourn in and Exodus from Egypt in the 13th century BC; their conquest of Palestine; the Sea Peoples and the Philistine conquest of the Palestinian littoral

iii. The Syro-Hittite states and the migration of the Semitic Aramaeans into Syria and Palestine *c.* 1100 BC, and their foundation of states in Syria: spread of the Aramaic language; trends in religion and the arts

3. Mesopotamia from *c.* 1600 to *c.* 900 BC

a. The Kassites in Babylonia (*c.* 1595–*c.* 1155 BC): their conjectured origins; their adoption of Mesopotamian culture; Elamite and Assyrian invasions after *c.* 1250; the fall of the Kassites

b. The kingdom of the Hurrians and the Mitanni (*c.* 1500–1360 BC) in northern Mesopotamia; its displacement by Assyria

c. The rise of Assyria (*c.* 1360–1076 BC): expansion under Ashur-uballit I (*c.* 1365–*c.* 1330 BC); conquest of Babylon; continued expansion to Tiglath-pileser I (*c.* 1115–*c.* 1077 BC); temporary eclipse of Assyria (to *c.* 900 BC)

4. The Elamite kingdom and its struggle with Babylonia in the 13th and 12th centuries BC

5. Mycenaean (Achaean, Late Helladic) civilization in Greece (*c.* 1450–1100 BC): the eruption of Thera (*c.* 1500 BC), the conquest of Minoan Crete (*c.* 1450 BC), and the arrival of the Greeks

a. The overthrow of the existing social order; introduction of new artistic styles; conquest of the Cyclades; the evidence of the Linear B tablets; destruction of the palace at Knossos and period of the Mycenaean Empire

b. The end of the Bronze Age in the Aegean: destruction of Mycenaean centres; invasion from the north and the coming of the Greeks

c. The people of the Bronze Age Aegean: physical types, dress, society, economy, warfare, religion, and arts

F. The era of the new states of Southwest Asia: the beginning of the Iron Age (*c.* 1050–700 BC)

1. Egypt and Babylonia in decline; further Assyrian expansion

a. Egypt under the 21st–25th dynasties (1085–656 BC): loss of influence in Syria; disunity and the diminution of royal power; Libyan domination; civil war and Kushite (Ethiopian) rule; the Assyrian conquest (671–664 BC)

b. Babylonia (*c.* 1050–750 BC): the brief resurgence of Babylonian power under Nebuchadrezzar I (1124–1103 BC); the cult of Marduk; Aramaean, Assyrian, and Chaldean invasions from the 11th to the 9th century BC

articles	article sections	other references
BOGAZKÖY **2**:1181–1183		**1**:819c–e/**2**:190g–191e/ **11**:1061g–1062c/ **17**:935d–936e
SYRIA AND PALESTINE, HISTORY OF **17**:934–942	**1**:817d–819a	**17**:967d–g
UGARIT **18**:832–833	**17**:936e–939e/ **13**:146e–h/ **19**:264h–265f	**12**:885d–e
	17:939f–942a/ **2**:895h–896d/ **10**:1088h–1089b	**1**:11e–13d *passim*/ **6**:475h–476a/**10**:303d–305e/ **11**:988c–e/**12**:487h–490d
	17:942a–h/ **1**:619f–620c/ **1**:621b–g	
MESOPOTAMIA AND IRAQ, HISTORY OF **11**:979–982		
	11:979h–980e	
	11:980e–981a/ **1**:817d–819a	**6**:472f–473d/**17**:934g–935d/ **18**:366e–g/**18**:1039b–c
	11:981b–982g	
	9:831e–h	**11**:981h–982a
AEGEAN CIVILIZATIONS **1**:119–122		**5**:252g–253a
	1:119g–121a/ **1**:822h–823e/ **8**:392g–393b	**8**:393e–f/**14**:898f–g
	1:121a–e	
	1:121f–122h/ **19**:275e–277g	
	12:914b–d	
	6:479a–480a	**11**:896g–h/**13**:109e–f
BABYLON **2**:554–556	**11**:981h–982g	**9**:831g–h

	articles	article sections	other references
c. Emergence of Assyria as the dominant Mesopotamian state after *c.* 900 BC: internal dissension and the challenge of Urartu in the 8th century BC		**11**:982g–984a/ **2**:192f–h/ **9**:832a/ **18**:1039g–1041a	
2. Palestine, Syria, Anatolia, and Iran			
a. Development of Canaanite–Phoenician commercial city-states from *c.* 1100 to *c.* 700 BC (*e.g.*, Tyre, Sidon): trade and colonization; Phoenician civilization		**13**:146f–h/ **17**:942h–944h	**17**:402c–e
b. The Hebrew kingdom (*c.* 1020–*c.* 700 BC): subjection of the Philistines; territorial expansion in Syria and Palestine		**10**:305e–309b/ **17**:944h–947e	**6**:479b–c/**16**:281f–282c
i. The reigns of David and Solomon in the 10th century; growth of separate kingdoms of Judah (south) and Israel (north, conquered by Assyria in 722 BC)		**2**:896e–897f/ **17**:945b–947e	**5**:517g–519f/**16**:207g–208e/ **16**:1044d–1045f
ii. The cult of Yahweh and biblical literature; social and political structure; arts		**3**:599h–600e/ **5**:227f–229d/ **6**:322b–f	**2**:910g–916e *passim*/ **10**:199f–h
c. The neo-Hittite states of southeastern Anatolia: Carchemish, Milid (Malatya), Tabal, and Que (*c.* 1180–700 BC); conquest by the Aramaeans and Assyrians		**1**:819e–g/ **1**:820h–822a	**2**:192f–g/**17**:942b–h
d. Foundation of Urartu in about the 13th century BC; rise of the Urartian kingdom (*c.* 840–*c.* 744 BC) Assyrian influences; the Cimmerian invasion (*c.* 714 BC) and destruction of the kingdom (*c.* 609 BC); influence of the Urartian state; the Armenian Empire under the Artaxiads	URARTU AND ARMENIA, HISTORY OF **18**:1039–1041	**19**:267d–e	**11**:984c–h *passim*
e. Phrygia in central and western Anatolia (*c.* 1180–*c.* 700 BC): capital at Gordium; relations with Assyrians and Luwians; the Cimmerian invasions in the beginning of the 7th century; the cult of Cybele		**1**:819h–820h	**2**:192f–193c/**18**:1040e–h
f. The Aramaean kingdoms (*e.g.*, Damascus): their cultural and commercial role; conquest by Assyria		**17**:942c–h	
g. The Neo-Elamite period: the occupation of Iran by the Indo-European Medes and Persians by the 9th century BC		**9**:832a–f/ **19**:268h–270c	**11**:985h–986c
G. The era of the Assyrian and Neo-Babylonian empires, and the Achaemenid Persian Empire (746–250 BC)	MESOPOTAMIA AND IRAQ, HISTORY OF **11**:984–989		
1. The first imperial unification of the ancient Near East under the Assyrian Empire (746–609 BC)			
a. Assyrian culture in the context of the Mesopotamian tradition: the great cities (*e.g.*, Nineveh)	NINEVEH **13**:116–117	**19**:262h–264f	
b. Expansion of the empire under Tiglath-pileser III (744–727 BC), Sargon II (721–705 BC), and Sennacherib (704–681 BC); decline from the reign of Ashurbanipal (668–627 BC); conquest by the Medes (625–609 BC)		**11**:984b–988b/ **5**:406e–f	**2**:144d–145f/**6**:479h–480d/ **16**:248d–249a/**10**:308b–f/ **13**:117a–f/**16**:542c–543a/ **18**:401c–402a
2. The interval between Assyrian and Achaemenid hegemony (610–539 BC)			
a. The Neo-Babylonian Empire (636–539 BC): conquests; treatment of Jews; decline of the empire		**11**:988c–989d/ **1**:822b–h/ **19**:264g–h	**2**:555b–c/**12**:914d–e
i. The reign of Nebuchadrezzar II (604–562 BC): subjection of Syria and Palestine; the Babylonian Exile of the Jews and the post-Exile period; building activities		**11**:988c–f/ **2**:897g–898c/ **10**:308g–310a	**10**:134e–135d/**12**:925f–926d
ii. The last kings of Babylonia: internal dissension and early relations with Persia; surrender to Cyrus II the Great (539 BC)		**11**:988g–989d	
b. The Anatolian kingdom of Lydia (*c.* 700–*c.* 547 BC): early relations with Assyria; the Cimmerian invasions; suzerainty over the Greeks in Anatolia; Greco-Lydian culture; growth of independent Cilicia in the late 7th century; conquest by Persia		**1**:822b–h	
c. Saite Egypt (26th dynasty, 664–525 BC): its reassertion of independence after Assyrian rule; revival of traditional Egyptian culture; subjection to Persia		**6**:480a–481f	

	articles	article sections	other references
d. The Kingdom of the Medes in Iran (*c.* 700–550 BC) and the establishment of the Achaemenid Persian Empire		**9**:832f–833h	
i. Conjectured origins of the Median state; expulsion of the Scythians; extension of control over the other Iranian peoples, and into Armenia and eastern Anatolia after the downfall of Assyria		**9**:832f–833c/ **18**:1041c–d	
ii. Cyrus II the Great's (550–529 BC) establishment of his rule from Anatolia to east of Iran; relative generosity toward subject peoples		**9**:833d–h	**5**:409g–410f/**8**:347d–e/ **18**:792c–e
3. The Achaemenid Persian Empire (529–330 BC) under the successors of Cyrus II the Great; Greek rule to *c.* 250 BC		**9**:833h–839e/ **1**:823f–824e	**5**:406f–h
a. The empire under Cambyses II, Darius I, and Xerxes I (529–465 BC): the subjugation of Egypt; establishment of peace in the empire; penetration of the Balkan Peninsula and the unsuccessful attempts to conquer mainland Greece		**9**:833h–835e/ **8**:309d–311g/ **8**:349f–351e/ **11**:989d–g	**5**:491d–492b/**6**:480f–481b/ **8**:347f–h/**8**:348g–349e/ **9**:596d–597a/**12**:204c–e/ **17**:947b–e/**18**:270c–f/ **19**:1057b–1058b
b. Xerxes' weak successors: continued involvement in Greek affairs; internal disunity in the 4th century, resulting in conquest by Alexander III the Great (330 BC)		**9**:835e–836f/ **8**:362d–g/ **8**:374d–375c/ **16**:502b–e	**1**:469c–471b/**6**:481c–f
c. Achaemenid society and culture: Zoroastrianism; Persepolis and other capitals; social structure and economy	PERSEPOLIS **14**:105–106	**9**:836f–838a/ **12**:289b–c/ **19**:270c–271c/ **19**:1171f–1172a	**6**:329f–g/**9**:870a–b/ **19**:1169g–1170g
d. Seleucid rule to *c.* 250 BC; movement of Iranian peoples; revolt of the high satrapies		**9**:839f–841a/ **17**:948d–950b	**16**:503c–f
H. The Parthian and Sāsānian empires (*c.* 250 BC–AD 651; Armenia	IRAN, HISTORY OF **9**:841–851		
1. The revival of Iranian power with the establishment of the Parthian Empire by Arsaces; formation of the Arsacid Parthian state		**9**:841a–846a/ **19**:271g–272g	**18**:792e–f
a. The "Philhellenistic Period" (*c.* 171 BC–*c.* AD 10): eastern and western expansion until the mid-1st century BC; wars with Rome until the settlement of 20 BC		**9**:842c–844f/ **19**:1172a–b	**11**:990b–d
b. The "Anti-Hellenistic Period" (AD 2–162): Parthian government under Artabanus III (AD 12–38); dissolution of the Parthian state		**9**:844f–845e	
c. Roman invasions and the end of the Parthian Empire, AD 162–226		**9**:845e–846a	
2. Extension of Iranian power under the Sāsānian Empire		**9**:846b–851g	**18**:792g–h
a. Foundation of the empire: the rise of Ardashīr I in the early 3rd century BC; the wars of Shāpūr I (AD 241–272); organization of the empire		**9**:846b–848c	
b. Religious developments: Zoroastrianism; Christianity; Manichaeism; art and literature		**9**:848d–850c/ **10**:317e–318c/ **11**:442g–443g/ **19**:272g–273c/ **19**:1172b–e	**6**:329g–330b/**9**:870c–d
c. Foreign policy: conflicts with the Romans, Byzantines, and Turks under Khosrow I (AD 531–579) and Khosrow II (AD 590/591–628); subsequent decline, and extinction of the empire with the Arab conquest (AD 636/637–651)		**9**:850c–851g	**3**:555h–556c/**3**:556g–557b/ **3**:625f–h/**10**:453d–454c/ **10**:454d–455c/**11**:990g/ **16**:654g–655b
3. Armenia: client status under the Iranian empires of Rome in the period dominated by the Arsacids		**18**:1041g–1042b	
I. The Nilotic Sudan, South Arabia, and Ethiopia until *c.* AD 600; North Africa until the Roman conquest (from 146 BC)			
1. Emergence of civilization in the Nilotic Sudan (Nubia): the origins of Nubian culture	NILOTIC SUDAN, HISTORY OF THE **13**:108–109		
2. Egyptianization and the Kingdom of Kush (*c.* 1786–751 BC); conquest of Egypt (*c.* 730 BC), and later expulsion by the Assyrians (by 654 BC); conquest by Aksum (AD 350)		**13**:109a–g	**6**:473f–h/**6**:479f–h

	articles	article sections	other references
3. Pre-Islāmic South Arabia: the kingdoms of Ma'īn, Saba', Qatabān, Ḥaḍramawt, and the tribes of central and northern Arabia; economic activities; religion; foreign relations	ARABIA, HISTORY OF **1**:1043–1046	**1**:620d–e/ **1**:621g–622f/ **1**:1057f–1058e/ **9**:957d–958d/ **12**:914g–h/ **19**:265g–h	
4. Ethiopia to *c.* AD 650	ETHIOPIA, HISTORY OF **6**:1006–1008		
a. Remotest antiquity: the land of Punt; the Sabaean period		**6**:1006g–1007a	
b. The Aksumite Empire (2nd century AD): the Abyssinian peoples; maritime trade; Ezana's rule (4th century AD); reign of Ella-Asbeha (6th century AD) and relations with Persia		**6**:1007a–1008a	**1**:1046b–c
5. North Africa until the Roman conquest	NORTH AFRICA, HISTORY OF **13**:146–152		
a. Emergence of civilization in North Africa: the Early Neolithic culture in the Maghrib and Libya; the Berbers; the influence of Egypt; the advent of the mercantile Phoenicians and their foundation of Carthage *c.* 814 BC (Utica, 1101 BC?); the Greeks in Cyrenaica from *c.* 630 BC		**13**:146b–h/ **13**:149f–h/ **8**:332f–333a	**6**:475h–476a/**6**:479d–e/ **17**:944d–f
b. Emergence of Carthage as the leading western Mediterranean power: conflicts with the Greeks in the western Mediterranean; extension of Carthaginian power into Spain and the clash with Rome in the Punic Wars resulting in the destruction of Carthage in 146 BC		**13**:146h–149f/ **15**:277e–280g	**7**:1037d–g/ **8**:369c–371a *passim*/ **8**:625h–627f
c. Roman penetration into North Africa: the native kingdoms of Numidia and Mauretania; their eventual incorporation into the Roman Empire		**13**:150a–152f	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ASHURBANIPAL **2**:144
CYRUS II THE GREAT, OF PERSIA **5**:409
DARIUS I THE GREAT, OF PERSIA **5**:491
HAMMURABI **8**:598
KHOSROW I OF PERSIA **10**:453
KHOSROW II OF PERSIA **10**:454
NEBUCHADREZZAR II **12**:925
RAMSES II THE GREAT **15**:501
SARGON OF AKKAD **16**:247
SARGON II OF ASSYRIA **16**:248
SENNACHERIB **16**:542
SHĀPŪR II OF PERSIA **16**:654
SOLOMON **16**:1044
THUTMOSE III **18**:366
TIGLATH-PILESER III **18**:401
XERXES I OF PERSIA **19**:1057

Section 912. Peoples of ancient Europe and the Classical civilizations of the ancient Mediterranean world to AD 395

[for Part Nine headnote see page 563
for Division I headnote see page 563]

The articles and parts of articles referred to in Section 912 deal with five main subjects: A, non-Classical ancient Europe; B, Archaic Greece and the development of Classical Greek civilization (*c.* 1200–323 BC); C, the Hellenistic Age (323–27 BC); D, the rise of Rome; and E, the Roman Empire (31 BC–AD 395).

The outline of subject A first treats the spread of Neolithic farming communities and of Bronze Age industry throughout Europe. It then treats non-Classical Europe in the Iron Age (*c.* 650 BC–*c.* AD 100), covering the Etruscans and other Italic peoples, and the non-Greek peoples of the Balkan Peninsula; the Celts and the Germans; and the ancient peoples of the European steppe—the Cimmerians, the Scythians, and the Sarmatians.

The outline of subject B begins with Archaic Greece, covering the Dorian invasions and Greek migrations to Anatolia; the period of the Olympian religion and of the poetry of Homer and Hesiod; and developments in the later Archaic Period, taken as running to *c.* 500 BC. The outline of Classical Greece covers Athens in the age of Pericles; relations between the Greek states leading to the Peloponnesian War; the era of the Spartan and Theban hegemonies in Greece; the northern kingdoms; conflict with Carthage and the rise of Syracuse; Greek culture in the 4th century BC; and the empire of Alexander III the Great.

Subject C is the Hellenistic Age, taken as running from the death of Alexander in 323 BC to the establishment of the Augustan principate at Rome in 27 BC. The outline treats the establishment of the Hellenistic kingdoms and monarchies after Alexander's death; the relations between the Hellenistic states from *c.* 275 to 27 BC; and Hellenistic political, social, economic, and cultural institutions.

The outline of subject D, the rise of Rome, covers early regal Rome to the 6th century BC; the early Roman Republic to 264 BC; the middle republic, in which Rome emerged as the leading Mediterranean power (264–133 BC); and the late Roman Republic (133–31 BC).

Subject E is the Roman Empire from the establishment of the Augustan principate to the permanent East–West division of the empire after the death of Theodosius I in AD 395. The outline covers the consolidation of the empire under the Julio-Claudians (31 BC–AD 68); the growth of the empire under the Flavians and Antonines; the zenith of the empire in the 2nd century AD; and the changes and crises of the empire in the 3rd and 4th centuries AD.

	articles	article sections	other references
A. Non-Classical ancient Europe	EUROPE, ANCIENT **6**:1059–1063		**7**:582c–595f
1. Introduction: the geography and ethnography of Europe; archaeological and documentary historical sources; historiographic problems		**6**:1059a–e/ **3**:232g–233b/ **3**:282f–g/ **6**:920a–d/ **6**:1126a–e/ **9**:1076f–1077a	**1**:417d–419e/**2**:440h–444b/ **2**:817a–821d/**3**:468f–472e/ **5**:192a–b/**5**:402d–h/ **5**:411c–414g/**5**:580g–584b/ **6**:966h–967e/ **6**:1040h–1052d/ **7**:302b–303h/**7**:582c–595f/ **8**:7b–10f/**8**:44f–56a/ **8**:311h–318h/**9**:23c–24b/ **9**:881b–884c/**9**:1085b–1097f/ **10**:891c–d/**12**:301a–302a/ **12**:1058g–1062d/ **13**:237g–239d/**14**:625f–628d/ **14**:855e–859e/**16**:348f–349c/ **17**:321d–340h/ **17**:381h–389c/ **17**:845b–847b/ **17**:867d–875e/ **18**:864h–874e/ **19**:525c–527f/ **19**:1098h–1103d
2. Europe before the Iron Age		**6**:1059e–1062c/ **3**:282h–283h	**16**:304f–305c
a. Spread of Neolithic farming communities throughout all of Europe by *c.* 2000 BC		**6**:1059f–1061c/ **3**:193g–194a/ **3**:283c–f/ **17**:706d–708b	**17**:401d–f
b. Spread of Bronze Age industry throughout Europe by *c.* 1500 BC: population movements into southeastern Europe and Southwest Asia in the 2nd millennium BC; the Indo-Europeans		**6**:1061c–1062c/ **3**:283f–h/ **6**:1124g–1125g	**17**:401f–402b/**19**:277h–280g/ **19**:282e–283b
3. Non-Classical Europe in the Iron Age (*c.* 650 BC–*c.* AD 100)		**7**:1062c–1063a	
a. The Etruscans and other Italic peoples; the non-Greek peoples of the Balkan Peninsula	ITALIC PEOPLES, ANCIENT **9**:1077–1084		**19**:280g–281h
i. Conjectured Etruscan origins; their language and writing; cities; government and society; art and religion; maritime expansion; foreign relations with the Greeks, Carthaginians, and other Italic peoples; decline after *c.* 500 BC and eventual Roman conquest in the mid-3rd century		**9**:1077b–1082f/ **1**:624f–h/ **6**:1018b–g/ **11**:1096h–1097b/ **14**:900d–f/ **15**:1060h–1061e/ **15**:1086a–e	**6**:476c–e/**8**:330e–331d/ **15**:1063a–1064e *passim*/ **15**:1066f–g
ii. Other Italic peoples: the Umbro-Sabellians, Oscans, Apulians, Latins, Siculi, Ligurians, Veneti, and Piceni; their cultures; their relations with the Greeks, Etruscans, and Carthaginians; eventual absorption by Rome		**9**:1082f–1084h/ **15**:1089h–1090d	**15**:1090e–1091a
iii. Non-Greek peoples of the Balkan Peninsula: (*e.g.*, Illyrians, Thracians: their culture and relationship to Classical civilizations	BALKANS, HISTORY OF THE **2**:611–616		
b. Trans-Alpine Europe and the Iberian Peninsula			
i. The Celts: the Halstatt Period (7th–6th centuries BC); Celtic occupation of Europe from the Danube to the Iberian Peninsula and the British Isles by *c.* 500 BC; Celtic penetration of Italy, the Balkan Peninsula, and Anatolia during the La Tène period (after *c.* 500 BC); subjugation in Gaul by Rome by 50 BC, and later by the Germans by the 5th century AD; Celtic art, religion, social, and political organization	CELTS, ANCIENT **3**:1071–1075	**2**:449f–h/ **3**:194b–e/ **3**:283h–284a/ **3**:1069b–1071f/ **17**:403b–404a	**1**:625g–626a/**3**:1064a–d/ **14**:865a–c/**15**:1090d–e/ **19**:283b–284f

	articles	article sections	other references
ii. The Germans: their acquisition of Iron Age culture; migration into the Elbe–Rhine region by *c.* 500 BC; pressure on the Celts and Rome; inundation of the western half of the Roman Empire by the 5th century AD; Germanic social and political organization; religion and mythology	GERMANS, ANCIENT **8**:40–44	**8**:36c–39g/ **15**:1123a–d/ **15**:1131h–1132d	**1**:625b–e/**16**:305c–g
c. Ancient peoples of the European steppe			
i. The Cimmerians: conjectured origins; southward migration, under Scythian pressure, from north of the Caucasus into Southwest Asia in the 8th and 7th centuries BC			**1**:822b–f/**16**:438e–f
ii. The Scythians (Sakas): westward migration from the 8th century BC and eventual establishment in India and southern Russia after *c.* 600 BC; the Kingdom of the Royal Scyths in southern Russia from *c.* 600 BC to *c.* AD 100; relations with the Greeks and with Achaemenid Persia; government, society, and military tactics; art and religion	SCYTHIANS **16**:438–442	**9**:868g–869g	
iii. The Sarmatian migration into southern Russia in the 4th century BC and gradual displacement of the Scythians by *c.* AD 100; conflict with Rome; conquest by the Goths and Huns in the 3rd and 4th centuries AD; society, art, and religion	SARMATIANS **10**:249–251	**9**:869g–870a	
B. Archaic Greece and the development of Classical Greek civilization (*c.* 1200–323 BC)	GREEK CIVILIZATION, ANCIENT **8**:326–376	**3**:605g–606c/ **4**:578c–579a/ **6**:918f–919c/ **6**:922f–923b	
1. The Early Archaic and Archaic periods (*c.* 1200–*c.* 500 BC)		**8**:326b–349f	
a. The Dorian invasions, the Greek migrations to Anatolia, and their results (Proto-Geometric Period, *c.* 1100–*c.* 900 BC)		**8**:326a–327h	**8**:393f–h/**19**:285b–d
b. The Geometric Period (*c.* 900–*c.* 750 BC): the world of Homer and Hesiod; the beginning of writing and of the *polis;* mythology and religious developments; the panhellenic centres (*e.g.*, Olympia, Delphi); social and political organization	OLYMPIA **13**:564–566	**8**:327h–329c/ **8**:334e–335b/ **6**:322f–323a/ **8**:407b–f/ **19**:285d–286d	**1**:623e–g/**6**:907c–g/**8**:394c–h/ **8**:1017g–1021d *passim*/ **8**:1170h–1171e/ **10**:1089d–1090a/ **10**:1090g–1091b
c. The Archaic Period (*c.* 750 *c.*–500 BC		**8**:329c–333a/ **8**:335f–349b	
i. General trends in the *poleis:* displacement of monarchy by aristocracy; development of a money economy; socioeconomic crises and the rise and fall of tyranny; the colonization movement; relations among the *poleis* (*e.g.*, leagues, wars)		**8**:329c–f/ **8**:335f–337d	**12**:885f–886c/**18**:30e–h
ii. The *poleis* of mainland Greece: the emergence of Spartan dominance over the Peloponnese, and of a military-oriented polity and repression; aristocracy and tyranny at Athens, the reforms of Solon, and the institution of democracy under Cleisthenes; tyranny, aristocracy, and economic expansion at Corinth; the other *poleis* of the Peloponnese, the Isthmus, Euboea, and Boeotia	CORINTH **5**:173–174	**8**:329f–331b/ **8**:334b–d/ **8**:337d–345g/ **8**:347h–348c/ **6**:323a–h/ **8**:399d–g	**2**:265g–266c/**4**:707a–f/ **13**:1110c–h/ **16**:1045h–1046h
iii. The Greeks in Asia Minor (Anatolia): Dorian and Aeolian cities; Miletus, Ephesus, and other Ionian cities; their commercial and cultural efflorescence	EPHESUS **6**:904–905	**8**:345g–346a/ **1**:822b–823e	
iv. The Greek islands: the Cyclades, Sporades, Crete, Cyprus, and the Ionian Islands		**8**:330a–c	**5**:406f–h
v. The Greek colonies and emporia in the West and Africa: southern Italy and Sicily (*e.g.*, Cumae, Syracuse); Gaul and the Iberian Peninsula (*e.g.*, Massilia); Cyrene and Naukratis	SYRACUSE **17**:918–919	**8**:330e–332a/ **9**:1082f–1083a/ **17**:402g–403a	**8**:346b–d/**9**:1081e–h
vi. The Greeks in the North: Chalcidice, Thrace, Propontis (*e.g.*, Byzantium, Abydos, Lampsacus), and Pontus (*e.g.*, Black Sea region, Sinope, and Trapezus)		**8**:332a–f/ **8**:348d–g	
vii. The arts in the Archaic Period; rationalism and irrationalism, and the beginnings of philosophy and science; Orphism and the cult of Dionysus		**8**:333a–334a/ **5**:457h–458c/ **14**:898g–900b/ **15**:325b–d/ **19**:286d–291g	**8**:1170h–1171f/**10**:1091c–h/ **12**:704d–e/**12**:778g–779d/ **14**:250e–251c/**16**:366d–g/ **18**:219g–220a

	articles	article sections	other references
viii. The Greco-Persian Wars: the Persian (Achaemenid) conquest of Asia Minor and Thrace, and the Ionian revolt (499 BC); Darius' (490 BC) and Xerxes' (480 BC) invasions of Greece and eventual Greek victory; the Greek offensive (479 BC); results of the wars; Herodotus' account of the conflict	GRECO-PERSIAN WARS **8**:309–311	**8**:347b–351c/ **1**:823f–824e	**8**:946c–f/**9**:834f–835d/ **12**:204c–e/**18**:270c–f/ **19**:1057f–1058a
2. The Classical period (*c.* 500–323 BC)		**8**:349f–376e	
a. Athens in the age of Pericles		**8**:352a–356f	**14**:67c–68h
i. The Delian League and the Athenian Empire		**8**:352a–e	**14**:67g–68a
ii. Temporary retardation and final development of the democracy; society and economy		**8**:352e–h	**14**:67d–e
iii. Cultural efflorescence; *e.g.*, the rebuilding of the Acropolis, drama, the pre-Socratic philosophers		**8**:351e–352a/ **5**:1021c–1023a/ **11**:827a–h/ **14**:251c–252f/ **17**:11b–13h/ **18**:220a–d/ **18**:240c–h/ **18**:580f–582e	**1**:147h–149e/**2**:262g–264g/ **2**:266c–267b/**8**:823b–f/ **10**:1090b–e/ **10**:1091h–1092c/**11**:471a–d/ **14**:67f–g/**17**:15a–16c
b. The Peloponnesian League and the other Greek states in the 5th century BC: relations among the Greek states from 479 to 431 BC		**8**:354a–356f/ **14**:20d–g	**4**:617e–618a/**14**:68c–f
c. The Peloponnesian War (431–404 BC): the war to the Peace of Nicias (421); renewal of the war and the defeat of Athens; intellectual and political changes at Athens (*e.g.*, oligarchic revolution, the Sophists and Socrates); Thucydides' account of the war	PELOPONNESIAN WAR **14**:20–23	**8**:356g–361e/ **14**:252f–253e/ **17**:11b–f	**1**:436f–437e/**6**:323h–324b/ **8**:1171f–h/**14**:68f–g/ **16**:1001h–1002b/ **18**:359a–361a/**19**:1056e–h
d. The era of the Spartan and Theban hegemonies in Greece: Spartan policies toward the Greek states; relations with Persia; Athens and Thebes against Sparta; the Second Athenian League and the restoration of democracy; Theban expansion and containment; peace and the balance of power in Greece		**8**:361e–366d	**6**:902g–903c/**9**:835h–836c
e. The northern kingdoms: Epirus; the rise of Macedonia and the conquest of Greece under Philip II		**8**:366d–369c/ **19**:574e–g	**9**:836c–d/**14**:225h–227c
f. The western Greeks: conflict with Carthage; the rise of Syracuse under Dionysius the Elder		**8**:352h–353h/ **8**:369c–371a/ **13**:147g–148a	**9**:1081e–h
g. Greek culture in the 4th century BC		**8**:371a–373e/ **12**:779d–780b	**6**:324b–h/**8**:942g–943d/ **8**:1172a–b/**11**:640h–641f/ **16**:366g–367b
i. Developments in philosophy: the contributions of Plato and Aristotle; philosophy of education; philosophy of law; political philosophy		**8**:372e–373e/ **6**:409g–410a/ **11**:612b–c/ **14**:253f–255d/ **14**:685g–687b/ **15**:325f–g	**1**:1162d–1165f/**2**:349d–g/ **6**:931e–932e/**10**:716a–d/ **12**:863e–864a/**14**:532f–538d/ **14**:539e–g/**15**:528h–529c/ **15**:787c–e
ii. Developments in the arts: literature, music, and the visual arts		**8**:371f–372e/ **19**:291h–297e	**7**:892b–c/**10**:1093d–f/ **12**:704e–f
h. The empire of Alexander III the Great: relations with the Greeks; the conquest of the Persian Empire (334–330 BC), Bactria, and the Indus Valley (330–323 BC); the ideals and governing practices of Alexander, and the diversity of his empire		**8**:373e–376e/ **9**:839e–840c/ **19**:574h–575a	**1**:469b–472d/**9**:836d–f/ **17**:947e–g
C. The Hellenistic Age (323–27 BC)	GREEK CIVILIZATION, ANCIENT **8**:376–390		
1. Establishment of the Hellenistic kingdoms and monarchies		**8**:376e–382h	**11**:989h–990b
a. The regency, and warfare among rival generals after Alexander's death (323–276 BC)		**8**:376f–379b	**1**:990e–991c/**15**:181a–f/ **16**:501a–c
b. Macedonian and Ptolemaic Egypt (323–30 BC)		**8**:379c–f/ **6**:481g–485d	
i. The Ptolemaic dynasty: dynastic strife and the end of the dynasty with the death of Cleopatra (30 BC)		**6**:482a–484a	**2**:369h–370b/**4**:712d–713f/ **15**:181f–h/ **15**:182a–g *passim*

	articles	article sections	other references
ii. Government and civilization of Hellenistic Egypt		**6**:484a–485d/ **19**:256h–257d	**1**:479d–f/**6**:508h–509c/ **11**:471d–g
c. The Seleucid Kingdom in Asia: the dynasty, government, society, culture, and economy in its diverse regions; Jewish resistance; territorial losses in the 3rd century	SELEUCID KINGDOM **16**:501–502	**8**:379f–380b/ **9**:840c–841a/ **10**:310b–e/ **19**:271d–f	**11**:224g–225h/**11**:1018d–e
d. Greek rule in Bactria and India		**8**:380c–e/ **1**:173b–d	**9**:350b–351a/**9**:353c–e
e. The Attalid kingdom of Pergamum and the native states in Asia Minor: Bithynia, Pontus, Cappadocia, Galatia, and Rhodes		**8**:380e–381c/ **15**:1102c–e	**1**:824f–825a/**12**:287h–288e
f. The Antigonid kingdom of Macedonia: government and foreign policy		**8**:381d–f	**1**:991d–992b
g. Greece: social and political changes in the *polis;* the Achaean and Aetolian leagues; Athens and the other Greek states		**8**:381f–382e	**1**:991g–h
h. The western Greeks; Epirus; Sicily under Agathocles (317–289 BC) and Hieron II (*c.* 270–215/216 BC) until its absorption by Rome		**8**:382f–h	
2. Relations among the Hellenistic states from *c.* 275 to 27 BC		**8**:382h–386f	
a. Expansionist policies of the Ptolemies in the Aegean and Asia Minor and Syria, and their conflicts with the Seleucids		**8**:382h–383d	**17**:947g–948a
b. Conflicts between the Greek leagues and the Antigonids in the 3rd century BC		**8**:383d–384a	
c. The Celtic migrations: expansion into the Iberian Peninsula, the British Isles, and Rome and southern Italy; later expansion into central Europe, the Carpathians, and the Balkans		**3**:1074a–c	
d. The vigorous policies of Antiochus III and Philip V; the breakup of the Seleucid Empire; the entrance of Rome into the affairs of the Hellenistic states resulting in their eventual incorporation into the Roman Empire		**8**:384a–386f/ **15**:1093d–1095d	**1**:825a–c/**1**:993d–994d/ **1**:994e–995d/**11**:224g–225h
3. Hellenistic political, social, economic, and cultural institutions		**8**:386f–390b/ **8**:747d–g	**13**:847d–f
a. Hellenistic monarchy and royal administration		**8**:386f–387f	
b. Cultural developments		**8**:387f–390b	
i. The process of Hellenization, and the social composition in non-Greek lands: the foundation of new cities (*e.g.*, Alexandria, Antioch)	ANTIOCH **1**:992	**8**:387f–388a/ **17**:948a–d	**11**:224h–225f
ii. Commerce, travel, and exploration		**8**:388b–e/ **8**:389g–390b	
iii. Developments in philosophy: Epicureanism, Stoicism, and Neoplatonism		**8**:389c–d/ **6**:911d–912g/ **14**:255d–256h/ **14**:539h–540c/ **17**:698g–699e	**1**:1156c–g/**6**:914g–915a/ **6**:932e–f
iv. Science, the arts, and education		**8**:388f–389a/ **6**:324h–326h/ **8**:1172b–g/ **16**:367c–e	**1**:623g–624c/**10**:1093f–1094c/ **19**:297e–300c
v. Religion: the mystery religions and other developments		**8**:389a–b/ **8**:408b–c/ **8**:750d–751b/ **12**:780b–g	**8**:749g–h/ **10**:310b–314f *passim*
D. The rise of Rome	ROME, ANCIENT **15**:1084–1106		
1. Introduction: the character and achievements of the Romans; the archaeological and documentary historical sources (*e.g.*, Pompeii and Herculaneum); historiographic problems	POMPEII AND HERCULANEUM **14**:789–792	**15**:1084d–1085e/ **3**:598f–599a/ **4**:579a–580a/ **6**:919c–g/ **6**:923b–e/ **15**:1033a–e	**18**:30h–32a/**18**:1075d–e
2. Early (regal) Rome to the 6th century BC		**15**:1085f–1087b	
a. Myths of origins and the early monarchy		**15**:1085f–1086a	

	articles	article sections	other references
b. The Etruscan hegemony and formative influence over Rome		**15**:1086a–e/ **1**:624h–625b/ **18**:220d–f	**5**:1023b–f/**9**:1082a–c/ **15**:1060h–1061d
c. Development of Roman social, religious, political, and military institutions; Roman virtues		**15**:1086e–1087b/ **6**:326h–327d/ **15**:1063a–1064b	
3. The early Roman Republic (6th century–264 BC)		**15**:1087b–1091c	
a. Overthrow of the monarchy and establishment of the republic and its institutions: the magistracies; judicial institutions; the Senate; plebeian institutions		**15**:1087b–1089g	
b. Expansion of Rome in Italy: Rome and its Latin neighbours; the Gallic invasion and further conquests; Roman mastery of Italy		**15**:1089h–1091c/ **7**:960a–d	**9**:1082c–f/**9**:1083h–1084a/ **15**:1066h–1067d
4. The middle republic: the emergence of Rome as the leading Mediterranean power (264–133 BC)		**15**:1091d–1099d	**15**:1067d–h
a. The First and Second Punic Wars	PUNIC WARS **15**:277–280	**15**:1091d–1093d/ **13**:148a–c/ **13**:149c–f	
i. The First Punic War (264–241 BC) and its aftermath: the emergence of Roman naval power, and acquisition of Sicily (241 BC); later annexation of Corsica and Sardinia (238 BC)		**15**:1091d–h/ **15**:277e–278d	**12**:886e–g
ii. Roman expansion into Cisalpine Gaul, and entry into Greek affairs		**15**:278d–279b	**7**:960c–d
iii. The Second Punic War (218–201 BC): Hannibal's invasion of Italy; his initial victories and the war of attrition in Italy; Roman defeat of the Carthaginians at the Battle of the Metaurus (207 BC); the First Macedonian War (214–205 BC) and the conflict in Spain; Roman counteroffensive and victory in Africa (202 BC); Roman pacification of conquered territories		**15**:1091h–1093d/ **15**:278d–280e	**8**:625h–627f/**12**:396f–397b/ **17**:402f–g
b. Establishment of Roman hegemony in the Hellenistic world		**15**:1093d–1096c	
i. Establishment of a Roman protectorate over Greece after the Second Macedonian War (200–196 BC); the conquest of Macedonia and Illyricum (168 BC); the reduction of Rhodes; Roman exclusion of Seleucid power from the Aegean		**15**:1093h–1095a/ **8**:384g–385e	
ii. The Third Punic War (149–146 BC): the destruction of Carthage; subjugation of Macedonia and Greece		**15**:1095a–d/ **15**:280e–g/ **18**:1041d–f	**1**:994b–d/**16**:394h–395b
iii. Beginning of Roman provincial administration; abuses; Romanization of the empire		**15**:1095d–1096c/ **15**:1099g–h	**13**:150f–g
c. Roman government and economy in the middle republic: consuls, the Senate, and popular assemblies; development of large business interests, grazing estates, and urban immigration		**15**:1096c–1098e/ **15**:1055b–e	**10**:779h–780a
d. Roman culture in the middle republic: Hellenizing influences		**15**:1098e–1099d/ **18**:220f–h/ **19**:300d–301d	**6**:327d–328a/**8**:1172g–1173a/ **14**:762f–764a/**19**:314e–h
5. The late Roman Republic (133–31 BC)		**15**:1099d–1106g	
a. Social and economic ills in Italy and the reform movement of the Gracchi (133–121 BC): its results; the rise of middle class equites		**15**:1099h–1101c	**8**:261d–264b/ **15**:1067h–1068f/**16**:395e–g
b. Roman wars against the Celts and the conquest of Gallia Narbonensis (121 BC); wars against Jugurtha of Numidia (112–105 BC) and the Germans (105–101 BC); Marius' career and military reforms	GAUL **7**:960	**15**:1101c–1102c	**11**:504a–505a
c. Events in Asia and the first war with Mithradates VI Eupator (88–84 BC): Italian allies (*socii*) against Rome in the Social War (90–89 BC), and their subsequent enfranchisement; the dictatorship and constitution of Sulla (82–80 BC)		**15**:1102c–1103f/ **8**:385e–386a	**12**:288c–d/**17**:793f–794b
d. The Roman state in the two decades after Sulla		**15**:1103g–1105b	
i. Pompey's early career; revolts against Roman rule; Pompey's alliance with Crassus and repeal of the Sullan system; his extraordinary commands		**15**:1103g–1104g	**12**:288d–e/**14**:793c–f/ **17**:950b–d

	articles	article sections	other references
ii. Growing political suspicion and the outbreak of violence in the mid-1st century BC: the conspiracies of Catiline; Cicero's decline; the rise of Caesar and Pompey		**15**:1104g–1105b	**4**:607e–608d/**14**:793g–794a
e. The alliance of Caesar, Pompey, and Crassus (59–44 BC): Caesar's conquest of Gaul; political manoeuvres and the outbreak of the Civil War; Caesar's triumph, dictatorship, and assassination		**15**:1105c–1106c/ **3**:601b–602a/ **19**:575f–h	**1**:999h–1000b/**3**:577c–579c/ **4**:607h–608d/**6**:483f–h/ **7**:960h–961a/**8**:819g–h/ **11**:132d–g/**14**:794a–795c
f. The initial cooperation of Octavian and Mark Antony in the Triumvirate, and Octavian's achievement of sole power (43–31 BC): the annexation of Egypt and its administration		**15**:1106d–g/ **6**:485d–486f/ **8**:386b–f	**1**:367b–d/**1**:1000c–1001a/ **2**:369c–370c/**6**:483g–484a/ **8**:819h–820c
g. Roman law during the late republic: the development of new procedures; the role of magistrates; the law of succession		**15**:1059b–d	**9**:590a–b
h. Culture in the late republic: oratory and philosophy; the arts		**14**:687b–d/ **18**:241d–242d	**4**:609a–610b/**6**:328a–d/ **10**:857c–d/**10**:1095d–e/ **11**:174a–175g/**16**:185a–e/ **19**:307g–309a
E. The Roman Empire (31 BC–AD 395)	ROME, ANCIENT **15**:1106–1131		
1. Consolidation of the empire under the Julio-Claudians (31 BC–AD 68)		**15**:1106g–1112e	**17**:405a–c
a. Augustus' establishment of the principate (27 BC–AD 14): the role of the *princeps;* the imperial administration, fiscal and military reforms, and the founding of new colonies; social and religious legislation; economic growth		**15**:1107a–1108g/ **15**:1110g–h	**2**:370d–g/**11**:216g–h/ **15**:1068g–1069a
b. The Roman Empire at the time of Augustus: provincial administration; the imperial frontiers; the western provinces; the eastern provinces; the economic unification of the Mediterranean		**15**:1108g–1110a	**1**:331b–g/**1**:367e–g/**2**:371a–c/ **7**:961b–c/**10**:146f–148g/ **13**:847g–848a/**17**:950e–f
c. Foreign policy: Roman relations with Parthia and the other states in the East; the southern, western, and northern frontiers		**15**:1110a–f	**2**:370g–371a/**9**:844c–e
d. The culture of the Augustan Age: contributions of Livy, Virgil, and Horace; religion; the visual arts		**15**:1110h–1111c/ **14**:791c–h/ **14**:900f–901b/ **18**:220h–221b	**2**:372d–f/**8**:749h–750b/ **8**:1071h–1073g/ **10**:1095e–1096a/**11**:3f–4h/ **19**:309a–h/**19**:314h–315c
e. The empire under Tiberius (AD 14–37), Gaius (AD 37–41), Claudius I (AD 41–54) and Nero (AD 54–68): internal and frontier policies; the annexation of Britain; Tacitus' accounts; civil war and revolt in "the year of the four Emperors" (AD 69); Jesus Christ and the origins of Christianity	BRITAIN, ANCIENT **3**:194–195	**15**:1111g–1112e	**2**:371d–h/**4**:536a–f/ **4**:696g–697e/**10**:148g–154a/ **10**:242e–243b/ **12**:965g–966g/ **13**:1090g–1093f *passim*/ **14**:153d–156e *passim*/ **18**:370h–371h/**19**:95f–96c
2. Growth of the empire under the Flavians and Antonines (AD 69–192)		**15**:1112e–1115e	
a. The Flavian emperors (AD 69–96): Vespasian's fiscal and provincial reorganization; military and frontier policies; Titus and the suppression of the Jewish revolt; Domitian's despotism; military development and frontiers		**15**:1112g–1113f	**3**:195g–h/**5**:950d–951a/ **10**:278a–g/**11**:1018d–e/ **17**:983h–984b/**19**:96c–97b
b. The Antonine emperors (AD 96–192): the reigns of Nerva, Trajan, Hadrian, Antoninus Pius, Marcus Aurelius, and Commodus; the beginning of imperial decline after AD 180		**15**:1113f–1115e	**8**:539c–541d/**11**:492b–493b/ **18**:593d–594e
3. The zenith of the Roman Empire in the late 1st and 2nd centuries AD		**15**:1115e–1119e	
a. The city of Rome and the empire: methods of Roman imperialism; the cities, culture, society, politics, and economy of the western and eastern provinces; the legions and frontier defenses		**15**:1116d–1118e/ **13**:150h–152f	**3**:196c–197f/**7**:940d–f/ **8**:540f–541a/**17**:951a–c/ **18**:593e–594a
b. Greco-Roman culture of the late 1st and 2nd centuries AD		**15**:1118f–1119e	**6**:328d–h/**8**:1173a–c
i. Philosophy and religion		**2**:946c–d/ **10**:316a–g/ **12**:289d–f/ **12**:780g–781d/ **15**:325g–h/ **17**:13h–14b	**4**:710e–711h/**8**:215e–h

	articles	article sections	other references
ii. Technology		1:1036c–1038a/ 3:175b–f	
iii. The arts		19:301d–306d	9:704e–705c/10:365h–366e/ 14:578c–579b/ 17:984b–985a/ 19:309h–313h
4. Changes and crises in the Roman Empire in the 3rd and 4th centuries AD		15:1119e–1132e	
a. Civil wars, conflict with Parthia, the growth of bureaucracy, and militarization of government under the Severan dynasty (AD 193–235)		15:1119e–1121c/ 13:152f–153a	3:811a–e
b. Religious and cultural life: the public religions under the empire, and the rise and spread of Christianity and other Eastern religions; official persecution of Christianity		15:1121d–1122b/ 4:536h–537e/ 4:538d–g/ 8:215h–216b	2:940a–e/8:750b–d/ 13:153a–b/15:1062b–1063a/ 19:313h–314d
c. The transformation of Greco-Roman culture in late antiquity (3rd and 4th centuries AD): Greek revival and growth of Christian theology		15:1122b–e/ 6:328h–329e/ 6:333f–h/ 14:540d–542e/ 17:699h–700c/ 19:318g–324e	2:940f–941a/18:160g–161c
d. Military anarchy and disintegration of the Roman Empire (AD 235–270): the Gordians; the beginning of Germanic invasions; loss of eastern provinces; economic and social crisis		15:1122f–1124b	7:961h/11:132g–133a/ 17:951c–e
e. The recovery of the Roman Empire and the establishment of the dominate (AD 270–337): the recovery measures of Aurelian and his immediate successors		15:1124c–1127b/ 3:548h–549e/ 13:152f–153a	4:540c–d/13:153b–e
i. Diocletian's (284–305) fundamental political and economic measures: persecution of Christians; struggle for power		15:1124f–1126c	5:805d–806h/13:848a–c
ii. Constantine the Great (307–337): his conversion to Christianity, administration, and founding of Constantinople		15:1126c–1127b	4:590d–f/5:71g–73d/ 6:1130b–1131b/ 9:1069g–1070a
f. The Roman Empire under the 4th-century successors of Constantine to Theodosius I (AD 379–395)		15:1127b–1131e	18:272d–273h
i. The rule of Constantine's sons (337–361): renewed wars with Sāsānid Persia, and increased penetration of the empire by the Germans		15:1127b–f/ 9:850d–g/ 13:154b–f	16:654g–655b
ii. Julian's reign (361–363): the attempt to restore the old empire		15:1127f–1128h	10:333a–f
iii. Establishment of Christianity as the sole state religion; social, economic, and urban decline; remnants of pagan culture		15:1128h–1131e/ 3:549e–550b	4:541g–542c/4:590f–591a/ 16:859d–f
g. The provinces under the later empire and the eclipse of the empire in the West: Germanic hegemony and the invasions by other peoples		15:1131e–1132d/ 3:229b–f/ 3:550b–f/ 6:486g–487d/ 13:153h–154f	2:1180c–1181e/3:197f–198c/ 17:951f–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AGRIPPA, MARCUS VIPSANIUS 1:367
ALCIBIADES 1:436
ALEXANDER III THE GREAT 1:468
ANTIGONUS I MONOPHTHALMUS 1:990
ANTIGONUS II GONATAS 1:991
ANTIOCHUS III THE GREAT 1:993
ANTIOCHUS IV EPIPHANES 1:994
ANTONIUS, MARCUS 1:999
AUGUSTUS 2:368
CAESAR, JULIUS 3:575
CARACALLA 3:810
CIMON 4:617
CLAUDIUS I 4:696
CLEISTHENES OF ATHENS 4:706
CLEOPATRA 4:712
CONSTANTINE THE GREAT 5:71
DEMOSTHENES 5:578
DIOCLETIAN 5:805
DOMITIAN 5:950
EPAMINONDAS 6:902
GRACCHI, THE 8:261
HADRIAN 8:538
HANNIBAL 8:625
HEROD I THE GREAT 8:819
JULIAN THE APOSTATE 10:332
MAECENAS, GAIUS 11:291
MARCUS AURELIUS 11:491
MARIUS, GAIUS 11:504
MILTIADES 12:203
MITHRADATES VI EUPATOR 12:287
NERO 12:965
PEISISTRATUS 13:1109
PERICLES 14:68
PHILIP II OF MACEDONIA 14:225
PLUTARCH 14:578
POLYBIUS 14:762
POMPEY THE GREAT 14:792
PTOLEMY I SOTER 15:180
PTOLEMY II PHILADELPHUS 15:182
SCIPIO AEMILIANUS 16:393
SCIPIO AFRICANUS 16:395
SELEUCUS I NICATOR 16:502
SOLON 16:1045
SULLA, LUCIUS CORNELIUS 17:793
TACITUS, CORNELIUS 17:982
THEMISTOCLES 18:269
THEODOSIUS I THE GREAT 18:272
TIBERIUS 18:369
TRAJAN 18:593
VESPASIAN 19:95

Division II. Peoples and civilizations of medieval Europe, North Africa, and Southwest Asia

[for Part Nine headnote see page 563]

The outlines, and the articles and parts of articles referred to, in the four sections of Division II deal with the civilizations directly descendant from those of the ancient Near East and of Classical antiquity, which were treated in the two sections of Division I. The general period covered in Division II is the Middle Ages, beginning with the death of Theodosius I in AD 395, conventionally taken as marking the permanent division of the Roman Empire into East and West, and extending to *c.* 1500, conventionally taken as the starting point of modern history.

The sectional organization of this division, and the outlines in its four sections, reflect significant cultural and political interaction between the Eastern Christian, Western Christian, and Islāmic spheres, and also involve some breaking points in the history of each sphere.

The articles referred to in Section 921 cover the history of western and eastern Europe, and of the Byzantine Empire, from AD 395 to *c.* 1050.

Section 922 deals with the formative period in Islāmic history from 622 to *c.* 1055, covering the rise and rule of the Empire of the Caliphate, the subsequent disintegration of that empire, and the emergence of a number of independent Islāmic states.

Section 923 deals with Western Christendom in the High and later Middle Ages (*c.* 1050–*c.* 1500), covering the economic, political, and cultural revival from *c.* 1050 to *c.* 1300, and the decline of medieval institutions and the incipient transition to the modern age, from *c.* 1300 to *c.* 1500.

Section 924 treats, for the period *c.* 1050 to *c.* 1480, the confluent and interpenetrating histories of the peoples of Southwest Asia, North Africa, Muslim Spain, and eastern Europe, pivoting around the crusading movement's expansion of Europe and the Muslim response.

Section 921. Western Europe, the Byzantine (Eastern Roman) Empire, and the states of eastern Europe from AD 395 to *c.* 1050 578
922. The Empire of the Caliphate and its successor states to *c.* AD 1055 583
923. Western Christendom in the High and later Middle Ages (*c.* 1050–*c.* 1500) 585
924. The crusading movement, the Islāmic states of Southwest Asia, North Africa, and Europe, and the states of Eastern Christendom from *c.* 1050 to *c.* 1480 592

Section 921. Western Europe, the Byzantine (Eastern Roman) Empire, and the states of eastern Europe from AD 395 to c. 1050

[for Part Nine headnote see page 563]

The articles and parts of articles referred to in Section 921 deal with five main subjects.

Subject A is the eclipse of the Roman Empire in the West and the development and Christianization of Germanic successor states (AD 395–*c.* 750).

Subject B is the early Byzantine (Eastern Roman) Empire (AD 395–717). The outline treats the origins of Byzantium; the Byzantine Empire from the death of Theodosius I to the accession of Heraclius (610); the rehabilitation of the empire under the dynasty of Heraclius (610–685); and the decline of that dynasty (685–711).

Subject C is Western Christendom and Scandinavia from the Carolingian era to the general European revival (*c.* 750–*c.* 1050). The outline deals first with the rise, decline, and dissolution of the Carolingian Empire. It next treats the history of the British Isles and of Scandinavia from *c.* 800 to 1066; the history of Germany, Burgundy, and Italy: the development of the Holy Roman (German) Empire in the 10th and early 11th centuries; the Kingdom of France under the early Capetians (987–1180); and the growth of Christian kingdoms in northern Spain. Finally, it deals generally with the sociopolitical and economic structure of early medieval Europe.

Subject D is the peoples and states of eastern Europe to *c.* 1050. The outline first deals with the Slavic peoples, covering their origin and their division, after western migrations, into eastern, western, and southern branches. It next deals with the eastern European states and peoples within the Byzantine orbit, treating the Bulgarian domains to 1018; the migration of the Croats and Serbs into the Balkans; the rise of the Rus and the Turkic Khazar state in southern Russia; and the Russian state of Kiev. Finally, the outline deals with the eastern European states within the orbit of Western Christendom, treating developments in Moravia and Bohemia; the Avar Empire and the early Magyar kingdom; and the development of the Kingdom of Poland in the 10th century.

Subject E is the zenith and incipient decline, hastened by the schism with Rome of 1054, of the Byzantine Empire (717–1081) and the growth of Venice in the early Middle Ages.

	articles	article sections	other references
A. The eclipse of the Roman Empire in the West and the development and Christianization of Germanic successor states (AD 395–*c.* 750)	MIDDLE AGES (*c.* 395–1500) **12**:138–142		
1. Introduction to medieval history: the historical sources; historiographic problems; chronological outline		**12**:139e–142a	
2. The end of the Western Roman Empire and the Germanic Völkerwanderung (AD 395–*c.* 500)			
a. The general decline of government, economy, society, and culture; the Visigothic invasions in the 5th century and settlement in Provence and Spain	SPAIN, HISTORY OF **17**:405–407		**14**:865c–e
b. Establishment of the Germanic hegemony: the invasions of Vandals; the invasions of Angles, Saxons, and Jutes (Britain); the Frankish conquest of Gaul (*c.* 481/482–511), and the Burgundian flight to the south; the Huns; abolition of the Western Empire, and Ostrogothic rule in Italy (493–553); other Germanic tribes: the issue of Arianism versus Catholic Christianity; Germanic law and society	BURGUNDY, HISTORY OF **3**:497	**12**:139e–g/ **3**:550b–f/ **9**:1115d–h/ **11**:133a–134e/ **11**:926c–927c/ **13**:154b–f/ **18**:270h–271h	**2**:359g–h/**3**:198a–e/**4**:540e–g/ **4**:761h–762f/**6**:333h–334a/ **8**:422b–f/**17**:691h–692d
3. The Germanic successor states and the remnants of the Roman Empire in the West from *c.* 500 to 750			
a. Byzantine conquests and later diminution of Byzantium's western possessions (540–751); the Exarchate of Ravenna; Lombard conquests in Italy; beginning of the political role of the Roman papacy	RAVENNA **15**:534	**3**:551f–558g/ **9**:1115h–1119g/ **13**:956d–h	**4**:542g–543b/**13**:154g–155a
b. Early development of the Germanic kingdoms: the Visigothic kingdom to 711; origins of early feudalism		**11**:926g–929d	
i. The Anglo-Saxon kingdoms in England and the Celtic kingdoms in Ireland	BRITAIN AND IRELAND, HISTORY OF **3**:199–202	**3**:283h–284f	**19**:347b–348c
ii. The Franks under the Merovingians and early Carolingians: the successors of Clovis; rise and establishment of the Carolingians under Charles Martel and Pepin III the Short (714–768); Carolingian relations with the papacy and entry into Italian affairs	MEROVINGIAN AND CAROLINGIAN AGE **11**:926–929		**4**:44d–f/**4**:61h–62b/ **9**:1121b–f/**14**:35h–36b/ **19**:346c–347b
c. Effects of the rise of Islām on western Europe		**9**:1123a–c	**3**:629c–e/**9**:1122a–b
4. Religion, the arts, and society in the early Middle Ages: the amalgamation of late Classical and Germanic cultures and Christianity		**11**:931d–934d/ **12**:161f–162a/ **3**:200a–h/ **7**:612e–h	**3**:284g–285b/**4**:44g–45b
a. Conversion of the Celts and the Germans to Catholic Christianity: religious and cultural functions of monasticism and the Western Church		**11**:933a–g/ **4**:543d–544d/ **8**:44b–e/ **13**:956f–957b	**3**:31g–32b/**3**:775b–c/ **4**:542d–f/**4**:591f–592a/ **8**:39g–40b/**8**:422g–423a
b. The arts, intellectual life, and education in the early Middle Ages		**11**:933g–934d/ **6**:334b–g/ **8**:948h–949g/ **8**:1173c–1174a/ **10**:1099c–f/ **12**:704g–705a/ **15**:1036b–f/ **18**:221d–222c/ **18**:242d–g/ **19**:341b–342d/ **19**:345g–354e	**5**:1024d–h/**8**:1174g–1175b/ **10**:857e–858a/**14**:257b–g/ **14**:807f–h/**15**:223h–224a
c. Social and economic life in the early Middle Ages		**11**:931d–933a/ **6**:1115h–1116c	
B. The early Byzantine Empire (AD 395–717)	BYZANTINE EMPIRE **3**:547–558		
1. Introduction to Byzantine history: the historical sources; historiographic problems		**3**:547d–548b/ **19**:575h–576a	

	articles	article sections	other references
2. Origins of Byzantium in the late Roman Empire: the reforms of Diocletian and Constantine		**3**:548d–549e/ **15**:1124f–1127b	**5**:72g–74c/**5**:805f–806b
3. Persistence of Greco-Roman society in the East in the 5th century: the empire from the death of Theodosius I to the accession of Heraclius (610)		**3**:549e–556d	
a. Economic and social policies: agriculture; coinage; relations with the barbarians (*e.g.*, Huns, Goths, Isaurians, Avars, Slavs)		**3**:549f–550f/ **9**:851a–e/ **15**:1131e–1132d	**2**:359d–g/**9**:1070c–d/ **13**:154g–155a
b. Ecclesiastical controversies, Syrian and Egyptian disaffection, and the beginning of conflict with the Western Church		**3**:550f–551b/ **4**:540h–541e/ **6**:136f–137g/ **6**:138c–139b/ **6**:140c–f/ **13**:1085b–e	**4**:591c–f/**10**:364h–365d
c. The empire at the end of the 5th century: internal tensions; political and economic policies under Anastasius I		**3**:551b–f	
d. The reign of Justinian I (527–565): realignment with the Roman Church; Code of Justinian; military campaigns in the West; effects of the plague; later campaigns		**3**:551f–554f/ **15**:1056b–f	**2**:826d–g/**4**:661d–e/**9**:590c–d/ **10**:362h–364f/**13**:154g–155a
e. Early Byzantine culture: Christianity, the arts, and intellectual life		**3**:554f–555g/ **6**:330b–331a/ **10**:1124f–1125e/ **18**:221c–d/ **19**:318g–324e/ **19**:325f–331b	**8**:1174a–d
f. Justinian's successors (565–610): relations with the barbarians and with the Persians; revolt of the army		**3**:555g–556d	
4. Rehabilitation of the empire under the dynasty of Heraclius (610–685)		**3**:556d–558c	
a. Heraclius' reorganization of the empire along military lines: wars with Persia; the loss of Syria, Palestine, Armenia, and Egypt to the Arabs, and continued Arab pressures; recognition of Byzantine overlordship in the Balkans		**3**:556d–557b	**8**:781h–782e/**18**:1042c–g
b. Decline of the dynasty (685–711): renewed wars with the Slavs; settlement with the Arabs; fiscal, agricultural, and defensive policies; military anarchy (711–717)		**3**:557b–558c	
C. Western Christendom and Scandinavia from the Carolingian era to the general European revival (c. 750–*c.* 1050)			
1. The Carolingian Empire and its later dissolution (*c.* 750–887); France in the 10th century	MEROVINGIAN AND CAROLINGIAN AGE **11**:929–931		
a. The reign of Charlemagne (king, 768–814; emperor from 800): further military expansion of the Frankish kingdom; legislation, administration, and defense; ecclesiastical policies; patronage of arts and learning		**11**:929d–h/ **6**:334h–335c	**4**:44f–46g
b. Decline and dissolution of the Carolingian Empire under the successors of Charlemagne: the society, government, and culture of the Frankish world		**11**:929h–934d/ **7**:612e–615c	
i. Louis the Pious; partitioning of the empire by the Treaty of Verdun (843) between Louis's sons (Lothair, Charles the Bald, and Louis the German); Muslim, Norman, and Magyar invasions and the debilitation of central authority		**11**:929h–931d/ **8**:69h–70e	**7**:614f–h/**11**:116c–e
ii. The Frankish world: society; institutions; economic life; the church; literature and the arts		**11**:931d–934d/ **7**:612e–613e/ **19**:349d–350f	**4**:44g–45b/**8**:422g–423a
c. The East Frankish kingdom (Germany): the last Carolingians (to 911); the emergence of the four stem duchies (Saxony, Franconia, Swabia, and Bavaria)	GERMANY, HISTORY OF **8**:69–71		

	articles	article sections	other references
d. The West Frankish kingdom (France): dynastic rivalry between Carolingians and Robertians (to 987), and the ascendancy of the feudal magnates	FRANCE, HISTORY OF **7**:613–614		
e. The Middle Frankish kingdom (Lotharingia): Burgundy, Provence, and Italy		**7**:614d–f/ **9**:1119g–1121b	**3**:498a–b
2. The British Isles and Scandinavia (*c.* 800–1066)			
a. England: the decline of Mercia and the rise of Wessex; the 9th-century Danish invasions; King Alfred's legal, administrative, and ecclesiastical policies and patronage of the arts; Anglo-Saxon political unification and monastic revival in the 10th century; the conquest of the Danes and their rule over the Anglo-Danish state; the reign of Edward the Confessor and the Norman Conquest		**3**:202b–204g/ **16**:306a–c/ **10**:1107c–1108b	**1**:486a–g/**3**:785g–786c/ **6**:335d–e/**6**:879f–880c/ **9**:706d–f
b. Development of the Kingdom of Scotland; the Welsh; Ireland during the Norse invasions			
i. Roman penetration in Scotland; Christianity; Norse influence		**3**:233b–234a	**3**:1067a–e *passim*
ii. Early Christianity in Wales: relations with the Anglo-Saxons; Welsh society		**3**:229f–230g	**3**:1067h–1068f *passim*
iii. Ireland: conversion to Christianity; monasticism; the Norse invasions		**3**:284g–285g	**3**:1066b–1067a *passim*
c. The Viking Age in Scandinavia: the Vikings and Varangians; widespread raids and conquests (*c.* 800–*c.* 1050); social and political organization; arts; paganism and conversion to Christianity from *c.* 850	SCANDINAVIA, HISTORY OF **16**:305–308	**3**:202c–e/ **3**:233h–234a/ **3**:285d–g/ **8**:34h–36a/ **8**:39g–40c	**7**:1037g–1038a/ **10**:1117d–1119h/ **16**:39h–40c/**16**:157f–158a
3. Germany, Burgundy, and Italy: development of the Holy Roman (German) Empire (911–1056)		**8**:70e–74a	
a. Revival of central authority in Germany, and intervention in Italy by the Saxon dynasty: Conrad (911–918); rise of the nobility; early opposition from Arnulf of Bavaria; drive against Magyars and Slavs; Germanic kingship		**8**:70e–73b	**8**:758e–759c
b. Promotion of the German church under Otto I (936–973): his conquest of Italy and establishment of the Holy Roman Empire (962); early Salian kings (1024–56)		**8**:73b–74a/ **9**:1125h–1129e/ **15**:1002h–1003b	**5**:27f–28e *passim*/ **8**:759f–760d/**13**:768c–h/ **17**:898g–899h
c. Development of medieval Italy: political, economic, and social developments on the peninsula and in Sicily	ITALY AND SICILY, HISTORY OF **9**:1121–1125		
i. Origins of the Papal States and growth in power of the papacy; early years of the commercial cities of Venice in the north, and Gaeta, Naples, Sorrento, and Amalfi in Campania; the Arabs in Sicily		**9**:1121b–1123c/ **8**:73f–75e	
ii. Cities and countryside: persistence of an urban tradition despite the exodus to rural areas; the role of bishops in urban life; economy and society		**9**:1123c–1125h	
4. The Kingdom of France under the early Capetians (987–1180): the relative weakness of the monarchy vis-à-vis the great feudatories (Normandy and Anjou); Capetian attempts to expand the royal domain	FRANCE, HISTORY OF **7**:615		
5. Growth of the Christian states in northern Spain (Asturias–Leon–Castile, Navarre, Aragon–Catalonia): their relations with one another and with the Muslims in Spain; the first phase of the Reconquista to the fall of Toledo (1085)		**17**:416c–g	**1**:7c–e
6. The sociopolitical and economic structure of early medieval Europe: origins, development, and spread of feudalism; its elements and structure; the manorial economy and mainly localized commerce to *c.* 1050		**12**:142a–e/ **12**:150d–152g/ **6**:1118c–e/ **7**:612e–613e/ **8**:73b–e/ **16**:855d–e/ **16**:859d–860b	**1**:331h–332f/**8**:32h–33b/ **8**:70g–71d/**9**:1120f–1121b
D. Peoples and states of eastern Europe to *c.* 1050: early empires and later development of Christianized states			

	articles	article sections	other references
1. The Slavic peoples: origins; early society and culture; movement into Pannonia and south Russia; plundering expeditions and eventual settlement in the Balkans		**2**:616b–g	
2. The eastern European states and peoples within the Byzantine orbit			
a. The Bulgarian domains to 1018: origins; migration into the Balkans (*c.* AD 650), and mixture with the local Slavic populations; early contacts and wars with Byzantium; adoption of Christianity (870); the First Bulgarian Empire (893–1014) and subsequent conquest by Byzantium			**2**:617g–618c/**2**:749c–d/ **3**:43d–h/**3**:553f–554a/ **3**:561e–h
b. The Balkans: the migration of the Croats and Serbs into the Balkans and their subsequent relations with the Bulgars and Byzantium to *c.* 1050			**2**:618h–619e
c. Exploration and the rise of the Rus raids on Constantinople; development of trade routes; Khazar state north of the Black Sea	RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:39–40		**3**:561f–g
d. The Russian state of Kiev (*c.* 980–1054): Slavic-Varangian (Scandinavian) origins; economic decline; social and political institutions		**16**:40d–42a/ **16**:306e–f	**6**:331b–c/**10**:468d–g
3. Eastern European states within the orbit of Western Christendom		**8**:72c–e	
a. Developments in Moravia and Bohemia to 1055: the Celtic and Germanic tribes supplanted by Slavic peoples in the 6th century; Czech dominance in the 8th century; unification under the Přemysl rulers	BOHEMIA AND CZECHOSLOVAKIA, HISTORY OF **2**:1185–1186		
i. Unification of Greater Moravia under Mojmír (814): religious conflicts with Frankish clergy and temporary adherence to the Eastern rite; political expansion		**2**:1185e–1186a	
ii. The early Přemysl rulers of Bohemia: capital at Prague; ties with Bavaria and the Saxon dynasty; Boleslav I (929–967); Boleslav II (967–999); annexation of Moravia under Břetislav (1034–55)		**2**:1186a–d	
b. The Avar Empire and the early Magyar (Hungarian) kingdom to *c.* 1050: alliance with the Carolingian ruler Arnulf; establishment of the Árpád dynasty: settlement of the central plain; conversion to Christianity; reign of Stephen I (997–1038)	HUNGARY, HISTORY OF **9**:30		**2**:450c–e/**2**:616d–g
c. Development of the Kingdom of Poland in the 10th century, and Polish conversion to Western Christianity; civil strife, and later restoration under Casimir I (1039–58)	POLAND, HISTORY OF **14**:637–638		
E. The zenith and incipient decline of the Byzantine Empire (717–1081); the growth of Venice	BYZANTINE EMPIRE **3**:558–564		**9**:1070a–b
1. The age of iconoclasm (717–867): the reforms of Leo III the Isaurian; repulse of the Arabs; Bulgar incursions and continued religious dissension under Leo's successors		**3**:558d–560e	**4**:45f–g/**4**:542h–543g *passim*/ **10**:808f–809g/**14**:290f–291c
2. The Macedonian era (867–1025): territorial expansion; foreign relations; continued strength and prosperity under its rulers until 1025		**3**:560e–563e	**13**:64g–65b
a. Military revival; relations with Slavs and Bulgars; estrangement from the West		**3**:560h–562c	**2**:616h–617d
b. Culture and administration: legal reforms under Basil I and Leo VI		**3**:562c–g/ **19**:331b–336g	**2**:748c–f/**5**:74d–75a
c. Social and economic change; reforms of Basil II		**3**:562g–563e/ **2**:748h–749e	
3. Byzantine decline and subjection to Western influences: 11th-century weakness; arrival of new enemies; the schism with Rome (1054)		**3**:563e–564g/ **4**:544h–545a	**5**:298h–299b
4. Venice: the development of its institutions, commerce, and naval power in the early Middle Ages		**9**:1122b–1123a	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ALFRED THE GREAT, OF WESSEX **1**:485
ATTILA **2**:359
BASIL I THE MACEDONIAN **2**:748
BASIL II BULGAROCTONUS **2**:748
BELISARIUS **2**:826
BORIS I OF BULGARIA **3**:43
CANUTE THE GREAT, OF DENMARK AND ENGLAND **3**:785
CHARLEMAGNE, EMPEROR **4**:44
CHARLES MARTEL **4**:61
CLOVIS **4**:761
CONRAD II, EMPEROR **5**:27
CONSTANTINE VII PORPHYROGENITUS **5**:74
HENRY II THE SAINT, EMPEROR **8**:758
HENRY III, EMPEROR **8**:759
HERACLIUS **8**:781
JUSTINIAN I **10**:362
LEO III THE ISAURIAN **10**:808
LOUIS I THE PIOUS, EMPEROR **11**:115
NICEPHORUS II PHOCAS **13**:64
OTTO I THE GREAT, EMPEROR **13**:768
PEPIN THE SHORT **14**:35
STILICHO **17**:691
THEODORIC THE GREAT **18**:270

Section 922. The Empire of the Caliphate and its successor states to c. AD 1055

[for Part Nine headnote see page 563
for Division II headnote see page 578]

The articles and parts of articles referred to in Section 922 deal with two main subjects: A, the rise and spread of Islām and the Arab Empire to the end of the Umayyad dynasty (AD 622–750); and B, the 'Abbāsid Empire and its successor states (750–*c.* 1055).

The outline of subject A begins with the life and career of Muḥammad, the rise of Islām, and Muslim expansion outside Arabia under the four Patriarchal Caliphs (632–661). It goes on to the Ummayad caliphate (661–750), which brought about Syrian domination and transfer of the capital to Damascus. The outline treats the zenith of Umayyad power, its later disintegration under attack from the 'Abbāsids, and the administrative and cultural characteristics of Umayyad society, including the spread of the Arabic language during this period.

The outline of subject B begins with the rise and decline of the 'Abbāsid caliphate and with economic, social, and cultural life under the 'Abbāsids. It goes on to the eclipse of the 'Abbāsids and the growth of provincial dynasties to *c.* 1055. The outline covers the Umayyad amirate and caliphate in Spain, with its capital at Córdoba; the Fāṭimid state of North Africa and Syria from 909 to *c.* 1055; other dynasties in North Africa and Syria; the Sāmānid dynasty of Khorāsān; the Būyid dynasty in Iran and Iraq; and other states in eastern Arabia, eastern Turkistan, Afghanistan, and northwestern India.

articles	article sections	other references
CALIPHATE, EMPIRE OF THE **3**:623–635		
	3:600e–h/ **4**:580e–581b/ **13**:155f–h	**9**:912b–e/**9**:927d–f/ **17**:980g–981c
	3:624a–626h/ **1**:1046f–1047e	**13**:156a–b
	3:624b–625a/ **8**:536b–f/ **9**:927g–928f	**1**:1046g–1047a/**9**:912e–f/ **9**:914g–h/**12**:606b–609b
	3:625a–626h/ **9**:851g–853a	**1**:1047a–e/**18**:792h–793b
	3:625a–626b/ **9**:851e–g/ **11**:990f–991b	**6**:487f–488c/**9**:928f–929d/ **17**:951h–952a
	3:626c–h/ **4**:591a–b/ **9**:915b–d/ **9**:958d–g	**1**:573d–h/**9**:916g–917b/ **9**:929b–d/**9**:1013e–g/ **13**:110a–c
	3:626h–635a	**6**:488c–g/**9**:929d–h/ **13**:156a–c
	3:626h–628a	**1**:1047e–f/**11**:991c–e/ **12**:605c–g/**17**:952b
	3:628b–630a/ **17**:414a–f	**1**:5d–6a/**11**:991f–h
	3:630a–632b	
	3:632b–635a	

A. The rise and spread of Islām and the Arab Empire to the end of the Umayyad dynasty (AD 622–750)

1. Introduction to Islāmic history: the historical sources; historiographic problems
2. Islām and Arab expansion in the 7th century
   a. The life and career of Muḥammad and the rise of Islām; the doctrine of the *jihād* (holy war)
   b. Muslim expansion outside Arabia under the four Patriarchal Caliphs (632–661)
      i. Abū Bakr (632–634) and 'Umar I (634–644): the tribe of Quraysh; divisions among the followers of Muḥammad; the conquest of Iraq and the Sāsānid (Persian) Empire and the Byzantine territories of Jordan, Palestine, Syria, and Egypt
      ii. 'Uthmān (644–656) and 'Alī (656–661): expeditions into North Africa, Armenia, and Persia; social and religious grievances; civil unrest; the origins of Shī'ism
3. The Umayyad caliphate (661–750)
   a. The consolidation of the caliphate (661–684) under Mu'āwiyah I and his successors: westward orientation of the caliphate and its capital at Damascus; growing opposition to the Umayyads
   b. The zenith of Umayyad power with the advent of the Marwānids: 'Abd al-Malik (685–705) and al-Walīd (705–715); suppression of revolts; new conquests
   c. The later Umayyads (715–750): conciliation of state policies with religion; peace and prosperity under Hishām (724–743); disintegration of the empire under his successors and the 'Abbāsid revolt
   d. Umayyad government and society

	articles	article sections	other references
i. Administration of the Arab lands: utilization of local officials; the position and functions of the caliph; Islāmization and Arabization; social classes		**3**:632b–633f	
ii. Cultural life under the Umayyads: spread of the Arabic language; literary revival; fragmentation into religious sects; accomplishment in the arts		**3**:633f–635a/ **6**:332a–c/ **9**:958g–959b	**8**:664h–665b/ **9**:984h–993c *passim*/ **9**:1013h–1014a
B. The ʿAbbāsid Empire and its successor states (750–*c.* 1055)	CALIPHATE, EMPIRE OF THE **3**:635–645		
1. The ʿAbbāsid caliphate from 750 to 945		**3**:635a–639a/ **3**:641d–645c	
a. Establishment of the new dynasty and its advance under Abū al-ʿAbbās as-Saffāḥ (749–754), al-Manṣūr (754–775) and al-Mahdī (775–785): the ʿAbbāsids at their zenith (786–861)		**3**:635a–637f	**1**:1047g–h/**2**:723h–724e/ **8**:659f–660c/**9**:853d–e/ **11**:417g–418f/**11**:461d–h/ **11**:991h–992g
b. Decline of the caliphate after the death of al-Mutawakkil (861): growth of provincial autonomy		**3**:637f–639a/ **9**:853g–854d	**11**:992g–993a
c. Economic and social life under the ʿAbbāsids: manufactures and trade		**3**:641d–643a	
d. Cultural life under the ʿAbbāsid caliphate		**3**:643a–645c/ **6**:332c–333a	**9**:853b–d/**11**:610d–g
i. Religion: theology and philosophy; Islāmic mysticism		**8**:537h–538b/ **9**:915e–916f/ **9**:929h–930e/ **9**:943d–944b/ **9**:1015b–1016c/ **9**:1020b–1021a	**1**:1158a–c/**8**:555g–556b/ **9**:1013b–e
ii. The arts and sciences: Greek and Persian influences; the aniconic principle in the arts		**9**:959c–961a/ **14**:901c–f	**7**:892f–893a/ **9**:984h–993c *passim*/ **16**:368a–b
2. Eclipse of the ʿAbbāsids and the growth of provincial dynasties from *c.* 755 to 1055		**3**:639a–641c/ **6**:488g–490b	**1**:1047h–1048b
a. The Umayyad amirate and caliphate in Spain (756–1031) and its capital at Córdoba	CÓRDOBA **5**:171–172	**17**:414f–416g	**17**:407g–408a
i. Foundation of the independent amirate by ʿAbd ar-Raḥmān I (756–788): defeat of the Franks at Roncevalles (778); political and cultural splendour in the reign of ʿAbd ar-Raḥmān II; defeat of the *muwallad*s		**7**:414f–415f	
ii. The Umayyad caliphate under ʿAbd ar-Raḥmān an-Nāṣir III: relations with Arabs, Berbers, and the Christian states in Spain; conquest of Morocco by his successors; the *ṭā'if*as and internal disorders		**17**:415g–416g	**1**:7b–g
iii. Social and economic life in Muslim Spain: the culture of Muslim Spain; developments in literature and the sciences		**17**:419b–420h/ **9**:961a–962b/ **10**:319e–320c	**6**:333a–c/**9**:145g–146h/ **9**:147a–e/**9**:708b–709b
b. The Fāṭimid state of North Africa and Syria from 909 to *c.* 1055: the foundation of the Fāṭimid caliphate in Tunisia and Algeria; its conquest of Morocco (926) and Egypt (969), and expansion into Syria	FĀṬIMIDS **7**:193–194	**3**:640a–e/ **6**:489e–490b/ **9**:993f–994h	**13**:157c–f
c. Other dynasties in North Africa and Syria: the Shīʿite Idrīsids of Morocco (789–926); the Rustamid kingdom in the central Maghrib (787–911); the Aghlabid state in Tunisia, Algeria, and Sicily (800–909); minor dynasties			**13**:156d–157b/**17**:952e–g
d. The Sāmānid dynasty of Khorāsān (875–999): its role in the Islāmization of the Turkic peoples; patronage of art and learning		**3**:639f–640a/ **9**:854d–g	**18**:793b–f
e. The Būyid dynasty in Iran and Iraq (932–1055): Shīʿism and the Iranian revival; Isfahan	ISFAHAN **9**:910–911	**3**:639a–f/ **9**:855a–856a/ **11**:993a–e	**2**:541b–d
f. Other eastern states: the Qarmaṭians in eastern Arabia (*c.* 900–1078); the Turkish Qarakhanid dynasty of Mā Warā ʿan-Nahr (Transoxania) and eastern Turkistan (922–*c.* 1050); the Turkish Ghaznavids of Afghanistan and northwestern India (998–1050); minor states and dynasties		**9**:854g–855a/ **9**:962d–964b	**1**:1047h–1048b/**2**:540d–541a/ **9**:362d–h/**11**:352a–d/ **18**:793d–f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ʿABD AL-MALIK IBN MARWĀN **1**:5
ʿABD AR-RAḤMĀN III AN-NĀṢIR **1**:7
ʿALĪ **1**:573
BARMAKIDS **2**:723
HĀRŪN AR-RASHĪD **8**:659
MAḤMŪD OF GHAZNA **11**:352
MAʾMŪN, AL- **11**:417
MANṢŪR, AL- **11**:461
MUʿĀWIYAH I **12**:604

Section 923. Western Christendom in the High and later Middle Ages (c. 1050–c. 1500)

[for Part Nine headnote see page 563
for Division II headnote see page 578]

The articles and parts of articles referred to in Section 923 deal with two main subjects: A, the medieval western European revival, and the economy, society, and culture of Western Christendom in the High Middle Ages (*c.* 1050–*c.* 1300); and B, the decline of medieval European political institutions, economy, and culture, and the incipient transition to the modern age (*c.* 1300–*c.* 1500).

The outline of subject A first deals with the broad economic, social, ecclesiastical, and cultural characteristics of the High Middle Ages. It goes on to deal separately with the history of different parts of Western Christendom. It covers the history of the papacy, of the Holy Roman Empire, and of that empire's constituent kingdoms, Germany and Italy, to *c.* 1300; the growth of the Kingdom of France under the later Capetian dynasty (1180–1328); the history of the Low Countries, including the towns of Ghent and Bruges; the Spanish Christian kingdoms of Castile and Leon, Aragon, Portugal, and Navarre; the history of England, Scotland, Wales, and Ireland from the Norman Conquest of 1066 to 1307; the establishment and expansion of the kingdoms of Denmark, Norway, and Sweden; and the Slavic and Magyar states of Western Christendom—Poland, Bohemia, and Hungary.

The outline of subject B begins with the general cultural, social, economic, and ecclesiastical characteristics of the late Middle Ages (*c.* 1300–*c.* 1500). It then deals separately with the histories, during that period, of Germany, Bohemia, and the Swiss Confederation; Italy; France and the Low Countries; England, Wales, Scotland, and Ireland; Spain and Portugal; the Scandinavian kingdoms; and Hungary, Poland–Lithuania, the Teutonic Order, and the Baltic peoples.

	articles	article sections	other references
A.	The medieval western European revival, and the economy, society, and culture of Western Christendom in the High Middle Ages		
	MIDDLE AGES (*c.* 395–1500) **12**:142–164		
1.	Society, economy, and culture	**12**:143h–164a	
a.	Western European society in the High Middle Ages: the feudal nobility; the clergy; the bourgeoisie: the peasantry (serfs); the status of women	**12**:142f–148c/ **6**:1119a–h/ **7**:940f–h/ **16**:859f–860b	**2**:18e–h/**7**:616f–g/**8**:77d–e/ **8**:1164g–1165d/**9**:1128d–g/ **11**:136e–f/**17**:409h–410b/ **19**:909h–910a
b.	Growth of agricultural productivity and population: revival of a money economy, manufacturing, and the commercial effects of the Crusades; revival of towns, and population movements	**12**:147b–g/ **12**:148e–150d/ **6**:1118e–f/ **16**:41a–b/ **19**:522b–523a/ **19**:935b–d	**1**:332f–333a/**7**:619g–621f/ **9**:1133b–d/**11**:136g–138b/ **17**:410b–c/ **18**:32a–35b *passim*/ **18**:1072d–f/**18**:1076b–c
c.	The church in medieval society: growth of papal hegemony; reform movements affecting the church (the friars of St. Francis); use of the Inquisition from 1233; role of religion in medieval society	**12**:154c–155g/ **3**:205e–g/ **3**:209d–h/ **11**:298h–299c/ **11**:1104b–1105b/ **13**:848a–h/ **13**:957g–958c/ **15**:1005a–1006h	**5**:298d–h/**5**:942e–943b/ **7**:621f–622c/**7**:682c–683d/ **9**:605d–f/**10**:805c–e/ **14**:222e–g *passim*/ **18**:1045a–e
d.	The culture of the High Middle Ages	**12**:162a–c/ **6**:1116c–1118b/ **12**:864b–f/ **15**:1004g–1005a/ **15**:1006d–f/ **17**:419g–420h	**7**:622c–g
i.	Intellectual life: the intellectual revival of the 11th and 12th centuries; Scholasticism; developments in science, historiography, law, and political theory; education in cathedral schools and universities	**3**:1085g–1086b/ **6**:335h–339d/ **6**:410a–c/ **8**:949h–950f/ **14**:257g–260d/ **14**:687h–688d/ **16**:354e–356f/ **16**:367f–h	**1**:10c–11c/**1**:937d–938d/ **1**:1158e–1159c/**2**:861c–862b/ **4**:998c–e/**6**:793h–794g/ **6**:932f–933d/**8**:1175b–f/ **10**:716h–717a/**14**:544b–d/ **18**:346b–348a
ii.	The arts: Latin and vernacular literature; Romanesque and Gothic visual arts; music; theatre; the decorative arts	**18**:242g–243d/ **19**:354e–379b	**9**:706f–708b/ **11**:1097h–1098h/ **12**:705b–706a/**15**:224b–d

	articles	article sections	other references
e. The status of Jews in medieval society: their economic role, persecutions, and migrations		**10**:320d–322a/ **15**:1006h–1007b	**10**:185c–187c *passim*/ **14**:640h–641a/**15**:527b–f
2. The Holy Roman Empire, the papacy, and Italy from *c.* 1050 to *c.* 1300			
a. The empire, the papacy, and Italy in the era of the Investiture Controversy	ITALY AND SICILY, HISTORY OF **9**:1128–1133		
i. Church reform in the 10th and 11th centuries and the clash between the papacy and the emperors over lay investiture at its height between the emperor Henry IV and Pope Gregory VII; the resulting incipient decline of German monarchical authority under the Salian emperors		**9**:1128g–1130e/ **4**:592a–c/ **8**:74a–75e/ **13**:957c–958c/ **15**:1003f–1004d	**1**:467b–g/**2**:450e–g/ **2**:787b–h/**3**:776a–e/ **8**:417h–418g/**8**:761f–762b/ **8**:762g–763d/**10**:804g–805b
ii. The Norman conquest of southern Italy and Sicily and establishment of a strong monarchy: relations with the papacy, Venice, and the Byzantine Empire		**9**:1130e–1131f	**2**:1201e–1202a/**13**:930d/ **15**:906h–907e/ **15**:984g–985a
iii. The growth of communes in northern Italy; the status of German imperial power; the political role of the papacy in Italy; the commercial expansion of Italian cities (*e.g.*, Genoa, Pisa); continued growth of Venetian maritime power	PISA **14**:471	**9**:1131g–1133f	**5**:480g–481c/**6**:337c–f/ **7**:419g–420a/**12**:190f–h/ **14**:757d–758d/ **15**:662g–663b/**16**:158c–d
b. The empire under the Hohenstaufen dynasty and after its extinction to *c.* 1300; the papacy and Italy			
i. Steady inroads of the German princes into German monarchical authority: colonization of Slavic territory; development of commercial centres (*e.g.*, Lübeck); the reign of Frederick I Barbarossa and Frederick II; extinction of the Hohenstaufen dynasty and the Great Interregnum (1250–73); the election and reign of Rudolf of Habsburg	LÜBECK **11**:167–168	**8**:75e–79b/ **3**:497g–498a/ **9**:1131g–1132h	**2**:450g–451f/**2**:451h–452b/ **2**:849b–d/**5**:307d–308a/ **7**:697g–699d/**7**:700a–701e/ **8**:419d–h/**8**:776d–777c/ **9**:605h–606b/**9**:607b–h/ **13**:393f–h
ii. The Kingdom of Sicily: centralized government; ethnic mixture; Palermo; control by the Hohenstaufens (1194–1266); the Angevin conquest and expulsion (1282); the advent of Aragonese control	PALERMO **13**:930	**8**:78e–f	**7**:619b–d/**7**:700c–d
iii. The decline of German imperial control in northern Italy, and the continued development of the communes (*e.g.*, Milan, Pisa, Florence, Siena: their internal and external conflicts	SIENA **16**:733	**9**:1132h–1133f	
iv. Continued commercial expansion of Italian cities: Venetian expansion in the Levant, and aid to the Normans in the conquest of Byzantium (1204); commercial inroads into the Levantine trade by Genoa and Pisa	GENOA **7**:1016–1017		**5**:305h–306f/**7**:1038h–1039e
3. The growth of the Kingdom of France under the later Capetian dynasty (1180–1328); the Low Countries			
a. Growth of the power of the French kings and extension of the territory under their control	FRANCE, HISTORY OF **7**:615–622		**3**:498b–c/**17**:776g–777b
i. Philip II Augustus (1180–1223): acquisition of territory and consolidation of the realm; royal administration; feudal policies		**7**:615h–616g	**10**:236h–237c/**11**:136c–e/ **14**:221d–223b
ii. Louis VIII (1223–1226) and Louis IX (1226–70): institution of the granting of appanages to nobility; the Albigensian Crusade; rise of bureaucracy; attitudes toward the clergy and the lay nobility		**7**:616g–617f	**2**:1105a–f/**11**:118h–120c
iii. The later Capetians: Philip IV the Fair (1285–1314); claims of the monarchy; beginnings of the States General; conflict with Boniface VIII		**7**:617f–618g	**3**:32h–33f/**4**:592c–d/ **14**:223h–225b
iv. Foreign relations: conflict with the Holy Roman Empire under Philip II; the religious crusades of Louis IX; the wars of Philip IV		**7**:618g–619g/ **9**:15f–16c	**5**:308b–e/**11**:119c–f
v. Economy, society, and culture in the 13th century: increase in population; growth of towns and urban prosperity; rural life; religion; culture and learning		**7**:619g–622g/ **10**:1103b–1104b	**6**:337f–338a/**19**:368c–h

	articles	article sections	other references
b. The Low Countries: development of the territorial principalities and the rise of towns; *e.g.*, Ghent, Bruges	GHENT AND BRUGES, HISTORY OF **8**:147	**11**:134f–137g	
i. Secular and spiritual principalities		**11**:134h–135h	
ii. Struggle for independence; French and British influence		**11**:135h–136e	
iii. Social and economic structure		**11**:136e–137g	
4. The Spanish Christian kingdoms of Castile and Leon, Aragon (including Barcelona), Portugal, and Navarre (1035–*c.* 1260): their expansion into Muslim territory, and their mutual rivalries; their ethnic-cultural mixtures and internal political development; the role of the church	SPAIN, HISTORY OF **17**:408–410		**10**:1030d–h/**13**:157h–158d
a. The medieval empire (1035–1157): the division of the kingdoms and the emergence of Portugal as an independent state	PORTUGAL, HISTORY OF **14**:865–867	**17**:408b–409b	**1**:485c–f/**4**:615b–616a
b. The rise of Castile and Aragon and the expulsion of the Muslims, led especially by the rulers of Aragon (James I; 1213–76) and Castile (Ferdinand III; 1217–52)		**17**:409b–f/ **17**:416g–417h	**10**:20h–21d/**16**:581c–d
c. Society, economy, and culture: administration of the Spanish kingdoms; development of feudalism, growth of towns, and appearance of trade and industry; establishment of the Cortes; foundation of the universities of Valencia and Salamanca		**17**:409f–410f	**10**:1122d–h
5. The Kingdom of England and its continental dependencies from the Norman Conquest to the death of Edward I; Scotland, Wales, and Ireland (1066–1307)	BRITAIN AND IRELAND, HISTORY OF **3**:204–212		
a. The Norman Conquest: introduction of feudalism and the development of royal administration under William I the Conqueror (1066–87) and his immediate successors		**3**:204g–207g/ **3**:230g–231a/ **4**:998c–999b/ **8**:793e–g/ **10**:1105d–1106c/ **10**:1108c–1109a	**6**:880h–881d/**19**:829g–830h
i. Church–state relations and the place of the clergy in the feudal structure; the Domesday survey		**3**:205e–h	**1**:937h–938e
ii. Strengthening of central government under William's successors: relations with the church in their reigns		**3**:205h–206h	**8**:763g–764c
iii. The period of the Anarchy (1135–54): Matilda and Stephen; civil war		**3**:206h–207g	
b. The early Plantagenets		**3**:207g–212d	**6**:338a–d
i. The reign of Henry II (1154–89): military and administrative reforms; Henry's conflict with the church and the struggle with Becket; the rebellions of Henry's sons		**3**:207g–208g	**2**:786f–787h/**6**:524g–525b/ **8**:764f–766d
ii. Richard I (1189–99): administration in Richard's absence; the Saladin Tithe; attempts to establish a standing army		**3**:208g–209b	**15**:827a–h
iii. The reign of John (1199–1216): loss of French possessions; John's conflict with Innocent III; the revolt of the barons, and Magna Carta		**3**:209c–210b	**10**:236h–237g/**14**:222b–f
iv. Henry III (1216–72) and Edward I (1272–1307): Simon de Montfort and the Barons' War; Edward's restoration of royal power; his legal, administrative, and military policies		**3**:210d–212d/ **4**:999b–e	**4**:999g–1000a/**6**:435a–436e/ **12**:409d–f
c. Scotland, Wales, and Ireland: relations between the Kingdom of Scotland and the English crown; the extent of English control in Wales and Ireland			
i. The unification of Scotland and the development of the monarchy		**3**:212a–c/ **3**:234b–235f	
ii. Norman infiltration in Wales; the three kingdoms; internal conflicts and the Edwardian settlement		**3**:211g–212a/ **3**:230g–232d	
iii. Ireland: the Anglo-Norman invasion and its effects; establishment of the Irish Parliament		**3**:285h–286b	
6. Scandinavia (*c.* 1050–*c.* 1300): establishment of the kingdoms of Denmark, Norway, and Sweden		**16**:307c–312f	

	articles	article sections	other references
a. The trend toward unity and strong monarchy: political developments in the three kingdoms		**16**:307c–311b/ **8**:33d–f	
b. Expansion into Finland, Iceland, and Greenland: introduction of feudalism; economic developments and influence of the Hanseatic League; society		**16**:311b–312f	
7. The Slavic and Magyar states of Western Christendom (*c.* 1050–*c.* 1300)			
a. Poland: the reigns of Bolesław II (1058–79) and Bolesław III (1102–38); the division of Poland between Bolesław III's sons; the seniority system; territorial losses; the early role of the Teutonic Order in eastern Europe; internal developments		**14**:638h–639g	
b. Bohemia under the later Přemysl rulers (1055–1306): struggles within the ruling family; privileges secured from the Holy Roman emperor; territorial expansion; losses to Rudolf of Habsburg		**2**:1186d–1187d	
i. German interference in Bohemia: attacks upon the position of the Prague princes by Frederick I Barbarossa; the Golden Bull of Sicily (1212)		**2**:1186e–h	
ii. Political and economic growth: German immigration; founding of urban communities; expansion under Otakar II (1253–78) into Austria; silver mining and coinage		**2**:1186h–1187d/ **8**:75h–76f/ **8**:78e–79b	**2**:451g–h
c. Hungary: the early kings; expansion into Transylvania and Dalmatia; the nobility; Golden Bull (1222); Mongol invasion (1241); extinction of the Árpád dynasty in 1301		**9**:30h–32a	
B. The decline of medieval European political institutions, economy, and culture, and the incipient transition to the modern age (*c.* 1300–*c.* 1500)			
1. The culture of the late Middle Ages in western Europe			
a. The early Renaissance in Italy: historiographic problems; the contribution of the city-states; developments in literature and the fine arts	RENAISSANCE **15**:660–665	**15**:666d–667a/ **5**:807d–e	**8**:951f–952f
i. Revival of Greek studies and the formation of Classical libraries in Italy: Humanism; relationship of Humanism to Christianity		**15**:663h–665c/ **6**:343c–344g/ **8**:1175f–1176h/ **10**:1130g–1132g/ **15**:1036f–h	**2**:1176c–e/**6**:882d–e/ **10**:858a–d/**14**:161h–163d/ **14**:544f–h/**16**:368h–369e/ **19**:19c–20c *passim*
ii. New concepts and techniques in painting, sculpture, and architecture: patronage of the arts by the papacy		**19**:379b–383g/ **19**:397c–400a/ **19**:406h–408h/ **19**:411e–412e	**2**:1022f–1023e/**3**:75h–78b/ **7**:893f–894a/**8**:150d–151c/ **10**:203g–204c/ **10**:810d–817a/ **11**:462a–464a *passim*/ **14**:454b–455c/**14**:905f–906g/ **18**:222e–223b/ **18**:824d–825c/**19**:373a–f
b. The late Gothic style in northern Europe		**19**:373f–379b	**7**:893e–f/**8**:87a–c
c. Late medieval intellectual developments: political theory, law, and the decline of ideals of imperial unity and papal supremacy; the rising power of national monarchies; decline of Scholasticism; science; witchcraft		**12**:158h–160a/ **12**:162d–164a/ **3**:776d–h/ **6**:1118g–1119a/ **6**:1120a–1120e/ **8**:84h–85f/ **14**:260d–261d/ **14**:688d–f/ **16**:356f–357a	**1**:1159d–h/ **5**:482b–485f *passim*/ **6**:882a–c/**6**:933d–e/**8**:87a–c/ **10**:213d–214c/ **13**:504d–506b
2. Late medieval society and economy			
a. The exaggeration of chivalry and declining importance of the feudal nobility in the face of changing military technology and organization: growing influence of the bourgeoisie; growth of royal government		**12**:152g–154b/ **12**:156c–158h/ **12**:160b–161e/ **1**:698h–699c/ **14**:868c–e	**2**:18h–19a/**5**:1024h–1026b/ **7**:627f–h/**11**:138a–139b/ **16**:894e–g

	articles	article sections	other references
b. Gradual inflation and continued development of capitalism: peasant revolts; economic, social, and political effects of the Black Death (1347–50); gradual disappearance of serfdom in western Europe; decline in prosperity and population; the guild system; the Hanseatic League		**12**:149e–150d/ **1**:333a–f/ **1**:1018g–1019c/ **3**:214c–215a/ **8**:694g–695c/ **9**:1135a–f/ **16**:860b–d/ **19**:935d–936h	**3**:219c–g/**7**:627a–e/ **7**:767h–768d/**8**:85f–86f/ **8**:86h–87a/**8**:580h–582a/ **9**:1133d–f
3. The church in the later Middle Ages: papal monarchy and taxation; the Avignon papacy (1309–77) and the Great Schism (1378–1417) the conciliar movement and other reform movements with regard to the church; mysticism		**12**:155g–156c/ **3**:215a–c/ **4**:592c–e/ **8**:83b–84b/ **15**:547g–549b/ **15**:1007c–1009d	**1**:468b–f/**2**:1188c–h/ **3**:32h–34a/**3**:42c–g/ **4**:547c–e/**7**:618e–g/**7**:627e–f/ **8**:79h–80b/**8**:86f–h/ **10**:233f–234a/**13**:958d–959a/ **17**:422d–423e
4. Germany, Bohemia, and the Swiss Confederation (*c.* 1300–*c.* 1500)			
a. Limitations on the imperial office and the continued ascendancy of the princes in Germany: internal strife between the cities and the princes; the Habsburg and Luxemburg emperors; the division of the Habsburg lands and the enhancement of Habsburg power and influence in Europe by 1500	HABSBURG, HOUSE OF **8**:530–532	**2**:452c–453g/ **8**:79b–87c	**4**:47h–48b/**11**:117a–118b/ **11**:716f–717f
i. Development of the individual states		**2**:452f–453c/ **8**:84h–85f	**2**:1187d–1188c
ii. Society, economy, and culture in the 14th and 15th centuries		**8**:85f–87c	
b. Bohemia in the later Middle Ages: political and religious developments		**2**:1187d–1190h	
i. The Luxemburg dynasty (1310–1437): territorial expansion under Charles I; growth of the city of Prague; Wenceslas IV		**2**:1187d–1188c	**4**:47d–48b/**8**:79e–f/ **14**:946a–c
ii. Beginning of the religious reform movement (*c.* 1360): the Chapel Bethlehem's preachers; the activities of Jan Hus and his execution at the Council of Constance (1415)		**2**:1188c–h/ **12**:435f–436a	**8**:83b–f/**9**:64f–66a/ **15**:1008g–1009a
iii. The struggle between Sigismund and the Hussites: the Four Articles of Prague; Žižka's leadership of the Hussites; the Hussite preponderance (1437–71); George of Poděbrady		**2**:1188h–1190c	**8**:83f–84b
iv. The Jagiellon kings (1471–1526): the decline of royal authority; growth of power of the first two estates		**2**:1190c–h	
c. Early Swiss history; development of the Swiss Confederation after 1291; struggle against the Habsburgs; the French invasion and the Peace of Constance (1446)	SWITZERLAND, HISTORY OF **17**:879–881		
5. Italy in the late Middle Ages and the Renaissance	ITALY AND SICILY, HISTORY OF **9**:1133–1145		
a. Social and political developments in the period 1300–1400: withdrawal of imperial and papal authority; Italian society; the crises of the 14th century (*e.g.*, the Black Death, economic decline, urban unrest)		**9**:1133g–1135f	**5**:481f–482a/**8**:82c–d
b. The Italian states in the 14th century: forms of rule; use of mercenaries; cultural developments		**9**:1135g–1140e/ **10**:1121b–1122b	**15**:663c–h
i. Milan: the Visconti family; rule at home; expansion in northern Italy; Visconti attitudes toward the state		**9**:1136d–1137a	**12**:190h–191d
ii. Florence: republicanism; the cloth industry; banking; movement into the city from the countryside; plots against the republic		**9**:1137b–1138d	
iii. Venice: republican institutions; economic prosperity and commercial empire		**9**:1138d–1139a	
iv. The Papal States: their locations and proprietors; breakdown of papal control during the Avignon papacy and the Great Schism (1378–1417)		**9**:1139a–g	

	articles	article sections	other references
v. Naples, Sicily, and the other Italian states; *e.g.*, Angevin rule in Naples until its union with Sicily (1442) under Alfonso V of Aragon; Savoy; Genoa; Verona		**9**:1139h–1140e	**6**:965f–966e/**7**:1017b–c/ **14**:471f–h/**16**:733c–e
c. The Italian states in the 15th century: expansion of the major Italian powers; Italy as a political system; cultural developments		**9**:1140e–1145e	**4**:60g–61c
i. The crisis of Florentine republicanism: the threat from Gian Galeazzo Visconti of Milan and his successors; Florentine historiography; rule by the Medici		**9**:1141a–1142e/ **9**:1143b–h	**7**:420a–b/**11**:816f–819h/ **15**:666g–667a
ii. The Papal States: papal policy to strengthen its position; reliance of the popes on their relatives to control the domains		**9**:1142e–h	**3**:42c–43a/**14**:481d–g
iii. Despotisms: Alfonso I (Alfonso V of Aragon) in Naples and Sicily, and division of the territory on his death in 1458; the Sforza in Milan		**9**:1142h–1143b	**16**:612b–613a
iv. Venice: the stability of Venetian life; increased interests in activities on the Italian peninsula		**9**:1143h–1145e	
6. France and the Low Countries (*c.* 1300–*c.* 1500)			
a. The period of the Hundred Years' War: the stages of the war; the role of the French kings in the conflict; the war's significance	HUNDRED YEARS' WAR **9**:15–21	**7**:622g–625d	
i. Remote and proximate causes of the war: the problem of English lands in France; the problem of the French succession; the Flemish revolt		**9**:15f–16f	
ii. From the outbreak of the war (1337) to the Treaty of Brétigny (1360): the reign of Philip VI (1328–50); the Crécy campaign and its aftermath (1346–54); negotiations during John II the Good's captivity (1356–60); burgeoning power of the estates and revolt of the peasants		**9**:16g–18e	**6**:437d–438a/**7**:622g–623h
iii. From the Treaty of Brétigny (1360) to the accession of Henry V of England (1413): Charles V (1364–80); the dispute over Flanders; temporary peace; Charles VI (1380–1422); struggle between Burgundians and Armagnacs		**9**:18e–19e	**7**:623h–624h/**10**:243g–244a
iv. From the accession of Henry V (1413) to the siege of Orléans (1428–29): Charles VII (1422–61); France divided between the dauphin Charles, Philip the Good of Burgundy, and Henry V of England		**9**:19f–20b/ **3**:216g–217b/ **3**:218c–220a	**4**:51d–h
v. Recovery and reunification (1429–83) and the expulsion of the English: Joan of Arc and the stirring of French national feeling; reconquest of Maine and Normandy; conquest of Guyenne (1453); final settlement at Picquigny (1475)		**9**:20d–21c/ **3**:217c–e	**7**:624h–625d/**10**:226c–227g/ **15**:835a–c
b. Administrative and military reforms and the strengthening of royal power vis-à-vis the nobility and towns under Charles VII (1422–61) and Louis XI (1461–83): foreign, fiscal, and ecclesiastical policies; social and cultural developments		**7**:625d–628a	**4**:51h–52c/**11**:120d–121f
c. The Low Countries: continued growth of towns, industry, and commerce, with attendant class conflicts and interference by the French monarchy; unification under the House of Burgundy; Burgundian administration	LOW COUNTRIES, HISTORY OF **11**:137–140	**3**:498d–499a/ **9**:16g–17d/ **12**:706b–707b	**1**:1001g–1002b/**4**:60g–61e/ **4**:818a–e/**14**:229d–h/ **17**:881g–h
7. England, Wales, Scotland, and Ireland (*c.* 1307–*c.* 1500)			
a. Royal decline under the later Plantagenets and the struggle for the crown between the Lancastrians and Yorkists	BRITAIN AND IRELAND, HISTORY OF **3**:212–220	**9**:16c–21a/ **19**:576h–577c	
i. Royal decline under Edward II (1307–27) and its restoration under Edward III (1327–77): the Hundred Years' War; domestic achievements; the crises of Edward III's later reign		**3**:212e–214b	**6**:436h–438b/**6**:439g–440d/ **9**:16b–18g *passim*/ **19**:1050f–h

	articles	article sections	other references
ii. Richard II (1377–99): the Peasants' Revolt (1381); the influence of John Wycliffe; later political struggles and Richard's deposition		**3**:214b–215h	**15**:1008e–g/**19**:1050h–1051d
iii. Henry IV (1399–1413), Henry V (1413–22), and Henry VI (1422–61 and 1470–71): rebellions under Henry IV and his relations with Parliament; domestic rivalries and the loss of France under Henry VI; Cade's rebellion and the Wars of the Roses		**3**:215h–218b	**7**:623a–c/**8**:767b–f
iv. The reigns of Edward IV (1461–70 and 1471–83) and Richard III (1483–85): England in the late Middle Ages		**3**:218c–220a/ **10**:1109a–1111a	**6**:438d–439b
b. Scotland: the wars of independence; relations with the English crown; Bruces and Stewarts; Scotland in the 15th century		**3**:235f–237h	**6**:305a–b/**15**:906c–f
c. Establishment of English suzerainty over Wales; fluctuating English influence in Ireland and the rise to power of the earls of Kildare		**3**:232d–g/ **3**:286b–f	
8. Spain and Portugal (*c.* 1300–*c.* 1500)		**17**:410g–414a/ **17**:417h–419b	
a. Castile and Leon: continued pressure on the Muslims under Alfonso XI (1312–50); increasing power of the Cortes; development of the woollen industry; literary achievements		**14**:866g–867d/ **17**:410g–412d/ **10**:1122h–1124c	
b. The Aragon Confederation (Aragon, Catalonia, and Valencia): acquisition of Sicily (1282) and growth of Aragon as a Mediterranean power; the Cortes, law, and administration; acquisition of the Kingdom of Naples (1442) under Alfonso V (1416–58)		**17**:412d–414a	**1**:484c–f
c. Creation of a united Spain and expansion of Spanish dominance in the early Age of Discovery		**17**:420h–424g	
i. The union of Aragon and Castile–Leon under Ferdinand and Isabella: strengthening of their positions vis-à-vis the nobility; the Inquisition and the treatment of Jews; conquest of Granada (1492) and acquisition of Naples (1503)		**17**:420h–424a	**7**:232h–233e/**9**:907c–908d/ **10**:222h–223b
ii. Spanish explorations and territorial acquisitions: colonial policy in the New World; the Atlantic trade		**17**:424a–g/ **4**:881e–882c/ **10**:691e–692d	**4**:937g–942f/**7**:1040a–1041g
d. Portugal: development of the monarchy under the House of Avis (1383–1580); alliance with England; consolidation of the monarchy and establishment of its overseas empire under John I (1385–1433), Prince Henry the Navigator, and Manuel I (1495–1521)		**14**:867b–h/ **4**:881a–e/ **16**:859b–c	**1**:430h–431e/**3**:1093d–h/ **5**:230g–231a/**5**:701e–h/ **7**:860h–862b/**7**:1039f–1040a/ **8**:778c–779a/**10**:239d–240b/ **10**:240d–h/**10**:1031a–c/ **11**:464e–465b
9. The Scandinavian kingdoms (*c.* 1300–*c.* 1500)		**16**:312g–315f	**1**:478g/**11**:493e–494d
a. Developments in the 14th century leading to the formation of the Kalmar Union (1397–1523); Scandinavia under the union		**16**:312g–314a	
b. Developments in Denmark, Norway, and Sweden during the union: decline of Norway and rise of Sweden		**16**:314a–315f	
10. Hungary, Poland–Lithuania, and the Teutonic Order		**9**:32b–33g	**9**:53d–54h/**11**:705h–706h
a. Hungary under foreign kings: foreign affairs, economy, and society under the Angevins and Sigismund; the reign of Matthias Corvinus (1458–90)		**14**:639g–642c	
b. Poland–Lithuania, the Teutonic Order, and the Baltic peoples	BALTIC STATES, HISTORY OF THE **2**:670–671		
i. The Mongol invasions (1241–42) and re-establishment of the Kingdom of Poland (1253–1382): Władysław I and the struggle with the Teutonic Order; Casimir III and Louis I of Hungary; social classes, the church, and policies toward the Jews		**14**:639g–641a	**1**:572g–573c/**3**:978d–979b/ **16**:44g–45d
ii. The Jagiellon dynasty (1382–1492): the union of Poland and Lithuania (1385–86); extension of the empire; growth in power of the nobility and growth of parliamentarianism		**14**:641a–642c	**3**:979c–980b/**19**:904d–905a

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ALBUQUERQUE, AFONSO DE 1:430
ALEXANDER III, POPE 1:466
ALEXANDER VI, POPE 1:467
ALFONSO V THE MAGNANIMOUS, OF ARAGON 1:483
ALFONSO VI OF CASTILE AND LEON 1:484
ALGIRDAS 1:572
ARTEVELDE, JACOB VAN 2:64
BECKET, THOMAS 2:786
BLANCHE OF CASTILE 2:1105
BONIFACE VIII, POPE 3:32
BORGIA, CESARE 3:41
CASIMIR III THE GREAT, OF POLAND 3:978
CASIMIR IV OF POLAND 3:979
CHARLES IV, EMPEROR 4:47
CHARLES VII OF FRANCE 4:51
CHARLES THE BOLD, DUKE OF BURGUNDY 4:60
CID, EL 4:615
COEUR, JACQUES 4:817
COVILHÃ, PÊRO DA 5:230
DIAS, BARTOLOMEU 5:701
EDWARD I OF ENGLAND 6:434
EDWARD III OF ENGLAND 6:436
EDWARD IV OF ENGLAND 6:438
EDWARD, THE BLACK PRINCE 6:439
ELEANOR OF AQUITAINE 6:524
ESTE, HOUSE OF 6:965
FERDINAND II THE CATHOLIC, OF ARAGON 7:232
FREDERICK I BARBAROSSA, EMPEROR 7:697
FREDERICK II, EMPEROR 7:699
FUGGER FAMILY 7:767
GREGORY IX, POPE 8:419
HENRY IV, EMPEROR 8:760
HENRY V, EMPEROR 8:762
HENRY I OF ENGLAND 8:763
HENRY II OF ENGLAND 8:764
HENRY V OF ENGLAND 8:766
HENRY THE LION, DUKE OF SAXONY 8:776
HENRY THE NAVIGATOR 8:777
INNOCENT IV, POPE 9:606
ISABELLA I THE CATHOLIC, OF CASTILE 9:906
JAMES I THE CONQUEROR, OF ARAGON 10:20
JIMÉNEZ DE CISNEROS, FRANCISCO, CARDINAL 10:222
JOAN OF ARC, SAINT 10:225
JOHN XXII, POPE 10:233
JOHN OF ENGLAND 10:236
JOHN I OF PORTUGAL 10:239
JOHN II OF PORTUGAL 10:240
JOHN THE FEARLESS, DUKE OF BURGUNDY 10:243
LOUIS IV, EMPEROR 11:116
LOUIS IX OF FRANCE 11:118
LOUIS XI OF FRANCE 11:120
MANUEL I OF PORTUGAL 11:464
MARGARET OF DENMARK, NORWAY, AND SWEDEN 11:493
MATTHIAS I CORVINUS 11:705
MEDICI FAMILY 11:815
MONTFORT, SIMON DE 12:408
PHILIP II AUGUSTUS, OF FRANCE 14:221
PHILIP IV THE FAIR, OF FRANCE 14:223
PHILIP THE GOOD, DUKE OF BURGUNDY 14:229
RICHARD I THE LION-HEART, OF ENGLAND 15:827
RICHEMONT, CONSTABLE DE 15:834
ROBERT I THE BRUCE, OF SCOTLAND 15:906
ROBERT GUISCARD 15:906
ROGER II OF SICILY 15:984
SAVONAROLA, GIROLAMO 16:289
SFORZA, LUDOVICO 16:612
SUGER OF SAINT-DENIS 17:776
URBAN II, POPE 18:1044
WILLIAM I THE CONQUEROR, OF ENGLAND 19:821
WŁADYSŁAW II JAGIEŁŁO AND JADWIGA 19:904

Section 924. The crusading movement, the Islāmic states of Southwest Asia, North Africa, and Europe, and the states of Eastern Christendom from c. 1050 to c. 1480

[for Part Nine headnote see page 563
for Division II headnote see page 578]

The articles and parts of articles referred to in Section 924 deal with two main subjects: subject A is the expansion of western Europe in the crusading movement and the Muslim response; and the states of Eastern Christendom and the crusader states from *c.* 1050 to *c.* 1480. Subject B is the Islāmic states of Southwest Asia, North Africa, and Europe (*c.* 1050–*c.* 1480); and the Turkish and Kurdish dynasties, the Mongol invasions, and the rise of the Ottoman Empire.

The outline of subject A begins with the establishment and history of the Latin states during the first three crusades. It next treats the history of the Byzantine Empire from 1081 to 1204; the decline of the crusading movement and of the Latin enclaves; developments in Russia from 1054 to 1300; and the Second Bulgarian Empire under the Asenid dynasty from *c.* 1185. It goes on to treat the expansion and establishment of Moscow as the leading Russian power and the rise of the Serbian Empire in the Balkans. Finally, it deals with the restoration of the Byzantine Empire under the Palaeologus dynasty and with its history until the fall of Constantinople in 1453.

The outline of subject B begins with Southwest Asia before the Mongol invasions, covering the Great Seljuq Empire in Syria, Iraq, and Iran (*c.* 1050–*c.* 1190) and the Great Seljuq successor states (*c.* 1100-1250). It goes on to the Mongol invasions in the 13th century, covering the Mongol successor states in Iraq, Iran, and southern Russia, and the rise of the Ottoman Empire to 1481. Dealing with North Africa and Muslim Spain from *c.* 1050 to *c.* 1490, the outline treats the decline of the Fāṭimids in the face of Seljuq and crusader invasions; the Ayyūbids and Mamlūks in Egypt and Syria (1171–*c.* 1500); the Berber Almoravid and Almohad empires in northwest Africa and Spain (1056–1269); and the eastern medieval dynasties of North Africa from the 13th through the 15th century.

articles	article sections	other references
A. The expansion of western Europe in the crusading movement and the Muslim response; the states of Eastern Christendom and the crusader states from *c.* 1050 to *c.* 1480		
1. The crusading era and the states of Eastern Christendom (*c.* 1050–*c.* 1480)		
CRUSADES 5:297-310		
	5:298b-301e	3:565a-e
a. The First Crusade (1096–99) and the establishment of the Latin states		
i. Background of the First Crusade: religious renewal in Europe; disruption of the pilgrimage routes by the Muslims; role of papal leadership at the Council of Clermont (1095); preparations for the Crusade and its participants	5:298b-300a/ 15:1004d-g	
ii. The sieges of Antioch (1097–98) and Jerusalem (1099): establishment of the crusader states	5:300a-301e	2:1201e-1202a
b. The Second (1147–48) and Third (1188–92) crusades: the crusader states to 1187; the institutions of the First Kingdom; the magnates of the Third Crusade	5:301e-305g	16:177f-h
c. The Byzantine Empire from 1081 to 1204: policies aimed at revival implemented by Comnenus dynasty	3:564g-567a	6:154a-d/18:1043a-b

	articles	article sections	other references
i. Alexius I Comnenus and the First Crusade: pressures from the Seljuqs and Pechenegs		**3**:564g–565e	**1**:483b-g/**2**:1201e–1202a
ii. The later Comneni and fluctuating relations with the Venetians, Normans, and crusaders		**3**:565e–566c	
iii. The Fourth Crusade (1202–04) and the establishment of the Latin empire		**3**:566c–567a/ **5**:305h–306f	**5**:481a-c/**9**:1070d–e
d. The later crusades: decline of the crusading movement and of the Latin enclaves; results of the crusades		**5**:306g–310f	
i. The Latin East after the Third Crusade: the Fifth (1218–21) and Sixth (1227–29) crusades		**5**:306g–308a	
ii. The crusades of Louis IX of France (1248–50, 1270); final loss of the crusader states; Kingdom of Cyprus		**5**:308b–310a	**5**:407f–h/**7**:619a–d/ **11**:119c–f
e. Russia (1054–1300): the lands of Rus and the rise of new centres (*e.g.*, Novgorod, Vladimir, Galicia); the Mongol invasion (1223) and Tatar rule		**16**:42a–44a	**1**:478g–479b/**19**:335f–336g
f. The Second Bulgarian Empire under the Asenid dynasty from *c.* 1185; decline after 1241		**2**:618d–f	
2. The Slavic states of Eastern Christendom from *c.* 1300 to *c.* 1500			
a. Russia: the rise of the Muscovite state under the suzerainty of the Golden Horde, and its later successful revolt (1380); expansion and establishment of Moscow as the leading Russian power under Tsar Ivan III (1462–1505); foreign policy		**16**:44a–45d/ **19**:339h–341b	**9**:599g–h/**9**:1178d–1179c/ **12**:372f–373a/**12**:477a–c
b. The Balkans: growing strength of Serbia vis-à-vis the Byzantine and Bulgarian empires; subjugation of Albania, Macedonia, and Bulgaria under Stefan Dušan in the 14th century; Romania; subjection to the Ottoman Turks by 1453		**2**:619e–620f	**17**:664c–665b
3. Restoration of the Byzantine Empire under the Palaeologus dynasty (1261); efforts to restore Byzantine power in the Balkans; foreign relations; cultural life		**3**:567a–571c/ **6**:154e–155g	**13**:771d–772c
a. Michael VIII (1261–82) and attempts to revive the empire; threats from the West; relations with the papacy		**3**:567c–568b/ **19**:336g–339g	**12**:96c–97c
b. The successors of Michael VIII: cultural revival; civil wars		**3**:568c–570a	**13**:905f–906a
c. Turkish expansion; limited recovery by the Byzantine Empire before the final Turkish assault; the fall of Constantinople (1453)		**3**:570a–571c	**9**:1070f–g/**11**:860a–c/ **13**:773c–774e
B. The Islāmic states of Southwest Asia, North Africa, and Europe (*c.* 1050–*c.* 1480): Turkish and Kurdish dynasties, the Mongol invasions, and the rise of the Ottoman Empire			
1. Southwest Asia before the Mongol invasions			
a. The Great Seljuq Empire in Syria, Iraq, and Iran (*c.* 1050–*c.* 1190)	SELJUQS **16**:503–504	**11**:993e–994a	
i. Origins and conversion of the Seljuqs to Islām, and their establishment in Khorāsān (*c.* 1000) under Maḥmūd of Ghazna; the foundation of the Seljuq state under Toghrïl Beg (1038–63); his conquest of Iran and Iraq and establishment of a protectorate over the ʿAbbāsid caliphate		**16**:503g–504c/ **3**:640f–h	**9**:856a–c
ii. Extension of Seljuq hegemony into Syria and Palestine, and victory over the Byzantines; partition and partial breakup of the empire after 1092; Seljuq restoration of Sunnī supremacy and patronage of the Iranian cultural revival		**16**:504c–h/ **5**:302e–303c/ **9**:856c–e/ **9**:994h–999g	**1**:617g–618c/**3**:564c–e/ **9**:931a–d/**13**:135d–136a
b. Great Seljuq successor states (*c.* 1100–*c.* 1250): the Zangïd *atabeg*s in Syria and northern Iraq; the Ismāʿīlī Assassins in Iran and Syria (*c.* 1090–*c.* 1250); the Khwārazm shahs of Iran and Central Asia (1097–1234); other dynasties		**16**:504h–505d/ **9**:856e–857b/ **14**:902b–h	
c. The foundation of the independent sultanate of Rum from territory conquered from Byzantium in Anatolia (from 1071); commercial prosperity and territorial expansion in the 13th century; the Turkish Dānishmendid state in northern Anatolia (*c.* 1071–1177); its absorption by the Seljuqs		**16**:505e–506e	**5**:298h–299b

	articles	article sections	other references
2. The Mongolian invasions of eastern Europe and Southwest Asia in the 13th century		**9**:857c–d/ **14**:639g–h/ **16**:42g–43c	**5**:308f–g/**9**:599b–c/ **18**:1042h–1043a
3. Southwest Asia and eastern Europe after the Mongolian invasions		**9**:857d–858b	
a. Mongol successor states (*c.* 1250–*c.* 1480)		**11**:994a–d	
i. The Mongolian Il Khans in Iraq and Iran (*c.* 1250–1353): trade, administration, and eventual conversion to Islām; the Timurids and other Il Khan successor states		**9**:964b–f/ **9**:1002h–1004h/ **16**:506e–f	**8**:146c–h/**9**:932h–933b
ii. The khanate of the Golden Horde in southern Russia (from 1240): adoption of Islām; gradual absorption of the Mongols into the Turkish *ulus* to form the Tatar people; the zenith of the empire in the early 14th century; Timur's invasion (1395), and its later partition		**9**:964b–967b/ **16**:43d–44a	**1**:478h–479b/**9**:599g–600c/ **12**:372f–373a
b. Turkish Anatolia and the rise of the Ottoman Empire to 1481	OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE **13**:771–777		
i. Origins and expansion of the Ottoman state (*c.* 1300–1402): its expansion in Anatolia, and conquest of Serbia and Bulgaria in the 14th century; defeat by Timur (1402); restoration of the empire and beginning of the Ottoman challenge to the European states by the invasion of Hungary (1434); conquest of Constantinople (1453) and conquest of Anatolia		**13**:771d–775c/ **3**:570a–571c	**2**:620g–621a/**3**:363a–b/ **9**:54b–h/**9**:858c–e/ **9**:1070f–g
ii. Development of Ottoman administrative and military institutions		**13**:773b–d/ **13**:775c–777b	**9**:1070g–1071a/**11**:859h–860f
4. North Africa and Muslim Spain (*c.* 1050–*c.* 1490)			
a. The decline of the Fāṭimids (*c.* 1050–1171) in the face of Seljuq and crusader invasions		**5**:300e–f/ **7**:194d–195b/ **9**:932d–f	**17**:953b–d
b. The Ayyūbids and Mamlūks in Egypt and Syria (1171–*c.* 1500)	MAMLŪKS **11**:399–401	**6**:490c–491h	**1**:1048d–h
i. Establishment of the Ayyūbid dynasty in Egypt and expansion of its control over Muslim Syria under Saladin (1171–93): conflict with the crusader states; pacific policies of his successors		**6**:490c–f	**16**:177d–178a/**17**:953d–e
ii. Displacement of the Ayyūbids by the Turkish Mamlūks in 1250; the Bahri Mamlūks' resistance to the Mongols and extension of European power in Syria under Quṭuz and Baybars I (1260–77); their displacement by the Burjī Mamlūks in 1382; Mamlūk administration and military institutions; the continued maintenance of Sunnī orthodoxy		**11**:399f–401c/ **6**:490g–491h/ **9**:1001e–1002h	**2**:773d–774b/**9**:933b–d/ **13**:110c–d/**17**:953e–g/ **18**:1043b–d
c. The Berber Almoravid and Almohad empires in northwest Africa and Spain (1056–1269)		**17**:416g–417h	**13**:157g–158d
i. Almoravid origins as a religious reform federation in the western Sudan; conquest of Morocco and western Algeria under Abū Bakr and Yūsuf ibn Tāshufīn (1062–92); the latter's intervention in Spain against the expanding Christian states; Almoravid conquest of Muslim Spain (1090–91); weakness and decline in the face of the renewal of the Reconquista and the Almohad revolt in North Africa (*c.* 1123)		**17**:416g–417c	**9**:931e–f
ii. The Almohad religious reform movement under the Berber Muḥammad ibn Tūmart (d. 1130) and the extension of Almohad control over Muslim Spain (capital at Seville) and the Maghrib (1145–72); initial containment of the Reconquista and later disintegration of the empire in Spain after 1212; subsequent eclipse in the Maghrib; Almohad patronage of philosophy and the arts	SEVILLE **16**:581	**9**:999g–1001e/ **9**:1021a–1022d/ **10**:210c–212f/ **13**:158e–159b/ **17**:417d–h	**1**:6c–h/**2**:538c–540c/ **9**:148e–149a/**9**:932a–d
d. The east medieval dynasties of North Africa (13th–15th century): political and cultural developments		**13**:159d–160b	**9**:931g–932a

	articles	article sections	other references
i. The Ḥafṣids in Tunisia; the ʿAbd al-Wādid kingdom of Tilimsān; the Marīnids in eastern Morocco; their problems with the Arabs; political life; the Naṣrid kingdom of Granada		13:159d–g/ 17:417d–419b	
ii. Religious, intellectual, and artistic life: Ṣūfism; literary and artistic influences from Muslim Spain		17:419b–420h	13:159h–160b

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ʿABD AL MUʾMIN 1:6
ALEXANDER NEVSKY 1:478
ALEXIUS I COMNENUS 1:482
ALP-ARSLAN 1:617
BAYBARS I 2:773
BOHEMOND I, PRINCE OF ANTIOCH 2:1201
CARPINI, GIOVANNI DA PIAN DEL 3:956
DANDOLO, ENRICO 5:480
HUNYADI, JÁNOS 9:53
IBN KHALDŪN 9:147
IVAN III THE GREAT, OF RUSSIA 9:1178
MEHMED II 11:859
MICHAEL VIII PALAEOLOGUS 12:96
NIẒĀM AL-MULK 13:135
POLO, MARCO 14:757
SALADIN 16:177
STEFAN DUŠAN 17:664

Division III. Peoples and traditional civilizations of East, Central, South, and Southeast Asia

[for Part Nine headnote see page 563]

The articles referred to in Section 931 deal with China until the beginning of the late T'ang (AD 755). They cover first the geography and ethnography of China and the general character and achievements of Chinese civilization. They then treat the emergence of Chinese civilization and its development in the classical phase; the unification of China under the Ch'in and Han dynasties (221 BC–AD 220); and the breakdown and revival of the empire.

Section 932 is concerned with China from the beginning of the late T'ang (AD 755) through the early Ch'ing (1644–*c.* 1790). It treats the Ten Kingdoms, the Five Dynasties, and the Sung dynasty (to 1279); Mongol–Chinese rule under the Yüan dynasty (1279–1368); and the Ming and Ch'ing dynasties (to *c.* 1839).

The subject of Section 933 is Inner (Central and Northeast) Asia to *c.* 1750. The outline first deals with the geography and ethnography of Inner Asia and with the cultures of the peoples of the steppes. It then treats the peoples and states of Inner Asia to *c.* 1200, encompassing for that period the history of Manchuria, of Turkistan, and of Afghanistan; the Mongol Empire and its successor states; Tibet and Nepal to *c.* 1750; and the waning of nomad power from the 16th to the 18th century.

Section 934 treats the geography and ethnography of Japan and Korea, and the character and achievements of Japanese and Korean civilizations; the history of early Japan to 1185; of feudal Japan to 1868; and of Korea to 1910.

Section 935 deals first with the geography and the ethnography of the Indian subcontinent and Ceylon, and with the character and achievements of traditional Indian civilizations. It then treats separately India from the prehistoric period to AD 300; North India from 300 to 1200, and the Deccan and South India from 300 to *c.* 1330; and Ceylon from the prehistoric period to the end of the Classical Age (AD 1200).

Section 936 continues the history of the Indian subcontinent and of Ceylon begun in the previous section. It treats North India under Muslim hegemony (*c.* 1200–1526; the Deccan (*c.* 1320–1627) and South India (1336–

Section 931. China to the beginning of the late T'ang (AD 755) 596
932. China from the beginning of the late T'ang (AD 755) to the late Ch'ing (*c.* 1839) 598
933. Inner (Central and Northeast) Asia to *c.* 1750 600
934. Japan to the Meiji Restoration (1868), and Korea to 1910 602
935. The Indian subcontinent and Ceylon to *c.* AD 1200 604
936. The Indian subcontinent from *c.* 1200 to 1761, and Ceylon from *c.* 1200 to 1505 606
937. The peoples and civilizations of Southeast Asia to *c.* 1600 608

1646); the beginning of the political and administrative unification of the subcontinent under the Mughal Empire (1526–1761); the emergence of the Marāthā Empire in Mahārāshtra; and Ceylon from 1200 to the arrival of the Portuguese (1505).

The subject of Section 937 is the peoples and civilizations of Southeast Asia to *c.* 1600. The outline first deals with the geography and ethnography of Southeast Asia and with the character and achievements of traditional Southeast Asian civilizations. Dealing with mainland Southeast Asia to *c.* 1600, it treats the history of Burma, of Siam, of Cambodia, of Vietnam, and of Malaya. It then deals with the history of the islands of the Indonesian Archipelago to *c.* 1600, including the early kingdoms of Java and Sumatra, and the spread of Islām in Indonesia.

Section 931. China to the beginning of the late T'ang (AD 755)

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 931 deal with four main subjects: A, the character and achievements of Chinese civilization, and the geography and ethnography of China; B, the emergence of traditional Chinese civilization; C, the unification of China under the Ch'in and the Han dynasties (221 BC–AD 220); and D, the breakdown and revival of the empire.

The outline of subject B first deals with what is known of prehistoric China and of the first, though historically uncertain, Hsia dynasty (*c.* 2205–*c.* 1766 BC). It next treats the Shang, or Yin, period (*c.* 1766–*c.* 1122 BC). It goes on to the Chou period, regarded by the Chinese as their classical period of literature and philosophy, and traditionally divided into the Western (early) Chou (1122–771 BC) and the Eastern (later) Chou (771–481 BC), also known as the Chun-ch'iu period.

The outline of subject C begins with the establishment of the Ch'in empire (221–206 BC), which replaced the feudal states and developed central government. Going on to deal with the Han dynasty, the outline treats the Western Han, the Eastern Han, and the political developments, foreign relations, and cultural attainments in the Han period.

The outline of subject D begins with the period of disunion and turmoil, traditionally called the Six Dynasties period (AD 220–589). It then treats the reunification of China under the Sui dynasty (581–618) and the early T'ang dynasty (618–624) and the period of T'ang power (626–755).

	articles	article sections	other references
A. Introduction: the character and achievements of Chinese civilization; the geography and ethnography of China; archaeological and documentary historical sources; historiographic problems		**4**:573b–e/ **6**:122e–123d/ **6**:918d–f	**4**:259f–275g/**8**:1125a–f/ **9**:11e–12h/**9**:55e–56d/ **9**:602g–603a/**10**:387f–388b/ **10**:554e–555e/**10**:843h–844e/ **17**:995e–998g/ **19**:1113h–1114d
B. The emergence of traditional Chinese civilization	CHINA, HISTORY OF **4**:297–307		
1. The prehistoric period		**4**:297g–301e	
a. The Paleolithic and Mesolithic stages in North China: industries in the Ordos region; microlithic tools		**4**:297h–298e	
b. The Neolithic stage: pebble tools and domesticated animals; "Mongolian Neolithic"		**4**:298e–h	
c. The Yang-shao Painted Pottery culture		**4**:298h–299h	**8**:1052e–f
i. Stratigraphy: villages of Hsi-yin-ts'un and Yang-shao-ts'un; pottery styles		**4**:299b–d	
ii. Painted pottery styles; sites in Kansu; ornamental designs; stone implements		**4**:299d–h	**19**:177b–c
d. The Lung-shan Black Pottery complex and western limits of Black Pottery culture; the Late Neolithic Period in South China and the Early Bronze Age in North China; bronze objects in the Ordos region		**4**:299h–301e	**19**:177c–e
2. The beginnings of the Chinese civilization: the early dynasties		**4**:301e–307c	**9**:727a–g
a. Origins of the Chinese people and culture: legends and cultural centres; the Hsia dynasty (*c.* 2205–*c.* 1766 BC)		**4**:301e–302a/ **4**:411f–413d	**1**:327h–328d
b. The Shang, or Yin, period (*c.* 1766–*c.* 1122 BC): Chengchow site as early capital, cultural centre at An-yang; social system; early calendar; warfare; industry and commerce; script	AN-YANG **1**:1009–1010	**4**:302a–303c/ **3**:608d–609b/ **19**:177f–179e	**4**:415c–d/**4**:422e–f

	articles	article sections	other references
c. The Western (early) Chou (1122–771 BC): the conquest of Shang under Wen Wang and Wu Wang (1111 BC); Chou feudal system		**4**:303c–304d/ **6**:320d–h	**19**:179e–180c
d. The Eastern (later) Chou (771–481 BC), also called the Chun Ch'iu period; internal chaos; period of the Warring States (481–221 BC)		**4**:304d–306h/ **16**:858b–f	**6**:320h–321c
i. Breakdown of the Chou feudal system: capital at Lo-yang; rivalry among Chou states; various Chou successor states in the Warring States period (481–221 BC)	LO-YANG **11**:164–165	**4**:304c–305a	**19**:180d–181e
ii. Social, political, and cultural changes: decline of feudalism; urbanization and assimilation; rise of monarchy under Wen Kung; economic development		**4**:305b–306h	
e. The Classical period of Chinese literature and philosophy: Chinese religion and cosmology; Confucianism and Taoism; the "hundred schools" (the Naturalists, the Dialecticians, Mo-tzu, Meng-tzu [Mencius], Chuang-tzu, the Legalists)		**4**:306h–307c/ **4**:416a–417g/ **4**:422g–423a/ **4**:1092c–1094g/ **4**:1099g–1100f/ **10**:1051g–1053a/ **17**:1036g–1038e	**4**:408a–d/**4**:415d–f/ **4**:584f–585c/**4**:1108d–1109g/ **6**:321a–c/**7**:417g–h/ **8**:1127e–1128d/ **10**:679e–680c/**11**:898a–d/ **12**:577c–f/**16**:803f–g/ **17**:1045f–g
C. The unification of China under the Ch'in and Han dynasties (221 BC–AD 220)	CHINA, HISTORY OF **4**:307–315		
1. Establishment of the Ch'in empire (221–206 BC): development of central government; fall of the dynasty after death of Shih Huang Ti		**4**:307d–308g	**6**:321c–e
a. Early successes of the Ch'in under Mu Kung; reforms of Hsiao Kung and Shang Yang		**4**:307d–308c	
b. Ch'in strategy; unification of China by the Ch'in (221 BC); abolition of feudal system; highway building and construction of the Great Wall in the reign of Shih Huang Ti; the minister Li Ssu; political repression		**4**:308c–g	**4**:428d–429b
2. The Han dynasty		**4**:308g–315e	
a. Western (Former or Earlier) Han (206 BC–AD 8) and the Wang Mang usurpation (AD 9–23)		**4**:309b–311b	
i. Establishment of the dynasty by Liu Pang (Han Kao Tsu): the capital at Ch'ang-an; reign of Liu Heng (Han Wen Ti) from 179 to 157 BC; consolidation of Imperial power	CH'ANG-AN **4**:29–30	**4**:309e–310e	
ii. Expansion under Han Wu Ti (140–87 BC) into southern China and Central Asia; dynastic crisis (91–87 BC); ascendancy of the Wang family and Wang Mang's usurpation of throne (AD 9–23)		**4**:310e–311b	**8**:630e–631a/**19**:121h–122d/ **19**:537c–g
b. The Eastern (Later) Han: restoration of the dynasty by Liu Hsiu (Han Kuang Wu Ti) (AD 25–57); capital at Lo-yang; domestic and foreign policy; decline of government after AD 125		**4**:311c–f	
c. Political developments, foreign relations, and cultural attainments in the Han period		**4**:311f–315e	
i. The Han political system: the structure and the practice of government		**4**:311f–313g	
ii. Relations with other peoples: the Hsiung-nu of Central Asia; Pan Ch'ao's campaigns in Central Asia		**4**:313g–314e	
iii. Han cultural life: educational developments; invention of paper; prose writing; developments in music and the visual arts; introduction of Buddhism		**4**:314f–315e/ **4**:1094g–1095h/ **4**:1100g–1101d/ **10**:1053a–e/ **11**:824g–825h/ **12**:673d–h/ **16**:803g–h/ **17**:1046b–g/ **19**:181e–184d	**3**:408b–e/**6**:321e–322b/ **8**:625b–f/**13**:948a–c/ **14**:919b–c/**17**:525d–e
D. The breakdown and revival of the empire	CHINA, HISTORY OF **4**:315–326		
1. The Six Dynasties period (AD 220–589)		**4**:315f–319g	

	articles	article sections	other references
a. The division of the empire into the Three Kingdoms of Wei (North China), Shu Han (Szechwan), and Wu (South China): era of barbarian invasions and rule; the period of the Sixteen Kingdoms (304–589)		**4**:315f–317e	**11**:165c–d
b. Intellectual and religious trends: decline in Confucianism; Taoist resurgence; spread of Buddhism		**4**:317f–319g/ **4**:417h–418c/ **10**:1053e–1054b/ **19**:184d–188c	**3**:408e–g/**4**:423a–c/ **12**:822b–d
2. The reunification of China under the Sui and early T'ang dynasties		**4**:319g–326c	
a. The Sui (581–618): Sui founder Yang Chien (Sui Wen Ti); institutional reforms		**4**:319g–320f	**17**:782d–g
b. The reign of Yang Ti (605–618): integration of the South; foreign affairs; military reverses and collapse of the dynasty		**4**:320g–321g	
c. The early T'ang (618–624) and the period of T'ang power (626–755)		**4**:321g–326c	
i. Li Yüan's (618–626) establishment of the dynasty: resistance to T'ang conquest; administration of the state; fiscal and legal system		**4**:321g–323b	**4**:30d–e
ii. The era of good government in the reign of T'ai Tsung (627–649): educational and administrative reforms; conquest of eastern Turks; Kao Tsung (649–683) and influence of Empress Wu; conquest of Oxus Valley and later military reverses		**4**:323c–325c	**17**:1016h–1017b/ **17**:1018b–1019a/ **19**:1049f–1050c
iii. Prosperity and progress in the reign of Hsüan Tsung (712–756): internal reforms; military reorganization		**4**:325d–326c	**17**:1017b–g

Section 932. China from the beginning of the late T'ang (AD 755) to the late Ch'ing (c. 1839)

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 932, which continues the history of China begun in Section 931, deal with three periods of that history: A, the period from 755 to 1279; B, the period from 1279 to 1368; and C, the period from 1368 to *c.* 1839.

The outline of subject A begins with the achievements and the fall of the late T'ang dynasty (755–907). It goes on to the chaotic period of the Five Dynasties and the Ten Kingdoms (907–960). It then treats the unifying achievements of the Northern Sung dynasty (960–1126); the consolidating achievements of the Southern Sung (1126–1279); and the administrative, economic, and cultural changes during the Sung dynasty.

The outline of subject B treats the Mongol conquest of China under Genghis Khan; the establishment of the Yüan dynasty (1279–1368) under Kublai Khan, grandson of Genghis Khan; the characteristics of Mongol government and administration, and the later decline of Mongol rule; and commercial and cultural contacts with western Asia and Europe during the period of Mongol rule.

The outline of subject C begins with the Ming dynasty (1368–1644), treating political and administrative developments during the Ming period; developments in foreign relations and economic policy; and developments in philosophy, religion, the arts, and literature. It then deals with the Ch'ing (Manchu) dynasty to *c.* 1839, covering the rise of the Manchus to power and the consolidation of their position; the characteristics of the mid-Ch'ing society and economy; and the dynastic degeneration and political corruption from the onset of the 1760s.

	articles	article sections	other references
A. The late T'ang dynasty, the Ten Kingdoms, the Five Dynasties, and the Sung dynasty	CHINA, HISTORY OF **4**:326–341		
1. The late T'ang and the Northern Sung		**4**:326d–330a	
a. The late T'ang (755–907): the rebellion of An Lu-shan (755–757) and its effects; provincial separatism; attempts to restore central authority; growth in power of provincial warlords		**4**:326d–328b	**1**:927c–h/**17**:1017g–1018a
b. T'ang cultural life: the growing influences of Buddhism; developments in music and the visual arts		**4**:328b–h/ **4**:418d–g/ **4**:1101d–g/ **6**:340c–h/ **12**:674a–g/ **19**:188d–191d	**3**:408g–409b/**4**:423c–d/ **10**:1054c–g/**14**:919d–h

	articles	article sections	other references
c. Social and economic developments: the decline of the aristocracy and social mobility; agricultural advances and expansion of trade		4:328h–330a/ 6:340h–341c	
d. The period of the Five Dynasties and the Ten Kingdoms (907–960)		4:330a–332e/ 19:191d–192c	10:1054h–1055c
i. The short-lived Five Dynasties in North China: the Liang dynasty; advance of talented bureaucrats in government posts		4:330e–331c	11:435g–436b
ii. The more permanent Ten Kingdoms: the Tanguts; the Khitan, or Liao, empire; the kingdoms of Wu, the Southern T'ang, the Southern P'ing, the Ch'u, the Earlier and Later Shu, the Min, the Southern Han, and the Wu-yüeh		4:331c–332e	
e. The Northern Sung (960–1126): foundation of the dynasty and its expansion under T'ai Tsu and T'ai Tsung and their successors		4:332e–335d	
i. Unification and centralization of the empire: development of the Imperial civil service in Chao K'uang-yin's (T'ai Tsu's) reign (960–976); further consolidation under Tseng Tsung (998–1022)		4:332e–333g	6:124g–h/17:809a–810a
ii. Reforms in the reign of Shen Tsung (1068–85): leadership of Wang An-Shih; criticism of the reforms leading to the decline and fall of the dynasty		4:333g–335d	13:796g–797c/19:536f–537a
2. The Southern Sung (1126–1279): survival and consolidation; defeat by the Juchens and removal of the Sung to South China under Kao Tsung		4:335d–340b	4:586a–c
a. Relations with the Juchens; establishment of peace; absorption of the Juchens by the Chinese majority; the Chinese court's relations with the bureaucracy		4:335e–339a	
b. Internal solidarity during the decline of the Southern Sung: defense against the Mongols		4:339g–340b/ 9:598g–599b	
3. Sung cultural and economic developments; *e.g.*, resurgence of Neo-Confucianism, visual arts and music, scholarship, historiography, invention of printing, manufacturing advances		4:339b–341c/ 4:418h–420c/ 4:1095h–1096h/ 10:1055c–g/ 12:674h–675a/ 14:919h–921b/ 19:192c–197g	3:409b–c/4:585g–586a/ 4:586c–e/4:1101g–1102d/ 7:898g–899e
B. Mongol-Chinese rule under the Yüan dynasty (1279–1368)	CHINA, HISTORY OF 4:341–346		
1. The Mongol conquest of China: imposition of Mongol government and policies		4:341d–343g	10:542c–543e/11:436d/ 12:371d–372b
a. Genghis Khan's conquest of the Chin (1211–34); invasion of the Sung and the establishment of the Yüan dynasty under Kublai Khan		4:341d–342b	7:1015f–g/9:599b–f/ 12:373a–d
b. Mongol government and administration: transfer of the capital to Ta-tu (Peking); nonassimilation with the Chinese; expansion of trade		4:342b–343g	14:1h–2b
2. Religious and intellectual life; relations with the West; decline of Mongol rule		4:343g–346d/ 4:346h–347a	
a. Religious toleration and patronage of Buddhism; the status of the Confucian scholar; developments in the arts		4:343g–345c/ 6:341c–e/ 10:1055g–1056f/ 12:675b–c/ 14:921c–d/ 19:197h–200d	
b. Yüan China and the West: commercial and cultural contacts; arrival of Catholic missionaries		4:345c–346b	14:758d–759c
C. The Ming and Ch'ing dynasties to *c.* 1839: the tribute system, relative stability, ethnocentrism, and emphasis on cultural unity	CHINA, HISTORY OF 4:346–358		
1. The Ming dynasty (1368–1644)		4:346e–354a	
a. Foundation of the Ming and its political and social structure		4:346e–349h	14:2b–c

	articles	article sections	other references
i. Peasant uprisings and the foundation of the dynasty (1368) by Chu Yüan-chang (Hung-wu): pattern of dynastic succession; gradual degeneration of Ming government		**4**:346e–348b	**9**:45d–46c/**19**:1111d–1111g
ii. Government and administration: local and central government; later innovations to coordinate central government and regional administration		**4**:348c–349h	**9**:46d–f
b. Developments in foreign relations and economic policy		**4**:349h–352e	**11**:436e
i. Foreign relations: tributary system; relations with the Mongols; prohibitions on trade and travel; appearance of foreign missionaries		**4**:349h–351b	**4**:193g–194a/**6**:123d–g/ **15**:826c–g/**19**:1111g–1112d
ii. Economic policy: population movements; agricultural reform; taxation; coinage		**4**:351c–352e	**1**:329b–c
c. Cultural life in the Ming period: philosophy and religion; developments in the visual arts; music; literature and scholarship		**4**:352e–354a/ **6**:341e–f/ **10**:1056f–1057d/ **14**:921d–922h/ **19**:200e–203d	**4**:193a–c/**4**:1102d–f/ **12**:675c–677b *passim*/ **16**:368d–g/**19**:537h–538e
2. The Ch'ing (Manchu) dynasty to *c.* 1839		**4**:354a–358c/ **11**:436e–437b	**9**:601b–d
a. The Manchu rise to power (1644): preservation of the Ming administration under joint Manchu–Chinese supervision		**4**:348a–b/ **4**:354a–356d	**12**:374c–f/**13**:392g–393e
i. Manchu entrance in Peking and territorial conquest ending with the seizure of Taiwan (1683): early Ch'ing institutions		**4**:354c–355a	**4**:193a–c/**5**:958c–g/ **10**:379h–380e
ii. Early foreign relations in Asia; contacts with the West		**4**:355a–356d	**10**:380e–381b
b. Mid-Ch'ing social and economic developments: the role of religious associations; expansion of industry; social unrest; intellectual and cultural advances		**4**:356d–357g/ **6**:341f–342b	**4**:216f–217g/**12**:374g–h/ **14**:924a–e/**15**:1014b–c
i. Advances in agriculture through increased rice cultivation and introduction of new crops; expansion of crafts and industries; commerce and finance		**4**:356d–h	
ii. Population growth and immigration; religious associations; the White Lotus Rebellion (1796–1804)		**4**:356h–357e	
iii. Cultural developments; *e.g.*, government interference in scholarship; introduction of Western sciences; advances in music, literature, and the visual arts		**4**:357e–g/ **19**:203d–206a	**4**:420d–e/**4**:1102g–h/ **10**:381b–f/**10**:1057d–h/ **12**:675c–677b *passim*
c. Dynastic degeneration and widespread governmental corruption beginning in the 1760s; economic decline, famine, and social unrest in the early 1800s		**4**:357h–358c	

Section 933. Inner (Central and Northeast) Asia to c. 1750

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 933 deal with five main subjects: A, the cultural characteristics of the peoples of the steppes and the geography and ethnography of Inner Asia; B, the peoples and states of Inner Asia till *c.* AD 1200; C, the Mongol Empire and its successor states; D, Tibet and Nepal to *c.* 1750; and E, the waning of nomad power from the 16th to the 18th century.

The outline of subject B treats the Hsiung-nu tribal confederation, which dominated Mongolia, southern Siberia, and eastern Turkistan from *c.* 400 BC to *c.* AD 50; the Manchurian tribes and their relations with the Chinese until the advent of the Mongols; internal developments in West and East Turkistan until *c.* 1750; the Mongol and Tungusic states from the 10th to the 13th century; and the early development of Afghanistan to *c.* 1700.

The outline of subject C begins with the establishment of a united Mongol Empire in Central, Eastern, and Western Asia by Genghis Khan and his successors, and with the conquest of China and the establishment there of the Yüan dynasty by Kublai Khan. It then treats the Mongol khanates in Turkistan and Afghanistan; the establishment by Timur (Tamerlane) of the Timurid dynasty (1370–1506), with its capital at Samarkand; the Il Khans in Iran and the Golden Horde in southern Russia; and the developments in Mongolia proper from the 13th to the 18th century.

The outline of subject D begins with the history of Tibet from its early rulers, through the period of disunity in the 9th to the 14th century and its reunification in 1642, and later developments to *c.* 1750. The treatment of the history of Nepal covers its rule by Indian princely families, the influence of Hinduism, and its relations with China and Tibet.

Subject E, the waning of nomad power from the 16th to the 18th century, involves the Manchu conquest of China and parts of Inner Asia; the Afghans as the last nomad power in Inner Asia; and Russian expansion into Siberia.

A. Introduction: the peoples of the steppes and their cultures; their interactions with neighbouring civilizations; the geography and ethnography of Inner Asia; archaeological and documentary historical sources; historiographic problems

B. The peoples and states of Inner Asia to *c.* AD 1200

1. The Hsiung-nu tribal confederation dominating Mongolia, southern Siberia, and eastern Turkistan from *c.* 400 BC to *c.* AD 50; pressure on it and its destruction by Han China
2. The Manchurian tribes: attempts at unification; fluctuating relations with the Chinese until the advent of the Mongols
   a. The Tung-hu tribes and Chinese presence in Manchuria to the 3rd century BC; ascendancy of the Hsien-pei and establishment of the Yin kingdom by Mu-jung Hui (AD 352); Parhae (P'o-hai) kingdom (AD 712)
   b. The Khitan and Juchen empires: penetration into China, Korea, and Mongolia; Juchen conquest of Chinese Sung territory; capital at Yen-ching (Peking); conquest by Mongols in 1234
3. Development of West and East Turkistan to *c.* 1750
   a. West Turkistan: the early empires; Muslim rule; the Chagatai khans and Timurids; the Uzbek and Kazakh khanates
   b. East Turkistan (Kashgaria): Kirgiz; Uighur tribes; Qarakhanid rule in the 10th century; Mongol conquest and rule in the 13th century; conquest by Manchus (1758–59)
4. The Mongolian and Tungusic states from the 10th to the 13th century: the Liao (Khitan) empire and the later Chin (Juchen) state in North China and Manchuria (947–1125); the Western Liao (Kara khitai) of Turkistan (1124–1211)
5. The development of Afghanistan to *c.* 1700: rule by Achaemenians and Greeks to *c.* 1st century AD; various nomadic rulers; advent of Muslim control in the 7th century; Mongol conquest (1221); later rule by Timurids and Mughals

C. The Mongol Empire and its successor states

1. The establishment of a united Mongol Empire in Central, eastern, and western Asia by Genghis Khan and his successors (1206–60)
   a. The rise of Genghis Khan: his military and political organization, tactics, and conquests
   b. The division of his empire among his sons: further expansion under Ögödei Khan; Mangu (Möngke) Khan's friendly relations with Western Christendom
2. The Mongol successor states
   a. The completion of the conquest of China (1260–79) and the foundation of the Yüan dynasty by Kublai Khan
   b. The Chagatai khanate (*ulus*) of Turkistan in the 13th and 14th centuries
   c. Timur's (Tamerlane's) establishment of the Timurid dynasty (1370–1506): his capital at Samarkand; his conquests; Turkistan, Afghanistan, and Transoxania under his successors
   d. The Iranian Il Khans (1258–1335): the Golden Horde (later Kipchak empire) in southern Russia and its successor states (1240–1783)
   e. Mongolia from the 13th to the 18th century: internecine strife; the revival of Buddhism; subjection to Yüan China and later autonomy and disunity until the ascendancy of the Manchus (Ch'ing China) in the 18th century

articles	article sections	other references
INNER ASIA, HISTORY OF **9**:595–597	**3**:1119a–h/ **18**:378d–g/ **18**:792a–c	**1**:164h–168h/**2**:876g–877b/ **7**:1013g–1014b/ **8**:882e–885f *passim*/ **8**:920h–921f/**10**:407c–409a/ **11**:435b–c/**12**:362a–366e/ **12**:370b–e/**12**:951e–954e/ **18**:372g–375a/**18**:798f–799c
	9:597b–f	**4**:313g–314e/**12**:370e–h
MANCHURIA, HISTORY OF **11**:435–436		
	11:435c–g	
	11:435g–436d/ **4**:335a–336h	
TURKISTAN, HISTORY OF **18**:792–798	**9**:597g–598h/ **3**:407h–408b	**4**:321c–d/**4**:323g–324a
	9:600b–c/ **9**:601d–e/ **18**:792c–796c	**1**:174c–d/**4**:325g–h
	9:598c–h/ **18**:797f–798a	**11**:444d–e/**12**:370g–371d
		11:435g–436d/**12**:370h–371d
AFGHANISTAN, HISTORY OF **1**:172–174		
MONGOLS **12**:370–374		
	12:371d–373b/ **1**:173h–174b/ **9**:857c–d	**10**:541h–542c/**18**:793g–h
	12:371d–372d/ **4**:341d–f	**7**:1014c–1015g/**9**:599b–c
	12:372d–373b	**4**:341f–g
	12:372d–374b	
	12:373a–d/ **4**:341g–343h	**9**:599d–f/**10**:542c–f
	18:793h–794c	
SAMARKAND **16**:204		**7**:893b–e/**9**:599h–600a/ **9**:858c–f/**9**:934a–c/ **16**:43g–44a/**18**:424e–425c/ **18**:794c–g
	9:857d–858d/ **16**:42g–44a	**1**:478h–479b/**9**:599d–600a/ **12**:372f–373a/**18**:795g–796c
	12:373d–374h	**4**:355c–e/**18**:380a–b

D. Tibet and Nepal to *c.* 1750

1. Tibet to *c.* 1750

a. The legendary origins of the Tibetan people; consolidation of Tibet under Gnam-ri srong-btsan (*c.* AD 570–619); later rulers to the 9th century; introduction of Buddhism; cultural developments

b. Tibetan disunity from the 9th to the 14th century: eclipse and resurgence of Buddhism; conquest by Mongols; developments in literature and the visual arts

c. Rule by the Dge-lugs-pa (Yellow Hat) monastic order; unification of Tibet (1642); Tibet under Chinese overlordship (1720)

2. Nepal to *c.* 1750: rule by Indian princely families; influence of Hinduism; relations with China and Tibet

E. The waning of nomad power from the 16th to the 18th century: the Manchu conquest of China and parts of Inner Asia; the Afghans as the last nomad power in Inner Asia; Russian expansion into Siberia and western Turkistan

articles	article sections	other references
TIBET, HISTORY OF **18**:378–381		
	18:378d–379f/ **3**:410h–411c	**3**:416c–e
	18:379g–380d/ **3**:1123d–g/ **3**:1141c–1143a	
	18:380e–381f	
NEPAL, HISTORY OF **12**:957	**3**:1140a–1141b	
	4:354a–355g/ **9**:600d–601e	**16**:54f–h

Section 934. Japan to the Meiji Restoration (1868), and Korea to 1910

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 934 deal with four main subjects: A, the geography and ethnography of Japan and Korea, and the character and achievements of Japanese and Korean civilizations; B, early Japan; C, feudal Japan; and D, Korea to 1910.

The outline of subject B begins with prehistoric cultures in Japan. It goes on to the ancient period, in which Japan was unified under the Yamato court, and to subsequent periods. Dealing with the Imperial state from 710 to 1185, it treats government-directed religious and cultural developments in the Nara period (710–794), and political and economic developments in the Heian period (794–1185).

The outline of subject C, feudal Japan, covers the Kamakura period (1185/92–1333), beginning with the founding of the shogunate in 1185; the second feudal era, the Muromachi period (1338–1573); the period of the "warring country" and the beginning of unification under the Oda regime; and the military-bureaucratic rule during the Edo period (1603–1867).

The outline of subject D, after dealing with the prehistoric origins of the Korean people, treats the Three Kingdoms of Korea (Koguryŏ, Paekche, and Silla) and their interactions (*c.* 57 BC–AD 668); the unification of Korea under Silla control (668–918); and the Koryŏ dynasty, founded in 918 and lasting, despite subjection to China, until 1392. Finally, dealing with the Yi state of Chosen (1392–1910), which had the present city of Seoul as capital, the outline treats the consequences of the establishment of a Confucian state; invasions by Japan (1592–98) and by China (1619–27); the maintenance of tributary status to Ch'ing (Manchu) China; the relations with foreign countries; the growth of Japanese influence; and Japanese supremacy in Korea (1910).

A. Introduction: the character and achievements of Japanese and Korean civilizations; the geography and ethnography of Japan and Korea; archaeological and documentary historical sources; historiographic problems

B. Early Japan

1. Prehistoric cultures: non-ceramic cultures in the Paleolithic Period; Jōmon (5th or 4th millennium to *c.* 250 BC) and Yayoi (*c.* 250 BC–AD 250) Neolithic pottery cultures; agriculture and the influx of Chinese culture

2. The ancient period: unification of Japan under the Yamato court and subsequent governments (*c.* 250–710)

a. The rise and fall of the Yamato court: relations with Korea; internal power struggles; introduction of Buddhism

b. The governmental reforms of Shōtoku Taishi of the Soga family: theories of ideal government; the 12 court rank and the "Seventeen Article Constitution"; relations with China; spread of Buddhism

articles	article sections	other references
	4:573e–574a	**10**:34e–45f/**10**:516e–520c/ **10**:522d–523h
JAPAN, HISTORY OF **10**:57–64	**6**:342c–e	
	10:57d–59b/ **16**:671h–672b	**14**:926e–f/**19**:216f–217h
	10:59c–61b/ **12**:680b–681g	
	10:59d–h	**19**:217h–219e
	10:59h–60c/ **10**:101a–g/ **10**:111b–g/ **19**:219e–221d	**3**:409f–410a/**10**:110a–c/ **10**:1065g–1066b/**16**:672d–e

	articles	article sections	other references
c. The Taika reforms (645); elimination of the Soga family; land reform; intervention in Korea; the *ritsu-ryō* system of social and land reform		**10**:60c–61b	
3. The Imperial state from 710 to 1185		**10**:61b–64d	
a. Government-directed religious and cultural developments in the Nara period (710–794): flowering of Buddhism; Chinese and Indian influences on literature, music, and visual arts		**10**:61b–g/ **10**:102a–c/ **12**:681g–682b/ **19**:221d–224f	**9**:728g–729c/**10**:1066b–f
b. The Heian period (794–1185): changes in the *ritsu-ryō* system; ascendancy of the Fujiwara family and growing importance of the aristocracy		**10**:61h–64d	**7**:771b–772a *passim*/ **17**:994h–995e
i. Failure of Taika land reforms; power struggles among the nobility; growth of Fujiwara control over government; rise of Japanese literature and rejection of Chinese culture		**10**:61h–63d/ **10**:102d–103a/ **10**:1066g–1068b/ **12**:682c–684a/ **19**:224f–228h	**3**:410b/**10**:110c–d/ **10**:111g–112d
ii. Government by "cloistered" emperors: decline of Fujiwara power and rise of the samurai class; the Hōgen (1156) and Heiji (1159) uprisings; introduction of feudalism		**10**:63d–64d/ **16**:858f–g	
C. Feudal Japan	JAPAN, HISTORY OF **10**:64–78		
1. The Kamakura period (1185/92–1333)		**10**:64d–67b	
a. Minamoto Yoritomo and the founding of the *bakufu* (shogunate) at Kamakura (1185); the samurai *shugo* as feudal lords		**10**:64d–f	**8**:988g–h/**12**:221d–222a
b. The rise of the Hōjō family from 1199: the Jōkyū War (1221); Hōjō Yasutoki's (1224–42) administrative reforms; the Jōei law code		**10**:64f–65c	**8**:988h–989c
c. Resistance to the Mongol invasions of Japan (1274 and 1281); the Kamakura *bakufu* and feudal administration of farming regions		**10**:65c–66d	**8**:989c–e
d. Buddhist culture during the Kamakura period (*e.g.*, growth of Zen) and Neo-Confucianism; literature, philosophy, and visual arts		**10**:66d–g/ **10**:103a–105a/ **10**:1068c–1069a/ **12**:684a–685g/ **19**:228h–232a	**3**:410e–f/**6**:342e–f/**7**:900a–d/ **8**:1060c–g/**10**:110d–e/ **10**:112d–h/**13**:65e–66d/ **14**:926g–927a
e. Decline of Kamakura society: economic problems leading to the rise of daimyo (domain lord) class and decline of *bakufu*		**10**:66g–67b	
2. The second feudal era: the Muromachi, or Ashikaga, period (1338–*c.* 1573)		**10**:67b–68g	
a. The Kemmu restoration (1333) and return to direct Imperial rule: Emperor Daigo II; the Kemmu legal code; Ashikaga Takauji and the dual dynasties (1336–92)		**10**:67b–e	**5**:424a–h
b. Yoshimitsu's establishment of the Muromachi *bakufu* (1378) and unification of the dual dynasties (1392): taxation and strong military governors; feudal warfare after 1428		**10**:67e–68b	
c. Increased trade with China: piracy; the Ōnin War (1467–77); provincial self-government and growing influence of farmers		**10**:68b–g	
3. The period of the "warring country" and the beginning of unification under the Oda regime		**10**:68g–71c	
a. Unification under *sengoku* (civil war) daimyo league leaders: development of commerce and guilds		**10**:68g–69c	
b. Arrival of the Portuguese (1543) and Spanish (1549): opening of trade; Catholic Jesuit missionary activity (1549)		**10**:69c–d	
c. Cultural development in the 15th and 16th centuries: the influence of Zen Buddhism on philosophy, drama, literature, and the visual arts		**10**:69e–70d/ **10**:105b–c/ **10**:1069b–e/ **14**:927a–g/ **19**:232a–236h	**7**:417h–418b/**7**:900d–g
d. The Oda regime: unification under Oda Nobunaga (1550–82) and Toyotomi Hideyoshi (1582–98)		**10**:70d–71c	**13**:506a–f/**15**:537e–h/ **18**:474h–475d

articles	article sections	other references
4. The Edo period (1603–1867): military-bureaucratic rule	**10**:71d–78c	
a. Establishment (1603) and consolidation of the Edo (Tokyo) *bakufu* by Tokugawa Ieyasu: Japanese policy of national seclusion (1630s) from Christian missionaries and most European traders	**10**:71d–72g	**10**:110f-h/**10**:112h–113b/ **16**:672g-h/**18**:475b–476a
b. The Tokugawa postfeudal military-bureaucratic system: class structure and *bakuhan* system	**10**:72h–73c	
c. Industrial and commercial developments; advances in literature and the visual arts	**10**:73c–74d/ **10**:105c–106b/ **10**:1069e–1070g	**12**:685g–689b *passim*/ **19**:236h–238h
d. The weakening of the *bakuhan* system and its eventual collapse	**10**:74d–78c	
i. Economic crises: impoverishment of small farmers and commercial problems; political reform; opening of Japan to Western influences (1840s)	**10**:74d–75h	
ii. Cultural developments in the 18th and 19th centuries: Confucianism and the Shintō revival; Buddhism; literature and the visual arts	**10**:75h–77e/ **10**:106b–107e/ **10**:1070h–1071c/ **14**:927g–928b/ **19**:238h–240h	**3**:410f-h/**7**:418d-f/ **10**:113b-d/**16**:672h–673c
iii. The Tempō reform and downfall of the *bakuhan:* economic and administrative measures; pressure from the Europeans and the U.S.	**10**:77f–78c	**9**:234h–235b
D. Korea to 1910	KOREA, HISTORY OF **10**:506–511	
1. The prehistoric origins of the Korean people; the use of ironware and emergence of tribal states in the Bronze Age	**10**:506g–507e/ **10**:1060h–1061b/ **19**:207f–208a	
2. The Three Kingdoms of Korea (Koguryŏ, Paekche, and Silla) and their interactions (*c.* 57 BC–AD 668); introduction of Buddhism; literature and the visual arts	**10**:507e–508a/ **10**:1061c–e/ **12**:678a–f/ **19**:208b–209f	**3**:409d-e/**4**:321d-e
3. The unification of Korea under Silla control (668–918): adoption of Chinese governmental organization and land tenure system; emergence of provincial magnates; cultural developments	**10**:508b–e/ **10**:1061e–h/ **19**:209g–211c	**12**:678g–679c
4. The Koryŏ dynasty (918–1392): social and cultural developments; military rule; land reform and social change after the Mongol invasions (1231–*c.* 1261)	**10**:508e–509c/ **10**:1061h–1062c/ **14**:925d–f/ **19**:211c–213a	
5. The Yi state of Chosen (1392–1910)	**10**:509d–511c/ **19**:213b–214g	**3**:409e–f
a. The establishment of a Confucian state: royal bureaucratic government; decline of Buddhism and emergence of Confucian culture; introduction of printing	**10**:509d–e/ **10**:1062c–f/ **14**:925h–926b	**12**:679d–h
b. Invasions by Japan (1592–98) and China (1619–27): Korea as a Ch'ing (Manchu) vassal; Silhak scholarship and cultural development; introduction of Roman Catholicism	**10**:509e–510c/ **10**:1062f–1063e	
c. Relations with foreign countries: growth of Japanese influence; the Tonghak Revolt (1894) and government reform; Japanese supremacy in Korea (1910)	**10**:510d–511c/ **10**:1063f–1064a	

Section 935. The Indian subcontinent and Ceylon to c. AD 1200

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 935 deal with five main subjects: A, the character and achievements of traditional Indian civilizations, and the geography and ethnography of the Indian subcontinent and Ceylon; B, India from the prehistoric period to AD 300; C, North India, the Deccan, and South India (AD 300–750); D, North India, the Deccan, and South India from 750 to *c.* 1330; and E, Ceylon until the end of the Classical Age (AD 1200).

The outline of subject B begins with evidence for Neolithic village communities in the Indus Valley and in Baluchistan, and with the Indus civilization (*c.* 2300–*c.* 1750 BC). It goes on to the development of Indo-Aryan states from *c.* 1500 to 600 BC, and to

the characteristics of the pre-Mauryan states. It next treats the Mauryan Empire, founded by Candragupta and notable for the reign of Aśoka, one of the most celebrated of Indian rulers. Finally, it deals with the invasions of North India by Central Asians and Indo-Greeks, and with the characteristics of the South Indian civilizations.

The outline of subject C begins with the Guptas, a dynasty of kings of North India, ruling during a flourishing period of Hindu literature, art, and science. It goes on to the various kingdoms and dynasties in the Deccan, the area south of the Narbada (Narmada) River, and to the Pallavas, a warrior dynasty ruling in the Tamil country of South India.

The outline of subject D covers developments from 750 to 1200 in North India, and from 750 to *c.* 1330 in the Deccan and South India.

The outline of subject E begins with the first Indian colonial settlements of Ceylon in the 5th century BC and the bringing of Buddhism to Ceylon in the latter part of the 3rd century BC. It then deals with the Polonnaruva dynasties, with the political and social Sinhalese institutions, and with agricultural developments.

	articles	article sections	other references
A. Introduction: the character and achievements of traditional Indian civilizations; their influence on Ceylonese and Southeast Asian civilizations; the geography and ethnography of the Indian subcontinent and Ceylon; archaeological and documentary historical sources; historiographic problems		**9**:334f–335e/ **9**:344e–345e/ **3**:606h–608d/ **4**:574b–575c/ **6**:918b–d	**2**:207g–208h/**2**:687g–691e/ **7**:879b–882d *passim*/ **9**:276c–288f/**13**:739g–740a/ **13**:892g–898d/**15**:285f–h/ **15**:495h–496d/ **17**:519h–521g/ **18**:206e–207a/**19**:786h–787c
B. India from the prehistoric period to AD 300: the emergence of civilization in the Indus River Valley; the growth of kingdoms and the great empires	INDIAN SUBCONTINENT, HISTORY OF THE **9**:336–357		
1. Late Stone Age hunters and Neolithic settlement in Baluchistan and the Indus Valley; first settlements east of the Indus		**9**:336d–339a	
2. Indus civilization (*c.* 2300–*c.* 1750 BC): social, economic, and cultural developments		**9**:339a–344e/ **6**:319b–e	
a. Development of urban centres; *e.g.*, Mohenjo-daro, Harappā, Kalibangan, Lothal		**9**:340c–341g	
b. Developments in agriculture, animal husbandry, metalwork and pottery, transportation, and trade		**9**:341g–343b	**1**:329d–f
c. Developments in languages, religion, and the visual arts		**9**:343b–344a/ **8**:908c–909f	**1**:622f–g/**5**:990b–f/ **17**:184h–185c
3. The development of the Indo-Aryan states (*c.* 1500–600 BC): urbanization at Kāśī (Vārānasi) and elsewhere in the Ganges Valley; other cultures in the Indian subcontinent	VĀRĀNASI **19**:25–26	**9**:344e–348c/ **4**:1h–2c/ **8**:890c–891h/ **8**:909g–910e/ **17**:133e–134a/ **17**:151e–152e	**8**:908c–e/**8**:909a–c/**9**:315a–e
a. Early Ganges cultures to *c.* 1200 BC: social organization and religious development		**9**:345e–346f	
b. Later Ganges cultures to *c.* 600 BC: development of the caste system and emergence of Brahmin, Kṣatriya, Vaiśya, and Śūdra castes		**9**:346f–348c/ **8**:910f–911e/ **16**:857g–858a	
4. Pre-Mauryan states (*c.* 600–150 BC): development of political and economic systems; Taxila as a cultural centre	TAXILA **17**:1082–1083	**9**:348e–350e	**1**:329g–h/**17**:135a–e
a. The early development of Buddhism and Jainism; growth of Magadhan ascendancy		**9**:349e–350b/ **3**:404b–405h/ **6**:319f–h	**3**:369d–373e/**3**:415g–416a/ **8**:911e–h/**11**:347d–348b
b. Invasion of Alexander the Great (327 BC) and establishment of Greek settlements		**9**:350b–e/ **9**:353c–e/ **8**:375d–376a/ **8**:380c–e	**1**:471b–f
5. Development of the Mauryan Empire (*c.* 321–185 BC): the capital at Pāṭaliputra (Patna)	PATNA AND PĀṬALIPUTRA **13**:1076	**9**:350e–353b/ **3**:405h–406c/ **3**:510g–511a/ **4**:2d–e/ **9**:317a–g	**3**:406h–407a/**8**:911h–912b
a. Establishment of the empire by Candragupta Maurya (*c.* 321–*c.* 297 BC) and consolidation by Aśoka (*c.* 265–238 BC)		**9**:350e–351d	**2**:205f–g
b. Mauryan economic, social, and administrative developments; evolution of the concept of the state		**9**:351d–353b	
6. The rise of small kingdoms in the north (150 BC–AD 300): Indo-Greek and Asian rulers; various local republics and kingdoms (Śuṅga, Kaliṅga, Andhra)		**9**:353b–354f	**9**:315e–g
7. South Indian civilizations to AD 300		**9**:354f–357b	

a. Development of guilds, banking systems, and extensive maritime trade with the West

b. Cultural and religious development; *e.g.*, patronage of religious art and literature; growth of sects in Hinduism and Jainism; assimilation of foreigners into caste society

C. North India, the Deccan, and South India (AD 300–750)

1. The Guptas of North India (AD 320–540): expansion and administration of territory; invasions by the Hūṇas (*c.* mid-5th century); successor states to the Guptas

2. Various kingdoms of the Deccan: the Vākāṭaka dynasty, the Viṣṇukuṇḍins, the Cālukyas, and the Rāṣṭrakūṭas

3. The Pallavas in South India: developments in religious art and architecture, literature, and science

D. North India (750–1200), the Deccan, and South India (750–*c.* 1330): new dynasties and centres of power

1. The tripartite struggle in North India; the Rājput kingdoms; Turkish control in Ghazna from 998

2. The decline of the Cālukyas in the Deccan and the rise of the Cōḷas in the 10th century; later Hoysaḷas and Pāṇḍyas control; relations with the south

3. Social, economic, and cultural developments; *e.g.*, feudalism and economic decentralization, partial social mobility, growth of Tantrism, literature and the visual arts

E. Ceylon from the prehistoric period to the end of the Classical Age (AD 1200)

1. Prehistoric settlements in Ceylon; colonization by Indo-Aryan tribes in the 5th century BC; conversion to Buddhism (*c.* 3rd century BC)

2. Ceylon in the Classical Age (*c.* 200 BC–AD 1200): the Polonnaruva dynasties; growth of Sinhalese political institutions; social and agricultural developments

articles	article sections	other references
	9:356a–d	
	9:354f–356a/ **9**:356d–357b	**3**:406c–f/**17**:173h–174d
INDIAN SUBCONTINENT, HISTORY OF THE **9**:357–361	**11**:823h–824g	**1**:622g–623e
	9:357e–358h/ **6**:319h–320c/ **8**:912e–913c	**3**:407a–d/**8**:913g–914c
	9:358h–359g	
	9:359g–361a/ **4**:2f–g	
INDIAN SUBCONTINENT, HISTORY OF THE **9**:361–365		
	9:361a–362h	
	9:362h–363e	
	9:363e–365d/ **3**:407d–h/ **8**:891h–893b/ **8**:914d–h/ **17**:175b–183g	**15**:499e–500a/**17**:197f–198d
CEYLON, HISTORY OF **4**:1–3		
	4:1a–2e	**3**:411e–g
	4:2f–3g	

Section 936. The Indian subcontinent from c. 1200 to 1761, and Ceylon from c. 1200 to 1505

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 936 deal with five main subjects: A, North India under Muslim hegemony (*c.* 1200–1526); B, the Deccan (*c.* 1320–1627) and South India (1336–1646); C, the Mughal Empire (1526–1761); D, the Marāthā Empire in Mahārāshtra; and E, Ceylon from *c.* 1200 to 1505.

The outline of subject A begins with Ghurid conquest of North India and the establishment of the Delhi sultanate (1206), which lasted until Bābur laid the foundations of the Mughal Empire in 1526. It goes on to the five successor dynasties that ruled Hindustan during this period, and then treats the rise of regional kingdoms and the cultural and political role of provincial dynasties.

The outline of subject B begins with the Deccan. It first treats the Bahmanī dynasty, which set up a Muslim sultanate in 1347 in rebellion against the Delhi sultanate. It then treats the rise, from the breakup of the Bahmanī kingdom, of the five sultanates of Ahmadnagar, Berār, Bīdar, Bijāpur, and Golconda. The outline of subject B next treats the foundation of the state of Vijayanagar (1336–1646); its expansion over most of South India; its conflicts with Muslim dynasties in the Deccan; the political and social organization of the empire; and its eventual breakup.

Subject C is the beginning of the political and administrative unification of the subcontinent under the Mughal Empire (1526–1761). The outline begins with the origins of the Mughals and their conquest of North India under Bābur, a descendant of Timur and Genghis Khan. It goes on to the reign of Akbar (1556–1605), the greatest of the Mughal emperors, who expanded the empire and consolidated it by conciliatory policies toward his Hindu subjects and by skillful imperial government. It next deals with the empire in the 17th century under Akbar's three successors, and with the Mughal decline in the 18th century, during which dynastic rivalries made the empire vulnerable to a series of foreign invasions.

Subject D is the Marāthā Empire from 1674 to 1761. The outline begins with the foundation (1674–80) of the dynasty by Śivajī, who led a revolt against Mughal religious persecution of the Hindus and established an independent Hindu kingdom in

Mahārāshtra. It next deals with the expansionist efforts into North India led by a line of Brahmans who served as prime ministers to the weaker successors of Śivajī. It carries the history of the Marāthās to 1761, when they suffered a decisive defeat near Delhi at the hands of a powerful Afghan invader and a coalition of northern Muslim chiefs.

The outline of subject E covers the history of Ceylon from *c.* 1200 to the beginning of contact with Europe in the early 16th century. The article referred to treats political and economic changes in the Sinhalese state, and developments in Buddhism.

articles	article sections	other references
INDIAN SUBCONTINENT, HISTORY OF THE **9**:365–370		
A. North India under Muslim hegemony (*c.* 1200–1526)	**9**:365e–369e	
1. The completion of the Ghurid conquest; the Delhi sultanate (1206–1526): the military and administrative policies of the five dynasties		
a. The consolidation of the conquest of North India by the Slave dynasty (1206–90)	**9**:366c–367e	
b. The revival of efficient administration by the Khaljī dynasty (1290–1320)	**9**:367e–368e	
c. The Tughluq dynasty (1320–1413): administrative reforms by Muḥammad ibn Tughluq (1325–51): Mughal invasion (1398) and decline of Tughluq control	**9**:368e–370a	**12**:610h–611d
d. Tenuous control by the Sayyid dynasty (1414–51); expansion and decline of Lodī dynasty (1451–1526)	**9**:370a–f	
e. Cultural and religious developments during the Delhi sultanate; *e.g.*, Islāmic and Hindu movements and education	**6**:339e–g	**9**:944b–c
2. The 14th-century rise of regional kingdoms in the north: Bengal, Mālwa, Gujarāt, Jaunpur, and Kashmir	**9**:369f–370a	
B. The Deccan (*c.* 1320–1627) and South India (1336–1646)		
INDIAN SUBCONTINENT, HISTORY OF THE **9**:370–378		
1. The Deccan (*c.* 1320–1627): the Bahmanī dynasty and the five Deccan sultanates	**9**:370f–374b	
a. The Bahmanī dynasty (1347–*c.* 1527): introduction of Muslims into the Deccan and their relations with the Hindus	**9**:370f–372g	
b. The rise (*c.* 1500) of the five sultanates of Ahmadnagar, Berār, Bīdar, Bijāpur, and Golconda; Muslim–Hindu relations; Mughal conquests in the Deccan in the 16th century	**9**:372g–374b	
2. The Hindu Vijayanagar Empire (1336–1646) in South India	**9**:374b–378b	
a. Foundation of the state (1336) and its expansion in South India: conflicts with Muslim dynasties in the Deccan; decentralization and decline of state	**9**:374c–377h	
b. Administrative and social organization of the empire; cultural and religious development	**9**:377h–378b	
C. The beginning of the political and administrative unification of the subcontinent under the Mughal Empire (1526–1761)		
INDIAN SUBCONTINENT, HISTORY OF THE **9**:378–386		
1. The origins of the Mughals: the conquest of North India under Bābur; the Mughals' use of firearms	**9**:378d–379e	**2**:553f–554e
2. Extension and consolidation of empire by Akbar (1556–1605)	**9**:379e–382g	
a. Subjection of neighbouring territories: the conquest and annexation of Bihār, Bengal, Afghanistan, and Kashmir	**9**:373f–374b/ **9**:380b–381d	**1**:174c–d/**1**:400c–f
b. Akbar's administrative, fiscal, military, judicial, and religious policies	**9**:381d–382g/ **9**:1008b–e	**1**:400f–401c/**9**:333b/ **9**:935c–f
3. The empire under Jahāngīr (1605–27), Shāh Jahān (1628–58), and Aurangzeb (1659–1707): developments in the arts and agriculture	**9**:382g–385b/ **9**:387d–388g	**1**:330a–e/**2**:372h–373f/ **3**:586h–587b/**6**:339h–340c/ **16**:812a–e/**17**:200a–g/ **17**:204d–205c

4. Mughal decline in the 18th century: dynastic disputes and weakness after 1707 culminating in foreign invasions (1731–61)

D. The emergence of the Marāthā Empire in Mahārāshtra: rise to power and decline after 1761

1. The foundation (1674–80) of the dynasty by Śivajī: his challenge to Mughal authority in the Deccan; the Marāthā war of independence
2. The Marāthās as the major power in India in the early 18th century: the contribution of the peshwas (prime ministers) to Marāthā success; struggle with the Portuguese; establishment of the Marāthā Confederacy

E. Ceylon from *c.* 1200 to the arrival of the Portuguese (1505)

1. Political and economic changes in the Sinhalese state: collapse of central authority; foreign invasions; growth of foreign trade
2. Developments in culture and the Buddhist religion

articles	article sections	other references
	9:385b–386g	**3**:587b-c/**4**:742c-e
INDIAN SUBCONTINENT, HISTORY OF THE **9**:386–392		
	9:386h–388g	**2**:373c-e/**16**:812a-e
	9:386c–g/ **9**:388h–390b	
CEYLON, HISTORY OF **4**:3–5		
	4:3g–5d	
	4:5d–g/ **17**:205d–206h	

Section 937. The peoples and civilizations of Southeast Asia to c. 1600

[for Part Nine headnote see page 563
for Division III headnote see page 595]

The articles and parts of articles referred to in Section 937 deal with three main subjects: A, the geography and ethnography of Southeast Asia, and the character and achievements of traditional Southeast Asian civilizations; B, mainland Southeast Asia to *c.* 1600; and C, islands of the Indonesian Archipelago to *c.* 1600.

The outline of subject B covers the history of Burma, of Siam, of Cambodia, of Vietnam, and of Malaya.

The account of the history of Burma begins with the early contribution to Burmese culture of the Mon people, among the earliest Mongoloid peoples from west China to spread over the river lowlands of Southeast Asia. It goes on to the invasions from Tibet and to the establishment in 849 of the kingdom of Pagan, which lasted until 1287 when it was captured by invading Mongol armies and split into states under Shan princes. It then treats the reunification and expansion of Burma from *c.* 1300 to *c.* 1600.

The account of the history of Siam treats the hypothesis that the Thai people were the founders and rulers of the kingdom of Nanchao in China's Yunnan province; the founding early in the 13th century of the state of Sukhothai in the central plain; the foundation of the Ayutthaya kingdom (1350); and the organization of the Siamese state in the reign of King Trailok (1448–88). The outline also treats the Lao, a branch of the Thai people; the Lan Xang kingdom; and later developments.

The account of the history of Cambodia begins with the rise of the kingdom of Funan (from *c.* AD 100) and with its incorporation into the successor state of Chenla. It goes on to the emergence *c.* 800 of Angkor under the Khmer dynasty. It treats the zenith of Khmer civilization and empire in the 12th century under Suryavarman II and Jayavarman VII, and the decline and fall of the Angkor kingdom after 1220.

The account of Vietnam treats the origins and characteristics of the Vietnamese people; the states of Funan and Champa (in southern Vietnam, 1st century AD to 1471); Chinese domination of Nam Viet (in northern Vietnam, 111 BC–AD 939); independence under the Ly, Tran, and Le dynasties; the repulsion of Mongolian armies in the 13th century; and the social character of precolonial Vietnam.

The account of Malaya treats the rise of Indianized states and their role in the formation of Malaya; the advent of Islām and the rise of the sultanate of Malacca (*c.* 1400); early European intrusions; and the Portuguese conquest of Malacca in 1511.

The outline of subject C, the islands of the Indonesian Archipelago to *c.* 1600, treats the Malay kingdom of Śrivijaya; central Java in the 8th and 9th centuries; eastern Java and the rest of the archipelago from 1019 to 1292; the Majapahit empire in eastern Java (1319–89); and the spread of Islām in Indonesia.

articles	article sections	other references
	3:510b–d/ **8**:913c–e	**1**:839c–g/ **2**:486h–489a *passim*/ **3**:502e–507a/**3**:675b–g/ **9**:457d–467g/ **9**:898e–899e *passim*/ **10**:673b–674d/**10**:677e–g/ **11**:359d–360b *passim*/ **11**:368f–374f *passim*/ **14**:231f–235f *passim*/ **16**:784d–786c/ **18**:197h–203b/ **19**:131h–132d/ **19**:138e–140a

A. Introduction: the character and achievements of traditional Southeast Asian civilizations; South and East Asian influences; the geography and ethnography of Southeast Asia; archaeological and documentary historical sources; historiographic problems

B. Mainland Southeast Asia to *c.* 1600

1. Burma from the Anyathian culture (5000 BC–AD 1600)

   a. Origins of civilization in Burma: the Anyathian Stone Age culture; the Mons of Lower Burma (*c.* 3rd century BC–11th century AD); Indian trade and cultural influences

   b. The Tibeto-Burmese invasions of the Upper Irrawaddy Valley (*c.* 500 BC) and the establishment of the Pyu state of Upper Burma (*c.* AD 50)

   c. The city kingdom of Pagan (849–1287): the influence of Theravāda Buddhism; Pagan as a cultural centre; destruction by the Mongols (1287)

   d. Burma from *c.* 1300 to *c.* 1600: reunification and expansion

2. The Thai people and the kingdom of Siam to *c.* 1500

   a. The origins and settlement of the Thais: the kingdom of Nanchao in Yunnan (8th century AD)

   b. Establishment of Thai power at Sukhothai (*c.* 1220): social and cultural developments

   c. Establishment of the Thai state of Ayutthaya (1350): organization of administrative, social, and legal systems; wars with Cambodia during reign of King Trailok (1448–88)

   d. Laos to *c.* 1600: the Lao as a branch of the Thai people; establishment of the Lan Xang kingdom by Fa Ngum (1353–71); later rulers to 1571; successful Burmese invasion (1574)

3. Cambodia from the prehistoric period to *c.* 1500

   a. Prehistoric peoples in Cambodia; mythological origins of kingdom of Funan (*c.* AD 100) and the influence of Indian culture

   b. Emergence of the state of Chenla and its dominance (*c.* 598) over Funan

   c. Establishment of the state of Angkor (*c.* 800) by the Khmer dynasty; Javanese influences on religion and the concept of kingship; social and administrative structures; expansion (*c.* 1113) and decline (1177) of state

   d. Jayavarman VII (1181–*c.* 1218) and the re-establishment and extension of Khmer authority

   e. Decline of the Angkor kingdom after 1220; introduction of Theravāda Buddhism; Thai invasions (1369 and 1389) and fall of city of Angkor (1444)

4. Vietnam from the prehistoric period to *c.* 1615

   a. The legendary and historical origins of the Vietnamese people; the influence of Chinese rule (from 111 BC) on Vietnamese society

   b. The states of Funan (*c.* 1st–6th century AD) and Champa (AD 192–1471) in southern Vietnam; annexation by Nam Viet in northern Vietnam (1471)

   c. Chinese political and cultural domination of Nam Viet from 111 BC to AD 939; independence under Ly, Tran, and Le dynasties (939–1600); political unification of Nam Viet and Champa (1471); government and society in precolonial Vietnam

5. Malaya to the 16th century AD

   a. Rise of Indianized states and their role in the formation of Malaya: the advent of Islām and the rise of the sultanate of Malacca (*c.* 1400–1511)

articles	article sections	other references
BURMA, HISTORY OF **3**:510–512		**3**:412c–d
	3:510d–511a/ **17**:253c–g	
	3:511b–512b	
PAGAN **13**:860–861	**3**:511f–512b/ **17**:253g–255h	
	3:512c–f	**17**:234e–g
SIAM AND THAILAND, HISTORY OF **16**:718–720		
	16:718d–h/ **17**:255h–256c	
	16:718h–719f/ **17**:256d–h	**3**:412d–e/**14**:928d–e
	16:719f–720f/ **17**:256h–258e	
LAOS, HISTORY OF **10**:677		
CAMBODIA, HISTORY OF **3**:681–686		
	3:681g–682f	**19**:121e–h
	3:682f–683b	**17**:259e–260a
ANGKOR **1**:885–886	**3**:683b–685c	**17**:260a–262f
	3:685c–f	**10**:118h–119e/**17**:262f–263b
	3:685f–686e	**1**:886d
VIETNAM, HISTORY OF **19**:120–124		
	19:120b–121e	
	19:121e–h/ **17**:263c–264b	**3**:412e–h
	19:121h–124g/ **17**:264b–e	
MALAYA, HISTORY OF **11**:365–366		
	11:365d–366a	

b. Early European intrusions: the Portuguese conquest of Malacca (1511); Achinese aggressions in the 16th century

C. Islands of the Indonesian Archipelago to *c.* 1600

1. The settlement of the Indonesian Archipelago: the introduction of Hinduism by Indian Brahmins
2. The Malay kingdom of Śrivijaya in southeast Java: the influence of Buddhism; the importance of the maritime trade with China from the 7th to the 12th century
3. Central Java in the 8th and 9th centuries: cultural, religious, and economic development during the Śailendra dynasty; the concept of divine kingship
4. Eastern Java and the rest of the archipelago from 1019 to 1292: political and cultural developments; the Singhasāri empire of Kertanagara and the royal cult
5. The Majapahit empire in eastern Java (1319–89): religious and cultural developments
6. The spread of Islām in Indonesia: the rise of Muslim states in Sumatra and Java (*c.* late 13th century); conflicts between Islām and older Indonesian cultures

articles	article sections	other references
	11:366b–e	
INDONESIA, HISTORY OF **9**:477–483		
	9:477b–478f	
	9:478f–479e/ **17**:250c–251b/ **17**:264f–265c	**3**:412h–413a
	9:479f–480e/ **17**:265c–269c	
	9:480e–481f/ **17**:269c–270a	**10**:435h–436f
	9:481f–482d	**7**:825f–826d/**17**:235f–h
	9:482d–483g	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AKBAR **1**:399
AN LU-SHAN **1**:927
AURANGZEB **2**:372
BĀBUR **2**:553
CHENG CH'ENG-KUNG **4**:192
CHENG HO **4**:193
CH'IEN-LUNG **4**:215
CH'IN SHIH HUANG TI **4**:428
DAIGO II **5**:429
DORGON **5**:958
FUJIWARA FAMILY **7**:771
GAJAH MADA **7**:825
GENGHIS KHAN **7**:1013
HAN WU TI **8**:630
HŌJŌ FAMILY **8**:988
HUNG-WU **9**:44
JAYAVARMAN VII **10**:118
K'ANG-HSI **10**:379
KERTANAGARA **10**:435
KUBLAI KHAN **10**:541
MINAMOTO YORITOMO **12**:221
MUḤAMMAD IBN TUGHLUQ **12**:610
NURHACHI **13**:392
ODA NOBUNAGA **13**:505
OU-YANG HSIU **13**:796
PAN KU **13**:947
RICCI, MATTEO **15**:826
ŚIVAJĪ **16**:811
SUI WEN TI **17**:782
SUNG T'AI TSU **17**:808
TAIRA FAMILY **17**:994
T'ANG HSÜAN TSUNG **17**:1016
T'ANG T'AI TSUNG **17**:1018
TIMUR **18**:424
TOKUGAWA IEYASU **18**:474
TOYOTOMI HIDEYOSHI **18**:537
WANG AN-SHIH **19**:536
WANG MANG **19**:537
WU HOU **19**:1049
YUNG-LO **19**:1110

Division IV. Peoples and civilizations of sub-Saharan Africa to 1885

[for Part Nine headnote see page 563]

The history of North Africa, because of its early involvement with Europe and Islām, was dealt with up to *c.* 1480 in Sections 911 and 924; and it is carried to the 19th century in Section 962. The history of Nilotic Sudan to *c.* AD 550 and of Ethiopia to *c.* AD 650 were dealt with in Section 911.

With those exceptions, the articles referred to in the five sections of Division IV deal with the histories of the peoples and civilizations of the African continent to *c.* 1885.

Section 941 treats West Africa to *c.* 1885. The outline covers West Africa until the advent of the Europeans (*c.* AD 1500); the initial (precolonial) period of European contact, involving the formation of new states and the development of the slave trade; and the colonial establishments in the 19th century.

Section 942 continues the history of the Nilotic Sudan, begun in Section 911, to *c.* 1885, and continues the history of Ethiopia, also begun in Section 911, to 1855.

The outline in Section 943 first deals with the geography and ethnography of East Africa and Madagascar and with the character and achievements of civilization in East Africa. It next deals with the history of East Africa in two periods—up to *c.* 1856, and from then to *c.* 1900. Finally, it deals with

Section 941. West Africa to *c.* 1885 611
942. The Nilotic Sudan and Ethiopia from *c.* AD 550 to 1885 612
943. East Africa and Madagascar to *c.* 1885 612
944. Central Africa to *c.* 1885 613
945. Southern Africa to *c.* 1885 614

the history of Madagascar in two periods—up to *c.* 1810, and from then to 1896.

The outline of Section 944, after dealing with the geography, ethnology, and civilizations of Central Africa, treats the history of Central Africa to *c.* 1885.

Section 945 is on southern Africa to *c.* 1885. The outline first deals with the geography and ethnography of southern Africa, and with the character and achievements of civilizations in southern Africa. It then treats the history of southern Africa. first in the period before *c.* 1500, and then in the period from *c.* 1500 to *c.* 1900—a period marked by the involvement in this region of the Portuguese, the Dutch, and the British.

Section 941. West Africa to c. 1885

[for Part Nine headnote see page 563
for Division IV headnote see page 610]

The articles and parts of articles referred to in Section 941 deal with three main subjects: A, the geography and ethnography of West Africa, and the character and achievements of civilizations in West Africa; B, West Africa until the advent of the Europeans (*c.* AD 1500); and C, the precolonial period of European activity (*c.* 1400–*c.* 1885) in West Africa.

The outline of subject B treats the development of the West African monarchies of Ghana and Kanem to *c.* AD 1000, and the later development of the western Sudan empires—the Mali empire, with Timbuktu as the cultural and commercial centre; the Songhai empire of Gao; and the migrations of the Fulani people and the Mande-speaking peoples.

The outline of subject C first treats the Portuguese trade with the Guinea states from *c.* 1460; the rise and expansion of the Atlantic slave trade (*c.* 1600–1860); and the Islāmic revolutions in the western Sudan. Dealing with West Africa from 1800 to *c.* 1885, the outline covers the European anti-slavery movements; the British colonial settlements from *c.* 1800; and the 19th-century British and French exploration of the West African interior, the establishment of colonies, and the exploitation of trade.

	articles	article sections	other references
A. Introduction: the geography and ethnography of West Africa; definition of the region; the archaeological and documentary historical sources, and historiographic problems; the character and achievements of civilizations in West Africa		**8**:472g–473d/ **19**:760h–761f	**4**:17a–18c *passim*/ **5**:420h–421h/**7**:863d–864a/ **7**:865c–h/**8**:136e–140c/ **8**:466f–469b/**9**:1181e–1182f/ **10**:851h–853g/ **11**:381c–382h/**11**:710e–712c/ **13**:79h–81f/**13**:85b–91e/ **16**:531h–533b/ **16**:734a–736d/ **18**:471d–473a/ **18**:1018f–1019g/**19**:516c–f
B. West Africa until the advent of the Europeans (*c.* AD 1500)	WEST AFRICA, HISTORY OF **19**:760–765		
1. Development of the West African monarchies of Ghana and Kanem to *c.* AD 1000		**19**:760h–762g	
2. Development of the western Sudan empires		**19**:762h–765g	
a. Emergence of the Keita dynasty of the Mali empire (*c.* 1235): Timbuktu as the cultural and commercial centre of Mali; fall of the Mali empire (*c.* late 15th century) and rise of the Songhai empire of Gao	TIMBUKTU **18**:409	**19**:762h–763g	**1**:282e–g/**11**:458c–g/ **12**:300b–h
b. The migrations of the Fulani people; migrations and military conquests of the Mande-speaking peoples; development of trade routes by the Dyula		**19**:763g–765g	
C. The precolonial period of European activity (*c.* 1400–*c.* 1885): exploration, development of the slave trade, and eventual collapse of indigenous states	WEST AFRICA, HISTORY OF **19**:765–777		**3**:798g–h
1. Portuguese trade with the Guinea states from *c.* 1460		**19**:765h–766h	**7**:860h–861f/**14**:868f–g
2. The rise and expansion of the Atlantic slave trade (*c.* 1600–*c.* 1860): the pattern and development of European slave trade routes; the African slave merchant class		**19**:766h–772b/ **8**:473g–474e	**1**:283b–e/**10**:594g–h
3. The Islāmic revolutions in the western Sudan: spiritual and military leadership of Sīdī Mukhtār (d. 1811) and Usman dan Fodio (d. 1817); the Fulani and Hausa *jihād*s (holy wars) and conquests		**19**:772b–774b	**8**:552h–553d/ **18**:1100d–1101b
4. West Africa from 1800 to *c.* 1885		**19**:774b–777c	
a. The Guinea coastlands and the European anti-slavery movements		**19**:774b–h/ **8**:474e–475c	**10**:594h–595d

	articles	article sections	other references
b. British colonial settlements from *c.* 1800: the colonies of Sierra Leone, the Gold Coast, Lagos, and Ashanti		**19**:774h–775g	
c. 19th-century British and French exploration of the West African interior, establishment of colonies, and exploitation of trade		**19**:775h–777c	**7**:143g–144c

Section 942. The Nilotic Sudan and Ethiopia from c. AD 550 to 1885

[for Part Nine headnote see page 563
for Division IV headnote see page 610]

The articles and parts of articles referred to in Section 942 treat two main subjects: A, the Nilotic Sudan from *c.* 550 to 1885; and B, Ethiopia and Eritrea from *c.* 650 to 1855.

The outline of subject A covers the medieval Christian kingdoms in the Nilotic Sudan; the spread of Muslim domination from *c.* 639; the rise of the sultanate of Funj (1500), and the spread of Islām; and the Egyptian occupation from 1820 to 1885.

The outline of subject B covers the decline of the Christian Aksum empire (*c.* 600–*c.* 976); the Zague dynasty (*c.* 11th century); the Solomonid restoration (1270); contacts with the Portuguese (1520–1632); Turkish attacks on Ethiopia in the 16th century; and Gonder Ethiopia (1632–1855).

	articles	article sections	other references
A. The Nilotic Sudan from *c.* 550 to 1885	NILOTIC SUDAN, HISTORY OF THE **13**:109–112		
1. The medieval Christian kingdoms of Nobatia, Maqurrah, and ʿAlwah; the Beja people		**13**:109h–110a	
2. The spread of Muslim domination from *c.* 639: Mamlūk attacks in the 13th and 14th centuries; invasion of nomadic Arabs in the 15th century and intermarriage with Nubians; Kingdom of ʿAlwah as the last Christian barrier until its conquest (*c.* 1500)		**13**:110a–e	
3. The rise of the Funj (*c.* 1500); the spread of Islām		**13**:110f–111d	
4. The Egyptian occupation from 1820 to 1885: the administration of Muḥammad ʿAlī and his successors; Ismāʿīl Pasha and the growth of British influence		**13**:111d–112g	
B. Ethiopia and Eritrea from *c.* AD 650 to 1855	ETHIOPIA, HISTORY OF **6**:1008–1010		
1. The decline of the Christian Aksum empire (*c.* 600–*c.* 976): cordial relations with Islāmic states to the 8th century; conflicts with neighbouring peoples in the 9th century		**6**:1008a–e	
2. The Zague dynasty (*c.* 11th century); the Solomonid restoration (1270); the influence of the Coptic Church on culture and religion		**6**:1008e–1009c	
3. Contacts with the Portuguese (1520–1632) and Turkish attacks on Ethiopia (1523–43, 1578, and 1589); brief conciliation with the Roman Catholic Church (1595–1610)		**6**:1009c–f	
4. Gonder Ethiopia (1632–1855): alliance with Egyptian Coptic Church; friendly relations with Muslims; rivalry between the Gallas and Tigreans		**6**:1009f–1010a	

Section 943. East Africa and Madagascar to c. 1885

[for Part Nine headnote see page 563
for Division IV headnote see page 610]

The articles and parts of articles referred to in Section 943 deal with three main subjects.

Subject A involves the geography and ethnography of East Africa; sources for and problems about its history; and the character and achievements of civilizations in East Africa.

Subject B is East Africa to *c.* 1856 and Madagascar to *c.* 1810. The outline first deals with the development of the coastal regions and of Madagascar and other offshore islands; the foundation of colonies by Muslim immigrants from the Persian Gulf region; the Portuguese invasions and their gradual expulsion; and the Malagasy kingdoms of Sakalava and Merina (1500–1810). Dealing with the peoples and states of the East African interior, the outline treats the Stone Age origins of the East African interior peoples in the Rift Valley (now Kenya, Tanzania, and

Uganda); the Iron Age settlements in the Rift Valley; the Somali and Galla invasions (*c.* 10th–15th century); and the migrations of Nilotic and Kushitic peoples (*c.* 16th–18th century).

The outline of subject C first deals with internal developments in East Africa and with European exploratory and missionary activities during the mid-19th century. It then treats the formation of the Kingdom of Madagascar (1810–61), and English and French influences in Madagascar in the late 19th century.

	articles	article sections	other references
A. Introduction: the geography and ethnography of East Africa and Madagascar: definition of the region; the archaeological and documentary historical sources, and historiographic problems; the character and achievements of civilizations in East Africa		**6**:91b–c/ **6**:109e–111a	**6**:998d–1002b/**10**:423b–425h/ **11**:268e–273d/ **11**:714g–715g/**12**:592e–596f/ **16**:108g–110a/ **16**:1057c–1061a/ **17**:1025f–1031b/ **18**:825f–828e
B. East Africa to *c.* 1856 and Madagascar to *c.* 1810	EAST AFRICA, HISTORY OF **6**:90–97		
1. The development of the coastal regions and of Madagascar and other offshore islands		**6**:91c–94f	
a. Medieval commercial contacts of Azania with Arabia, India, and the Mediterranean: the development of coastal trading cities		**6**:91c–92a	
b. The Shirazi dynasty (*c.* late 12th–15th century): the spread of Islām and growth of towns		**6**:92a–e	
c. The Portuguese invasions and occupation from 1502: gradual expulsion of the Portuguese (1631–98); the Omani influence (*c.* 1700–1856)		**6**:92e–94f	
d. Madagascar from *c.* AD 1000 to 1810: early Indonesian settlement; later Muslim and African influx; kingdoms of Sakalava and Merina (1500–1810)	MADAGASCAR, HISTORY OF **11**:277		
2. The peoples and states of the East African interior to *c.* 1800		**6**:95a–97a	
a. The Stone Age origins of the East African interior peoples in the Rift Valley (now Kenya, Tanzania, and Uganda)		**6**:95a–d	
b. The Iron Age settlements in the Rift Valley; the Bantu migrations and the Chwezi peoples		**6**:95d–96d	
c. The Somali and Galla invasions (*c.* 10th–15th century); migrations of Nilotic and Kushitic peoples (*c.* 16th–18th century)		**6**:96d–97a	
C. East Africa from 1856 to *c.* 1900 and Madagascar from 1810 to 1896	EAST AFRICA, HISTORY OF **6**:97–99		
1. Internal developments in East Africa		**6**:97b–99c	**15**:362e–f
a. Development of political institutions and military kingships as defenses against Ngoni raids and Masai raiders: expansion of Rwanda and Buganda		**6**:97b–h	
b. The rise of Zanzibar as the leading East African coastal power: the slave trade		**6**:97h–98d	
c. European exploratory and missionary activities		**6**:98d–99c	**3**:526h–527b/**11**:715g–716a
2. Formation of the Kingdom of Madagascar (1810–61); English and French influences in the late 19th century		**11**:277h–278c	

Section 944. Central Africa to c. 1885

[for Part Nine headnote see page 563
for Division IV headnote see page 610]

The articles and parts of articles referred to in Section 944 deal with two main subjects.

Subject A involves the geography and ethnography of Central Africa; sources for and problems about the writing of its history; and the achievements of civilizations of Central Africa.

Subject B is Central Africa to *c.* 1885. The outline treats the origins of Central African cultures in the Stone Age; the emergence of the Bantu states from *c.* AD 1400; and the development of Portuguese influence, including control of the slave trade, in Central Africa from 1491.

	articles	article sections	other references
A. Introduction: the geography and ethnography of Central Africa; definition of the region; the archaeological and documentary historical sources, and historiographic problems; the character and achievements of civilizations in Central Africa		**4**:1118g–1119f	**3**:1101f–1104g/ **4**:1113e–1116d/ **7**:818g–819g/ **9**:1176c–1177g *passim*/ **19**:1119b–1123f
B. Central Africa to *c.* 1885	CENTRAL AFRICA, HISTORY OF **3**:1090–1094		
1. The origins of Central African cultures in the Stone Age; emergence and expansion of the Bantu-speaking peoples		**3**:1090f–1091g	
2. The development of the Bantu states from *c.* AD 1400: the Luba and Lunda kingdoms; the Mongo people; the Kongo (Congo) kingdom		**3**:1091g–1093c	**4**:1121b–g
3. Development of Portuguese hegemony over Central Africa from 1491: trade and missionary activity; military support of the Kongo kingdom; control of the slave trade; influence on Central African unity		**3**:1093d–1094h	

Section 945. Southern Africa to c. 1885

[for Part Nine headnote see page 563
for Division IV headnote see page 610]

The articles and parts of articles referred to in Section 945 deal with three main subjects.

Subject A involves the geography and ethnography of southern Africa; the sources for and problems about the writing of its history; and the character and achievements of civilizations in southern Africa.

The outline of subject B treats the origins of human culture in southern Africa in the Stone and Iron ages; the southeast coastal trade in the Late Iron Age; and the interior trade routes to what are now southwestern Rhodesia, Zambia, and northern Transvaal.

Subject C is southern Africa from *c.* 1500 to *c.* 1885. The outline covers such topics as the Portuguese penetrations and conquests in southern Africa; the Dutch settlement at the Cape of Good Hope from 1652; the slave and ivory trade north of the Zambezi in the 19th century; the Cape eastern frontier; the era of mineral discoveries in southern Africa; and the later history of the Portuguese and of the Germans in southern Africa.

	articles	article sections	other references
A. Introduction: the geography and ethnography of southern Africa: definition of the region; the archaeological and documentary historical sources, and historiographic problems; the character and achievements of civilizations in southern Africa			**1**:890f–892d/**3**:71a–74c/ **3**:791e–793a *passim*/ **10**:373a–375a *passim*/ **10**:834f–h/**11**:360d–g/ **12**:592g–596f/**12**:819h–821a/ **12**:845e–846d/**13**:638e–639c/ **15**:814h–819b *passim*/ **17**:60g–66a/**17**:300e–302c/ **17**:842d–843f/ **18**:685d–686b/**19**:56f–57g/ **19**:114a–h/**19**:1127b–e/ **19**:1129a–1132b
B. Southern Africa before *c.* 1500	SOUTHERN AFRICA, HISTORY OF **17**:274–276		
1. Origins of human culture in the Stone Age and Iron Age; the migrations of Bantu-speaking peoples in southern Africa from *c.* AD 700		**17**:274f–276a	
2. The southeast coast trade in the Late Iron Age (*c.* AD 1300) and interior trade routes to Zimbabwe (southwestern Rhodesia), Ingombe Ilede (Zambia), and Mapungubwe (northern Transvaal)		**17**:276a–g	
C. Southern Africa from *c.* 1500 to *c.* 1885	SOUTHERN AFRICA, HISTORY OF **17**:276–290		
1. Portuguese expansion (1530s) into the Zambezi Valley and defeat of the Mwene Mutapa's empire in 1629: Portuguese defeats (1694) by the Rozwi empire		**17**:276g–278c	
2. The Portuguese in west central Africa: conquests over the Kongo kingdom (1681) and Ndongo kingdom (early 17th century); control of slave trade		**17**:278d–279f	

	articles	article sections	other references
3. The Dutch settlement at the Cape of Good Hope from 1652: expansion toward the Orange River and relations with the Khoisans		17:279g–281b	3:791g–792a/3:794b–f
4. Early 19th-century African migrations and rise of the Zulu Empire (1816) under Shaka; later black migrations into Rhodesia		17:281c–282e	16:614d–615b
5. The slave and ivory trade north of the Zambezi in the 19th century: decline of the slave trade in some areas and increased commerce in ivory; Yao migration into present-day Malawi; influence of missionaries		17:282f–283c	
6. The Cape eastern frontier: Xhosa resistance to the British; the Boer Great Trek (1835–54) into the interior; continued friction with the British		17:283c–286a	
a. Relations between Boers and the black population in the Transvaal		17:283h–285a	18:685b–c
b. Establishment of the Orange Free State; the British colonies of Natal and Cape Colony		17:285b–286a	3:792a–c/13:638b–e
7. The era of mineral discoveries and confederation: diamonds; Transvaal–Pedi and Zulu wars		17:286a–e	
8. Portuguese loss of control in Angola and Mozambique in the mid-19th century; Portuguese re-emergence of control in the early 20th century; German annexation of South West Africa (1884)		17:288h–290a	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BURTON, SIR RICHARD **3**:526
COVILHÃ, PÊRO DA **5**:230
FAIDHERBE, LOUIS **7**:143
HĀJJ 'UMAR, AL- **8**:552
KRUGER, PAUL **10**:538
MANSA MŪSĀ OF MALI **11**:458
MOHAMMED I ASKIA OF SONGHAI **12**:300
SA'ID IBN SULṬĀN **16**:152
SHAKA **16**:614
USMAN DAN FODIO **18**:1100

Division V. Peoples and civilizations of pre-Columbian America

[for Part Nine headnote see page 563]

The subject in Section 951 is Andean civilization to *c.* 1540. The outline begins with the character and achievements of Andean civilization, with the ethnography and geography of the Andean region, and with archaeological and documentary historical sources. It goes on to the history of the pre-Inca cultures and states in the Andean region. It then deals with the empire of the Incas (*c.* 1400–*c.* 1540), treating the origins and development, and the social, economic, political, and cultural characteristics of that empire, to the time of the Spanish conquest (1532–40).

The subject in Section 952 is Meso-American civilization to *c.* 1540. Again, the outline begins with the geography and ethnography of Meso-America and with the character and achievements of Meso-American civilization. It goes on to Meso-America in the Pre-Classic and Classic periods, treating such topics as the early Olmec and the Izapan civilizations; the urban civilization at Teotihuacán; Late Classic non-Maya Meso-America; and the lowland Maya civilization. Dealing with the Post-Classic Period in the Valley of Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1519), the outline treats the rise and decline of the Toltec state, the development of the Aztec state, its extension of rule over the Valley of Mexico (*c.* 1325–*c.* 1519), and its conquest and destruction by the Spanish.

Section 951. Andean civilization to *c.* AD 1540 616
952. Meso-American civilization to *c.* AD 1540 617

Section 951. Andean civilization to c. AD 1540

[for Part Nine headnote see page 563
for Division V headnote see page 615]

The articles and parts of articles referred to in Section 951 are concerned with Andean civilization—the term referring to the aboriginal American Indian cultures that developed and flourished in the highlands of northwestern South America from several thousand years before the Christian era to their subjugation by Spanish conquerors in the 16th century AD. They treat three main subjects: A, the character and achievements of Andean civilization and the geography and ethnography of the Andean region; B, pre-Inca cultures and states; and C, the empire of the Incas (*c.* 1400–*c.* 1540).

The outline of subject B covers the periods of development reconstructed by archaeologists, who, by studying the sequence and distribution of pottery styles and other artifacts, have mapped the progress of Andean civilization from the hunters and gatherers of the 1st millennium BC to the takeover of the Andean regions by the Incas in the 15th and 16th centuries AD.

The outline of subject C deals with the origins, development, and destruction by the Spanish of the Inca Empire in the Andean regions. It carries the history of the Incas from the mythical origins of the Inca dynasty, *c.* 1400, through the Inca conquests in the Andean region, to the Spanish conquest of the Incas (1532–40). The outline also treats the characteristics of Incan imperial government and the achievements of Incan society and culture.

A. Introduction: the character and achievements of Andean civilization; the geography and ethnography of the Andean region; archaeological and documentary historical sources; historiographic problems

B. Pre-Inca cultures and states

1. Late Preceramic (*c.* 3500–*c.* 1800 BC) cultures: development of agriculture
2. Initial (*c.* 1800–*c.* 1000 BC) and Early Horizon, or Chavín and Paracas (*c.* 1000–*c.* 200 BC), cultures in Peru: development of textiles, pottery, and ceremonial architecture
3. Early Intermediate (Florescent, or Classic) Period (*c.* 200 BC–*c.* AD 600): metallurgy, pottery, and textile production in the Nazca and Moche cultures
4. Middle Horizon Period (*c.* AD 600–*c.* 1000): the Huari and Tiahuanaco cultures: urban settlements; cultural decline after *c.* AD 800
5. Late Intermediate Period (*c.* AD 1000–*c.* 1400): pottery and the introduction of bronze; the Chimú Empire (*c.* 1300–*c.* 1460) located at Chan Chan; spread of urban settlements

C. The empire of the Incas (*c.* 1400–*c.* 1540)

1. The origins and development of the Inca Empire
   a. The autochthonic mythical origins of the Inca dynasty; establishment of the Cuzco Valley settlement (*c.* 1400)
   b. The reigns of Capac Yupanqui, Inca Roca, Yahuar Huacac, and Viracocha Inca: Inca expansion into the Urubamba Valley and Titicaca Basin; the Chancas invasion (1438)
   c. Inca victory over the Chancas (1438); Incan civil war between Cuzco and Calca factions; Cuzco victory and reign of Pachacuti Inca Yupanqui (1438–*c.* 1471); renewed battles with Chancas (*c.* 1445); further conquest of Titicaca Basin region; victory over Chimú Empire
   d. Inca conquests during the reign of Topa Inca Yupanqui (*c.* 1471–*c.* 1493): annexation of highland Bolivia, northern Chile, northwestern Argentina, and southern Peru
   e. Reign of Huayna Capac (*c.* 1493–*c.* 1525): conquest of northeastern Peru and northern Ecuador; Atahuallpa's victory (1532) over Huascar in civil war
   f. The Spanish conquest of the Incas (1532–40): Pizarro's execution of Atahuallpa and support of Topa Huallpa (1533); later support of Manco Inca (1533–35); Manco's rebellion and defeat (1536); Spanish consolidation of power
2. Incan government, society, and culture

articles	article sections	other references
	1:839h–843d/ **1**:847b–848d/ **1**:688b–691f/ **9**:259b–d/ **17**:105g–h/ **17**:119a–g	**14**:993d–g/**17**:94b–f
ANDEAN CIVILIZATION, HISTORY OF **1**:839–847		**9**:259d–g
	1:840h–841f	**1**:855b–c/**17**:118b–c
	1:841f–843d	
	1:843e–845a	**14**:929f–g
	1:845a–g	
	1:845g–847a	**1**:688d–690e
ANDEAN CIVILIZATION, HISTORY OF **1**:847–854		
	1:848a–851f	
	1:848a–d	**1**:662a–c
	1:848d–h	**9**:259h–260a
	1:848h–850a	**17**:118c–e
	1:850a–d	**1**:690e–691f/**3**:9h–10a
	1:850d–851c	
	1:851c–f/ **10**:639b–g	**4**:882a–c/**6**:291a–b/ **14**:488a–d/**17**:120b–d
	1:851f–854a/ **17**:109e–f	**6**:318h–319a

	articles	article sections	other references
a. Divine monarchy and the royal corporations; administrative hierarchy; taxation; the census and the quipu system of numerical records		1:851f–852e	
b. The settlement of people loyal to the Incas in newly conquered territories; the spy system; religious practices; military policy and organization; technology; agriculture; transportation system; calendar; oral narratives		1:852e–854a/ 1:855d–g/ 3:611d–g	9:259a–261g *passim*/ 14:929h–930a/17:118d–e

Section 952. Meso-American civilization to c. AD 1540

[for Part Nine headnote see page 563
for Division V headnote see page 615]

The articles and parts of articles referred to in Section 952 deal with the history of Meso-American civilization—the term Meso-America referring to that part of Mexico and Central America that was civilized in pre-Spanish times. They treat three main subjects: A, the character and achievements of Meso-American civilization and the geography and ethnography of Meso-America; B, Meso-America in the Pre-Classic and Classic periods; and C, the Post-Classic period in the valley of Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1519).

The outline of subject B covers the reconstruction by archaeologists of the development of Meso-American civilization from *c.* 21,000 BC to AD 100, covering such topics as the very early development of agriculture, the Olmec civilization at San Lorenzo, and in the Late Formative Period, the Izapan civilization. The outline goes on to the Classic Period (*c.* AD 100–*c.* 900). It treats the urban and expansionist civilization at Teotihuacán, the largest city of the New World before the arrival of the Spaniards; Late Classic non-Maya Meso-America; and the lowland Maya civilization, the greatest in the New World, which after six centuries of almost unbroken evolution mysteriously collapsed.

Subject C is the Post-Classic Period in the Valley of Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1519). The outline treats the rise and decline of the Toltec state in southern Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1200); the development of the Aztec state and extension of Aztec rule over the Valley of Mexico (*c.* 1325–*c.* 1519); and the major features of Aztec culture and social structure. It ends with the Spanish conquest of the Aztec state, and the Spanish destruction of Aztec government and culture.

	articles	article sections	other references
A. Introduction: the character and achievements of Meso-American civilization; the geography and ethnography of Meso-America; archaeological and documentary historical sources; historiographic problems		11:947b–951b/ 4:581c–582e/ 8:453g–456b/ 11:719e–g/ 11:934f–935d	8:1056c–1057c/11:957c–f/ 11:960b–961b/13:940e–942f
B. Meso-America in the Pre-Classic and Classic periods	MESO-AMERICAN CIVILIZATION, HISTORY OF 11:935–947	11:961e–962a	
1. The development of Meso-American civilization in the Pre-Classic periods		11:935h–940b	
a. Late Pleistocene and Early Hunter (*c.* 21,000–*c.* 6500 BC) peoples of Meso-America; development of agriculture (*c.* 6500–*c.* 1500 BC)		11:935h–936f	1:327b–f/12:166a–b
b. Early Formative Period (*c.* 1500–*c.* 900 BC): the Ocós and Caudros settlements; the Olmec civilization at San Lorenzo (*c.* 1150–*c.* 900 BC) and development of its stone monuments		11:936f–937f	1:684h–685d
c. Middle Formative Period (*c.* 900–*c.* 300 BC): the Olmecs at La Venta (*c.* 800–*c.* 400 BC); ceremonial architecture, pottery, and writing system; colonization and trade; pre-Maya villages in Guatemala		11:937g–938h	14:929b–c
d. Late Formative Period (*c.* 300 BC–*c.* AD 100): regionalism and cultural integration; the Cuicuilco-Tilcomán cultures in the Valley of Mexico; the Zapotecs of Oaxaca; the Izapan civilization; Mayas of the Chicanel in northern Petén		11:938h–940b	
2. Maya and non-Maya Meso-America in the Classic Period (*c.* AD 100–*c.* 900)		11:940b–947b	1:662f–663a/ 11:719h–720b/ 11:721h–722c/12:166c–e/ 14:929c–e
a. Early Classic Period (*c.* AD 100–*c.* 600)		11:940b–943e	1:685d–686c
i. Teotihuacán cultural and urban development; ceremonial architecture and pottery; the Zapotecs at Monte Albán		11:940b–942d	
ii. The Cotzumalhuapo culture in the Maya highlands; Tzakol and Tepeu cultures in lowland Maya civilization (*c.* AD 300–*c.* 900)		11:942d–943e	

	articles	article sections	other references
b. Late Classic non-Maya Meso-America (*c.* AD 600–*c.* 900): decline of Teotihuacán political and cultural influence; rise of Xochicalco culture; the Mixtecs of northern Oaxaca		**11**:943e–944a	
c. Late Classic lowland Maya culture (*c.* AD 600–*c.* 900)		**11**:944b–947b	
i. Urban settlements; temple-pyramids and palaces; Maya art; the calendar and writing system		**11**:944b–946b/ **3**:609c–610g/ **11**:962e–f	**6**:318e–f/**11**:721f–h
ii. Maya religion; social and political life; the collapse of the Maya civilization (*c.* AD 900)		**11**:946b–947b	**11**:720d–721c
C. Post-Classic Period in the Valley of Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1519)	MESO-AMERICAN CIVILIZATION, HISTORY OF **11**:947–954		**1**:663b–c
1. The rise and decline of the Toltec state in southern Mexico and the Yucatán Peninsula (*c.* 900–*c.* 1200): secular and religious institutions; art and architecture; the legend of Quetzalcóatl; Toltec–Maya culture of Tollan (Tula) and Chichén-Itzá		**11**:947b–948e/ **11**:949b–e	**1**:686d–687d/**11**:720b–c
2. The development of the Aztec state and extension of Aztec rule over the Valley of Mexico (*c.* 1325–1519): military campaigns of Itzcoatl, Montezuma I and Ahuitzotl; administrative techniques under Montezuma II (1502–20)		**11**:948f–949b/ **11**:950g–951b/ **11**:952a–953d	**1**:661h–662a/**6**:318g
3. Aztec culture and society up to the time of the Spanish conquest; *e.g.*, agriculture and technology, political organization, governmental structure, militarism, economy, religion, art and architecture		**11**:950g–954d/ **2**:548h–552c/ **3**:610h–611d/ **11**:1117e–1118b	**3**:1107g–1108a/**12**:89f–90c
D. The Spanish conquest of the Aztec state and the Yucatán Peninsula (1519–*c.* 1540): destruction of Aztec government and culture; imposition of Spanish colonial policies and religion		**10**:692d–693b	**4**:881h–882a/**5**:195b–f/ **12**:166f–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CORTÉS, HERNÁN **5**:194
PIZARRO, FRANCISCO **14**:487

Division VI. The modern world to 1920

[for Part Nine headnote see page 563]

The theme of western expansion, imperialism, and colonialism pervades the eleven sections of Division VI. The separation of the history of the modern world (*c.* 1500–*c.* 1920) into eleven sections reflects conventional regional analyses of modern history, and, within each of those sections, conventional judgments regarding turning-point dates of the regional histories.

The subject in Section 961 is western Europe from *c.* 1500 to *c.* 1789. The outline covers the emergence of the nation-state system and European overseas expansion and commercial development from *c.* 1400 to 1763; Spain, France, and Great Britain as dominant powers; and the emergence of Prussia and Austria as European powers. Articles are also referred to in Section 961 that separately treat the histories in this period of each of the European states.

The subject in Section 962 is eastern Europe, Southwest Asia, and North Africa, from *c.* 1480 to *c.* 1800. The outline in the section first deals with the histories in this period of the Christian states of eastern Europe—Poland–Lithuania, Hungary, and the emerging Russian Empire. Then, dealing with the Islāmic states of eastern Europe, Southwest Asia, and North Africa, the outline treats the Ottoman Empire

from 1481 to 1807; Morocco from 1459 to 1830; Iran from *c.* 1500 to 1779; and Afghanistan from *c.* 1500 to 1812.

The subject in Section 963 is Europe, 1789–*c.* 1920. The long outline in the section deals with broad themes, developments, and changes during this epoch, divided in the outline into three periods—from 1789 to 1815, from 1815 to 1850, and from 1850 to *c.* 1920. In addition, for each of these three periods, articles are referred to that separately treat the histories of all the European states.

The subject in Section 964 is European colonies in the Americas from 1492 to *c.* 1790. The outline covers Spanish and Portuguese colonies in the Americas; English, French, and Dutch territorial expansion (from *c.* 1600) into areas of Spanish and Portuguese colonization in Latin America and the Caribbean; and Norse, English, Dutch, Swedish, and French discoveries, explorations, and settlements in North America (*c.* 1000–1763).

The subject in Section 965 is the development of the United States and Canada as independent nations. The articles and parts of articles referred to cover separately the United States from 1763 to 1865; the United States from 1865 to 1920; Canada under British colonial rule from 1763 to 1867; and the Dominion of Canada from 1867 to 1920.

The subject in Section 966 is the development of the Latin American and Caribbean nations to *c.* 1920. The outline, after dealing generally with the Latin American independence movement (1790–1825), separately treats the histories of Mexico from 1821 to 1917; of Central America and the Caribbean to *c.* 1920; of the successor states of Gran Colombia to *c.* 1930; of the Indian nations of the Andes to *c.* 1930; of Chile from 1810 to 1920; of the successor states of the Río de la Plata to *c.* 1920; and of Brazil from 1822 to 1930.

The outline of Section 967 first deals with the history to *c.* 1920 of Oceania as a whole—the history of the islands and archipelagoes of the Central and South Pacific. It then treats separately the history of Australia to 1920, and the history of New Zealand to 1928.

The subject in Section 968 is South Asia under the influence of European imperialism from *c.* 1500 to *c.* 1920. The articles referred to treat European activity in India from 1498 to *c.* 1760; the extension of British power (1760–1858); British imperial rule in India from 1858 to 1920; Ceylon under foreign rulers (*c.* 1505–1920); and Tibet and Nepal from *c.* 1750 to *c.* 1920.

The subject in Section 969 is Southeast Asia under the influence of European imperialism to *c.* 1920. The outline covers the histories in this period of Burma, Malaya, Indochina, Siam, Laos, the Philippines, and the Indonesian Archipelago.

The subject in Section 96/10 is East Asia in the 19th century and its reaction to growing Western influence. The articles referred to deal with the history of China from 1839 until the onset of the 1911 Revolution, and with the history of Japan from the Meiji Restoration (1868) to *c.* 1910.

The subject in Section 96/11 is Southwest Asia and Africa under the influence of European imperialism. The articles referred to treat the Ottoman Empire from 1807 to 1920; Egypt from 1798 to 1922; the Maghrib from 1830 to *c.* 1930; the Arabian Peninsula from *c.* 1850 to 1920; Iran from 1779 to 1925; Afghanistan from 1809 to 1921; and sub-Saharan Africa from *c.* 1885 to *c.* 1920.

Section 961. Western Europe from *c.* 1500 to *c.* 1789 620
962. Eastern Europe, Southwest Asia, and North Africa from *c.* 1480 to *c.* 1800 628
963. Europe from 1789 to *c.* 1920 631
964. European colonies in the Americas from 1492 to *c.* 1790 642
965. Development of the United States and Canada from 1763 to 1920 644
966. Development of the Latin American and Caribbean nations to *c.* 1920 649
967. Australia and Oceania to *c.* 1920 654
968. South Asia under the influence of European imperialism from *c.* 1500 to *c.* 1920 655
969. Southeast Asia under the influence of European imperialism to *c.* 1920 657
96/10. China from 1839 until the onset of revolution (to *c.* 1911), and Japan from the Meiji Restoration to *c.* 1910 659
96/11. Southwest Asia and North Africa (*c.* 1800–1920), and sub-Saharan Africa (1885–*c.* 1920) under the influence of European imperialism: the early colonial period 660

Section 961. Western Europe from c. 1500 to c. 1789

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 961 deal with three main subjects: A, the emergence of the nation-state system (*c.* 1500–1648); B, European overseas expansion and commercial development from *c.* 1400 to 1763; and C, the changing power balance and the early modern European intellectual revolution, *c.* 1649–*c.* 1790.

The outline of subject A first deals with certain broad factors in the emergence of modern Europe; the later Renaissance in Italy and northern Europe; the Scientific Revolution; the religious divisions in Europe; and the major currents in international diplomacy and warfare (1494–1648). Articles are then referred to that deal separately with the history of the national and dynastic states from *c.* 1500 to 1648. They treat the histories, in this period, of Italy, Spain and Portugal, the British Isles, France, Germany and the Holy Roman Empire, the Swiss Confederation, the Low Countries, and Scandinavia.

The outline of subject B first deals with the beginnings of European imperialism—the rapid expansion of European trade with and control over the non-European world after *c.* 1450. It next treats the decline of the feudal system and the growth of commercial activity, and the technological advances and manufacturing systems prior to the Industrial Revolution. Finally, it deals with the effects of colonial expansion on Europe. It treats first the economic effects—the effects on the organization of businesses, on prices, on the volume of world trade, and on economic thought. It then treats the political effects—the effects of the growth of Spanish power from its overseas possessions, and the influence of colonial rivalries on European conflicts in the 17th and 18th centuries.

The outline of subject C first deals with European diplomacy and wars in the period from *c.* 1649 to *c.* 1790. It then presents separately the histories, in this period, of Great Britain, France, Austria, Germany, Spain and Portugal, Italy, the Low Countries, Scandinavia, and the Swiss Confederation. Finally, it treats the cultural, political, scientific, philosophical, and religious developments from which the Enlightenment originated in the 17th century, and the further developments with the expansion of the Enlightenment in the 18th century.

	articles	article sections	other references
A. The effects of religious and cultural change: the emergence of the nation-state system; the predominance and decline of Habsburg power centred in Spain (*c.* 1500–1648)			
1. The later Renaissance in Italy and northern Europe	RENAISSANCE **15**:665–670		
a. The influence of Italian statecraft and political theory: Machiavelli and the principle of *raison d'état*		**15**:665c–666d/ **15**:667b–668e/ **9**:1146d–1147c/ **14**:688f–689a/ **17**:610c–g	**3**:43a–c/**10**:717a–b/ **10**:1132g–1133a/ **11**:229b–230f/**14**:262d–263a
b. Cultural and intellectual life in the later Renaissance		**15**:666d–667a/ **15**:668e–670e	
i. Expansion of Humanist literary development in Italy and northern Europe		**6**:343h–345h/ **9**:1147c–1148a/ **10**:1133b–1145a	**1**:1159h–1160c/**6**:951h–954a/ **8**:952f–953d/ **8**:1176h–1177c/ **10**:334e–h/ **10**:858d–859a/ **14**:643d–e
ii. Developments in theatre, music, and the visual arts		**12**:701e–702c/ **12**:706b–708f/ **13**:579c–580a/ **18**:243d–244g/ **19**:383g–393h/ **19**:394d–397b/ **19**:400b–406h/ **19**:408h–411e	**3**:111h–113g/**3**:338f–339b/ **3**:957g–959e/ **5**:1026c–1027b/ **5**:1085a–1088e *passim*/ **8**:449f–450c/ **9**:709c–718c/ **10**:204d–f/ **10**:812a–817c/ **12**:97h–101b/ **13**:933a–935b *passim*/ **14**:808b–e/ **15**:512c–514f/ **16**:4b–e/ **18**:223b–224b/ **18**:433h–436b
2. The Scientific Revolution: the emergence of modern science and technology in the 16th and 17th centuries		**15**:669h–670e/ **6**:78h–79e/ **6**:79h–80g/ **6**:888a–e/ **11**:829a–830c/ **14**:386b–388b/ **16**:369e–371h/ **18**:35c–g	**3**:177a–c/**18**:97c–e/ **19**:94d–95c
3. The emergence of a religiously divided Europe in the 16th century		**2**:454b–455f/ **3**:286g–287a/ **4**:592f–594a/ **7**:629d–631g/ **8**:87g–90h	**3**:1086c–f/**8**:953d–954g/ **14**:643f–g

	articles	article sections	other references
a. The Protestant Reformation and its political and social consequences		**15**:99e–100d/ **15**:105e–107b/ **15**:549c–556h/ **3**:223b–224e/ **6**:345h–348a/ **6**:348h–349b/ **15**:557d–559f/ **17**:882d–883h	**3**:361f–362d/**3**:674b–f/ **7**:1011c–d/**11**:197a–e/ **11**:863f–864e
b. The Catholic Reformation and Counter-Reformation		**15**:1009d–1013a/ **2**:454h–455f/ **6**:348a–c/ **13**:959a–c	**10**:806h–807a
4. International diplomacy and warfare (1494–1648)	EUROPEAN DIPLOMACY AND WARS (*c.* 1500–1914) **6**:1081–1090		
a. The Italian Wars (1494–1516) and the concept of balance of power: French and Austro-Spanish expansionism in Italy		**6**:1082b–1084d/ **2**:453h–454b/ **8**:87c–f/ **9**:1145e–1146d/ **9**:1148a–1149c	**15**:667b–668a/**17**:882b–d
b. French and Austrian struggles for supremacy in Europe (1515–59): French anti-Habsburg alliances with England, German Lutheran princes, and the Turks		**6**:1084d–1087g	**4**:49a–50a/**7**:684f–685c/ **13**:779a–h
c. Conflicts between Catholic and Protestant powers after *c.* 1555: religious wars in France and the Low Countries; conflict with the Ottoman Empire		**6**:1087g–1089g/ **3**:227f–228b/ **17**:425h–427h	**3**:225g–226b/ **11**:142b–143e *passim*/ **11**:564b–d
d. The Thirty Years' War (1618–48) and the Peace of Westphalia: the end of religious struggles and resecularization of international affairs	THIRTY YEARS' WAR **18**:333–341	**6**:1089h–1090b/ **3**:241c–d/ **8**:92a–93d/ **17**:884a–b/ **19**:578b–e	**4**:458d–h/**7**:633a–b/ **8**:504c–505b/ **15**:1012g–1013a/ **17**:429h–430d
5. National and dynastic states (*c.* 1500–1648)			
a. Italy in the 16th and 17th centuries: political, economic, social, and cultural developments	ITALY AND SICILY, HISTORY OF **9**:1145–1151	**10**:1159b–g	**3**:346d–h/**9**:709c–711c/ **10**:251f–h/**16**:789f–790a
i. The French invasion (1494) and conquests of Naples (1495) and Milan (1499); the influence of Savonarola; the anti-French League of Venice and the Spanish defeat of France (1525)		**9**:1145e–1146d/ **9**:1148a–e/ **6**:1082e–1084d	**10**:334c–e/**11**:819h–820g/ **16**:289h–290g
ii. Italy under Spanish domination: Catholic religious reforms; Spanish Habsburg rule in Naples, Sicily, Sardinia, and Milan		**9**:1148e–1150f	**14**:482d–f/**15**:1010g–h/ **15**:1012d–g
iii. Relations between Spain and the independent states of Italy: Savoy, Genoa, Tuscany, Venice, and the Papal States		**9**:1150f–1151g	**11**:820g–822g/ **13**:1087f–1088e
b. Spain from 1516 to 1665	SPAIN, HISTORY OF **17**:424–431	**10**:691e–698e	**11**:289e–f
i. Establishment of the Habsburg dynasty (1516) by Charles I (Holy Roman Emperor Charles V); Spanish hegemony in Europe and the Americas; domestic and foreign policies of Philip II (1556–98); the Armada (1588); cultural developments in Spain's Golden Age		**17**:424g–428f/ **4**:883a–884a/ **9**:1148e–1151e/ **10**:1135d–1137b/ **11**:144b–d/ **18**:224c–f/ **18**:245f–246b	**3**:1035g–1036b/**4**:48d–50g/ **6**:1087f–1089g *passim*/ **8**:532b–h/**11**:140a–e/ **11**:564b–c/**14**:228c–229a/ **16**:581d–f
ii. Political and economic decline during the reigns of Philip III (1598–1621) and Philip IV (1621–65): expulsion of the Moriscos (1609); Olivares' administration; loss of Portugal (1640)		**17**:428g–431g/ **14**:869d–f/ **18**:341g–h	**13**:560b–f/**18**:338b–e
c. Portugal from *c.* 1500 to 1648: domination of East Indian trade; union with Spain (1580); independence under House of Bragança (1640)		**14**:867h–869f/ **4**:5h–6e/ **4**:882c–h/ **6**:92e–93e/ **17**:276g–279f	**3**:1093h–1094c/**10**:1031a–e/ **17**:427a–b/**17**:431c–d

	articles	article sections	other references
d. The British Isles (*c.* 1485–1649)	BRITAIN AND IRELAND, HISTORY OF **3**:220–245	**4**:1000b–1001d/ **15**:304d–306b	**4**:593d–594a/**9**:716c–717b/ **11**:91c–e
i. Henry VII (1485–1509): dynastic unity in England after the Wars of the Roses; political, judicial, social, and economic developments		**3**:220a–222d	**8**:768d–769d
ii. Henry VIII (1509–47): foreign and domestic policies; the divorce question, the English Reformation, and the establishment of the Church of England; Edward VI (1547–53) and Mary I (1553–58)		**3**:222d–226b/ **6**:346f–347b/ **15**:554c–h	**3**:1035a–c/**4**:593d–f/ **4**:1000d–g/**5**:236g–238f/ **5**:295h–296f/**8**:770a–772e/ **11**:563e–564d/**12**:439c–440a/ **15**:110f–h/**15**:1012b–c
iii. Elizabeth I (1558–1603): social and cultural developments; domestic policies; dynastic challenge of Mary, Queen of Scots; struggle with Spain		**3**:226b–229a/ **3**:238c–h/ **18**:224g–225b	**2**:561g–562e/**3**:1035c–1036b/ **6**:726f–728e/**8**:1065g–1066f/ **10**:1138e–1141g/**11**:565d–f/ **15**:497h–498e/**17**:427d–e/ **18**:947b–e
iv. James I (1603–25) of England (James VI of Scotland) and establishment of the Stuart dynasty: developments in religious doctrine, foreign relations, economic policy, and the arts; conflicts between crown and Parliament		**3**:239f–241f/ **2**:713e–714a/ **10**:1141c–1142f/ **10**:1148a–1150e/ **18**:245c–f	**2**:562f–563g/**4**:825h–826e/ **4**:1000g–h/**10**:21h–22h/ **15**:558f–559b/**16**:617g–629g/ **18**:582h–584h
v. Charles I (1625–49) and the English Civil War (1642–51): economic and political disputes between crown and Parliament; royal personal rule (1629–40); persecution of Puritans; the Long Parliament, Oliver Cromwell, and the Civil War; execution of Charles I (1649)		**3**:241g–245f/ **15**:305d–306b/ **17**:610g–611b/ **18**:336d–g/ **18**:947e–948b	**4**:52f–54f/**4**:682g–683b/ **4**:1000c–d/**5**:292a–293h/ **10**:708d–h/**15**:112c–d/ **15**:312e–313a
vi. Scotland in the 16th and 17th centuries: reigns of James IV and James V; Mary, Queen of Scots (1542–67), and the Scottish Reformation; John Knox and Calvinism; James VI (1567–1625) of Scotland (James I of England, 1603–25) and personal union of the two crowns		**3**:237h–239e/ **3**:242g–246a/ **15**:554h–555b	**10**:21h–22h/**10**:494g–497c/ **11**:565a–d
vii. Ireland in the 16th and 17th centuries: subjugation of Ireland by Henry VIII and Elizabeth I; the Irish revolt of 1641; Cromwell's invasion and anti-Catholic policies during the Commonwealth		**3**:286g–289e	**5**:293h–294a/ **10**:1152h–1153a/ **10**:1154a–d
e. France from 1483 to 1643	FRANCE, HISTORY OF **7**:628–633		
i. Development of a standing army and a professional bureaucracy in the reigns of Charles VIII (1483–98), Louis XII (1498–1515), Francis I (1515–47), and Henry II (1547–59)		**7**:628b–629d/ **6**:1082h–1087e	**3**:486b–c/**7**:683h–685e/ **9**:711d–f
ii. The Protestant Reformation and the French Wars of Religion (1562–98): the reigns of Catherine de Médicis (1560–74) and Henry III (1574–89); religious compromise and restoration of strong monarchy under Henry IV of Bourbon (1589–1610)	BOURBON, HOUSE OF **3**:79–80	**7**:629d–632e/ **4**:593c–d/ **6**:347c–g/ **6**:1089a–b/ **15**:553e–554c	**3**:1007h–1009b/**8**:477e–478b/ **8**:773b–775b/**15**:557h–558b/ **15**:831f–h
iii. The reign of Louis XIII (1610–43) and Cardinal de Richelieu: suppression of the Huguenots and the nobles; French success in the Thirty Years' War		**7**:632e–633c/ **18**:339c–d/ **18**:340b–d	**8**:532h–533c/**15**:832b–833f/ **18**:777b–f
f. Germany and the Holy Roman Empire from *c.* 1500 to 1648: the Reformation, Counter-Reformation, and Thirty Years' War	GERMANY, HISTORY OF **8**:87–93		
i. Maximilian I (1493–1519), Martin Luther, and the origins of Lutheranism; Charles V and the Diet and Edict of Worms (1521); the Peasants' Revolt (1524–25); diets of Speyer (1526 and 1529) and Augsburg (1530); the Schmalkaldic League and ensuing wars; abdication of Charles V (1555) and Peace of Augsburg		**8**:87c–90h/ **6**:346b–f/ **6**:1084e–1087g/ **11**:197a–e/ **15**:109b–d	**4**:48g–50e/ **11**:190h–195a *passim*/ **11**:716f–717f/**14**:230e–231d/ **15**:558c–d/**15**:1010a–d/ **18**:336g–337b
ii. Ferdinand I (1556–64) and Maximilian II (1564–76); internal disunity under their successors; the Thirty Years' War (1618–48); political and religious settlements of the Peace of Westphalia (1648)		**8**:91a–93d/ **2**:454c–455f/ **6**:1087g–1088g/ **18**:336c–d/ **18**:337d–338e/ **18**:342b–344a	**2**:1190h–1192e/**7**:231d–232a/ **8**:504c–505b/**9**:34b–c/ **19**:531g–532h

	articles	article sections	other references
g. The Swiss Confederation from 1474 to 1648	SWITZERLAND, HISTORY OF 17:881–884		
i. Swiss victory over Charles the Bold in the Burgundian War (1474–77); military prestige of the confederation; victory over Maximilian I (1499); the Italian campaigns (1499–1516)		17:881e–882d	4:61d–e/8:87c–e
ii. The Swiss Reformation: Zwingli and Calvin; the Counter-Reformation and emergence of Catholic and Protestant cantons; neutrality in the Thirty Years' War (1618–48); European recognition by the Peace of Westphalia (1648)		17:882d–884b/ 4:592f–h/ 6:347g–348a/ 15:552a–553c/ 18:338c–e	3:671f–674b/7:1011c–d/ 8:89c–e/15:557e–h/ 19:1177d–f/19:1178g–1179h
h. The Low Countries from 1494 to 1648	LOW COUNTRIES, HISTORY OF 11:141–147		8:543e–f
i. Habsburg unification of the Low Countries (1494); further consolidation under the future emperor Charles V (1506–55); economic, cultural, and religious developments; revolt of the provinces (1567–79)		11:140a–143e/ 6:1089b–g	1:416h–417c/3:499a–b/ 4:48d–49h *passim*/7:182a–e/ 8:147h–148a/8:431g–432b/ 9:34f–g/13:555f–g/ 19:833f–836a
ii. Establishment of the United Provinces of the Netherlands (the Dutch Republic) in 1579: leadership of the House of Orange; continued war against Spanish Habsburg power		11:143e–144g	3:1035g–1036a/ 13:555g–556b
iii. Commercial supremacy of the Dutch Republic; intermittent wars with Spain (1621–48)		11:144g–147a/ 4:884f–886e/ 6:221b–d	7:706g–707d/11:709c–710b/ 18:335d–e/18:716d–717c
iv. Cultural, social, religious, and economic developments in the Dutch Republic		11:148d–150a/ 10:1144c–e/ 10:1158d–1159b/ 19:425h–427g	9:715a–c/13:556b–g/ 15:558d–f
i. Scandinavia from 1523 to 1648: separation of Sweden from Denmark–Norway (1523) and Dano-Swedish conflicts; Christian III of Denmark (1534–59), Gustav I Vasa (1523–60), and Gustavus II Adolphus (1611–32) of Sweden; participation in Thirty Years' War (1618–48)		16:315g–318f/ 18:338e–339b/ 18:341h–342b/ 19:578b–e	2:672c–e/4:458d–h/8:92c–f/ 8:502b–d/8:502g–505b/ 13:802f–803a/18:335f–336a/ 18:339d–340e *passim*
B. European overseas expansion and commercial development from *c.* 1400 to 1763	ECONOMIC HISTORY SINCE 1500 6:219–229	4:879g–880d	
1. The beginning of European imperialism: rapid expansion of European trade with and control over the non-European world after *c.* 1450	COLONIALISM 4:879–890		
a. Advances in geographical knowledge and technological improvements; *e.g.*, ship design, navigational instruments, cartography		4:880d–881a/ 11:473b–474a/ 16:158e–159e	18:37e–f
b. Voyages of discovery and exploration: establishment of colonial empires		4:881a–883e/ 7:1039f–1043f/ 15:670f–h	11:292g–293d/18:665a–d
i. Discovery, exploration, and early settlement of the Americas		3:144d–g/ 10:691e–693g/ 17:424a–g/ 18:946h–950h	1:404g–h/3:733g–736a/ 4:937g–942f/5:978b–979a/ 8:550h–551a/ 14:1049h–1050a/ 18:18d–19a/ 19:68c–f/ 19:97d–98d
ii. Discovery, exploration, and early settlement of the coastal regions of Africa, Australia, India, and the East Indies		2:412h–413b/ 6:92e–93e/ 11:366b–e/ 17:276g–278c/ 19:765h–766h	2:178c–d/4:742c–743a/ 4:817c–f/5:701e–702a/ 7:860h–862b/16:721a–c/ 17:1070h–1071c
2. The decline of the feudal system and growth of commercial activity		6:219h–222e	
a. The changing relationship between tenant and landlord; agricultural developments; evolving role of the guilds; decline of Hanseatic League; demographic movements		6:220a–f/ 6:221d–g/ 1:333a–f/ 3:220e–221a	

	articles	article sections	other references
b. The decline in Mediterranean trade and growth of Antwerp and Amsterdam as international trade centres; the growth of a landed merchant class		**6**:220f–222e	**1**:712b-c/**15**:668b-e
3. Technological advances and pre-Industrial Revolution manufacturing systems: development of "putting-out" system and decline of guild power		**6**:222e–223h/ **18**:34d–35g/ **19**:935h–937h	
4. The impact of colonial expansion on Europe		**6**:223h–229e	
a. Economic effects		**6**:224h–229d	
i. Development of new business organizations to direct colonial exploitation: joint-stock and chartered companies		**6**:224h–225g	**5**:183c-e/**19**:768b-g
ii. The "price revolution": the relationship between the influx of precious metals from the Americas to Europe and the price rise in the 16th century		**6**:225g–226g	**4**:883g–884b
iii. Growth of mercantilism: theories and policies of economic nationalism developed by European powers; the concept of the balance of trade		**4**:888c–f/ **5**:377b–d/ **6**:227b–228c/ **18**:552g–553a/ **18**:947e–948g	
iv. Increase in volume of world trade: the growth of the luxury trade (silks, spices, precious metals); the agricultural trade (tobacco, sugar, and coffee); the raw materials trade		**4**:891c–893a/ **6**:228c–229d/ **1**:334g–h/ **14**:872d–e	**10**:1275g–h/**11**:217a–b/ **17**:502f–503c
v. Development and importance of the slave trade		**4**:888h–889d/ **3**:1093h–1094g/ **15**:362c–363b/ **17**:278e–279f/ **19**:766h–772b/ **19**:938b–e	**4**:892c–e/**18**:951h–952a
b. Political effects: the relationship between Spain's status as an international power and its colonial possessions in the 16th century; colonial rivalries among European powers in the 17th and 18th centuries		**4**:881e–884f/ **10**:693g–698e/ **11**:146d–147a	**3**:686f–h/**4**:56h–57b/ **4**:892a–c/**5**:979c–g/ **14**:241c–g/**15**:259f–g
C. France and Great Britain as the dominant powers in Europe; the emergence of Prussia and Austria as European powers			
1. International wars and diplomacy (*c.* 1649–*c.* 1790)	EUROPEAN DIPLOMACY AND WARS (*c.* 1500–1914) **6**:1090–1099		
a. The Age of Louis XIV (1661–1715): French successes in the War of Devolution (1667–68) and the Dutch War (1672–79); defeat in the War of the League of Augsburg (1689–97) and the War of the Spanish Succession (1701–14)		**6**:1090c–1095d/ **7**:637a–638c/ **8**:95e–96a	**3**:736a-c/**11**:122d–123b/ **11**:147d-g/**17**:433b-c
b. Development of the alliance system: the balance of power		**6**:1095d–1099f	**4**:57a–b/**17**:434f–h
i. The Quadruple Alliance: the emergence of Prussia and Austria as European powers; the War of the Austrian Succession (1740–48)		**6**:1095d–1096g/ **8**:97a–98c	**2**:458d–459c/**3**:82h–83b/ **3**:254d–f/**3**:736e-g/ **17**:433g–434a
ii. The Seven Years' War (1756–63) and France's defeat and loss of colonial territory in the Americas	SEVEN YEARS' WAR **16**:576–580	**6**:1096g–1098c	**3**:255e–h/**3**:736g–737a/ **7**:644e-g/**18**:953f–954a
iii. French recovery and Franco-Spanish cooperation (1778–81) against Britain in the U.S. War of Independence; Russian-Prussian partition of Poland (1772)		**6**:1098c–1099f	**7**:644g–645a/**14**:646f-g/ **19**:604d-e/**19**:605h–606e
2. The European states (*c.* 1648–*c.* 1790)			
a. Great Britain from 1649 to *c.* 1790	BRITAIN AND IRELAND, HISTORY OF **3**:245–263	**19**:417h–418a/ **19**:429b–430a	

	articles	article sections	other references
i. Oliver Cromwell, the Commonwealth, and the Protectorate (1649–60); the Stuart Restoration (1660) under Charles II (1660–85) and James II (1685–88); the Glorious Revolution of 1688 and end of crown rule without Parliament		**3**:245g–248f/ **15**:306b–h	**1**:808d–e/**4**:55d–56c/ **4**:683b–f/**5**:293h–295b/ **7**:580a–e/**10**:23g–24c/ **11**:91e–h/**11**:147b–g/ **14**:24d–25b/**16**:613f–614a/ **19**:831g–832a
ii. Limited monarchy under William III (1689–1702) and Mary II (1689–94) and Anne (1702–14); growth of Whig and Tory political parties (1689–1714); the Hanoverian succession and emergence of the cabinet system under George I and George II; Whig supremacy and political stability to 1760; ministries of Walpole, Pelham, and Pitt		**3**:248f–256c/ **6**:882g–883a	**2**:1204g–1205e/**11**:515f–516d/ **14**:476a–477a/ **19**:534c–535h/**19**:832a–d
iii. Early years of George III's reign (1760–1820) to *c.* 1790: eclipse of Whig power and political instability (1760–70); failure of colonial policies and U.S. War of Independence; beginning of parliamentary and reform movements		**3**:248f–251e/ **3**:256d–259a/ **2**:413d–414b/ **3**:737b–738d/ **6**:883a–c	**3**:500a–g/**4**:891e–g/ **7**:578d–579b/ **7**:1125h–1127e/ **11**:150g–151b/**14**:477b–f/ **18**:954b–956g *passim*/ **19**:602g–606e *passim*/ **19**:826a–827b
iv. Economic, cultural, and social developments: agricultural innovations; population growth; origins of the Industrial Revolution and factory system; influence of Methodism		**3**:260f–263a/ **6**:230b–233d/ **10**:1164a–1167c/ **16**:372b–c/ **18**:35c–37b/ **18**:42f–h	**12**:60e–61a/**15**:236h–238g/ **18**:38a–39e
v. Formal union of England and Scotland (1707); Edinburgh's status as an intellectual centre; Protestant Ascendancy in Ireland and growth of Irish patriotism among the Anglo-Irish; Wales in the 18th century		**3**:250c–d/ **3**:263a–h	**3**:289c–h/**5**:1072d–f/ **6**:305e–h
b. France from *c.* 1650 to *c.* 1790	FRANCE, HISTORY OF **7**:633–649		
i. The Frondes, Louis XIV's minority (1643–61), and Mazarin's control of government to 1661		**7**:633c–634b/ **18**:341g–h	**4**:1080a–b/**11**:121h–122d/ **11**:725g–726b/**18**:777g–h
ii. The Age of Louis XIV (1661–1715): development of the central government; the Versailles court; military policies; mercantilist policies of Colbert		**7**:634c–636a/ **6**:1092a–1095a/ **7**:941d–f	**4**:826g–828c/**7**:551g–552b/ **8**:94g–95e/**11**:122d–123b
iii. Louis' religious and political policies: revocation (1685) of the Edict of Nantes and the Huguenot emigration; political influence of Jansenism; royal absolutism		**7**:636b–638c/ **3**:249c–f/ **15**:1013d–1014b	**3**:54b–55b *passim*/**11**:123b–e/ **11**:130b–h/**15**:112d–g
iv. French cultural development in the 17th century		**7**:638c–639c/ **6**:350d–351c/ **10**:1154h–1157f/ **10**:1168g–1169e/ **18**:225f–226d/ **19**:416e–417h/ **19**:427g–429a	**7**:895b–f/**9**:711f–712h/ **13**:1041e–1042g
v. The *ancien régime* (1715–89): the close relationship between society and the state; the new urban class; the decline of the monarchy under Louis XV (1715–74) and Louis XVI (1774–92); power of the *parlements*; agricultural and industrial growth; domestic and colonial trade		**7**:639c–643e	**11**:124c–125a/**14**:788h–789e
vi. The reform movement: the influences of nationalism and individualism; attacks on political, social, and economic policies of the *ancien régime*; conflict between the nobility and bourgeoisie; the financial crisis and attempts at reform by Necker and Turgot; the States General and the beginning of the Revolution (1789)		**7**:643e–649d	**12**:935g–936e/ **15**:1014g–1015c/ **15**:1171e–1173d/ **18**:781f–782b
c. The lands ruled by the Austrian Habsburgs (1648–1790)	AUSTRIA, HISTORY OF **2**:455–460	**8**:93d–98c	**6**:1022e–h

	articles	article sections	other references
i. Austrian consolidation and expansion under Leopold I (1658–1705), Joseph I (1705–11), and Charles VI (1711–40): conquest of Hungary and penetration of the Balkans in the Austro-Turkish wars (1683–99 and 1716–1718); War of the Spanish Succession (1701–14) and acquisition of the Spanish Netherlands (1713)		**2**:455g–456h/ **8**:93d–97a/ **9**:35c–f/ **11**:156e–157c	**2**:1192e–f/**10**:818h–819f/ **13**:783d–e
ii. The Pragmatic Sanction and the accession of Maria Theresa (1740); War of the Austrian Succession (1740–48) and loss of Silesia to Prussia (1741); military, administrative, and educational reforms of Maria Theresa; acquisition of Polish Galicia (1772); failure of Joseph II's (1765–90) foreign policies; his enlightened domestic reforms (1780–90)		**2**:456h–460a/ **2**:462d–463f/ **6**:1095h–1096c/ **8**:96c–97f/ **9**:35f–36a/ **9**:1151h–1154f	**2**:1192g–1193a/**7**:703b–704c/ **8**:99b–f/**8**:533f–535a/ **10**:276e–277e/**11**:494e–495g/ **16**:576f–580d *passim*
d. Germany and the rise of Prussia (*c.* 1640–*c.* 1790)	GERMANY, HISTORY OF **8**:93–101		
i. Frederick William, the Great Elector (1640–88): strengthening of Hohenzollern power in Brandenburg and Prussia; end of Polish suzerainty over Prussia; War of the Spanish Succession (1701–14); Austro-Prussian rivalry in the 18th century; Frederick I (1701–13) and Frederick William I (1713–40) of Prussia		**8**:93d–97a/ **10**:1157g–1158d	**2**:849f–h/**4**:667g–668b/ **7**:708h–709g/ **16**:576f–580d *passim*
ii. Frederick II the Great (1740–86): War of the Austrian Succession (1740–48); Seven Years' War (1756–63); partitions of Poland (1772–95); development of Idealism (Goethe and Schiller); enlightened reform and benevolent despotism		**8**:97a–98c/ **8**:98h–101a/ **5**:65e–g/ **6**:1095h–1098c/ **14**:646d–647g/ **19**:560a–d	**2**:458d–459h *passim*/ **3**:486h–487a/**7**:702h–706a/ **8**:225b–228c/**8**:799f–800f
iii. The influence of Pietism; the German cultural revival in the second half of the 18th century		**8**:100d–101a/ **6**:352g–353g/ **10**:1172c–1174e/ **14**:456f–458b/ **15**:113b–d	**11**:197f–h/**19**:1155c–1156a
e. Spain and Portugal			**19**:424h–425g
i. Spain from 1665 to *c.* 1790: continued decline under Charles II (1665–1700); War of the Spanish Succession (1701–14) and establishment of the Bourbon dynasty; pro-French foreign policy under Philip V, Ferdinand VI, and Charles III; administrative and economic reforms of Charles III		**17**:431g–435h/ **6**:1092h–1093c/ **6**:1094d–g	**3**:80h–82d/**4**:56h–57e/ **7**:637g–638b/**8**:533c–f/ **11**:289f–290b/**12**:79b–e
ii. Portugal from 1640 to *c.* 1777: increasing economic and diplomatic ties to England under John IV (1640–56), Afonso VI (1656–83), Pedro II (1683–1706), and John V (1706–50); economic, religious, and administrative reforms under Pombal and Joseph I (1750–77)		**14**:869g–870f	**14**:788d–g
f. Italy in the 18th century	ITALY AND SICILY, HISTORY OF **9**:1151–1154		
i. Government reforms and the rule of Joseph II (1765–90) in Lombardy; reigns of Francis of Lorraine (1738–65) and Peter Leopold (1765–90) in Tuscany		**9**:1152b–1153g	
ii. The viceroyalty of Naples and the kingdom of Sicily: economic and social unrest; rule of Charles VI in Sicily; transfer of Naples and Sicily to Charles III in 1734; the Bourbon regime		**9**:1153g–1154g	
g. The United Provinces of the Netherlands from 1648 to 1789: economic and political stagnation; the first (1650–72) and second (1702–47) stadholderless periods; the patriotic movement; social, religious, and cultural development		**11**:147a–151b/ **6**:1093c–f/ **10**:1174e–f	**2**:413c–d/**7**:637e–f/ **19**:831e–g
h. Scandinavia from *c.* 1648 to *c.* 1792	SCANDINAVIA, HISTORY OF **16**:318–322		

	articles	article sections	other references
i. Swedish wars of conquest against Poland and Denmark-Norway under Charles X Gustav (1654–60) and Charles XI (1672–97); war with Russia under Charles XII (1697–1718) and displacement of Sweden by Russia as the chief Baltic power after the Great Northern War (1700–21)		**16**:318g–319c	**4**:57g–58g/**14**:158e–h/ **16**:50a–d
ii. Social and economic conditions in the Scandinavian countries		**16**:319g–320d	
iii. Denmark-Norway losses in the First Northern War with Sweden (1655–60); economic stagnation (1720–66); "Enlightened" reforms under Christian VII (1766–1808) Struensee and Bernstorff; revival of settlement in Greenland (1714)		**16**:320d–321h	
iv. Growth of parliamentary government in Sweden: Frederick I (1720–51) and Adolf Frederick (1751–71); the "Hats" and "Nightcaps" political parties; absolutism re-established by Gustav III (1771–92)		**16**:321h–322e	
i. The Swiss Confederation (*c.* 1650–1790): Villmergen wars (1656–1712); the influence of the Enlightenment		**17**:884c–h	**7**:1011d–f
3. The age of the Enlightenment: cultural, political, scientific, and religious developments in the 17th and 18th centuries	ENLIGHTENMENT **6**:887–894		
a. Origins of the Enlightenment in the 17th century		**6**:888a–e	
i. Emergence of Rationalism and Empiricism in the context of scientific achievements; *e.g.*, Bacon, Descartes, Galileo, Newton		**11**:642h–643h/ **14**:386h–388b/ **16**:369h–371h	**2**:563h–566a/**5**:599c–601f/ **7**:851h–853f/ **10**:786c–788c *passim*/ **13**:17c–20g
ii. Developments in political and religious philosophies		**6**:348f–h/ **6**:352a–353g/ **6**:410c–e/ **6**:933e–934f/ **10**:214d–215e/ **14**:263a–267c/ **14**:689a–690a/ **15**:113d–h/ **15**:1014b–g/ **17**:310d–h/ **17**:610g–611f	**1**:976d–g/**1**:1160c–g/ **6**:794h–795g/**8**:971c–972d/ **10**:717b–e/**15**:265f–266c/ **15**:529d–f/**15**:530d–h/ **16**:981e–g/**17**:509c–510h
iii. Developments in literature, music, drama, and the visual arts		**10**:1147c–1163f/ **13**:580b–581b/ **14**:808f–809a/ **14**:911a–e/ **15**:247h–248c/ **18**:246c–g	**3**:51c–52g/**8**:954c–956d/ **10**:859a–g/ **12**:205a–208d *passim*/ **14**:912b–d/ **15**:652g–658e *passim*/ **19**:86b–87d/ **19**:412e–432c *passim*
b. Expansion of the Enlightenment in the 18th century: the spread of religious, political, economic, and scientific theories in western Europe; cultural developments		**6**:888f–893f/ **1**:976h–977a/ **7**:643e–644c	**8**:99h–100b/**17**:435g–h
i. Growth of enlightened attitudes toward religion: Deism, Skepticism, and atheism; traditional Christian defenses		**6**:888f–890h/ **5**:561h–563e/ **14**:267d–269b	**15**:1015c–e/**17**:856c–e
ii. Investigations of man and his institutions: Locke, Hume, Diderot and the *Encyclopédie*, Voltaire, Rousseau, Montesquieu, Burke, and other philosophers and political theorists		**6**:890h–893f/ **4**:1001d–g/ **6**:353g–356a/ **6**:410e–f/ **8**:1183g/ **10**:847h–849d/ **14**:690a–691e/ **16**:981g–982c/ **17**:310h–311c/ **17**:611c–612b	**2**:785g–786b/**3**:501h–502b/ **4**:1081d–g/**5**:723f–724b/ **6**:795h–796c/ **8**:1192b–1193h/**11**:14a–f/ **11**:612d–e/**12**:402c–g/ **13**:868g–h/**15**:282h–283c/ **15**:1171d–1173d/**19**:2b–e/ **19**:104g–105c/**19**:512g–515g
iii. Development of economic theory and practice: the Physiocrats, Adam Smith, and the laissez-faire doctrine of classical economics; technological improvements in agricultural and industrial production		**6**:893f–h/ **1**:333g–335h/ **1**:336g–337c/ **6**:264f–h/ **10**:847a–g	**2**:505g–506a/**16**:905f–906f/ **18**:38a–39e

	articles	article sections	other references
iv. Developments in literature, music, drama, and the visual arts; theories of history and historical study		**6**:893h–894e/ **8**:956d–957e/ **8**:962c–963b/ **8**:1177c–1178g/ **10**:204f–205e/ **10**:1163f–1164a/ **12**:702c–g/ **12**:710d–712d/ **13**:582e–584g/ **14**:792b–c/ **15**:248c–h/ **18**:226d–227a/ **19**:432e–444f	**5**:724b–g/**8**:100b–d/ **8**:225b–228c/ **8**:602d–605c *passim*/ **8**:680h–684a *passim*/ **12**:600f–603h *passim*/ **13**:581c–e/ **14**:796a–798h *passim*/ **18**:399d–400f
v. Developments in scientific theories and equipment		**2**:1034f–1035b/ **6**:79e–h/ **6**:80g–81d/ **11**:474b–f/ **11**:830d–831d/ **16**:371h–372e	**1**:978a–979a/**11**:644a–b/ **14**:388c–f/**14**:390e–g/ **17**:855e–856a

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ALBA, DUKE OF **1**:416
ALBUQUERQUE, AFONSO DE **1**:430
BACON, FRANCIS **2**:561
BALBOA, VASCO NÚÑEZ DE **2**:610
BOLINGBROKE, HENRY ST. JOHN, 1ST VISCOUNT **2**:1204
BOSSUET, JACQUES-BÉNIGNE **3**:53
BURKE, EDMUND **3**:499
CABRAL, PEDRO ÁLVARES **3**:572
CALVIN, JOHN **3**:671
CARTIER, JACQUES **3**:970
CATHERINE DE MÉDICIS **3**:1007
CECIL, WILLIAM, LORD BURGHLEY **3**:1034
CHARLES V, EMPEROR **4**:48
CHARLES I OF GREAT BRITAIN **4**:52
CHARLES II OF GREAT BRITAIN **4**:54
CHARLES III OF SPAIN **4**:56
CHARLES XII OF SWEDEN **4**:57
CHRISTIAN IV OF DENMARK AND NORWAY **4**:458
CHRISTINA OF SWEDEN **4**:564
CLARENDON, EDWARD HYDE, 1ST EARL OF **4**:682
CLIVE, ROBERT **4**:741
COEN, JAN PIETERSZOON **4**:816
COKE, SIR EDWARD **4**:825
COLBERT, JEAN-BAPTISTE **4**:826
COLUMBUS, CHRISTOPHER **4**:937
CONDÉ, THE GREAT **4**:1079
CRANMER, THOMAS **5**:236
CROMWELL, OLIVER **5**:291
CROMWELL, THOMAS **5**:295
DRAKE, SIR FRANCIS **5**:978
ELIZABETH I OF ENGLAND **6**:726
ESTE, HOUSE OF **6**:965
EUGENE OF SAVOY **6**:1022
FARNESE, ALESSANDRO, DUKE OF PARMA **7**:181
FERDINAND II, EMPEROR **7**:231
FRANCIS I OF FRANCE **7**:683
FREDERICK II THE GREAT, OF PRUSSIA **7**:702
FREDERICK HENRY, PRINCE OF ORANGE **7**:706
FREDERICK WILLIAM, THE GREAT ELECTOR **7**:708
GAMA, VASCO DA **7**:860
GUICCIARDINI, FRANCESCO **8**:465
GUISE, HOUSE OF **8**:476
GUSTAV I VASA, OF SWEDEN **8**:501
GUSTAVUS II ADOLPHUS, OF SWEDEN **8**:502
HENRY VII OF ENGLAND **8**:767
HENRY VIII OF ENGLAND **8**:769
HENRY IV OF FRANCE **8**:772
HUDSON, HENRY **8**:1130
JAMES I OF GREAT BRITAIN **10**:21
JAMES II OF GREAT BRITAIN **10**:23
JOSEPH II, EMPEROR **10**:276
JULIUS II, POPE **10**:333
LAUD, WILLIAM **10**:708
LEO X, POPE **10**:805
LEOPOLD I, EMPEROR **10**:818
LOUIS XIV OF FRANCE **11**:121
LOUIS XVI OF FRANCE **11**:124
LOUVOIS, FRANÇOIS-MICHEL LE TELLIER, MARQUIS DE **11**:130
LUTHER, MARTIN **11**:188
MAGELLAN, FERDINAND **11**:292
MAINTENON, MADAME DE **11**:358
MARIA THERESA, EMPRESS **11**:494
MARLBOROUGH, DUKE OF **11**:515
MARY I OF ENGLAND **11**:563
MARY, QUEEN OF SCOTS **11**:564
MAURICE OF NASSAU, PRINCE OF ORANGE **11**:709
MAXIMILIAN I, EMPEROR **11**:716
MAZARIN, JULES, CARDINAL **11**:725
MEDICI FAMILY **11**:815
MORE, SIR THOMAS **12**:437
NECKER, JACQUES **12**:935
OLDENBARNEVELT, JOHAN VAN **13**:555
OLIVARES, CONDE-DUQUE DE **13**:559
OXENSTIERNA, AXEL, COUNT **13**:802
PAUL III, POPE **13**:1087
PHILIP II OF SPAIN **14**:227
PHILIP THE MAGNANIMOUS, LANDGRAVE OF HESSE **14**:230
PITT, WILLIAM, THE ELDER **14**:475
POMBAL, MARQUÊS DE **14**:788
POMPADOUR, MADAME DE **14**:788
PYM, JOHN **15**:312
RALEIGH, SIR WALTER **15**:497
RICCI, MATTEO **15**:826
RICHELIEU, CARDINAL DE **15**:830
SARPI, PAOLO **16**:251
SHAFTESBURY, ANTHONY ASHLEY COOPER, 1ST EARL OF **16**:613
STRAFFORD, THOMAS WENTWORTH, 1ST EARL OF **17**:714
TROMP, MAARTEN AND CORNELIS **18**:716
TURENNE, HENRI DE **18**:776
TURGOT, ANNE-ROBERT-JACQUES **18**:781
VESPUCCI, AMERIGO **19**:97
WALLENSTEIN, ALBRECHT WENZEL VON **19**:531
WALPOLE, ROBERT **19**:533
WILKES, JOHN **19**:825
WILLIAM III OF GREAT BRITAIN **19**:831
WILLIAM I THE SILENT, PRINCE OF ORANGE **19**:832
ZWINGLI, HULDRYCH **19**:1178

Section 962. Eastern Europe, Southwest Asia, and North Africa from c. 1480 to c. 1800

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 962 deal with two main subjects: A, the Christian states of eastern Europe—Poland–Lithuania, Hungary, and the emerging Russian Empire; and B, the Ottoman Empire, Morocco, and Iran and Afghanistan.

The outline of subject A begins with the history of Poland–Lithuania (1492–1795). It treats the Golden Age of the Polish–Lithuanian empire; the establishment of the royal republic; the period of wars and disintegration (1648–97); and the Saxonian era, the Russian Protectorate, and the partitions of Poland between Russia, Prussia, and Austria in the last quarter of the 18th century. The history of Hungary covers the last years of the Jagiellon dynasty; the country's division into Ottoman and Habsburg sectors in the 16th century; and the subjection of all Hungary to the Habsburgs in 1699. The history of Russia covers the extension of Muscovite control over Russia in the 16th century; the Romanov Muscovy in the 17th century; the beginning of westernization and further expansion under Peter I the Great (1689–1725); Russia under Peter's weak successors; and further westernization and expansion under Catherine II the Great (1762–96).

The outline of subject B first deals with the Ottoman Empire in the period (1481–1566) when it was dominant in Southwest Asia and southeastern Europe. It goes on to treat the stages of that empire's decline (1566–1807). The outline then covers Morocco from the Marīnid dynasty to the increasing isolation under the

'Alawī dynasty (1659–1830). The history of Iran begins with the rise of the Shī'ite Ṣafavid dynasty, which ruled in Iran from *c.* 1500 to 1736. It further treats the Iranian invasions of India and Turkistan (1739–40); the attempts to unite Shī'ite and Sunnī Muslims; and the establishment of the Zand and Qājār dynasties.

The treatment of Afghanistan covers the national awakening in the early 18th century; the establishment of a united nation in 1747 under the Durrānī dynasty; and the intrusion of Afghanistan into India, and its involvement with Anglo-Indian affairs in the early years of the 19th century.

A. The Christian states of eastern Europe

1. Poland–Lithuania (1492–1795): gradual weakening of the monarchy; decline and dismemberment of the state

articles	article sections	other references
POLAND, HISTORY OF **14**:642–647		
	14:642c–643g	
	14:642d–h/ **16**:46e–g	**13**:783c–d/**16**:48c–e
	14:642h–643g/ **10**:1145f–1146a	
	14:643g–645b	
	14:643g–644c/ **18**:336a–b	
	14:644c–645b	
	14:645b–f	**10**:238d–239c
	14:645g–647g	**2**:672e–f/**6**:1098h–1099c/ **16**:54c
	14:645g–646c/ **8**:96g–97a	**8**:96a–b
	14:646d–647g	**6**:1098h–1099c/ **10**:534h–535d
HUNGARY, HISTORY OF **9**:33–35		
	9:33h–34a	**13**:778h–779e/**17**:784f–785a
	9:34b–f	
RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:45–57	**6**:156g–158b	**6**:600g–601d
	16:45d–47e	**9**:1179d–1180g
	16:47f–49g/ **10**:1161g–1162b/ **18**:336a–b/ **18**:339h–340a	**6**:157e–f/**13**:101e–102d
	16:49g–53g	**6**:157f–158b/**14**:158b–160g

   a. The Golden Age of the Polish–Lithuanian empire (1492–1572)
      i. Foreign relations: Ottoman invasions; Russian invasion of Lithuania; alliance with Turks (1533) and re-establishment of Polish security; renewed Russian aggression
      ii. Domestic developments: population movements; constitutional reform; prosperous foreign trade; exploitation of the peasantry and their reduction to serfdom; effects of the Renaissance and the Reformation
   b. Establishment of the royal republic (1572–1648)
      i. The Interregnum (1572–75) and reform of the monarchy: Stephen Bathory (1575–86) and Sigismund III Vasa (1587–1632); indecisive wars with Sweden for possession of the Baltic region
      ii. Władysław IV Vasa (1632–48): the Cossack revolt; economic prosperity; increased power of the nobility; effect of the Counter-Reformation
   c. The period of wars and disintegration (1648–97): the Cossack–Russian and Swedish invasions in the reign of John II Casimir (1648–68); loss of Ducal Prussia to Brandenburg (1657); Michael Wiśniowiecki (1669–73); John III Sobieski's (1674–96) victories over the Turks
   d. The Saxonian era, the Russian Protectorate, and the partitions of Poland among Russia, Prussia, and Austria
      i. The reigns of Augustus II (1697–1733) and Augustus III (1733–63): participation in the Great Northern War; relations with Prussia; the Seven Years' War (1756–63)
      ii. The reign of Stanisław II August Poniatowski (1764–95): the Confederation of Bar; reform; the partitions of Poland (1772, 1793, and 1795)

2. Hungary: the Jagiellon kings (1490–1526) and the partition period (1526–1699)
   a. The peasant revolt (1514); defeat by the Ottoman Turks at Battle of Mohács (1526)
   b. Division into Ottoman and Habsburg sectors in the 16th century; the spread of Protestantism; the Fifteen Years' War; the rise of Transylvania; defeat of the Turks (1686) and subjection of all Hungary to the Habsburgs in 1699

3. Emergence of the Russian Empire (*c.* 1500–1796)
   a. Extension of Muscovite control over Russia under Vasily III (1505–33), Ivan IV the Terrible (1533–84), and Boris Godunov (1598–1605); civil revolt in the Time of Troubles (1598–1613)
   b. The Romanov Muscovy: election of Michael Romanov as tsar (1613) and continued autocracy under his successors; expansion into the Ukraine; 17th-century cultural and religious life
   c. The beginning of westernization and further expansion under Peter I the Great (1689–1725): the Petrine state

	articles	article sections	other references
i. The Table of Ranks and the new nobility: reform of the clerical hierarchy; urban legislation; building of St. Petersburg; conquest of the Baltic provinces		**16**:50d–52a	**10**:797h–800a
ii. Development of Russia's status as a European power in Peter's reign: westernization of its culture		**16**:52b–d/ **6**:331f–332a	
iii. Peter I's weak successors: Anna (1730–40) and Elizabeth (1741–62)		**16**:52e–53g	**3**:1005f–1006a
d. Further westernization and expansion under Catherine II the Great (1762–96): partitions of Poland and successful wars against the Ottoman Empire		**16**:53h–56d/ **6**:1098h–1099f/ **14**:646d–647g	**3**:1005h–1007b/**13**:783d–e/ **17**:835d–836c
e. Education and social change in the 18th century: the impact of the Enlightenment		**16**:56e–57c/ **10**:1177c–1178g	**6**:355d–f/**11**:89b–h
B. The Islāmic states of eastern Europe, Southwest Asia, and North Africa			
1. The Ottoman Empire from 1481 to 1807; Morocco from 1459 to 1830	OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE **13**:777–784	**13**:160b–162e	
a. The Ottoman Empire as the dominant power of Southwest Asia and southeastern Europe (1481–1566)		**13**:777b–781e	**9**:1070g–1071a/ **17**:953h–954c
i. Consolidation of the empire in the reign of Bayezid II (1481–1512); Selim I's (1512–20) successes against Iran and seizure of Syria and Egypt; Süleyman I's (1520–66) conflicts with the Habsburgs in Hungary, annexation of Iraq		**13**:777b–780b/ **6**:1086c–h/ **9**:33h–34f/ **18**:1043d–f	**1**:1049a–b/**2**:776g–777b/ **6**:491h–492b/**9**:934f–935c/ **11**:994d–f/**13**:160b–e/ **17**:425f–g/**17**:784f–785d
ii. Classical Ottoman society and administration: the class structure; the *mukataʿa*; religious and civil law		**13**:780b–781e	**2**:621c–622f/**6**:492b–g/ **9**:968f–g/**9**:1005d–1006f/ **14**:903e–904c
b. Decline of the Ottoman Empire (1566–1807): corruption and nepotism		**13**:781f–783e/ **9**:35c–e	**1**:1049b–g/**8**:95c–d/ **10**:505b–506g/ **11**:994g–995b/ **13**:160e–161a
i. Foreign relations: conflicts with the Russians, Austrians, and Iranians		**13**:782e–783a/ **6**:1088d–g	
ii. Attempts at reform in government administration; defeats by Poles, Habsburgs, and Russians		**13**:783a–e	**6**:1099c–f/**10**:238d–h/ **10**:505h–506g
c. Imperial disintegration in the 18th and early 19th centuries: westernization and rise of local rulers		**13**:783f–784h/ **2**:623b–d/ **6**:158c–159b/ **17**:954d–f	**2**:457b–c/**11**:401d–f
d. Morocco: disunity after the fall of the Marīnid dynasty; the anti-Portuguese policy of the Saʿdī of Marrakesh; increasing isolation under the ʿAlawī dynasty (1659–1830)		**13**:161a–162a	**14**:868h–869a
2. Iran and Afghanistan			
a. Iran from *c.* 1500 to 1779	IRAN, HISTORY OF **9**:858–860		**9**:936b–c
i. The rise of the Shīʿite Ṣafavid dynasty: conflict with the Turks; possession of western Afghanistan; disintegration and later restoration of the state by ʿAbbās I (1587–1629); relations with European powers; decline and foreign invasions in the later 17th century; the arts under the Ṣafavids		**9**:859a–e	**1**:4c–5a/**9**:911c–e/**13**:778c–e/ **13**:779h–780b
ii. The expulsion (1730–32) of the Afghans, Russians, and Turks by Nāder Shah; invasions of India and Turkistan (1738–39); attempts to unite Shīʿite and Sunnī Muslims; establishment of Zand and Qājār dynasties		**9**:859e–860a	**18**:795b–d
b. Afghanistan from *c.* 1500 to 1812: national awakening and rise of Afghan power in the early 18th century; subjection by Nāder Shah (1732); establishment of the Durrānī dynasty (1747); intrusions in India and involvement in British affairs		**1**:174e–175d	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

'ABBĀS I THE GREAT, OF PERSIA **1**:3
ALEXANDER I OF RUSSIA **1**:473
BAYEZID II **2**:776
CATHERINE II THE GREAT, OF RUSSIA **3**:1005
IVAN IV THE TERRIBLE, OF RUSSIA **9**:1179
JOHN III SOBIESKI, OF POLAND **10**:238
KÖPRÜLÜ FAMILY **10**:505
KOSCIUSZKO, TADEUSZ **10**:534
MENELIK II OF ETHIOPIA **11**:903
NIKON **13**:101
PETER I THE GREAT, OF RUSSIA **14**:157
SÜLEYMAN I THE MAGNIFICENT **17**:784
SUVOROV, ALEKSANDR VASILYEVICH **17**:835

Section 963. Europe from 1789 to c. 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 963 deal with the history of Europe: A, from 1789 to *c.* 1850; and B, from *c.* 1850 to *c.* 1920.

The outline of subject A begins with the French Revolution and its reverberating effects on Europe (1789–1815). It there treats the several phases of the Revolutionary period in France; international war and diplomacy in the Age of the French Revolution; the effects of French occupation in Germany, Italy, Switzerland, and the Low Countries; and the separate histories, during the period 1789–1815, of Great Britain, Russia, Prussia, Austria, the smaller German states, Spain and Portugal, Scandinavia, and Italy. The outline next deals with pan-European developments in the first half of the 19th century, treating such subjects as the Industrial Revolution; the Romantic movement; major developments in political philosophy, science and technology, and philosophy and religion; and international war and diplomacy in the Age of Metternich. Finally, the histories of the European countries from 1815 to *c.* 1850 are dealt with separately.

The outline of subject B begins with European cultural and economic life from 1850 to *c.* 1920, treating such subjects as the growth and intensity of nationalism; the influence of "Social Darwinism" and of Marxism; major developments in the arts, philosophy, religion, and science; and the course of industrialization from 1870 to 1914. Dealing with international war and diplomacy from 1850 to *c.* 1920, the outline treats the era of Italian and German unification; the first period of German predominance; the resurgence of colonial competition among the European powers (*c.* 1875–1914); and World War I. Finally, the outline separately treats the histories from 1850 to *c.* 1920 of the European states.

	articles	article sections	other references
A. European political and economic revolution (1789–1850): the French Revolution and its effects; the development and effects of industrialization			
1. The French Revolution and its reverberating effects on Europe (1789–1815)			
a. The climate of change: "patriotism" in America and the Netherlands (1770–90)		**18**:954b–956g	**11**:156h–157c
b. France from 1789 to 1815: the Revolution, the First Republic, and the First Napoleonic Empire	FRANCE, HISTORY OF **7**:649–662		
i. The revolt of the Third Estate: uprisings in Paris and the provinces; the reforms of the Constituent Assembly; abolition of the monarchy; Marat and the Jacobins; the Legislative Assembly		**7**:649d–653e	**6**:1099g–1100b/**7**:204d–e/ **11**:124e–125a/**11**:485g–h/ **12**:268e–269e/**15**:908c–h/ **15**:1015c–e/**17**:1003f–1004b
ii. The First Republic to 1795: the Convention; Danton; Robespierre; the Committee of Public Safety and the Terror; the Thermidorian reaction		**7**:653e–657f/ **3**:603h–604d/ **14**:809a–c	**3**:944g–945b/**5**:486h–488a/ **11**:485h–486b/**12**:832b–e/ **13**:868g–h/**15**:908h–909h/ **16**:171a–g
iii. The directories (1795–99) and the rise of Napoleon Bonaparte: Napoleon as first consul (1799–1804) and emperor (1804); the Code Napoléon and reconciliation with the church		**7**:657f–660h/ **4**:594c–e/ **4**:661h–662e/ **15**:1015e–g/ **19**:579b–f	**4**:668b–d/**12**:832f–837d/ **17**:1004d–1005d
iv. France under the Napoleonic First Empire: social, economic, and religious reforms		**7**:660e–661h/ **4**:661h–664a/ **10**:1192c–e	**12**:834h–837a
c. International war and diplomacy in the Age of the French Revolution	FRENCH REVOLUTIONARY AND NAPOLEONIC WARS **7**:718–732	**2**:623d–624b/ **3**:259b–260e/ **16**:322f–h/ **17**:435h–436h	**16**:57e–g/**19**:560d–g
i. The War of the First Coalition (1792–97): French support for revolution in neighbouring lands and annexation of Nice, Savoy, Austrian Netherlands, the Rhineland, and the Batavian Republic; Napoleon's Italian Campaign; the Treaty of Campo Formio (1797)		**7**:721c–722c/ **6**:1100b–1101e/ **11**:151c–152a/ **17**:884h–885c	**8**:101b–c/**9**:1155d–1156b/ **11**:157b–c/**12**:832g–833c/ **12**:947h–948c

	articles	article sections	other references
ii. The French expedition to Egypt and Syria (1798–1802): Continental campaigns of the Second Coalition (1798–1802); French occupation of Rome and Naples; Marengo and Hohenlinden; Peace of Lunéville (1801) and Treaty of Amiens (1802); Napoleon's reorganization of the German states and the formal end of the Holy Roman Empire (1806)		**7**:723a–724h/ **6**:1101e–1102b	**6**:492h–493b/**8**:101d–g/ **9**:1156c–1157c/**12**:833c–f/ **12**:948c–h/**17**:1004e–f
iii. The Third Coalition (1805–07) and the battles of Trafalgar, Austerlitz, Jena, and Friedland: the subjugation of Prussia; Treaty of Tilsit (1807) and the peak of Napoleon's power; the Continental System and its failure		**7**:724h–728c/ **6**:1102c–g/ **9**:1157d–1159a/ **18**:960b–f	**1**:474d–f/**8**:101g–102f/ **12**:835b–f/**12**:948h–949b
iv. The Franco-Austrian War (1809); the Spanish uprising and the Peninsular War (1808–14); Napoleon's defeat in the Russian campaign (1812) and the campaign of the Fourth Coalition; downfall (1814) and exile of Napoleon		**7**:728c–730h/ **6**:1102h–1104b/ **17**:436d–h	**1**:474g–475b/**2**:839f–g/ **7**:661e–g/**8**:103h–104c/ **12**:63b–f/**12**:835f–837a/ **13**:56f–g/**17**:1005c–d/ **19**:755g–756b
v. The Hundred Days and Napoleon's final defeat at Waterloo (1815); the Congress of Vienna and Metternich's attempt to restore the old order in Europe		**7**:731a–732b/ **6**:1104b–f/ **8**:104c–105a/ **17**:885g–886a	**2**:462b–d/**2**:463f–464a/ **8**:535b–c/**9**:1158a–c/ **12**:63f–64a/**12**:837a–d/ **13**:56g–57a/**17**:1005e–f
d. Political, economic, and social effects of French occupation in Germany, Italy, Switzerland, and the Low Countries		**8**:101d–105a/ **9**:1154g–1158a/ **11**:152a–d/ **17**:885c–f	**7**:723h–724h *passim*/ **11**:157d–e
e. Great Britain from 1789 to 1815	BRITAIN AND IRELAND, HISTORY OF **3**:259–263		
i. The influence of the French Revolution on the growth of English radicalism: governmental hostility to reform; Pitt's ministries and the war with France; Canning and Castlereagh; British gains in the peace settlements		**3**:259b–260e	**3**:772b–h/**3**:991h–992h/ **7**:579b–e/**14**:478e–479g
ii. Suppression of the Irish Rebellion of 1798 and union of Great Britain and Ireland (1801): Irish social, economic, and cultural life in the 17th and 18th centuries		**3**:289c–290e	**3**:259e–f
f. Russia in the reigns of Paul I (1796–1801) and Alexander I (1801–25): Russian participation in the Napoleonic Wars; the initial liberal reforms of Alexander I		**16**:57c–g/ **7**:729c–730b	**1**:473h–475c/**2**:672f–g/ **17**:497e–f
g. Prussia (1786–1815)	GERMANY, HISTORY OF **8**:101–105		
i. Military decline following the death of Frederick II the Great: participation in the French Revolutionary Wars; defeat by Napoleon in 1806		**8**:102a–103b	**7**:720d–721a
ii. The Stein reforms: Prussian leadership of Germany in the wars of liberation (1813–14); territorial acquisitions in the Vienna peace settlement (1815)		**8**:103b–105a	**17**:667c–f
h. Austria (1790–1815): the reigns of Leopold II (1790–92) and Francis II (1792–1806, as emperor of Austria, Francis I, 1804–35); participation in the coalitions against Napoleon, shift to compliance with him, and eventual intervention in the wars of liberation		**2**:460b–462d/ **7**:728c–f	**2**:1193b–c/**12**:63a–f
i. The smaller German states under French influence: the Confederation of the Rhine		**8**:101d–105a	**6**:1102d–g/**7**:724f–g/ **12**:835d–e
j. Spain and Portugal		**4**:893d–h	
i. Spain in the reign of Charles IV (1788–1808); French occupation (1808) and British aid in the War of Independence (Peninsular War); restoration of the Bourbons		**17**:435h–436h	**7**:728f–h
ii. Portugal: alliance with Britain in the struggle against France		**14**:870f–871a	**3**:144h–145d/**7**:728h–729b
k. Scandinavia from 1789 to 1815	SCANDINAVIA, HISTORY OF **16**:322–324		

	articles	article sections	other references
i. Denmark: defeat by the British (1801); alliance with France after 1807; the loss of Norway to Sweden (1814)		**16**:322f–323b	
ii. Sweden: Gustav IV and Charles XIII; the loss of Finland to Russia (1809); installation of Bernadotte as crown prince (1810); his anti-Napoleonic policy and the acquisition of Norway		**16**:323c–324a	
l. Italy during the French Revolution: support of revolutionary goals; French invasion and establishment of the republics; the French Consulate and the Napoleonic Empire		**9**:1154g–1158a/ **7**:223h–724f	**7**:725e–726b *passim*
2. Pan-European developments in the first half of the 19th century: economic, intellectual, cultural, and social movements	EUROPEAN CULTURE SINCE 1800 **6**:1066–1081	**16**:982d–986f	**15**:229c–g
a. The Industrial Revolution	ECONOMIC HISTORY SINCE 1500 **6**:229–236	**6**:1109e–1110c	
i. British commercial, agricultural, and military growth: the factory system and advances in textile and machine technology; development of railroads		**6**:230b–233d/ **3**:260h–262c/ **4**:773b–f/ **17**:630b/ **18**:653c–654b/ **18**:1076e–1077f	**15**:480d–f/**15**:925d–g/ **18**:39e–40a/**18**:43g–44f
ii. Conditions on the Continent and the spread of the factory system to Belgium, France, and Germany		**6**:233d–235h	**7**:666f–g/**8**:106h–107f/ **8**:696d–e
iii. The social consequences of the Industrial Revolution: division between capitalist and worker; wages and living and working conditions; new abundance of manufactured goods		**6**:235h–236h/ **1**:1019d–h/ **11**:601g–602e/ **16**:982g–983e/ **18**:563f–564a	**8**:695g–696a
b. The legacy of the French Revolution: cultural nationalism; populism; influence of Napoleon		**6**:1066d–1068d/ **7**:661h–662d/ **10**:1192c–e	**10**:1200c–1201a/**12**:852a–c
c. The Romantic movement: individualism and a concern for nature and "folk" in contrast with the Enlightenment		**6**:1068d–1072a	
i. Romanticism in literature, drama, music, and the visual arts		**6**:1069d–1071b/ **10**:1180h–1181e/ **10**:1192e–1194a/ **10**:1196f–1197c/ **10**:1200c–1201b/ **10**:1215c–f/ **12**:702h–703g/ **12**:712e–714d/ **13**:283a–d/ **13**:586h–588g/ **14**:915c–916g/ **16**:373a–c/ **18**:227a–f/ **19**:444b–458g	**2**:799f–800h/**7**:897g–898a/ **8**:228c–230b/**9**:721d–722h/ **15**:249a–b/**15**:250a–b/ **15**:250e–h/ **19**:517b–520d *passim*
ii. Social and political thought: application of "liberal" political philosophy to concrete situations; beginnings of Socialism and Utilitarianism		**6**:1071c–1072a/ **1**:808g–809c/ **5**:63d–65b/ **8**:105a–106h/ **14**:691e–692e/ **16**:965e–966c/ **16**:982g–983h	**2**:837h–838f/**3**:923f–924b/ **6**:264h–265c/**11**:395a–f/ **13**:801d–h/**13**:849c–f/ **14**:702h–703c/**15**:825c–g/ **16**:176e–177a/**16**:288h–289c/ **16**:984g–985c/ **18**:469d–470e *passim*
d. New facilities for scientific study in France and other Continental countries: effects of technological developments and scientific thought on society; principle of evolution		**6**:1072a–f/ **6**:81d–82e/ **16**:372f–373h	**11**:644b–645d/ **11**:831e–832e *passim*/ **14**:389e–390d/ **14**:390g–391b/**16**:895h–896f/ **19**:730c–g
e. Philosophy: the role of Immanuel Kant and his disciples (Fichte, Hegel, and Schopenhauer); German Idealism		**6**:1072g–1073b/ **5**:65e–g/ **6**:934g–936e/ **8**:733e–736h/ **14**:268c–270d/ **17**:612b–g	**1**:574c–d/**7**:289h–291a/ **8**:728h–732a/**10**:390f–393h/ **10**:718a–d/**15**:788d–h/ **16**:339h–341f *passim*/ **16**:358e–360c *passim*

	articles	article sections	other references
f. Religion and its alternatives: Catholic and Protestant revivals; Jewish emancipation; scientific positivism and the cult of art		**6**:1073b–f/ **14**:458h–460b	**2**:106b–e/**10**:322c–323h
g. The beginning of "scientific history" and modern philology		**8**:963c–h	**3**:484c–f/**8**:958b–h/ **11**:224a–b/ **12**:102g–103e *passim*/ **15**:507c–508c
h. International war and diplomacy in the Age of Metternich	EUROPEAN DIPLOMACY AND WARS (*c.* 1500–1914) **6**:1104–1107		**19**:560g–561b
i. Congress Europe: the Quadruple and Holy alliances for maintenance of the Vienna settlement; French intervention in Spain (1823); Austrian intervention in Italy (1821 and 1830); changes in the Congress system with the Revolution of 1830 in France and Belgium		**6**:1104b–1106f/ **2**:463f–464d/ **5**:65b–d/ **7**:663g–664a/ **14**:647g–648f	**12**:63f–64a
ii. General European unrest: the revolutions of 1848 and their suppression; Austrian intervention in Italy; Russian intervention in Hungary		**6**:1106g–1107b/ **2**:464d–466b/ **7**:664h–665d	**9**:36g–37a
i. Great Britain and Ireland (1815–50)	BRITAIN AND IRELAND, HISTORY OF **3**:263–267		
i. Economic depression and social unrest following the Napoleonic Wars: repression by the government		**3**:263h–264f	**4**:809g–810e
ii. Political and social reform measures (1822–48); *e.g.*, penal reforms, Catholic Emancipation (1828), First Reform Bill (1832), abolition of slavery in British colonies (1833), new Poor Law (1834), repeal of the Corn Laws (1846), Navigation Acts, the Chartist movement, the growth of trade unionism and the Factory Act (1847), Public Health Act (1848)		**3**:264f–267f	**3**:739e–h/**4**:892b–893a/ **6**:364h–365a/**8**:425f–h/ **8**:696c–d/**13**:936a–937f/ **13**:1106h–1107h/**16**:38c–f/ **18**:564d–f/**19**:756c–757c
iii. Developments in Ireland: the Great Famine of the 1840s; Roman Catholic unrest; O'Connell and the Young Ireland movement		**3**:264g–h/ **3**:290e–291a/ **10**:1187a–d	**5**:1072g–1073a
j. France from 1814 to 1852	FRANCE, HISTORY OF **7**:662–666		
i. The Restoration (1814, 1815–30): moderate constitutionalism under Louis XVIII; reaction and clericalism under Charles X		**7**:662d–663g	
ii. The Revolution of 1830; Louis-Philippe and the July monarchy; the preservation of the status quo under Guizot; growing dissatisfaction with the regime in the 1840s		**7**:663g–664h/ **10**:1192e–1194a	**15**:130f–131a
iii. The Revolution of 1848: Socialist thought and the establishment of the Second Republic; suppression of Socialist experiments; presidency of Louis-Napoléon		**7**:664h–666e	**2**:1104d–g/**12**:839g–840c/ **15**:131a–d
k. Germany from 1815 to *c.* 1850	GERMANY, HISTORY OF **8**:105–109		
i. The German Confederation: Austrian domination under Metternich; the student national unity movement and its repression by the Carlsbad Decrees (1819); beginning of industrialization and the Zollverein		**8**:105a–107f/ **5**:379h–380b	**6**:362h–363b/**6**:363g–364a/ **12**:64a–d/**16**:288h–289c
ii. The revolutions of 1848–49: the Frankfurt National Assembly and its failure to unite Germany		**8**:107f–108f	
iii. Frederick William IV: restoration of the German Confederation; return to conservative policies; continued industrialization		**8**:108f–109d	**7**:707h–708e
l. The Austrian Empire from 1815 to 1850	AUSTRIA, HISTORY OF **2**:463–466		

	articles	article sections	other references
i. Development of national consciousness among the peoples of the empire: cultural revival among Magyars, Croats, Serbians, Poles, Romanians, Czechs, Slovaks, and Slovenes; German and Italian nationalism		**2**:463f–466b/ **9**:36d–g/ **10**:1210h–1212e/ **10**:1214c–1215a	**2**:626c–e/**2**:1193c–e/ **8**:535c–d
ii. Metternich's hostility to liberalism: Austria as a symbol of reaction in Italy		**2**:463f–464d	**9**:1158c–g/**12**:64a–65c
iii. The revolutions of 1848 and 1849 in Vienna, Prague, and Budapest		**2**:464d–466b/ **9**:36g–37e	**2**:1193e–1194a
m. The Italian states from 1815 to 1850	ITALY AND SICILY, HISTORY OF **9**:1158–1160		
i. The Vienna settlement: the Austrian Habsburgs in Lombardy–Venetia; the Bourbons in the Two Sicilies; Victor Emmanuel in Savoy; the Carbonari		**9**:1158a–g	
ii. Abortive revolutions in Naples and Piedmont (1820); economic slump and revival; rebellions in Modena, Parma, the Romagna, the Marches, and Umbria (1831)		**9**:1158g–1159g	
iii. The *Risorgimento*: Mazzini, Young Italy, and Young Europe; the early liberalism of Pope Pius IX		**9**:1159g–1160b	**11**:726h–727e/**14**:483c–484a
iv. The revolutions of 1848: the first phase of the Italian War of Independence; defeat of Piedmont by Austria (1848–49)		**9**:1160b–g	**2**:465c–d/**3**:1031b–e/ **7**:908g–909b/**11**:727e–f
n. Switzerland from 1815 to 1860: conservative constitution of 1815; the Sonderbund War (1847); the new federal state established (1848–60); policy of neutrality		**17**:885g–886f	**7**:1011f–h
o. Russia from 1815 to *c.* 1850: later conservatism of Alexander I; the Decembrist revolt (1825); Nicholas I's (1825–55) conservative policies	RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:57–61		**1**:475c–g/**13**:68e–69h
i. Rule by bureaucracy; social classes; intellectual life; the empire and its various nationalities		**16**:58f–60f/ **10**:1207h–1208e/ **10**:1209e–1210h	**6**:365c–e/**10**:452h–453c
ii. Foreign policy: conflict with Poland; relations with Turkey		**16**:60g–61e	**14**:648f–649c/**18**:795d–e
p. The Low Countries from 1814 to 1848: union of The Netherlands, Luxembourg, and Belgium (1814); Belgian Revolution (1830) and establishment as a separate monarchy under Leopold I (1831–65); constitutional reform (1848) in The Netherlands		**11**:152d–153a/ **11**:157e–158b	
q. Spain and Portugal from 1815 to 1850			
i. Spain under Ferdinand VII; revolution and abortive liberal government (1820–23); loss of South American empire (1820s); Isabella II and the succession dispute; First Carlist War (1833–39) and the "Spanish marriages" controversy		**17**:436h–438e	**3**:83b–84c
ii. Portuguese loss of Brazil (1822); civil war between constitutionalists and absolutists (1832–34); British intervention (1826–34); Maria II (1834–53) and civil strife between Septembrists and Saldanha		**14**:871a–g	**3**:145b–d
r. Scandinavia from 1815 to 1850	SCANDINAVIA, HISTORY OF **16**:324–329		
i. Denmark in the reigns of Frederick VI (1808–39) and Christian VIII (1839–48): beginning of economic problems; tendencies toward constitutional government culminating in the constitution of 1849; war over Schleswig-Holstein (1848–51)		**16**:324a–f	
ii. Developments in Sweden–Norway: conservative era under Charles XIV John (1818–44); liberal reforms after 1840 and under Oscar I (1844–59); Norway's struggle to assert independence from Sweden		**16**:325e–326b/ **16**:327b–g	**4**:59h–60f
iii. Finland and Iceland: Finnish political organization and Russian influence; the position of Iceland after the Treaty of Kiel (1814)		**16**:328c–e	

	articles	article sections	other references
s. The Balkan states from *c.* 1804 to 1850	BALKANS, HISTORY OF THE **2**:624–626		**13**:787e–g
i. Serbian uprising (1804–13) and the rise of the principality; restoration of Ottoman power in Serbia (1813–15); Serbian autonomy (1830) under Ottoman Empire; Miloš Obrenović recognized as prince of Serbia (1833–39) and government of Alexander Karageorge (1842–58)		**2**:624e–625b	
ii. Greek revolution (1821–30) and establishment of independence; internal strife under Otho I (1832–62); constitutional government introduced in 1843		**2**:625b–f	
B. Realism and materialism; nationalism; the reorganization of Europe; imperialist expansion (1850–*c.* 1920)			
1. European cultural and economic life from 1850 to 1920	EUROPEAN CULTURE SINCE 1800 **6**:1073–1078		
a. Philosophy and political and social thought: the prevalence of Determinism and Materialism		**6**:1073g–1075f	
i. Growth of nationalist aspiration among peoples without their own national states; intensification of national rivalries among the great powers		**6**:1073g–1074c/ **6**:1107f–1109b/ **8**:108f–112e/ **14**:649c–650c	**2**:469b–h/**2**:473d–g/ **4**:893a–d/**6**:1106c–f/ **7**:667a–c/**12**:852d–g/ **16**:60h–61c
ii. *Realpolitik* and Darwinian evolution: the influence of "Social Darwinism"; Materialism; Victorian morality; advance of democracy		**6**:1074c–1075f/ **1**:979b–e	**5**:493b–494g/**10**:717d–718a/ **14**:1015d–h/**15**:362h–363c/ **17**:492g–493d
iii. Karl Marx and Marxism: "scientific" Socialism and revolutionary philosophy; Marxist influence among the European working class; the First and Second Internationals		**1**:574b–e/ **1**:809b–811c/ **11**:557a–560d/ **14**:692f–693e/ **14**:694h–695c/ **16**:966c–968b/ **17**:612h–613d	**2**:607h–608f/**2**:784g–785b/ **3**:487h–488b/**6**:265c–f/ **6**:410g–h/**6**:859e–860b/ **7**:668b–f/**10**:537e–538c/ **10**:690c–691a/**10**:719b–d/ **10**:792e–796g *passim*/ **11**:205c–h/**11**:549e–553a/ **14**:271a–b/**15**:131a–e
iv. Growth of anti-Semitism and beginning of the Zionist Movement: rediscovery of traditional Jewish themes in the arts		**10**:325f–326b/ **10**:197c–h	**2**:470e–g/**7**:670b–d/ **8**:829c–830a/ **10**:1259g–1260b/ **15**:1154e–1155c
b. Developments in the arts, philosophy, and religion		**6**:1075g–1078c/ **15**:230d–231e	**7**:670g–671a
i. Developments in literature and the visual arts; *e.g.*, Realism, Impressionism, Symbolism, Naturalism, Cubism		**6**:1075g–1076f/ **10**:1194d–1195g/ **10**:1197c–1198e/ **12**:513f–514f/ **13**:283d–284f/ **18**:227f–228g/ **18**:247f–249a/ **19**:460f–464h/ **19**:473g–480d	**7**:378d–380c *passim*/ **7**:675d–h/**9**:723a–f/ **10**:377b–378e/**10**:784f–785b/ **11**:439f–442c *passim*/ **14**:440h–442f/**15**:250b–c/ **15**:674f–675g/**18**:534c–535e
ii. Developments in philosophy: Realism; nationalism; psychology and social thought		**6**:1076g–1078c/ **5**:65g–66a/ **14**:211c–213c/ **14**:271c–g/ **15**:541e–g	**2**:843f–844d/**10**:465h–467g/ **13**:77f–78g
iii. Challenges to traditional religion: anticlericalism, reaction, and Modernism among Roman Catholics; Protestant social movements; Reform Judaism		**13**:959f–960a/ **15**:117d–f	**5**:494b–e/**10**:323g–324a/ **10**:807h–808d/**15**:116b–c/ **15**:672d–f/**15**:1015g–1016g
c. Scientific theory and practice: Einsteinian relativity; the social effects of medical advances; development of the behavioral sciences; new views of the universe		**6**:82e–84b/ **6**:85a–86c/ **6**:359f–362f/ **8**:802g–804b/ **14**:301a–302b/ **14**:391c–e/ **15**:457g–458e/ **16**:983f–987c	**6**:376f–377b/**6**:378f–379g/ **10**:719d–f/**11**:645d–646d/ **11**:658f–659c/**14**:388g–389d/ **16**:373h–374h

	articles	article sections	other references
d. Economic life: the course of industrialization, 1870–1914	ECONOMIC HISTORY SINCE 1500 **6**:236–242		
i. Industrial proliferation: expansion into new areas such as the U.S., eastern Europe, and Japan		**6**:236h–238d/ **4**:890b–891b/ **9**:1165e–h/ **18**:975f–976f	**10**:82d–e
ii. Changing balance of economic power in Europe: emergence of Germany as the leading industrial power; decline of British industrial strength		**6**:238d–239h/ **3**:273e–h/ **4**:895a–e	
iii. The revolution in transportation and communications: steam navigation and the beginning of air travel; the internal-combustion engine; the telegraph, telephone, and radio; industrialization on the eve of World War I		**6**:239h–242a/ **12**:511g–512c/ **15**:480g–481d/ **18**:40e–42e/ **18**:665d–666d	**1**:335h–336f/**2**:528f–529e/ **3**:177g–180b *passim*/ **18**:654g–655d
2. International war and diplomacy from 1850 to *c.* 1920: *Realpolitik* and European diplomatic realignments	EUROPEAN DIPLOMACY AND WARS (*c.* 1500–1914) **6**:1107–1115		
a. The era of Italian and German unification		**6**:1107b–1109b	
i. Final dissolution of the Congress of Vienna alliance system: the Crimean War (1853–56) and its aftermath		**6**:1107c–e	**7**:666h–667a/**16**:61e–f
ii. The Italian War of Independence: French intervention against Austria in Italy; the establishment of the Kingdom of Italy (1861)		**6**:1107f–1108b/ **9**:1160g–1162a	**2**:466g–h
iii. Bismarck and the creation of the German Empire: victories over Denmark (1864), Austria (1866), and France (1870–71)		**6**:1108c–1109b	**2**:466h–467f/**2**:1079c–1081a/ **7**:667f–668b/**8**:112e–f
b. The first period of German predominance		**6**:1110d–1115b	
i. Bismarck's system of alliances: the Dreikaiserbund and the isolation of France; the Russo-Turkish War (1877–78) and the Congress of Berlin (1878–79); the Triple Alliance (1882)		**6**:1110d–g/ **8**:113d–g/ **19**:942d–944b	**2**:469h–470c/**2**:472b–h/ **13**:787e–g
ii. The Franco-Russian alliance (from 1893) and the Entente Cordiale (1904): Russia's defeat in the Far East (1904–05) and the formation of the Triple Entente (1907)		**6**:1111a–1113f/ **3**:275a–c	**7**:670d–g/**10**:81b–c/ **16**:65h–66f
iii. Prelude to World War I: the Moroccan and Bosnian crises; the Balkan Wars (1912–13); the outbreak of war between the great powers (1914)		**6**:1113g–1115b/ **2**:630d–h/ **19**:944b–945b	**2**:472h–473c/**2**:473g–474f/ **8**:114h–115a
c. The resurgence of European imperialism (*c.* 1875–1914)	COLONIALISM **4**:894–902	**6**:1111a–f	
i. Renewed interest in overseas expansion by the European powers in the late 19th century: new acquisitions and new colonial powers; development of new theories of imperialism		**4**:894e–897a/ **3**:303f–304d/ **6**:1109a–e/ **13**:162f–164c	**4**:362d–e/**6**:1010d–g/ **6**:1111a–b/**11**:1c–3a/ **11**:366h–367c
ii. The European penetration of Asia and the partitioning of Africa: Russian expansion; economic penetration of China; rise of Japan; scramble for Africa		**4**:897b–902b/ **3**:1095e–1096g/ **4**:361c–362d/ **17**:286f–290a	**4**:359c–g/**6**:98d–h/**6**:396c–g/ **6**:1109b–c/**6**:1111b–f/ **14**:871h–872b
d. World War I (1914–18) and the Treaty of Versailles (1919)	WORLD WARS **19**:945–967		
i. The Serbian crisis and general mobilization: the opening German offensive in the east and west (August 1914); stabilization of the Western Front; trench warfare; new military technology (air power, tanks, and poison gas); the Battle of Verdun; renewed stalemate		**19**:945b–949d/ **19**:950h–952d/ **19**:954b–f/ **7**:552f–553b/ **19**:563c–564b	**2**:474a–475a/**6**:864h–865b/ **7**:393g–394a/**7**:671g–672c/ **8**:115c–f/**8**:490g–491g/ **11**:79g–80e/**12**:892h–893c/ **16**:899a–900a/**17**:749b–f/ **17**:1019e–g
ii. The entrance of Italy, Turkey, Japan, and other nations into the war: campaigns in the Balkans and the Middle East		**19**:949d–f/ **19**:950d–g/ **19**:952d–954a/ **19**:955d–956a/ **9**:1167c–d	**3**:742h–743a/**10**:81d–e/ **13**:790a–c

	articles	article sections	other references
iii. German submarine warfare and the U.S. entry into the war (1917); the Russian Revolution (1917), military collapse, and the Treaty of Brest-Litovsk (1918); the last Allied offensive and the armistice (1918)		**19**:949f–950d/ **19**:954f–955c/ **19**:956a–966c/ **12**:893d–g/ **18**:986c–987a	**8**:115h–116d/**8**:887g–888a/ **16**:67f–68a/**16**:70b–c/ **19**:837g–838h
iv. Total war and the mobilization of whole populations; the dissolution of the Austro-Hungarian, Russian, and Ottoman empires		**2**:474f–476d	**7**:672c–e/**8**:115g–116a/ **13**:789h–790e *passim*/ **14**:650c–g/**16**:67f–68a/ **19**:549c–f
v. The leadership, industrial strength, strategic plans and goals, and tactical and logistical procedures of the belligerents		**19**:960f–965c/ **8**:490g–491g/ **11**:79g–80e	**7**:447c–h/**8**:115f–g/ **19**:549g–550e
vi. The Paris Peace Conference (1919–20) and the peace treaty: Wilson's influence; German reparations, restrictions, and territorial losses; reorganization of central Europe and the Middle East by the Allies; the mandates and the League of Nations		**19**:966e–967f/ **2**:633a–h/ **8**:116h–117c/ **8**:1185a–e/ **9**:733g–734c/ **18**:987b–g	**4**:709f–710a/**13**:790c–e/ **17**:887b–c/**19**:838h–839b
3. The European states from 1850 to *c.* 1920			
a. Great Britain and Ireland and expansion of overseas empire (1850–1920)	BRITAIN AND IRELAND, HISTORY OF **3**:267–275	**3**:303f–304d	**1**:206g–207b/**3**:740b–f/ **3**:1095a–e/**11**:366g–367c
i. Mid-Victorian politics and economics: liberalism and free trade; the Great Exhibition (1851); Russell's and Palmerston's foreign policies regarding the Crimean War and the Indian Mutiny; Second Reform Bill (1867)		**3**:267f–268e/ **3**:269g–270g/ **4**:680h–681b/ **15**:240f–241b	**3**:193a–c/**4**:810h–811c/ **5**:899d–h/ **9**:408g–411e *passim*/ **13**:99g–100d/**13**:937f–938d/ **16**:38f–h/**19**:107c–g/ **19**:108c–109e
ii. Mid-Victorian society and religion: Victorian social attitudes (duty, thrift, hard work, and character); liberalism and the High Church movement; revival of Scottish Calvinism		**3**:268e–269g	**3**:912c–g/**4**:594g–h/ **10**:1185g–1186h/**13**:1c–f
iii. Gladstone's liberalism, and "Tory Democracy" and imperialism under Disraeli; Third Reform Bill (1884); the Irish Question and the rise of Fenianism, Parnell, and the Home Rule movement; Chamberlain and the split in the Liberal Party; Fabian socialism and growth of the Labour movement; South African War (1899–1902)		**3**:270g–272g/ **3**:273d–274b/ **3**:291a–292b/ **5**:67d–f/ **16**:968b–c	**3**:742b–e/**4**:21e–22b/ **4**:1001h–1002b/ **5**:899h–901a/**6**:365b–c/ **8**:179g–180h/ **13**:1021a–1022b/**16**:184a–c/ **16**:910a–b/**19**:712c–713a
iv. The return of the Liberals (1905–14): Lloyd George's people's budget and National Insurance Act (1911); Parliament Act of 1911; continuing struggle over Ireland, and Unionism in Ulster		**3**:274b–275a/ **9**:415b–f	**2**:206e–g/**4**:596a–e/ **5**:1073a–c/**11**:7c–g
v. British participation in World War I: Lloyd George's Coalition government; the Easter Rising of 1916 in Ireland		**3**:275c–276a	**4**:596e–597a/**10**:725f–726c/ **11**:7g–8a/ **19**:947a–966d *passim*
b. France from 1852 to 1920: the Second Empire and the Third Republic	FRANCE, HISTORY OF **7**:666–672		
i. Napoleon III's authoritarian policies and reassertion of France's role in Europe (the Crimea and Italy): partnership with Britain (1852–60); the liberal years (1859–70); foreign policy failures and defeat by Germany (1871)		**7**:666e–667g	**7**:862g–h/**8**:111f–112e/ **12**:82b–83a/**12**:840c–841e
ii. The siege of Paris, the Commune, and the establishment of the Third Republic (1870); attempts at restoration; the "Republican Republic"; opportunist control under Gambetta; the Boulangists; colonial expansion; the Dreyfus affair; separation of church and state (1905)		**7**:667g–670g	**2**:1106d–h/**4**:708d–709a/ **7**:862h–863b/**18**:333c–e
iii. The prewar years: conflicts between French rightists and Socialists; alignment with Russia and Britain before World War I; nationalism and revanchism		**7**:670g–671g	**1**:810c–e/**4**:709a–c/ **10**:118a–f/**16**:968d–e
iv. World War I (1914–18): German occupation of northeastern France; the crisis of 1917; the Clemenceau government; French human and material losses in the war		**7**:671g–672e	**4**:709d–710a/**7**:447c–h/ **14**:152f–g/ **19**:947a–966d *passim*

	articles	article sections	other references
c. The unification of Germany and Prussia (1850–1920)	GERMANY, HISTORY OF **8**:109–116		
i. William I and tentative reform: clashes with the liberals; Bismarck and reform of the Prussian Army; parliamentary subservience to the crown		**8**:109f–110d/ **2**:20c–e	**2**:1077g–1079g/**12**:332c–e
ii. Prussian and Austrian differences over the subjugation of Schleswig-Holstein (1864–66); the exclusion of Austria and union of north and south Germany in the German Empire after defeat of France (1871)		**8**:110d–112e/ **16**:324b–325b	**2**:466h–467f/**2**:1079c–1080b/ **7**:667f–668b/**8**:1013e–f/ **12**:332f–h
iii. Bismarck as imperial chancellor (1871–90): *Kulturkampf* and the breach with the National Liberals; anti-Socialist measures and social legislation; Bismarck's consolidation of German power and formation of the Triple Alliance (1882)		**8**:112e–113g/ **6**:1110d–g	**2**:1081a–1083g/**6**:363b–g/ **8**:1013f–g/**10**:889g–890b/ **15**:1016b–d/**15**:1016f–g
iv. The accession of Emperor William II (1888) and the fall of Bismarck; chancellorships of Caprivi, Hohenlohe, and Bülow (1890–1909); estrangement from Russia and rivalry with Britain; colonial expansion; militarists and Social Democrats in the period before World War I		**8**:113g–115c/ **11**:557a–f	**2**:868g–869d/**2**:1083g–1084e/ **6**:176g–h/**8**:1013g–1014a/ **10**:540c–f/**18**:437c–g/ **19**:562b–h/**19**:827h–828d
v. World War I (1914–18) and increasing influence of the army: German military defeat (1918); establishment of the German Republic (1919)		**8**:115c–116e/ **19**:945b–967f	**6**:176h–177c/**10**:890g–891a/ **11**:175d–h/**19**:828d–e
d. The Austrian and Austro-Hungarian Empire from 1850 to 1920	AUSTRIA, HISTORY OF **2**:466–476		
i. Constitutional experiments: the Kremsier and Stadion constitutions; the "Bach System," the October Diploma (1860) and February Patent (1861); federalism and centralism (1850–67); the role of Emperor Francis Joseph (1848–1916); exclusion from Italy (1859) and Germany (1866); the *Ausgleich* (Compromise) and the establishment of the Dual Monarchy (1867)		**2**:464f–469a	**2**:875g–876a/**5**:526d–f/ **7**:686a–687b/**8**:110d–112e/ **9**:37b–e/**10**:536d–537a
ii. Austria: the liberal ascendancy under the Auersperg ministry (1871–78) and the coalition of clericals, German aristocrats, and Slavs under Taaffe (1879–93); relations between Austrians and Slavic minorities in the empire; the introduction of universal male suffrage (1907); foreign policy (1878–1908); annexation of Bosnia and Hercegovina and the crises in the Balkans		**2**:469a–473c/ **19**:944g–945g	**2**:1194a–h/**7**:687b–d
iii. Hungary: the Andrássy government; internal conflict between the opponents and advocates of the Compromise of 1867; social reforms and economic progress; Magyar supremacy maintained under Tisza (1875–90)		**9**:37c–39a	
iv. Adherence to the Triple Alliance; increasing governmental paralysis and subordination to Germany during World War I; the dissolution of the Habsburg monarchy (1918) and the dismemberment of the empire		**2**:473d–476d/ **2**:1194h–1195f	**9**:38h–39a/ **19**:945a–967h *passim*
e. The Russian Empire from *c.* 1850 to 1917	RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:61–68	**10**:1208f–1209b	**2**:672h–673d/**12**:478a–c/ **13**:299d–g
i. Defeat in the Crimean War (1853–56); abolition of serfdom (1861) and local government reforms under Alexander II (1855–81); Polish rebellion of 1863 and the spread of revolutionary sentiment; the assassination of the Tsar (1881)		**16**:61f–62g/ **16**:968h–969b	**1**:476c–477d/**6**:365e–f/ **6**:1107c–e/**14**:649c–e
ii. Reversal of the reform movement under Alexander III (1881–94); the *zemstvos*; government hostility to non-Russian minorities; Nicholas II (1894–1917); anti-reform policies; foundation of the Social Democrats and Social Revolutionaries		**16**:62g–63b/ **1**:809c–g/ **4**:1020b–g/ **11**:558b–f	**1**:478c–e/**10**:537e–538c/ **13**:70c–h/**14**:464c–e/ **14**:595g–596a/**16**:969b–d

	articles	article sections	other references
iii. Economic, cultural, and social developments: Russification policies; foreign policies		**16**:63b–66e/ **14**:649f–650c	**6**:237b–e/**6**:385f–h/ **10**:792e–793f/ **10**:1252d–1253a/ **14**:569h–570d/ **18**:796c–797d/**19**:900f–901d
iv. Disorders following defeat in the Russo-Japanese War (1904–05); the Dumas; World War I and the abolition of the monarchy (1917)		**16**:66e–68a/ **16**:328g–329a	**6**:1113g–1114a/**8**:115h–116b/ **10**:81b–c/**10**:793f–794f/ **11**:437c–d/**12**:209h–210e/ **13**:70h–71c/**18**:717f–718b/ **19**:946h–967f *passim*
f. Italy from 1850 to 1920	ITALY AND SICILY, HISTORY OF **9**:1160–1167		
i. Cavour and the unification of Italy under Victor Emmanuel of Piedmont: alliance with France, and domestic liberalism; papal opposition; Austrian defeat and territorial cessions in northern Italy in the war of 1859; Garibaldi and the conquest of the south; the annexation of Venetia from Austria (1866) and acquisition of Rome (1870)		**9**:1160g–1162g/ **6**:1107f–1108b	**3**:1031e–1033a/**7**:909b–910c/ **14**:484b–e
ii. The Kingdom of Italy: Minghetti, Depretis, and Crispi; Italian adherence to the Triple Alliance; growth of Socialism, labour movements, and militant nationalism; the Giolitti era; participation in World War I		**9**:1162h–1167d	**11**:727g–728a/**19**:953e–g/ **19**:958g–959a/**19**:964e–g
g. Switzerland from 1850 to 1920: domestic policies; neutrality in World War I		**17**:886h–887a	**5**:87g–h/**7**:1011h–1012a
h. Spain and Portugal			
i. Continued civil strife in Spain: control by the military; Carlists, *moderados*, *progressistas*, and republicans; the First Republic (1873–74); constitutional monarchy in 1876; further colonial losses in the Spanish-American War (1898)		**17**:438e–439d	**1**:810g–811b/**18**:982a–d
ii. The reaction against liberalism following Spain's defeat; Spanish involvement in Morocco; civil tensions and neutrality in World War I		**17**:439d–440c	**13**:168e–h/**13**:171d–e
iii. Alternating progressive and conservative governments in Portugal under Pedro V (1853–61) and Luís I (1861–89); dispute with Great Britain over colonial policies; financial difficulties; dictatorship in 1906; the Portuguese Republic (1910) and Portugal's adherence to the British alliance in World War I		**14**:871g–873a	
i. Scandinavia from 1850 to 1920	SCANDINAVIA, HISTORY OF **16**:325–329		
i. Denmark: the Schleswig-Holstein question; defeat by Prussia and Austria (1864) and loss of the duchies; social and economic change under the Conservative regime		**16**:324h–325e	**2**:466h–467c/**2**:1079c–1081a
ii. Sweden–Norway: parliamentary reforms in Sweden under Charles XV (1859–72); foreign policy; attitudes in Sweden and in Norway toward the Swedish–Norwegian union		**16**:326b–327a/ **16**:327g–328b	
iii. Finland and Iceland: the language problem and political reforms in Finland; its relations with Russia; Iceland's demands for self-government		**16**:328e–329d	
j. The Low Countries from 1848 to 1920	LOW COUNTRIES, HISTORY OF **11**:158–160	**11**:152h–153g	
i. The Netherlands: liberalization after 1848; the establishment of the independence of Luxembourg (1890); Queen Wilhelmina and World War I		**11**:153a–g/ **11**:160b–d	

	articles	article sections	other references
ii. Belgian Liberal government (1857–84); rise of Catholic and Belgian Workers' (Socialist) parties; the education controversy and Catholic party rule (1884–1914); universal male suffrage and child labour laws; Leopold II's establishment of Congo Free State (1885) and annexation as Belgian Congo (1908); Flemish resistance to the French-speaking elite		**11**:158b–h/ **3**:1096a–g/ **10**:1199e–1200b	
iii. World War I: Dutch neutrality and the German conquest of Belgium		**11**:159a–c/ **19**:947c–948c/ **19**:959d–960a/ **19**:965c–e	
k. The Balkan States from 1850 to 1920: power conflicts resulting in the Balkan Wars (1912–13) and World War I	BALKANS, HISTORY OF THE **2**:626–633	**5**:408b–d/ **19**:944a–945g	**19**:949d–967h *passim*
i. Greece: the overthrow of Otho I (1862); the constitution of 1864; acquisition of the Ionian Islands (1864) and Thessaly (1881); Cretan union with Greece (1908); Venizélos' policies; eventual adherence to the Triple Entente in World War I		**2**:626h–627b	**19**:76f–g/**19**:958f–g/ **19**:963g–964a
ii. Serbia: restoration of Miloš Obrenović in 1858; defeat by Turkey (1876); the Kingdom of Serbia (1882); the pro-Austrian policy of the Obrenović dynasty; restoration of the Karageorgević dynasty and pro-Russian orientation; conflict with Austria-Hungary; conquest by the Central Powers in World War I		**2**:626f–h/ **2**:631f–632f/ **19**:944d–945g/ **19**:949d–e/ **19**:953g–954a	**2**:472h–473c/**2**:473g–474f/ **13**:1043d–1044c
iii. Bulgaria: "great Bulgaria" established by the Treaty of San Stefano (1878); Prince Alexander I and Russian influence (1879–86); Ferdinand I (1887–1918) and Stambolov's formation of a government; revolt of the Macedonian minority (1903); separation from Turkey (1908); adherence to the Central Powers in World War I		**2**:627h–628f/ **2**:629d–e/ **2**:632a–c/ **19**:967f	
iv. Romania: union of Moldavia and Walachia under Alexandru Cuza (1861); Carol I (1866–1914, king after 1881); independence from Turkey (1878); alignment with the Triple Entente and conquest by the Central Powers in World War I		**2**:627b–e/ **19**:967c–h	**3**:363d–f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ACTON, LORD **1**:71
ALEXANDER II OF RUSSIA **1**:475
ALEXANDER III OF RUSSIA **1**:477
ASQUITH, H.H. **2**:206
BAKUNIN, MIKHAIL ALEKSANDROVICH **2**:607
BEBEL, AUGUST **2**:784
BERNSTEIN, EDUARD **2**:868
BEUST, FRIEDRICH VON **2**:875
BISMARCK, OTTO VON **2**:1077
BLANC, LOUIS **2**:1104
BLANQUI, AUGUSTE **2**:1105
BRIGHT, JOHN **3**:192
CANNING, GEORGE **3**:771
CARNOT, LAZARE **3**:944
CASTLEREAGH, VISCOUNT **3**:991
CAVOUR, COUNT **3**:1029
CHAMBERLAIN, JOSEPH **4**:21
CHARLES XIV JOHN, OF SWEDEN AND NORWAY **4**:59
CLAUSEWITZ, CARL VON **4**:697
CLEMENCEAU, GEORGES **4**:707
COBBETT, WILLIAM **4**:809
COBDEN, RICHARD **4**:820
DALHOUSIE, JAMES RAMSAY, 1ST MARQUESS OF **5**:438
DANTON, GEORGES **5**:486
DEÁK, FERENC **5**:525
DISRAELI, BENJAMIN **5**:898
EBERT, FRIEDRICH **6**:176
FOCH, FERDINAND **9**:446
FOX, CHARLES JAMES **7**:578
FRANCIS JOSEPH I **7**:685
FREDERICK WILLIAM IV OF PRUSSIA **7**:707
GAMBETTA, LÉON **7**:862
GARIBALDI, GIUSEPPE **7**:908
GENTZ, FRIEDRICH VON **7**:1021
GEORGE III OF GREAT BRITAIN **7**:1125
GLADSTONE, WILLIAM EWART **8**:177
GREY, CHARLES GREY, 2ND EARL **8**:429
HARDENBURG, KARL VON **8**:643
HOLSTEIN, FRIEDRICH VON **8**:1013
JAURÈS, JEAN **10**:117
KOSSUTH, LAJOS **10**:535
KROPOTKIN, PETER **10**:537
KRUPP FAMILY **10**:539
LASSALLE, FERDINAND **10**:689
LENIN **10**:791
LIEBKNECHT, WILHELM AND KARL **10**:889
LLOYD GEORGE, DAVID **11**:6
LUXEMBURG, ROSA **11**:205
MARAT, JEAN-PAUL **11**:483
MARX, KARL **11**:549
MASARYK, TOMÁŠ **11**:572
MAZZINI, GIUSEPPE **11**:726
METTERNICH **12**:62
MILYUKOV, PAVEL NIKOLAYEVICH **12**:209
MIRABEAU, COMTE DE **12**:267
MOLTKE, HELMUTH VON **12**:331
NAPOLEON **12**:831
NAPOLEON III **12**:839
NELSON, LORD **12**:947
NEY, MICHEL **13**:55
NICHOLAS I OF RUSSIA **13**:67
NICHOLAS II OF RUSSIA **13**:70
PALMERSTON, LORD **13**:935
PARNELL, CHARLES STEWART **13**:1020
PAŠIĆ, NIKOLA **13**:1043
PEEL, SIR ROBERT **13**:1106
PIŁSUDSKI, JOZEF KLEMENS **14**:464
PITT, WILLIAM, THE YOUNGER **14**:477
PLEKHANOV, GEORGY VALENTINOVICH **14**:569
POBEDONOSTSEV, KONSTANTIN PETROVICH **14**:595
RAFFLES, SIR THOMAS STAMFORD **15**:476
RHODES, CECIL **15**:811
ROBESPIERRE **15**:907
ROTHSCHILD FAMILY **15**:1162
RUSSELL, JOHN RUSSELL, 1ST EARL **16**:38
SAINT-JUST, LOUIS DE **16**:170
SALISBURY, ROBERT CECIL, 3RD MARQUESS OF **16**:183
SPERANSKY, MIKHAIL MIKHAYLOVICH **17**:496
STEIN, KARL, FREIHERR VOM **17**:666
TALLEYRAND **17**:1003
THIERS, ADOLPHE **18**:332
TIRPITZ, ALFRED VON **18**:437
TROTSKY, LEON **18**:717
VENIZÉLOS, ELEUTHÉRIOS **19**:76
VICTORIA, QUEEN **19**:105
WELLINGTON, DUKE OF **19**:755
WILLIAM II, EMPEROR **19**:827
WITTE, SERGEY YULYEVICH **19**:900

Section 964. European colonies in the Americas from 1492 to c. 1790

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 964 deal with four main subjects: A, the geography and ethnography of the Americas; B, Spanish and Portuguese colonies in the Americas and the involvement of other European powers in South America and the Caribbean to *c.* 1790; C, Norse, English, Dutch, and Swedish discoveries, explorations, and settlements in North America (*c.* 1000–1763); and D, French discoveries, explorations, and settlements in North America.

The outline of subject B begins with the first period (1492–*c.* 1550) of Spanish conquests, covering the Spanish discovery, exploration, and conquest of the Caribbean islands, Mexico, Central America, Peru, Venezuela, Colombia, and Río de la Plata. It goes on to the general characteristics of the Spanish colonial empire: its administrative structure, its Indian policy, and the colonial economy. The outline further treats the exploration and colonization of Brazil by the Portuguese (from 1500); the administrative reforms of the Spanish Bourbon kings (1700–88); Spanish colonial expansion into North America (*c.* 1600–1790); and English, French, and Dutch territorial and economic expansion (from *c.* 1600) into areas of Spanish and Portuguese colonization in Latin America and the Caribbean.

The outline of subject C first deals with the Norse voyages to Greenland and North America (*c.* 1000), with early English exploration and attempted settlement (1497–*c.* 1600), and with Dutch and Swedish settlement and later expulsion by the English. It then treats the founding of the English colonies in North America, and their economic, political, social, and cultural development up to the expulsion of French power from North America in 1763.

The outline of subject D treats French discoveries, explorations, and settlements in North America from 1524 to the eclipse of French power in 1763.

articles	article sections	other references
A. Introduction: the geography and ethnography of the Americas	**1**:1129f–1130f/ **13**:216e–220e	**1**:414a–416d *passim*/ **1**:423d–425e *passim*/ **1**:649h–650b/ **1**:1015h–1018a *passim*/ **1**:1134h–1139h/**1**:1143g–h/ **2**:593c–f/ **2**:749g–750g *passim*/**3**:1a–6f/ **3**:123g–134c/ **3**:307c–308h *passim*/ **3**:713e–722e/ **3**:906h–908f *passim*/ **4**:863h–870d/**5**:208h–211d/ **5**:348g–352e/ **5**:539b–540c *passim*/ **5**:943c–945c/**6**:285d–287e/ **6**:731c–733g *passim*/ **8**:506c–509h/**10**:15g–17c/ **11**:452e–454b/**12**:65h–71a/ **12**:280a–282b *passim*/ **12**:1085a–1086b/**13**:58e–59f/ **13**:63f–64d *passim*/ **13**:176h–178f/**13**:984c–985e/ **13**:991h–993d *passim*/ **13**:999b–1001a/ **14**:127d–128a/**14**:130b–e/ **14**:525f–h/**14**:1050c–g/ **15**:259c–265c *passim*/ **15**:964g–965f/ **16**:172g–174a *passim*/ **16**:258f–259d/ **16**:739h–741a *passim*/ **17**:80d–96f/**18**:905f–931b/ **18**:1093g–1096c/ **19**:20d–e/**19**:58d–64c/ **19**:158d–159d
B. Spanish and Portuguese colonies in the Americas; other European powers in South America and the Caribbean to *c.* 1790	LATIN AMERICA AND THE CARIBBEAN, COLONIAL **10**:691–702	
1. Spanish discovery, exploration, and conquest of the Caribbean islands, Mexico, Central America, Peru, Venezuela, Colombia, and Río de la Plata (1492–*c.* 1550)	**10**:691e–693g/ **1**:851c–f	**2**:610f–611c/**4**:881e–882c/ **4**:938a–942f/**5**:195b–g/ **5**:356d–f/**11**:292g–293d/ **13**:1001c/**14**:487g–488d/ **14**:526b–c/**15**:259f–g/ **17**:424a–c/**18**:18d–g
2. Spain's colonial empire	**10**:693g–698e	**19**:68c–f/**19**:419g–421d
a. Colonial administration: the Council of the Indies; viceroys and other provincial officials; *audiencias;* legal restrictions on public officials	**10**:693g–695a	**4**:882h–883b/**12**:79b–d

	articles	article sections	other references
b. Indian policy: slavery and peonage under the *encomienda* and *repartimiento;* the missionary role of the Roman Catholic Church; decline of the Indian population; introduction of black slaves		**10**:695a–696c/ **10**:697f–698e/ **1**:687d–f/ **3**:1108b–h/ **6**:356a–e/ **16**:860f–861a/ **17**:119g–120f	**4**:883c–e/**5**:356f–h/**6**:291a–b/ **10**:684h–685h/**12**:166f–h/ **13**:195b–c/**15**:362c–e/ **15**:1017f–h/**17**:94f–h/ **17**:96g–97c/**17**:308h–309b/ **17**:424c–d/**19**:938c–d
c. Colonial economy: expansion of agriculture; gold and silver mining; cattle industry; mercantilism, smuggling, and piracy		**10**:696c–697f	**3**:10a–c/**6**:225g–226c/ **17**:97d–h/**17**:424d–g
3. The exploration and colonization of Brazil by the Portuguese (from 1500)		**10**:698f–700g/ **3**:144d–g	**3**:572e–f/**4**:882g–h/**14**:869a/ **15**:362g
a. Colonial economic policies: introduction of black slavery; gold and diamond mining; agricultural and commercial development		**10**:698f–699f	**3**:131d–h/**3**:144e–f/ **15**:853h–854f
b. Colonial administration: establishment of captaincies (1533); centralized royal control (1549); role of the Roman Catholic Church; the Brazilian racial mixture		**10**:699f–700g	**3**:144f–g/**17**:95b–g
4. Administrative reforms of the Spanish Bourbon kings (1700–88): decentralization of the governments of Peru, Venezuela, and Chile; encouragement of trade and agriculture		**10**:700g–702d	
5. Spanish colonial expansion into North America (*c.* 1600–1790): settlements and religious missions		**10**:698a–c/ **17**:434f–435b	**1**:404g–h/**13**:3b/**13**:542e–f/ **16**:218a–b/**18**:18g–19a/ **18**:164f–g
6. English, French, and Dutch territorial and economic expansion (from *c.* 1600) into areas of Spanish and Portuguese colonization in Latin America and the Caribbean		**10**:697b–f	**4**:886f–g/**4**:887g–h/ **5**:978b–979a/**7**:424e–g/ **11**:547h–548b/ **14**:869b–870b
C. Norse, English, Dutch, and Swedish discoveries, explorations, and settlements in North America (*c.* 1000–1763)	UNITED STATES, HISTORY OF THE **18**:946–954		**12**:1084c–e/**13**:174f–175g
1. Norse voyages to Greenland and North America (*c.* 1000)			**7**:1037g–1038a/**16**:312a–b
2. Early English exploration and attempted settlement (1497–*c.* 1600); Dutch and Swedish settlement and later expulsion by the English		**18**:947b–e	**4**:886c–e/**7**:1042e–f/ **8**:1131a–d/**13**:21f–g/ **13**:220g–221c/**14**:25g–h
3. Development of the English colonies in North America	BRITISH EMPIRE AND COMMONWEALTH **3**:301–303	**18**:947e–954a	**10**:419d–e/**12**:1092c–d/ **19**:154b–d
a. The founding of the thirteen Colonies: economic, political, and religious reasons for settlement		**18**:947e–950c/ **15**:306h–308d	**2**:714d–715a/**4**:887h–888c/ **4**:1129a–c/**5**:9g–h/ **11**:590g–591b/ **11**:696g–698b/**13**:21g–22a/ **13**:194g–h/**14**:24g–25c/ **14**:25h–26a/**15**:560d–e/ **15**:807g–808a/ **19**:890h–891c
b. Economic, political, and social development		**18**:950c–952e	**3**:55e–56a/**11**:566b–d/ **18**:921c–e
i. British economic policies: mercantilism and the Navigation Acts		**18**:950c–951b	**3**:302e–g/**4**:888e–f/**5**:183c–e
ii. Colonial administration: loose royal control prior to 1763; self-government and local political activity		**18**:951b–h	**3**:256d–g/**4**:645c–d/ **4**:1002f–h/**7**:694h–695b/ **12**:1095h–1096a/**18**:919c–d
iii. Social mobility and the rise of economic classes: immigration and the introduction of slavery; agricultural and commercial development		**18**:951h–952e/ **16**:861a–g	**1**:404h–405a/**4**:889a–d/ **12**:937e–h/ **19**:768g–769h *passim*/ **19**:938d–e
c. Colonial cultural and scientific achievements; *e.g.*, the American Philosophical Society, newspapers and almanacs, the beginning of public education, the "Great Awakening"		**18**:952e–953d/ **5**:463c–464a/ **5**:1029e–1030f/ **10**:1154e–h/ **10**:1167g–1168c/ **15**:114c–e/ **19**:432c–d	**6**:357b–358e/**6**:441c–442c/ **7**:694d–h/**8**:189g–190b/ **8**:695e–f/**9**:719f–721d/ **11**:1106g–h/ **11**:1113g–1114a/**15**:228f–g/ **15**:239b–e/**19**:419b–f

	articles	article sections	other references
d. Conflicts with the French and Indians, and expulsion of French power from North America (1763)		**18**:953e–954a/ **3**:736b–737a/ **6**:172e–173c	**3**:255e–h/**4**:889e–890b/ **7**:746h–747b/**12**:1080f–g/ **13**:194g–195a/ **13**:220h–221c/ **19**:611d–612e
D. French discoveries, explorations, and settlements in North America: New France and Louisiana (1524–1763)	CANADA, HISTORY OF **3**:733–737		**3**:970h–971c/**4**:29c–g/ **10**:683h–684e/**12**:282c–d/ **13**:6f–h/**19**:88b–c
1. The settlement of New France: missionaries, Indian relations, and the fur trade; royal administration and joint-stock companies		**3**:733g–736a/ **6**:356f–357b	**4**:29e–g/**4**:886e–f/**4**:887b–d/ **6**:173a–b/**7**:643a–e/ **7**:746f–h/**11**:125e–g/ **12**:411g–413b/**13**:195c–e/ **15**:336d–e
2. Expansion and eventual conflict with the English, resulting in the eclipse of French power in North America (1763)		**3**:736b–737a/ **18**:953e–954a	**3**:255e–h/**4**:889e–890b/ **6**:358f–g/**6**:1098a–b/ **7**:746h–747b/**8**:301c–d/ **12**:1080f–g/**13**:220h–221c/ **13**:573e–f/**15**:336e–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CARTIER, JACQUES **3**:970
CHAMPLAIN, SAMUEL DE **4**:29
COLUMBUS, CHRISTOPHER **4**:937
CORTÉS, HERNÁN **5**:194
DIAS, BARTOLOMEU **5**:701
EDWARDS, JONATHAN **6**:440
FRONTENAC, COMTE DE **7**:746
HUDSON, HENRY **8**:1130
LA SALLE, ROBERT CAVELIER, SIEUR DE **10**:683
LAS CASAS, BARTOLOMÉ DE **10**:684
MATHER FAMILY **11**:697
PENN, WILLIAM **14**:23
PIZARRO, FRANCISCO **14**:487
SOTO, HERNANDO DE **17**:18
WINTHROP, JOHN **19**:890

Section 965. Development of the United States and Canada from 1763 to 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 965 deal with three main subjects: A, the United States from 1763 to 1865; B, the United States from 1865 to 1920; and C, Canada under British colonial rule from 1763 to 1867, and the Dominion of Canada from 1867 to 1920.

The outline of subject A deals first with the establishment and consolidation of the United States, treating the American Revolutionary period (1763–87); the Constitutional Convention and the struggle for the ratification of the federal Constitution; the formation of political parties; the development of economic and foreign policies; and U.S. political history through the administration of James Madison. Dealing with the United States from 1816 to 1850, the outline treats such subjects as the "Era of Good Feelings" (1816–24), Jacksonian democracy, the "Age of Reform" (1830–50), westward expansionism, and cultural developments. Finally, the outline deals with sectionalism and slavery; political and geographical polarization; the secession of the Southern states; and the Civil War.

The outline of subject B deals first with Radical Reconstruction (1866–77) and the New South. It goes on to the transformation of American society from 1865 to 1900, treating urbanization and immigration, the development of the West, the industrialization of the American economy, the growth of foreign trade and commerce, the emergence of national labour unions, and national politics from 1877 to 1900. The outline further treats the emergence of the United States as an imperial power; the Progressive Movement (*c.* 1896–1920); and the role of the United States in World War I. Finally, the outline treats cultural developments—advances in the arts, and developments in education and other intellectual areas—from 1865 to 1920.

The outline of subject C, the history of Canada, begins with the character and structure of British colonial administrations from 1763 to the British North America Act of 1867. It goes on to social, political, and economic developments in Canada from 1790 to 1850, treating particularly immigration, the fur trade, the Canadian participation in the War of 1812, and the dissension between French and English settlers. The outline then deals with the Dominion of Canada from 1867 to 1920. It first treats the westward expansion, marked by the construction of a transcontinental railroad, and the aggravation of relations between French Canadians and the national government after the execution of Louis Riel at the end of the second Métis-Indian rebellion in 1885. It next treats the general political history of the Dominion of Canada: under Conservative governments to 1896, marked by electoral issues about tariff and commercial relations with the United States, and by depressions in the 1880s and early 1890s; under Liberal governments in the period from 1896 to 1911; and then under Conservative governments from 1911, returned to power on a wave of anti-American feeling about boundary and trade agreements. Finally, it treats the entrance of Canada into World War I; Canada's increased international prestige because of its position in the postwar conferences and in the League of Nations; and the postwar recognition of Canada as an autonomous nation within the British Empire.

	articles	article sections	other references
A. The United States to 1865: national formation and territorial expansion; conflict between North and South	UNITED STATES, HISTORY OF THE **18**:954–971		

	articles	article sections	other references
1. Establishment and consolidation of the United States (1763–1816)		**18**:954b–961c	**1**:404h–405a/**7**:1128c–d/**10**:419d–e/**12**:105a–b/**12**:1092d–e/**13**:22a–b/**13**:518e–h/**15**:808b–e/**19**:154d–e
a. The American Revolutionary period (1763–87)		**18**:954b–957a	**3**:737b–738b/**4**:891e–g/**5**:66a–d/**5**:85f–g/**7**:695c–g/**11**:227a–d/**11**:591b–c/**14**:26a–b
i. Political and economic opposition to Britain's taxation policies culminating in the Declaration of Independence (1776)		**18**:954a–956c	**1**:75g–76e/**1**:80d–81b/**3**:55h–56a/**3**:256h–257f/**7**:695b–e/**8**:775g–776a/**10**:127d–g/**13**:868c–g/**19**:613b–g
ii. The U.S. War of Independence (1775–83): land and sea campaigns; military leadership; French military support; peace treaty (1783)	WAR OF INDEPENDENCE, U.S. **19**:602–606	**18**:956c–e	**3**:257f–258d/**6**:1098d–f/**10**:534d–f/**19**:613g–615h
iii. The government of the Articles of Confederation (1781–87) and evolution of a western lands policy		**18**:956c–957a	**11**:281h–282b/**14**:708d–f/**18**:919c–d/**19**:616b–c
b. The strengthening of the national government (1787–1816)		**18**:957a–961c	**8**:585e–587g/**18**:55b–f
i. The Constitutional Convention, the federal Constitution, and the struggle for ratification (1787–89)		**18**:957a–h/**10**:1168c–e	**5**:66d–f/**7**:204c–d/**8**:585e–586b/**8**:776a–b/**10**:129a–d/**11**:282a–c/**19**:616b–e
ii. Development of national policies and formation of political parties: Hamilton's economic policies; foreign relations during the administrations of Washington and John Adams; Federalists and Democratic-Republicans		**18**:957h–959h/**14**:692e–f	**1**:76g–77f/**8**:586c–587g/**10**:129d–g/**11**:227d–f/**11**:282c–e/**12**:388c–d/**19**:616e–h/**19**:822d–823a
iii. Jefferson's administration and the Louisiana Purchase (1803); Madison's administration and the War of 1812; role of the Supreme Court		**18**:959h–961c/**3**:739a–c	**1**:78g–79c/**5**:90d–e/**10**:2b–e/**10**:129g–130d/**11**:282e–h/**11**:536g–537b/**18**:55b–f
2. The United States from 1816 to 1850: nationalism, expansionism, extension of the franchise, and industrialization		**18**:961d–967e	**1**:405a–b/**10**:419f–h/**12**:105c
a. Strengthening of national feelings: administrations of Monroe and John Quincy Adams; Supreme Court under Marshall		**18**:961d–964d	**1**:79c–80b/**5**:91d–92b/**11**:536g–537e/**19**:719d–f
i. "The Era of Good Feelings" (1816–24): nationalism and sectionalism; the Missouri Compromise (1820)		**18**:961d–962b	**1**:79c–e/**4**:699b–d/**12**:388g–389a
ii. Developments in commerce and finance: industrialization and early labour movements; transportation and internal improvements; cotton and slavery		**18**:962c–963c/**3**:755c–e	**11**:226e–h/**12**:937h–938c/**15**:479h–480c/**18**:665c–d
iii. Social development: German and Irish immigration (1830–50); urbanization and social mobility		**18**:963d–964d/**4**:893h–894b	
b. Jacksonian democracy (1829–41): extension of the franchise; development of Democratic, Whig, and minor party politics; bank war; nullification; Indian removal policy		**18**:964d–965e	**4**:668h–669a/**4**:699d–e/**10**:2h–4f/**11**:613f–614a/**13**:221d–f/**17**:222c–d/**17**:1016b–e/**19**:719f–720a
c. The "Age of Reform" (1830–50): the Abolitionist movement and other reform activities; diverse religious attitudes		**18**:965f–966h	**1**:79g–80a/**1**:101g–102b/**6**:365h–366h/**7**:913a–g/**8**:696e–f/**10**:987a–c/**12**:442c–h/**15**:560f–g
d. Westward expansionism: annexation of Texas; acquisition of Oregon; the Mexican War (1846–48) and the annexation of California and New Mexico; the Compromise of 1850		**18**:966h–967e/**4**:894b–e	**4**:699f–h/**4**:906e–g/**11**:614f–615b/**12**:80h–81d/**12**:246g–h/**13**:3c–d/**13**:234c–e/**13**:672e–673a/**14**:733f–734a/**15**:965f–g/**18**:164h–165c

	articles	article sections	other references
e. Cultural development to 1850: the growth of the novel; poetry; music; the visual arts; historical writings; the Transcendentalist movement		**10**:1176c-g/ **10**:1188c-1189c	**5**:133a-134b/**6**:754c-755h/ **8**:190c-191f/**8**:679b-680a/ **9**:723f-724f/**11**:1114a-d/ **13**:291d-e/**14**:810a/ **14**:993c-h/**15**:240d-f/ **15**:251a-b/**18**:228g-229a/ **18**:350f-351e/**19**:438g-439c/ **19**:453d-h
3. The United States from 1850 to 1865: sectionalism, secession, and Civil War		**18**:967e-971d	
a. Sectionalism and slavery: economic and psychological bases of slavery; the failure of popular sovereignty; the Abolitionist movement; literature of the period		**18**:967e-968d	**6**:755h-756d/**7**:913f-h/ **8**:680a-f/**10**:383c-d/ **10**:1189d-h/ **16**:861a-863b *passim*/ **17**:1016e-f/**18**:351f-g
b. Political and geographical polarization: disruption of the Democratic and Whig parties, emergence of the Republican Party, and Lincoln's election (1860)		**18**:968d-969h	**10**:987d-g
c. Secession of the Southern states and the Civil War (1861-65)	CIVIL WAR, U.S. **4**:674-681	**18**:969h-971d	**5**:522d-h/**10**:770f-771e/ **10**:987g-990h/**19**:800f-g
i. Relative military strengths: strategies and tactics of North and South		**4**:674d-675b/ **18**:970d-h/ **7**:552c-f/ **14**:313b-314d	**10**:988d-989a/**19**:561e-562b/ **19**:579h-580a
ii. The land and sea war (1861-65): initial Confederate victories; Union success in the West and final victory over the South		**4**:675b-680h	**8**:279b-d/**10**:5c-g/ **10**:770g-771a/**12**:891c-g/ **16**:670c-e
iii. Foreign affairs of the Union and the Confederacy; moves toward emancipation during the war		**4**:680h-681e/ **18**:970h-971b	**6**:1109c-e
B. The United States from 1865 to 1920: Reconstruction, industrialization, increased immigration, development of the West, and emergence as a world power	UNITED STATES, HISTORY OF THE **18**:971-987		
1. Radical Reconstruction (1866-77) and the New South (1877-1900)		**18**:971f-974c	
a. Lincoln's plan for Reconstruction and congressional opposition (1864-65); conflicts between the Radical Republican-controlled Congress and Andrew Johnson; state "Black Codes" and federal civil rights legislation		**18**:971d-972e	**10**:990f-h
b. Reconstruction (1866-77): freedmen, sharecropping, and "Black Reconstruction"; Grant's administrations and the decline of Republican control in the South		**18**:972e-973d/ **12**:938c-g	**8**:279d-h
c. The New South (1877-1900): conservative Democrats in control and erosion of black rights; Populist resurgence in the 1890s; white supremacy and Jim Crow legislation; the black response		**18**:973d-974c	**1**:405c-e/**3**:972h-973b/ **5**:92d-f/**5**:1075f-h/ **10**:120g-121c/ **11**:125h-126a
2. The transformation of American society: the United States from 1865 to 1900		**18**:974c-981g	
a. Urbanization and immigration: southern and eastern European immigrants and growth of slums; problems of prejudice; rise of city machine politics; development of public education		**18**:974c-e	**4**:208g-210e/**6**:366g-367a/ **9**:237c-e/**10**:326b-f/ **18**:921e-g/**18**:928a-c
b. The development of the West (1865-1900)		**18**:974f-975e	**1**:409g-h/**9**:186e-g/ **12**:397d-e/**18**:919g-920d/ **18**:925h-926f
i. The quest for gold and silver: boom and bust in mining towns		**18**:974f-g	**4**:906f-h/**12**:246g-h/ **17**:214h-215a
ii. Cattlemen and the open range: the cattle industry (1866-88); the cowboy and cattle drives; conflicts with settlers		**18**:974g-975a	**15**:981c-d
iii. Westward expansion of the railroads: early government subsidies; relationship of the transcontinental carriers to the national economy		**18**:975a-c/ **15**:218g-h	**3**:964f-g
iv. Violation of the Indian treaties: settlers' encroachments on Indian lands; Indian wars; corruption among agents of the Bureau of Indian Affairs		**18**:975d-e/ **13**:227a-d	**13**:207c-e/**13**:221f-222d/ **13**:230b-c/**13**:542f-h/ **13**:544e-f

	articles	article sections	other references
c. The industrialization of the American economy: the manufacturing boom		**18**:975f–976d/ **19**:938e–939d	**6**:236h–237b/**9**:497e–h
i. Technological advances in the iron and steel industry: exploitation of oil, ores, lumber, and other natural resources		**18**:975f–976b	**18**:40b–d
ii. Development of trusts and holding companies: development of a legal climate favourable to big business		**18**:976c–d/ **5**:183f–h/ **15**:218g–h	**6**:241b–c/**15**:217h–218a
d. U.S. foreign trade and commerce: growth of exports and imports		**18**:976d–e	**5**:357a–c
e. Emergence of national labour union organizations: strikes and boycotts; collective bargaining; anti-labour stance of government; the Haymarket Riot (1886)		**18**:976f–977b	**1**:812a/**18**:565f–h
f. National politics (1877–1900): general ascendancy of Congress and decline of the presidency		**18**:977b–981g	
i. Aftermath of the disputed election of 1876: the Compromise of 1877, the end of Southern Reconstruction, and Hayes's administration (1877–81); inflation and the silver issue		**18**:973b–d/ **18**:977b–978a	
ii. The election of 1880 and the presidency of Garfield: Garfield's assassination (1881); Arthur's administration (1881–85); establishment of the Civil Service Commission (1883)		**18**:978a–e	
iii. The election of 1884 and Cleveland's first administration (1885–89): the re-emergence of presidential leadership; the Treasury surplus and tariff issues; the Interstate Commerce Act (1887) and federal regulation of railroads		**18**:978f–979f/ **15**:218g–h	**3**:964f–g
iv. The election of 1888 and Benjamin Harrison's administration (1889–93): congressional leadership, the Sherman Anti-Trust and Sherman Silver Purchase acts, and the McKinley Tariff Act (1890)		**18**:979f–980c	**12**:379d–380a
v. Depressed agricultural conditions (1887–97): the Farmers' Alliances and the establishment of the Populist Party (1891); farmers' defection from Republican Party		**18**:980c–h	
vi. The election of 1892 and Cleveland's second administration (1893–97): gold reserves and the Panic of 1893; repeal of the Sherman Silver Purchase Act (1893); lowering of the tariff		**18**:980g–981c	
vii. The election of 1896 and McKinley's administration (1897–1901): the raising of the tariff (1897) and the Gold Standard Act (1900); gradual economic recovery		**18**:981c–g	**3**:742d–e
3. Imperialism, the Progressive Era, and the rise to world power, 1896–1920		**18**:981g–987g	
a. The emergence of the U.S. as an imperial power		**18**:981g–983c	**19**:562h–563c
i. The Spanish-American War and U.S. suzerainty over Cuba; acquisition of the Philippines, the Hawaiian Islands, and Puerto Rico (1898)		**18**:981g–982e/ **5**:357c–e/ **15**:242h–243b	**14**:242c–243e
ii. The "Open Door" policy and armed intervention in China (1900)		**18**:982e–g	**4**:364e–f/**4**:897h–899a
iii. Acquisition of the Panama Canal Zone (1903) and the Roosevelt Corollary to the Monroe Doctrine: intervention in Haiti, the Dominican Republic, Cuba, and Nicaragua		**18**:982g–983c	**3**:1114e–f/**3**:1116g–1117a/ **4**:903a–b/**5**:357d–f/ **8**:551e–f/**13**:946a–b/ **15**:1143c–g
b. The Progressive Movement (*c.* 1896–1920)		**18**:983d–986a	
i. Scholars, social workers, and "muckrakers" as leaders of the Progressive Movement; social and political urban reforms by state government		**18**:983d–984b/ **16**:968f–h	**4**:645e–646e/**5**:1075f–1076b/ **6**:372f–373a/**6**:373g–374f/ **6**:381c–382e/**7**:521b–g/ **10**:585g–586c/**10**:1191a–b/ **15**:242h–243b
ii. Theodore Roosevelt's administrations (1901–09) and expansion of presidential power and regulatory legislation; Taft's administration (1909–13) and the defection of Progressive Republicans in 1912 election		**18**:984b–985b	**10**:586c–d/**15**:1142e–1144c

	articles	article sections	other references
iii. Wilson's first administration (1913–17): tariff, currency, credit, tax, and labour reforms; intervention in Mexican affairs		**18**:985b–986a	**12**:85e–g/**19**:837a–e
c. The role of the U.S. in World War I		**18**:986a–987g	
i. Initial U.S. neutrality: loans and supplies to the Allies; submarine warfare and the break with Germany		**18**:986a–f/ **19**:956a–957b	**10**:586d–e/**19**:837f–838e/ **19**:950c–d
ii. U.S. entry into the war: mobilization of manpower and the economy; decisive effect of U.S. military forces on the Western Front (1918)		**18**:986f–987a/ **19**:957g–958b/ **19**:960a–c/ **19**:964h–966a	**12**:938g–939a/**15**:926g–927e/ **19**:838e–h
iii. Wilson's policies at the Paris Peace Conference (1919) and the U.S. Senate rejection of the Treaty of Versailles (1920); the election of 1920 and the return to isolationism		**18**:987b–g/ **19**:961d–e/ **19**:966e–967b/ **19**:970c–h	**9**:751e–g/**19**:838h–839f
4. Cultural developments from 1865 to 1920			
a. Advances in fiction, poetry, drama, music, and the visual arts		**5**:466h–467c/ **10**:1189h–1191d/ **12**:512c–513b/ **15**:241b–e/ **18**:231e–g	**5**:465g–466a/**8**:192f–193c/ **10**:121b–122e *passim*/ **11**:1114d–g/ **12**:514f–520d *passim*/ **12**:693e–694d/**13**:291e–g/ **14**:314d–318e/**14**:802e–f/ **15**:249d–e/**15**:250d–e/ **18**:229b–c/**19**:453h–454d/ **19**:462h–464e/ **19**:464h–465g/ **19**:820d–821e
b. Developments in education and historical writings; growth of American philosophy		**14**:941d–943b	**1**:74c–75a/**8**:736d–f/ **13**:1020a–e/**13**:1109a–f/ **14**:703g–704a
C. Canada under British colonial rule from 1763 to 1867; the Dominion of Canada from 1867 to 1920	CANADA, HISTORY OF **3**:737–743		
1. British colonial administration: the Quebec Acts of 1763 and 1774; immigration of United Empire Loyalists after U.S. War of Independence; establishment of French- and English-speaking provinces		**3**:737b–738d	**3**:722b–c/**6**:358h–359b/ **18**:521a–b/**18**:954d–f/ **19**:603c–e
2. Social, political, and economic development from 1790 to 1850		**3**:738d–740a/ **10**:1191h–1192b	**6**:367a–d/**13**:274d–g
a. Immigration, westward expansion, and the fur trade; participation in the War of 1812		**3**:738d–739c	**18**:960g–961b
b. Dissension between French and English settlers: the rebellions of 1837; the Union of Upper and Lower Canada (1841); self-government for domestic affairs (1848)		**3**:739c–740a	
3. The Dominion of Canada from 1867 to 1920		**3**:740a–743c	**3**:728a–b/**13**:573h–574a
a. The Confederation movement and the establishment of the Dominion (1867)		**3**:740a–e	**6**:367d–g
b. Westward expansion and internal disunity		**3**:740e–741d	**13**:260g–h
i. Louis Riel and the first Métis-Indian rebellion (1870); establishment of the provinces of Manitoba and British Columbia		**3**:740e–h	**3**:297d–e/**11**:452h–453a
ii. The transcontinental railroad; suppression of the second Métis-Indian rebellion (1885); economic depression and downfall of the Conservative government (1896)		**3**:740h–741d	**3**:297e/**10**:713a–b
c. Liberal governments under Laurier, and economic prosperity (1896–1911)		**3**:741d–742g	**10**:713b–e
i. The Klondike gold rush (1897) and the settlement of the Northwest Territories; creation of the provinces of Alberta and Saskatchewan (1905)		**3**:741d–h	**1**:423f–h/**13**:260g–h/ **16**:258b–e/**19**:792b–d/ **19**:1108h–1109c
ii. Involvement in Britain's imperialist policies: participation in South African War (1899); border disputes with the United States		**3**:741h–742g	**10**:713d–e
d. Economic nationalism and the Conservative government (1911–17): participation in World War I; recognition of Canadian autonomy (1917)		**3**:742h–743c	**3**:40d–f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ADAMS, HENRY **1**:73
ADAMS, JOHN **1**:75
ADAMS, JOHN QUINCY **1**:78
ADAMS, SAMUEL **1**:80
BORDEN, SIR ROBERT LAIRD **3**:39
CALHOUN, JOHN C. **3**:612
CARVER, GEORGE WASHINGTON **3**:972
CLAY, HENRY **4**:698
DAVIS, JEFFERSON **5**:522
DU BOIS, W.E.B. **5**:1075
EDISON, THOMAS ALVA **6**:308
FORD, HENRY **7**:520
FRANKLIN, BENJAMIN **7**:693
GARRISON, WILLIAM LLOYD **7**:913
GRANT, ULYSSES S. **8**:278
HAMILTON, ALEXANDER **8**:584
HENRY, PATRICK **8**:775
HOLMES, OLIVER WENDELL **8**:996
JACKSON, ANDREW **10**:1
JACKSON, "STONEWALL" **10**:4
JEFFERSON, THOMAS **10**:127
KOSCIUSZKO, TADEUSZ **10**:534
LA FOLLETTE, ROBERT M. **10**:585
LAURIER, SIR WILFRID **10**:712
LEE, ROBERT E. **10**:770
LINCOLN, ABRAHAM **10**:985
MCCORMICK, CYRUS HALL **11**:226
MCGILLIVRAY, ALEXANDER **11**:227
MADISON, JAMES **11**:281
MARSHALL, JOHN **11**:535
MONROE, JAMES **12**:387
PAINE, THOMAS **13**:867
POLK, JAMES K. **14**:733
ROOSEVELT, THEODORE **15**:11
SHERMAN, WILLIAM TECUMSEH **16**:669
TANEY, ROGER BROOKE **17**:1015
TECUMSEH **18**:54
TOCQUEVILLE, ALEXIS DE **18**:468
WASHINGTON, GEORGE **19**:610
WEBSTER, DANIEL **19**:718
WILSON, WOODROW **19**:836
WRIGHT, ORVILLE AND WILBUR **10**:1032

Section 966. Development of the Latin American and Caribbean nations to c. 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 966 deal with eight main subjects: A, the Latin American independence movement (1790–1825); B, Mexico, from independence (1821) through the end of the Mexican Revolution (1917); C, Central America and the Caribbean to *c.* 1920; D, the successor states of Gran Colombia to *c.* 1930; E, the Indian nations of the Andes to *c.* 1930; F, Chile from 1810 to 1920; G, the successor states of the Río de la Plata to *c.* 1920; and H, Brazil from 1822 to 1930.

The outline of subject A first deals with social, political, and intellectual movements in the background of the Latin American wars of independence. It then deals with the struggle for independence in its main centres, treating the struggle for independence in New Granada; the establishment of the United Provinces of the Río de la Plata (1813) at Buenos Aires; the Chilean independence movement (1817–18), and the liberation of Peru (1821) and Bolivia (1824); the establishment of Brazilian independence (1822); and the Mexican War of Independence (1810–21).

The outline of subject B first deals with Mexico from 1821 to 1855, treating the brief period of empire after independence, the early years of the republic interwoven with the military and presidential career of Santa Anna and the wars with the United States over Texas, New Mexico, and California. The treatment of Mexico from 1855 to 1876 covers Juárez and La Reforma; French intervention and the rule of Emperor Maximilian; and the restoration of the republic under Juárez' leadership. The outline further treats the Porfirio Díaz dictatorship (1876–1911) and the Mexican Revolutionary period (1910–17).

The outline of subject C begins with the history of Central America, the aggregation of republics occupying the isthmian bridge between Mexico and Colombia. It first deals with the establishment (1823), shortly after independence from Spain, of a Central American confederation of five states, and with its dissolution in 1838. It then deals separately with the histories, from 1838 to 1920, of Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama. The outline next deals with the island states of the Caribbean from *c.* 1800 to 1930. Articles referred to separately treat Haiti, the Dominican Republic, Cuba from 1790 to 1934, and the remaining European insular and mainland possessions in the Caribbean region.

The outline of subject D deals with the successor states of Gran Colombia—Venezuela from 1810 to 1935, and Colombia from 1819 to 1930.

Subject E is the nations of the Andes. The outline treats Ecuador from 1822 to 1925, Peru from 1824 to 1930, and Bolivia from 1809 to 1930.

The outline of subject F, Chile, covers the early liberal reforms under Bernardo O'Higgins; the conservative hegemony (1830–61); the widening of liberal influence and the growth of political splinter groups (1861–91); and the parliamentary republic (1891–1920).

Subject G is the successor states of the Río de la Plata. The articles referred to separately treat Argentina to 1930; the Uruguayan struggle for independence and national unity (1811–1929); and Paraguay from 1810 to 1924.

The outline of subject H treats the independent Empire of Brazil (1822–89), and Brazil during the First Republic (1889–1930).

A. The Latin American independence movement (1790–1825)

1. Background of the Latin American wars of independence
   a. Discontent among Indians, Creoles, and mestizos: the influence of the Enlightenment, the U.S. War of Independence, and the French Revolution
   b. Influence of Toussaint-Louverture's successful slave revolt (1791–94): war with the French (1802–03) and the establishment of Haiti (1804)
   c. Spanish involvement in European wars: the Peninsular War in Spain (1808–14); Napoleon's seizure of the Spanish throne, and Creole support of Ferdinand VII
2. The Spanish South American War of Independence (1810–25); the establishment of the independent Empire of Brazil (1822)

articles	article sections	other references
LATIN AMERICA AND THE CARIBBEAN, COLONIAL **10**:702–705		
	10:702d–703f	**6**:401c–f
	10:702d–f/ **10**:1204a–e	**6**:401c–d
	10:702f–g	**7**:722h–723a/**8**:551b–c/ **18**:536c–537a
	10:702g–703b/ **4**:893d–h	**12**:79d–h/**16**:225c–d/ **17**:436b–437c *passim*
	10:703b–705f	

	articles	article sections	other references
a. The struggle for independence in New Granada		**10**:703c–704b/ **17**:436h–437c	
i. Initial phases of the revolt under Miranda and Bolívar (1811–14); military setbacks (1815)		**10**:703c–f	**2**:1206b–1207f
ii. Final expulsion of the Spanish from Venezuela, Colombia, Ecuador, and Panama (1821); establishment of the Republic of Gran Colombia (1821–29)		**10**:703g–704b	
b. Establishment of the United Provinces of the Río de la Plata (1813) at Buenos Aires; division of provinces into states of Paraguay, Buenos Aires, and Uruguay (1828)		**10**:704b–c/ **1**:1143h–1145c	**13**:990c–e/**18**:1098d–g
c. San Martín's military support of the Chilean independence movement under O'Higgins (1817–18); the liberation of Peru (1821)		**10**:704d–f	**13**:516f–517a/**16**:225d–g
d. San Martín's withdrawal and assumption of control by Simón Bolívar; final defeat of Spanish troops (1824); Upper Peru's emergence as independent state of Bolivia (1825) under Sucre		**10**:704f–h	**2**:1207g–1208f/**16**:225h–226a
e. The Portuguese government in exile in Brazil (1808–22): reforms of King John VI (1816–22); establishment of the independent Empire of Brazil under Pedro I (1822)		**10**:704h–705b/ **3**:144h–145d	**14**:870g–871d/**15**:854g–h
3. The Mexican War of Independence (1810–21): Hidalgo's revolt (1810–11); social and economic reforms under Morelos (1811–15); Itúrbide's leadership (1820–21)		**10**:705c–f	**12**:79f–80b
B. Mexico from independence (1821) through the end of the Revolution (1917)	MEXICO, HISTORY OF **12**:80–86		**12**:166h–167b
1. Mexico from 1821 to 1855		**12**:80c–81e	
a. The independent Mexican Empire under Itúrbide (1821–23); Santa Anna and the establishment of the Mexican Republic (1824); the constitution of 1824; Centralist–Federalist struggles		**12**:80c–g	
b. Santa Anna's military career and intermittent terms as president (1833 to 1855): the Alamo (1836); war with U.S. (1846–48) over Texas, New Mexico, and California		**12**:80h–81e	**18**:967a–e
2. Mexico from 1855 to 1876		**12**:81e–83g	
a. Juárez and La Reforma: social and economic reforms of the 1857 constitution; anticlericalism; the civil war (1857–60)		**12**:81e–82b	**10**:281h–282e
b. French intervention (1862) and Emperor Maximilian's puppet rule (1864–67): attempted liberal reforms; loss of conservative support; French withdrawal, defeat of imperial forces, and Maximilian's execution (1867)		**12**:82b–83c	
c. Restoration of the republic under Juárez' leadership (1867–72); educational and economic reforms; Lerdo's presidency (1872–76); further separation of church and state		**12**:83c–g	**10**:282f–g
3. The Porfirio Díaz dictatorship (1876–1911)		**12**:83h–85e	
a. Díaz' economic and social policies: maintenance of public order and suppression of dissent; economic development through foreign investment; reconciliation with church; middle class control of land		**12**:83h–84d	
b. Emergence of radical and liberal political clubs (*c.* 1900): internal unrest; labour strikes; Madero's unsuccessful challenge to Díaz' re-election (1909); armed revolt, Díaz' resignation, and Madero's election (1911)		**12**:84d–85e	
4. The Mexican Revolutionary period (1910–17): Huerta's coup and Madero's execution (1913); Carranza's loose alliance with Pancho Villa, Zapata, and Obregón; civil war; the constitution of 1917; Carranza's election (1917)		**12**:85e–86b/ **18**:985f–986a	**19**:1138c–1139d
C. Central America and the Caribbean to *c.* 1920			
1. The Central American republics to *c.* 1920	CENTRAL AMERICAN STATES, HISTORY OF **3**:1109–1118		

	articles	article sections	other references
a. Independence from Spain (1821); participation in Mexican Empire (1822–23); federation of United Provinces of Central America (1823); armed conflict between Conservatives and Liberals; collapse of the federation (1838)		**3**:1109c–1110c	
b. Guatemala from 1838 to 1920: Carrera's Conservative dictatorship (1838–65); social and economic reforms of Barrios (1873–85) and subsequent Liberal regimes to 1898; Estrada Cabrera's administration (1898–1920)		**3**:1110a–h	**12**:166h–167b
c. Honduras from 1838 to 1920: Conservative domination to the 1870s; Aurelio Soto's Liberal regime (1876); return of Conservative control (1885); U.S. investments and military intervention (1912)		**3**:1111h–1112c	
d. El Salvador to 1930: establishment of the republic (1841); Liberal–Conservative conflicts to 1885; coffee economy; political stability (1899–1930)		**3**:1112g–1113b	
e. Nicaragua from 1838 to 1920: Liberal–Conservative conflicts; foreign intervention in 1850s; stable Conservative governments (1857–93); economic growth; Zelaya's Liberal regime (1893–1909); U.S. military intervention from 1910		**3**:1114a–f	
f. Costa Rica from 1838 to 1920: the coffee economy and social stability; Guardia dictatorship (1870–82) and the 1871 constitution; orderly presidential succession after 1890; Río San Juan dispute with Nicaragua		**3**:1115c–1116c	
g. Panama to 1920: union with Gran Colombia (1821–1903); civil war; U.S. intervention and establishment of Republic of Panama (1903); building of Panama Canal (1904–14); U.S. control of Canal Zone		**3**:1116f–1117a/ **3**:756b–e/ **18**:982g–983c	**10**:837g–h/**15**:1143d–f/ **18**:666g–h
h. British colonial and U.S. economic interests in, and conflicts over, the Central American region; *e.g.*, in British Honduras		**3**:1118d–f	
2. The island states of the Caribbean (*c.* 1800–1930)			**18**:982h–983c
a. Haiti to 1934: independence in 1804; civil war between the blacks and mulattoes; black hegemony under Christophe (later Henri I, 1806–20); ascendancy of mulattoes under Boyer (1820–43); political instability (1843–1915); U.S. military occupation (1915–34)	HAITI, HISTORY OF **8**:551		
b. The Dominican Republic to 1930: the struggle for independence (to 1844); despotic regimes (1844–1916); U.S. armed intervention (1916–30)	DOMINICAN REPUBLIC, HISTORY OF THE **5**:949		**15**:1143d–e/**18**:983b–c
c. Cuba from 1790 to 1934	CUBA, HISTORY OF **5**:356–357		
i. 19th-century social and economic developments: growth of the sugar industry; the abolition of slavery (1886)		**5**:356h–357a	
ii. Spanish suppression of Cuban liberation movement in the Ten Years' War (1868–78); economic relations with United States; the Cuban war of Independence from Spain (1895–98)		**5**:357a–c	**18**:981g–982c
iii. Cuba as a U.S. protectorate until 1934: military occupation (1899–1901); Republic of Cuba (1902); later U.S. occupation (1906–09); dictatorships and the sugar industry		**5**:357a–g	
d. The remaining European insular and mainland possessions in the Caribbean region from *c.* 1810 to *c.* 1920			**8**:509c–f/**15**:259h–260b/ **19**:159g–160a
D. The successor states of Gran Colombia to *c.* 1930			
1. Venezuela from 1810 to 1935	VENEZUELA, HISTORY OF **19**:68–69		
a. Venezuelan independence movement (1810–30); national development under Páez (1830–48); Conservative Party rule		**19**:68f–h	

	articles	article sections	other references
b. Monagas family regime (1848–58) and turmoil between Liberal and Conservative parties to 1870; regime of Guzmán Blanco (1870–88)		**19**:68h–69d	
c. Political instability to 1892; Crespo's regime (1892–96); the Castro (1899–1908) and Gómez (1908–35) dictatorships		**19**:69d–h	
2. Colombia from 1819 to 1930	COLOMBIA, HISTORY OF **4**:874–876		
a. Independence (1819); participation in Gran Colombia to 1830; power struggle between Conservative and Liberal parties (1840–80); social reforms; anticlericalism		**4**:875a–g	
b. Political instability and civil wars (1880s and 1899–1903); loss of Panama (1903); development of coffee industry (1909–28)		**4**:875g–876a	
E. The Indian nations of the Andes to *c.* 1930			
1. Ecuador from 1822 to 1925	ECUADOR, HISTORY OF **6**:291–292		
a. Participation in Gran Colombia (1822–30); independent republic (1830); dictatorial regimes to 1845; political instability (1845–60)		**6**:291c–f	
b. Clericalism in García Moreno's dictatorship (1860–75); Liberal ascendancy after 1875; Alfaro's administrations (1897–1911); social problems; depression in the 1920s		**6**:291f–292d	
2. Peru from 1824 to 1930	PERU, HISTORY OF **14**:134–135		
a. Establishment of republic (1824); power struggle among caudillos (1824–41); temporary union with Bolivia (1836–39); orderly government under Castilla (1845–51 and 1855–62)		**14**:134c–e	
b. Spanish military invasion (1864–69); Pardo's civilian government (1872–76) and economic crises; War of the Pacific (1879–84) and loss of territory to Chile; establishment of Peruvian Corporation (1889)		**14**:134f–h	**3**:10g–11a/**4**:256e–g
c. Economic and social reforms of Piérola's administration (1895–1908); conflict between Democratic and Civilian parties; Leguía's administrations (1908–12 and 1919–30) and economic development; formation of the Aprista Movement		**14**:134h–135d	
3. Bolivia from 1809 to 1930	BOLIVIA, HISTORY OF **3**:10–11		
a. Participation in Latin American wars of independence (1810–25); Bolivian independence (1825); Sucre's presidency (1826–28); economic decline		**3**:10c–e	
b. Dictatorship of Santa Cruz (1829–39); temporary union with Peru (1836–39); silver mining boom; War of the Pacific (1879–84) and territorial loss to Chile		**3**:10f–11a	**4**:256e–g/**14**:134g
c. Conservative Party rule (1880–99); economic growth; the Federal Revolution (1899); Montes' leadership in Liberal Party rule (1899–1920); growth of tin mining industry; Republican Party coup (1920); economic decline		**3**:11a–g	
F. Chile from 1810 to 1920	CHILE, HISTORY OF **4**:255–257		
1. Chile from the 1810 establishment of the republic to 1860		**4**:255e–256c	**16**:225d–g
a. The provisional government (1810–12); return of Spanish rule (1812); defeat of Spanish troops by combined Chilean–Argentinian army (1817)		**4**:255d–e	
b. Bernardo O'Higgins as head of state (1817–23): liberal reforms and conservative opposition; O'Higgins' abdication (1823); political instability (1823–30)		**4**:255f–g	**13**:516h–517a

	articles	article sections	other references
c. The conservative hegemony (1830–61): the 1833 constitution; political stability and conservative governments under Portales, Ovalle, Prieto, Bulnes, and Montt; economic prosperity; growth of liberal faction		**4**:255h–256c	
2. The widening of liberal influence and the growth of political splinter groups (1861–91)		**4**:256c–g	
a. The "Liberal Republic" under Pérez (1861–71) and the liberal-conservative alliance: cultural and economic ties with Great Britain; political conflict over church-state relations (1872)		**4**:256c–e	
b. The War of the Pacific (1879–84) and threatened European intervention: annexation of saltpetre mining provinces from Peru and Bolivia; civil war and Balmaceda's abdication (1891)		**4**:256e–g	**3**:10g–11a/**14**:134g
3. The parliamentary republic (1891–1920): era of legislative supremacy; growth of middle and lower classes; formation of Democratic (1887), Radical (1888), and Socialist (1901 and 1912) parties		**4**:256g–257b	
G. The successor states of the Río de la Plata (excluding Bolivia) to *c.* 1920			
1. Argentina to 1930	ARGENTINA, HISTORY OF **1**:1144–1148		
a. Efforts toward reconstruction (1820–29); confederation under Rosas and ascendancy of Buenos Aires (1829–52)		**1**:1144b–1146e	
i. Dominance of Buenos Aires: interprovincial rivalries; presidency of Rivadavia (1826–27)		**1**:1144c–1145c	
ii. The Rosas government (1829–52): domestic politics and foreign policies		**1**:1145c–1146e	
b. Period of national consolidation (1852–80); conservative regimes (1880–1916)		**1**:1146e–1148c	
i. The constitution of 1853 and civil wars (1853–60); government under Mitre (1862–68) and his successors		**1**:1146e–1147b	
ii. Economic development during Roca's administration (1880–86); economic crisis of 1890		**1**:1147b–g	
iii. The rise of radicalism: growth of social unrest; electoral reform of 1912		**1**:1147g–1148c	
c. The Radical regimes (1916–30): Irigoyen's presidency (1916–22); continued Radical rule in the 1920s; growth of foreign influence in the economy; military coup (1930)		**1**:1148c–g	
2. The Uruguayan struggle for independence and national unity (1811–1929)	URUGUAY, HISTORY OF **18**:1098–1099		
a. Independence from Spain (1811) and participation in United Provinces of the Río de la Plata (1813–28); establishment of independent Uruguay (1828)		**18**:1098e–g	
b. Civil war (1839–51) between Colorado and Blanco political parties; participation in war against Paraguay (1865–70); military rule (1875–90)		**18**:1098g–h/ **13**:990g–991d	**1**:1145h–1146c
c. Civilian rule and continued political crises and insurrections (1890–1904); Peace of Acequá (1904) and return to orderly government; social and economic reforms; economic boom during World War I		**18**:1098h–1099d	
3. Paraguay from 1810 to 1924	PARAGUAY, HISTORY OF **13**:990–991		
a. Independence from Spain (1811); struggle with Buenos Aires for autonomy; establishment of independent Paraguay (1813)		**13**:990c–e	
b. Isolationism during Rodríguez Francia's dictatorship (1814–40); encouragement of foreign trade during Carlos Antonio López' dictatorship (1841–62)		**13**:990e–g	
c. Francisco Solano López' regime (1862–70): loss of territory after war with Brazil and Argentina (1864–70); political instability after 1870		**13**:990g–991d	**1**:1146g–h

	articles	article sections	other references
H. Brazil from the establishment of the empire to the fall of the First Republic (1822–1930)	BRAZIL, HISTORY OF **3**:145–147		
1. The independent Empire of Brazil (1822–89)		**3**:145d–146c	**14**:871c–e
a. The empire under Pedro I (1822–31): the constitution of 1824; Pedro's abdication (1831); internal disunity during the regency (1831–40)		**3**:145d–f	
b. The empire under Pedro II (1840–89): intervention in Uruguayan affairs and war with Paraguay (1864–70); cessation of slave trade (1853), gradual emancipation, and abolition of slavery (1888)		**3**:145f–146c	
2. Brazil during the First Republic (1889–1930)		**3**:146c–147e	**15**:855a–b
a. The constitution of 1891 and social reforms; military dictatorships (1891–94); civilian governments (1894–1914)		**3**:146c–h	
b. Brazilian participation in World War I; postwar prosperity to 1922; economic problems during the 1920s; increasing political role of the military; civil disorders leading to the revolution of 1930		**3**:147a–e	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BOLÍVAR, SIMÓN **2**:1205
JUÁREZ, BENITO **10**:281
O'HIGGINS, BERNARDO **13**:516
SAN MARTÍN, JOSÉ DE **16**:224
TOUSSAINT-LOUVERTURE **18**:536
ZAPATA, EMILIANO **19**:1138

Section 967. Australia and Oceania to c. 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 967 deal with three main subjects.

Subject A is Oceania taken as a whole—the term designating the islands and archipelagoes of the Central and South Pacific. The outline deals with the geography, ethnography, and prehistory of Australia, Melanesia, Micronesia, and Polynesia; with the characteristics and historical development of the diverse peoples of Oceania; and with the effects of European exploration and colonization.

Subject B is the history of Australia to 1920. The outline treats the early European exploration of Australia by sea and land; the economic and political history of Australia from the British colonization of New South Wales in 1788 to the establishment of the commonwealth in 1901; and the early years of the commonwealth to 1920.

Subject C is the history of New Zealand to 1928. The outline treats the British annexation of the North and South Islands (1838–41); the relations with the indigenous Maori people; the establishment of self-government (1852); and the politics and foreign relations of New Zealand from 1890 to 1928.

	articles	article sections	other references
A. The character and historical development of the diverse peoples of Oceania and the effects of colonization	OCEANIA, HISTORY OF **13**:443–448	**13**:448g–454b	
1. The historical sources and historiographic problems		**13**:443e–f	**2**:485g–486b/**6**:131f–132b
2. Geography, ethnography, and prehistory of Australia, Melanesia, Micronesia, and Polynesia (including New Zealand)		**13**:443f–444d/ **13**:50g–h/ **13**:468c–e/ **14**:777d–778a	**2**:399b–405f *passim*/ **2**:431f–436d *passim*/ **3**:951a–h *passim*/ **6**:130e–131c *passim*/ **7**:125d–126g *passim*/ **7**:295c–296h *passim*/ **7**:826e–827h *passim*/ **12**:1088c–1089h *passim*/ **13**:43d–47e/ **13**:826a–830g *passim*/ **17**:1071d–1072h/ **18**:1003b–1006h *passim*/ **19**:111b–h
3. European exploration and colonial settlement: missionaries, trading societies, and colonial government		**13**:444d–445b/ **7**:1042g–1043f/ **13**:51b–d	**6**:131d–e/**7**:1041g–1042a/ **11**:869g–870a/**13**:828f–h/ **18**:1004d–1006a
B. Australia to 1920	AUSTRALIA, HISTORY OF **2**:412–419		

	articles	article sections	other references
1. Early European exploration by sea and land		**2**:412h–413g	**5**:131d–132c/**7**:1043b–f/ **7**:1044g–1045a/**17**:888c–f/ **17**:1070h–1071c
2. British colonization of New South Wales in 1788; expansion and development of self-government (1830–60); economic growth and the federation movement (1860–1901); the establishment of the commonwealth in 1901; social tensions; cultural developments		**2**:413g–418b/ **10**:1191d–g	**6**:367g–368d/**10**:1231b–d/ **17**:888f–889a
3. Early years of the commonwealth: establishment of a White Australia immigration policy; Labor Party reforms; industrial growth; cooperation with Britain in World War I		**2**:418c–419e	
4. Relations with the Aboriginal population		**2**:428g–429b	**13**:469g–h
C. New Zealand to 1928	NEW ZEALAND, HISTORY OF **13**:50–54		
1. The extension of British control over, and annexation of, North and South Islands (1838–41)		**13**:51d–f	
2. Relations between the indigenous Maori people and the British: encroachments and ensuing conflicts		**13**:52b–f	
3. Establishment of self-government (1852): economic development and immigration		**13**:51f–52b/ **13**:52f–53c	**6**:368d–g
4. Politics and foreign relations (1890–1928): Liberal and Reform Party governments; radical politics; the Labour Party; cooperation with Britain in World War I		**13**:53c–54b	**6**:368g–h

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

COOK, JAMES **5**:130
TASMAN, ABEL JANSZOON **17**:1070

Section 968. South Asia under the influence of European imperialism from c. 1500 to c. 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 968 treat five main subjects: A, European activity in India (1498–*c.* 1760); B, the extension of British power (1760–1858); C, British imperial power (1858–1920); D, Ceylon under foreign rulers from *c.* 1505 to 1920; and E, Tibet and Nepal from *c.* 1750 to 1920.

The outline of subject A treats the early Portuguese commercial relations with India; the later Dutch trading posts; the establishment and growth of British settlements and trading posts (1600–1740); the development of French trading companies from 1674; the Anglo-French rivalry (1740–63); the establishment of British hegemony; and the British seizure of Calcutta (1757).

The outline of subject B first deals with the growth of the political power of the British East India Company and the attempts by the British crown to regulate its affairs. It next treats the political, legal, economic, social, and cultural effects of the first century of British influence. Finally, it deals with the Indian Mutiny (1857), and with the British crown's subsequent assumption of total responsibility for the government of India.

The outline of subject C begins with the political structure and the social and economic policies after the Government of India Act of 1858, and with British foreign policy in India. It goes on to the beginnings of Indian nationalism in the late 19th century and the British response to it. Finally, it deals with events in the aftermath of World War I, treating anti-British activity, the Amritsar massacre, the Government of India Act (1919), Hindu–Muslim relations, and the emergence of Gandhi and the adoption of his non-cooperation policy.

The outline of subject D covers Portuguese political and commercial activities in Ceylon (1505–1658); Dutch rule in Ceylon (1658–1796); and the British in Ceylon from 1796.

The outline of subject E first deals with the decline of Chinese influence in Tibet and with the administration and culture under the Manchus. It then treats the accommodations made by Nepalese rulers with the British to preserve Nepal's independence.

	articles	article sections	other references
A. European activity in India (1498–*c.* 1760)	INDIAN SUBCONTINENT, HISTORY OF THE **9**:392–396		
1. Portuguese commercial relations with India from 1498: establishment of the colony of Goa; decline of Portuguese hegemony and rise of British and Dutch influence		**9**:392d–393c/ **9**:389f–h	**3**:572f–h/**7**:861f–862b/ **14**:869b–d/**19**:1055d–f
2. Dutch trading posts and conflicts with the British		**9**:393c–f	

	articles	article sections	other references
3. The British and French in India		**9**:393f–396f	
a. Establishment and growth of British settlements and trading posts (1600–1740): the East India Company; relations with indigenous peoples		**9**:393f–394d	
b. Development of French trading companies from 1674: Anglo-French rivalry (1740–63) and establishment of British hegemony		**9**:394d–395d	**4**:886h–887b/**4**:887d–g
c. The British seizure of Calcutta (1757) and Clive's establishment of British control over the local Bengal ruler (1757–60)		**9**:395c–396f	**4**:741g–742e
B. Extension of British power (1760–1858)	INDIAN SUBCONTINENT, HISTORY OF THE **9**:396–408		
1. Growth of the political power of the British East India Company and attempts by the British crown to regulate its affairs		**9**:396f–405c	**3**:587c–f/**4**:668e–g
a. Securing of British supremacy in Bengal		**9**:396f–397e	**4**:742d–743b/**8**:665e–g
b. Warren Hastings (1774–85) and the transition of the status of the company from revenue farmer to a ruling power in India		**9**:397e–399b	**3**:500h–501b/**8**:665g–666f
c. Wars with the Marāthās and Mysore at the end of the 18th century		**9**:390c–391h/ **9**:399c–h	**8**:666c–e
d. Expansion and consolidation of British control over various Indian states during administrations of Lord Wellesley (1798–1805), Lord Minto (1807–13), and Lord Hastings (1813–23)		**9**:399h–402c	
e. The organization and determination of administrative policy: Cornwallis and the transition toward British administrative procedures		**9**:402c–404a	
f. Completion of British annexation of or domination over the Afghan, Sikh, and Lower Burmese kingdoms in the 1840s and 1850s		**9**:401h–402c/ **9**:404a–405c	**1**:175f–176b/**3**:512g–h/ **5**:438h–439e/**15**:506b–f/ **16**:744h–745e
2. The political, legal, economic, social, and cultural effects of the first century of British influence		**9**:405d–406h	**2**:839h–840a/**6**:368h–370a
3. The cause, outbreak, suppression, and effects of the Indian Mutiny (1857): the British crown's assumption of total responsibility for the government of India		**9**:406h–408d	
C. British imperial power (1858–1920)	INDIAN SUBCONTINENT, HISTORY OF THE **9**:408–418		
1. Climax of the raj: social and economic policies; government organization; the influence of the viceroys		**9**:408d–411e	
2. British foreign policy in India: conflicts with Russia over the northwest frontier; the incorporation of Burma (1886); the Second Afghan War (1878–80) and the creation of the North-West Frontier Province (1901); the Third Afghan War (1919)		**9**:411e–412g	
3. Beginning of Indian nationalism in the late 19th century and the British response: formation of the Indian National Congress (1885); policies of Lord Curzon (1899–1905); partition of Bengal; founding of the nationalist Muslim League; the Indian Councils Act of 1909		**9**:412g–416a	**5**:375b–d/**6**:370a–d/ **6**:392g–393d/**10**:223e–224b/ **18**:407a–d
4. World War I and its aftermath: India's contribution to the war effort; anti-British activity; the Amritsar massacre; the Government of India Act (1919); Hindu–Muslim relations; the emergence of Mahatma Gandhi and the adoption of his non-cooperation policy		**9**:416a–418d	**6**:393d–394b/**7**:876h–877f/ **10**:224b–d/**13**:805b–g/ **18**:407d–e
D. Ceylon under foreign rulers from *c.* 1505 to 1920	CEYLON, HISTORY OF **4**:5–8		**3**:411h–412a
1. Portuguese political and commercial activities in Ceylon (1505–1658): conflict with the Kandyan kingdom		**4**:5h–7c	**4**:877h–878b

	articles	article sections	other references
2. Dutch rule in Ceylon (1658–1796): its influence on the political, economic, judicial, and administrative systems; commercial enterprises and missionary attempts		**4**:7c–h	
3. The British in Ceylon from 1796: unification and early administration; the reforms of 1833; the transition from a subsistence to a commercial economy; the beginnings of constitutional government; nationalist unrest during World War I		**4**:7h–8g	
E. Tibet and Nepal from *c.* 1750 to *c.* 1920			
1. Decline of Chinese influence in Tibet: administration and culture under the Manchus		**18**:381f–h	
2. Nepal's territorial expansion under the Shah rulers; decline of Shah family and rise of Thapa and Rana families; accommodation with the British to preserve Nepal's independence		**12**:957e–h	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

AURANGZEB **2**:372
BENTINCK, LORD WILLIAM **2**:839
CLIVE, ROBERT **4**:741
CURZON, LORD **5**:374
DALHOUSIE, JAMES RAMSAY, 1ST MARQUESS OF **5**:438
GANDHI, MAHATMA **7**:874
HASTINGS, WARREN **8**:665
RANJIT SINGH **15**:506
RAY, RAMMOHAN **15**:536
ŚIVAJĪ **16**:811
TILAK, BAL GANGADHAR **18**:406

Section 969. Southeast Asia under the influence of European imperialism to c. 1920

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 969 deal with two main subjects: A, the states and European colonies of mainland Southeast Asia from *c.* 1600 to *c.* 1920; and B, the Indonesian Archipelago and the Philippines under European influence from *c.* 1500 to *c.* 1920.

The outline of subject A covers the precolonial period in Burma and in Malaya and the advent of British rule; Siam from *c.* 1620 to *c.* 1910; and Vietnam, Cambodia, and Laos from *c.* 1615 to the establishment of French rule at the end of the 19th century.

The outline of subject B begins with Portuguese and Spanish rivalries in Southeast Asia, and with the Spanish control of the Philippines until the Philippine Revolution (1896–98) and the subsequent U.S. takeover and administration to *c.* 1920. It then deals with the history of Indonesia, treating the Dutch East India Company (1602–1799); the French and British in Java (1806–15); and Dutch rule in the 19th century.

	articles	article sections	other references
A. The states and European colonies of mainland Southeast Asia from *c.* 1600 to *c.* 1920			
1. Burma and Malaya from *c.* 1600 to *c.* 1920: the advent of British rule			
a. Burma from *c.* 1600 to *c.* 1920	BURMA, HISTORY OF **3**:512–514		
i. Renewed expansionism and wars with the Mons, Thais, and Chinese under the Alaungpaya dynasty from 1752: the First and Second Anglo-Burmese Wars (1824–26, 1852); traditional Burmese administration		**3**:512f–513c	
ii. The Third Anglo-Burmese War (1885) and union with British India (1886): effects of British colonialism		**3**:513c–514f/ **9**:412e–g	**4**:362e–g
b. Malaya from *c.* 1630 to *c.* 1920: loss of autonomy through Dutch and British intrusions	MALAYA, HISTORY OF **11**:366–367		
i. Dutch intervention in the Malay states (1633); immigration (*c.* 1650) of Minangkabau and Bugis people from Sumatra		**11**:366e–g	
ii. British invasions in Malaya (1795); clashes between Malays and Chinese immigrants (1874); British intervention and assumption of power from sultanates of Malaya		**11**:366g–367c	**15**:477d–e

	articles	article sections	other references
2. Indochina and the development of French rule from *c.* 1615	VIETNAM, HISTORY OF **19**:124–127		
a. Portuguese and French missionary involvement in Vietnam and Vietnamese reaction (1615–1858); French intervention in Indochina and territorial acquisition of Cochinchina and Cambodia (1858–63)		**19**:124g–126b	**1**:886e–f/**3**:687e–f/ **4**:362g–363a
b. Period of colonization (1873–93); establishment of French protectorates in Annam, Tongking, and Laos; French administration in Indochina		**19**:126b–127a	**8**:628f–g
3. Siam from *c.* 1620 to *c.* 1910	SIAM AND THAILAND, HISTORY OF **16**:720–722		
a. Trade relations with China and other Asian countries; influence of Theravāda Buddhism; Dutch and French intrusions and establishment of trade in the 1660s		**16**:720f–721c	
b. Burmese invasion (1767) and end of Ayutthayan kingdom domination; political reunification and establishment of Chakkri dynasty (1782); social, cultural, and legal development in the early 19th century; Chinese immigration; expansion of trade with the U.S. and with European countries; reign of Mongkut (1851–68)		**16**:721c–722b/ **17**:258f–h	**2**:684b–f
c. Political, social, and economic reforms in the reign of Chulalongkorn (1868–1910): Anglo-French activity in Southeast Asia and acquisition of Siamese territory (1893–1909)		**16**:722c–e	**2**:684g–h
4. Laos from *c.* 1600: establishment of separate kingdoms of Luang Prabang and Vientiane in 1707; Siamese domination from 1778; establishment of French protectorate in 1893	LAOS, HISTORY OF **10**:677–678	**17**:258h–259a	
B. The states and European colonies of the Indonesian Archipelago and the Philippines from *c.* 1500 to *c.* 1920			
1. The Portuguese and the Spanish in Southeast Asia			
a. Portuguese naval and commercial activities, domination of the Strait of Malacca and rivalry with the Spanish in the Spice Islands; collapse of Portuguese commercial empire with the defeat by the Dutch (1641)			**4**:881b–e/**4**:882c–f/ **4**:885b–886c/**14**:869c–d
b. The Philippines to *c.* 1920	PHILIPPINES, HISTORY OF THE **14**:240–242		**11**:448c–d
i. The people and culture of the Philippines prior to the arrival of the Spanish		**14**:240h–241b	
ii. Spanish control of the Philippines (1571–1898): government administration and influence of the Roman Catholic Church; land policy and overseas trade; rise of nationalism in the 19th century		**14**:241c–242b/ **17**:236g–237a	
iii. The Philippine Revolution of 1896–98; U.S. support in ousting the Spanish; subsequent U.S. takeover and administration to *c.* 1920		**14**:242b–h/ **18**:982b–e	
2. The Dutch and other European powers in Indonesia from *c.* 1600 to *c.* 1920	INDONESIA, HISTORY OF **9**:483–487		
a. The Dutch East India Company (1602–1799): Coen's establishment of Dutch commercial supremacy; company rule in Java; decline and abolition of the company		**9**:483h–484h	**4**:885b–886c
b. The French and British in Java (1806–15); Dutch rule in the 19th century		**9**:485a–487h	**15**:476h–477d
i. The Culture System (Cultuur-stelsel) and its deleterious effects on Java (1830–70): the Liberal Policy		**9**:485h–487b	
ii. The Ethical Policy and the rise of nationalism: social and economic benefits; formation of nationalist organizations		**9**:487b–h	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

COEN, JAN PIETERSZOON **4**:816
RAFFLES, SIR THOMAS STAMFORD **15**:476

Section 96/10. China from 1839 until the onset of revolution (to c. 1911), and Japan from the Meiji Restoration to c. 1910

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 96/10 deal with two main subjects: A, China under the late Ch'ing; and B, the modernization of Japan and its emergence as a world power (1868–*c.* 1910).

The outline of subject A covers the last phase of the Ch'ing, or Manchu, Imperial dynasty—a century marked by ineffective compromises resulting from Western challenges and penetration; by humiliating defeats in each of the foreign wars fought by the Manchus; and by Chinese nationalistic movements that at times flared up into bitter rebellions and that finally in 1911 brought an end to Manchu rule.

The outline of subject B begins with the social, political, and economic changes made in Japan after the return of power to the throne during the reign of the Meiji emperor. It then deals with foreign relations in Imperial Japan, treating the dispute with China over Korea; success in the Russo-Japanese War (1904–05); the annexation of Korea (1910); and economic expansion in China.

	articles	article sections	other references
A. China under the late Ch'ing: the challenges of rebellion and Western penetration	CHINA, HISTORY OF **4**:358–366		
1. The Western challenge (1839–60) and the collapse of the tributary system: rebellion and the re-establishment of the Ch'ing government		**4**:358c–361b	**4**:1102h–1103b
a. Problems created by the opium trade: British demands for trade advantages and diplomatic parity culminating in the Opium War (1839–42)		**4**:358c–359g	
i. The Opium War and its aftermath: granting of commercial privileges to Western powers		**4**:358c–359a	**4**:898a–d/**10**:1015d–f
ii. Reactions to foreign trade gains: anti-foreign movements concentrated at Canton		**4**:359a–g	
b. Popular uprisings of the Taiping and Nien and rebellions in western China; the effects of the rebellions		**4**:359a–361b	**9**:44a–g/**10**:970h–971a/ **18**:730d–f
2. Contending forces of westernization and Chinese tradition from *c.* 1850		**4**:361b–366d	**4**:31d–h/**4**:1103b–c/ **10**:1057h–1058c/ **14**:924f–925c
a. The "self-strengthening" movement: its effect on foreign relations and on domestic life		**4**:361b–362b	**10**:971b–c
i. Western attempts at treaty revision and the chilling of Sino-Russian relations; hostility toward Christian missionaries		**4**:361c–f	**4**:898d–g
ii. Industrialization for self-strengthening: mining and the weapons industry; malpractice and corruption in business		**4**:361g–362b	
b. Increasing foreign encroachments (1870–95): loss of Central Asian territories; problems resulting from Chinese hesitancy to engage in regular diplomatic relations; Korea and the Sino-Japanese War (1894–95)		**4**:362b–363f	**10**:80f–81a/**10**:971c–e/ **11**:437b–e/**12**:374h–375b/ **16**:66c–e/**18**:798b–c
c. The reform movement of K'ang Yu-wei, the conservative reaction, and the Boxer Rebellion (1900) as expressions of anti-foreign feelings: Western seizure of Peking (1900) and further Ch'ing concessions; U.S. Open Door Policy		**4**:363f–364g/ **18**:982e–g	**4**:898g–899a/**6**:387f–388b/ **10**:382b–g/**10**:971e–f
d. Reformist and revolutionist movements at the end of the dynasty: Ch'ing reforms after 1901; the Republican movement and the 1911 Revolution		**4**:364g–366d	
i. Sun Yat-sen and the United League: constitutional movements after 1905		**4**:365c–g	**4**:194d–f/**11**:437e–f/ **17**:810e–811b
ii. Peasant uprisings and the 1911 Revolution		**4**:365g–366d	
B. The modernization of Japan and its emergence as a world power (1868–*c.* 1910)	JAPAN, HISTORY OF **10**:78–81		
1. The Meiji Restoration and the process of modernization		**10**:78c–80f	

	articles	article sections	other references
a. The fall of the Tokugawa; leadership and initial policies of the new government; samurai opposition and government countermeasures		**10**:78d–h	**4**:363a–b/**4**:899a–e/ **16**:155f–156f
b. Beginning of Japanese modernization: abolition of feudalism; fiscal and economic policies; growth of *zaibatsu* (cartels); development of national loyalties; religious, educational, and cultural policies		**10**:79a–h/ **6**:370d–371g/ **10**:107f–108c/ **10**:113c–f/ **10**:1071d–1072f	**6**:237e–238d/**16**:675h–676a/ **19**:240h–241g/ **19**:1070g–1071c
c. Politics in Meiji Japan: creation of political parties; oligarchic control and gradual development of representative institutions		**10**:79h–80f	**9**:1175e–1176b
2. Foreign relations in Imperial Japan: dispute with China over Korea; success in the Russo-Japanese War (1904–05); annexation of Korea (1910); economic expansion in China		**10**:80f–81f/ **10**:510d–511c	**4**:363b–f/**4**:899e–f/ **6**:390e–391b/**11**:437e–g/ **15**:1143f–g/**19**:1071c–e

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CHANG CHIH-TUNG **4**:31
HUNG HSIU-CH'ÜAN **9**:43
II NAOSUKE **9**:234
ITŌ HIROBUMI **9**:1175
K'ANG YU-WEI **10**:381
LI HUNG-CHANG **10**:970
LIN TSE-HSÜ **10**:1015
SAIGŌ TAKAMORI **16**:155
SUN YAT-SEN **17**:810
TSENG KUO-FAN **18**:730
YAMAGATA ARITOMO **19**:1070

Section 96/11. Southwest Asia and North Africa (c. 1800–1920), and sub-Saharan Africa (1885–c. 1920) under the influence of European imperialism: the early colonial period

[for Part Nine headnote see page 563
for Division VI headnote see page 618]

The articles and parts of articles referred to in Section 96/11 deal with four main subjects.

Subject A is the Ottoman Empire from 1807 to 1920. The outline covers the beginning of fragmentation in various revolts in the first part of the 19th century; the loss of Romania, Serbia, Montenegro, and most of Bulgaria after the crisis of 1875–78; and the dissolution of the empire in the early 20th century.

The outline of subject B first treats the emergence of modern Egypt (1798–1922), covering the Napoleonic invasion, the regime of Muḥammad 'Alī and his successors, and Egypt under British rule (1882–1922). It goes on to the Maghrib from 1830 to *c.* 1930, treating European penetration into Algeria, Tunisia, Libya, and Morocco. It then deals with Arab nationalism from *c.* 1850 to 1920, and with the emergence of Zionism as a factor in Middle Eastern affairs.

Subject C is Iran under the Qājār dynasty from 1779 to its overthrow in 1925, and Afghanistan from 1809 to the recognition of Afghan independence in 1921.

Subject D is sub-Saharan Africa from *c.* 1885 to *c.* 1920. The outline treats the general character of the imperialistic scramble for African colonies; the establishment of European colonies in West Africa; foreign influences and national movements in northeast Africa; German, British, French, and Italian colonial conquests in East Africa and Madagascar; European penetration into Central Africa; and the British–Boer conflict and the establishment of the Union of South Africa (1910).

	articles	article sections	other references
A. The Ottoman Empire from 1807 to 1920: European intervention and the continuation of westernization	OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE **13**:784–790		**11**:995c–d
1. The empire under Mahmud II: internal reforms and centralization; the Greek revolt (1821–32); the Egyptian revolt (1831–41); Russian intrusions in Turkey		**13**:785c–786e/ **2**:623d–624g/ **6**:1106c–f/ **17**:954e–h/ **18**:1043f–1044a	**1**:1049h–1050d/**2**:622f–623a/ **9**:1071a–b/**16**:61c–f
2. Reaction, revolt, and further disintegration until World War I		**13**:786f–790e	
a. The era of the Tanzimat reforms (1839–76)		**13**:786f–787d	
b. Crisis of 1875–78 and the loss of Romania, Serbia, Montenegro, and most of Bulgaria; the constitution of 1876		**13**:787d–788d/ **2**:626f–628b	
c. The growth of Turkish nationalism in the reign of Abdülhamid II (1876–1909) and dissolution of the empire; domination by Germany in World War I		**13**:788e–790e/ **18**:1044a–d	**2**:255e–256e/**10**:725f–726b/ **17**:954h–955c/ **19**:942h–943b/ **19**:944d–945b/ **19**:949e–967f *passim*

	articles	article sections	other references
B. Egypt, the Maghrib, and the Arabian Peninsula: the development of Arab nationalism and Zionism			
1. The emergence of modern Egypt (1798–1922)	EGYPT, HISTORY OF **6**:492–498		
a. Egypt under French (1798–1801) and British (1801–03) occupation; centralized administration of Muḥammad ʿAlī and his successors (1805–82); construction of Suez Canal (1858–69); European financial and military intervention		**6**:492h–496e/ **3**:755h–756b/ **13**:111d–112g/ **17**:954f–h	**4**:900c–d/**10**:837f–g/ **12**:610b–g/**17**:767a–768c
b. Egypt under British rule (1882–1922): reforms by Baring's (later 1st Earl Cromer) administration (1883–1907); revival of nationalism; World War I and independence (1922)		**6**:496f–498b	**1**:8h–9d/**2**:723b–d/ **13**:112g–113h *passim*/ **19**:1118d–1119a
2. The Maghrib from 1830 to *c.* 1930: European penetration into Algeria, Tunisia, Libya, and Morocco	NORTH AFRICA, HISTORY OF **13**:162–173		**4**:900d–f
a. Algeria from 1830 to 1920: the French conquest (1830–71) and colonial settlements; national resistance movement under Abdelkader; suppression of the Muslim population		**13**:162f–164c	**1**:7h–8g
b. Tunisia from 1830 to *c.* 1930: French influence to 1881 and status as a French protectorate from 1881		**13**:166f–167f	
c. Morocco from 1830 to 1920: growth of French, Spanish, and British influence and decline of the traditional government; establishment of French and Spanish zones and protectorates (1912)		**13**:168d–h	
d. Libya (Tripolitania and Cyrenaica) from *c.* 1834 to 1920: subjection to direct Turkish rule (1835); growth of Italian influence resulting in conquest (1911–12)		**13**:172c–d	
3. Arab nationalism from *c.* 1850 to 1920; emergence of Zionism as a factor in Middle Eastern affairs	SYRIA AND PALESTINE, HISTORY OF **17**:954–956		
a. Origins, growth, and early accomplishments of Arab nationalism; British encouragement in World War I; the postwar settlement		**17**:954h–955g	**10**:725f–726d
b. Origins of the Zionist movement and Jewish immigration to Palestine after 1880; World War I developments and the beginning of conflict between Zionists and Arab nationalists		**17**:958a–b/ **10**:326a–b	**2**:836f–837a/**19**:737b–d
C. Iran under the Qājār dynasty from 1779 to 1925; Afghanistan from 1809 to 1921			
1. Iran: the reign of Āghā Moḥammad Khān and the subsequent European penetration of Iran by the British and Russians; overthrow of the Qājār dynasty (1925)		**9**:860b–g	
2. Afghanistan: the Barakzai dynasty; conflicts with the British government of India; British recognition of Afghan independence (1921)		**1**:175d–176d/ **9**:411g–412e	
D. Sub-Saharan Africa from *c.* 1885 to *c.* 1920			
1. The decline in the slave trade; European commercial, missionary, and exploratory activities in the 19th century; the imperialistic scramble for African colonies; the Berlin West Africa Conference (1884–85) and the European partition of Africa		**4**:899f–900c	**6**:98d–h/**7**:1043f–1044g
2. The establishment of European colonies in West Africa in the late 19th century	WEST AFRICA, HISTORY OF **19**:777–780	**4**:900f–902d	**11**:176c–h
a. French, British, and German rivalry: takeover of the Gold Coast, Senegal, Togo, the Cameroons, Dahomey, and the Ivory Coast		**19**:777c–778e	
b. Problems in establishing effective colonial regimes: military problems; control of the territories; reliance on Africans and development of indirect rule		**19**:778f–780b	
3. Northeast Africa: foreign influences and national movements			
a. The Mahdist movement in the Sudan (1881–98) and the Anglo-Egyptian condominium from 1899		**13**:112g–114d	**11**:348e–349b

	articles	article sections	other references
b. The consolidation of central governmental power in Ethiopia: Tewodros II (1855–68), Yohannes IV (1872–89), and Menelek II (1889–1913); struggles against Egypt, the Sudan, and Italy		**6**:1010b–g	**11**:903d–h
4. East Africa and Madagascar: German, British, French, and Italian conquests and establishment of colonies; relations with indigenous peoples		**6**:98h–101e/ **11**:278b–f	**6**:396g–397a/**19**:950f–h
5. European penetration into Central Africa during the 19th century and establishment of permanent colonies	CENTRAL AFRICA, HISTORY OF **3**:1095–1099		
a. British explorations under Livingstone and Stanley: attempts to explore the interior		**3**:1095a–1096a	**6**:118f–h/**11**:1c–3a/ **17**:583c–584d
b. King Leopold II's colonial enterprise in the Congo: establishment of the Belgian Congo (Congo Free State) and Belgium's Congo policies until World War I		**3**:1096a–1098a	
c. The French colonies and colonial administration until World War II		**3**:1098f–1099d	
6. The scramble for southern Africa; the British–Boer conflict and the establishment of the Union of South Africa (1910); curtailment of economic and political rights of Africans and Asians; the Botha (1910–19) and Smuts (1919–24) governments and Nationalist Party opposition under Hertzog		**17**:286f–291b	**3**:794e–f/**7**:875d–876d/ **10**:230d–f/**10**:538g–539e/ **13**:638b–e/**15**:811h–814f/ **16**:910a–c

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ABDELKADER **1**:7
ʿABDUH, MUḤAMMAD **1**:8
BARING, EVELYN, 1ST EARL CROMER **2**:722
KRUGER, PAUL **10**:538
LAWRENCE, T.E. **10**:725
LESSEPS, FERDINAND DE **10**:837
LIVINGSTONE, DAVID **11**:1
LUGARD, LORD **11**:176
MAHDĪ, AL- **11**:348
MENELIK II OF ETHIOPIA **11**:903
MUḤAMMAD ʿALĪ PASHA **12**:609
RHODES, CECIL **15**:811
SMUTS, JAN **16**:909
STANLEY, SIR HENRY MORTON **17**:582
USMAN DAN FODIO **18**:1100
ZAGHLŪL, SAʿD **19**:1118

Division VII. The world since 1920

[for Part Nine headnote see page 563]

The first of the eight sections in Division VII, reflecting the increasing internationalization since 1920, broadly treats major developments in contemporary world history. The remaining seven sections deal separately with the histories, since 1920, of the several regions of the world.

The subject in Section 971 is international movements, diplomacy, and war since 1920. The outline divides the treatment of this subject into four periods: the period between World Wars; World War II; international relations in the immediate postwar period; and international relations in the period since 1957.

The subject in Section 972 is Europe since *c.* 1920. The outline treats separately the histories of each of the nations of western Europe, the histories of the nations of eastern and central Europe, and the arts and intellectual life in Europe since 1920.

The articles referred to in Section 973 treat the history of the United States and Canada since 1920.

The articles referred to in Section 974 deal separately with each of the Latin American and Caribbean nations, and then treat developments in Latin American literature, music, and visual arts in the 20th century.

The subject in Section 975 is East Asia, covering the history of China since 1912; of Japan since *c.* 1910; and of Korea since 1910.

Section 971. International movements, diplomacy, and war since 1920 663
972. Europe since *c.* 1920 666
973. The United States and Canada since 1920 672
974. Latin American and Caribbean nations since *c.* 1920 675
975. East Asia: China in revolution, the era of Japanese hegemony, and the influence of the United States in the 20th century 680
976. South and Southeast Asia: the late colonial period and the emergence of new nations since 1920 683
977. Australia and Oceania since 1920 686
978. Southwest Asia and Africa: the late colonial period and the emergence of new nations in the 20th century 687

The subject in Section 976 is the recent history of South and Southeast Asia: the late colonial period and the period of the emergence of new nations. The outline covers the recent histories of the Indian subcontinent, Ceylon, Tibet, Nepal, Burma, Malaya, Thailand, Indochina, Indonesia, and the Philippines.

The outline in Section 977 first deals generally with international developments in the Pacific and with the disposition of the dependent territories of Oceania since 1920. It then treats separately the history of Australia since 1920 and the history of New Zealand since *c.* 1920.

The subject in Section 978 is Southwest Asia and Africa: the late colonial period and the period of the emergence of new nations. The outline covers Turkey since 1919; the development of the Arab states and Israel in Southwest Asia and Egypt; Iran and Afghanistan; North Africa since 1920; and sub-Saharan Africa since *c.* 1920.

Section 971. International movements, diplomacy, and war since 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 971 deal with four main subjects: A, the period between the World Wars (1920–39); B, World War II (1939–45); C, international relations in the postwar period; and D, international relations in the period since 1957.

The outline of subject A treats immediate post-World War I problems (1920–24); the temporary amelioration of international relations by the Locarno (1925) and Kellogg–Briand (1928) pacts; international affairs in the 1930s; and economic developments in the period between the World Wars (1920–39).

The outline of subject B first follows the course of World War II, covering the German subjugation of central and western Europe, the Battle of Britain, and the invasion of the Soviet Union; the war in Asia and the Pacific (1937–45); and the Allied invasions in North Africa and Europe (1942–45). The outline next treats the leadership, industrial strength, strategy, and tactics of the Axis Powers and of the Allied Powers. Finally, it deals with the expansion of military technology during the war.

The outline of subject C begins with the aftermath of World War II (1945–53), covering the postwar plans and conferences and the formation of the United Nations, and developments in postwar East Asia. It goes on to the military standoff between Communist and Western Powers in the later 1950s. Finally, it deals with developments in the Third World—the breakup of European colonial empires and emergence of independent states in Asia and Africa, problems of economic underdevelopment, and the pressures of East–West rivalry.

Subject D is international relations in the period since 1957. The outline first deals with the continued scientific and military rivalry between the United States and the Soviet Union, and with the continued tension between the Soviet Union and other Communist countries. It further treats the U.S. involvement in the Vietnam War; the growth of Japanese economic power and influence; continued hostilities in the Middle East; the expansion of black African independence movements; economic and political developments in western Europe; Socialist movements and social, economic, and political crises in Latin America; and the role of economic factors in international relations.

A. The period between the World Wars (1920–39)

1. Immediate postwar problems (1920–24)
   a. Failure of attempts to establish Socialist and new democratic governments in Europe: dictatorships in the new nations of central and eastern Europe
   b. Diplomacy after the Paris Peace Conference (1919–20): establishment of the League of Nations; U.S., Soviet Russian, and German diplomatic isolation; crises concerning enforcement of the peace settlement
2. The temporary amelioration of international relations by the Locarno (1925) and Kellogg–Briand (1928) agreements; European recovery and the rapprochement with Germany
3. International affairs in the 1930s
   a. The upsurge of strife in Asia: civil conflict in China and the Japanese seizure of Manchuria (1931–32); rise of the militarists in Japan and the Greater East Asia Co-prosperity Sphere
   b. The Popular Front and the Spanish Civil War (1936–39): unchecked Italian aggression against Ethiopia (1935–36); failure of the League of Nations and other diplomatic attempts (the Munich Conference) to avert war

articles	article sections	other references
WORLD WARS **19**:967–977		
	19:967g–971g	
	19:968b–969g/ **16**:70h–73e	7:673b–d/**11**:159d–f
	19:967g–968b/ **19**:969g–971g/ **16**:863d–g/ **18**:987b–g	**12**:750c–751c/**14**:708a–c
	19:971h–973g	**2**:1196c–d/**7**:673a–b/ **8**:118c–f
	19:973e–g/ **19**:977a–g/ **4**:372a–374a/ **11**:437e–438e	**10**:83g–85e
	19:975h–977a/ **2**:1196f–1197g/ **3**:277h–278e/ **6**:1011a–c/ **9**:1169b–c/ **17**:441f–442d	**3**:744f–h/**4**:597g–598a/ **7**:674a–c/**12**:751d–g

	articles	article sections	other references
c. The European colonial empires and client states: increased demands for self-determination among subject peoples; realignment of colonial powers		**4**:902d–903d/ **9**:418e–420g/ **17**:290a–291g	**3**:305a–f/**4**:597a–c/ **10**:430g–431c/**12**:945a–e/ **13**:114b–f/**13**:167f–168a/ **19**:1118d–1119a
4. Economic developments in the postwar period (1920–39)	ECONOMIC HISTORY SINCE 1500 **6**:242–249		
a. Increased government control (1920–29): reconstruction, social welfare, and inflation		**6**:242c–244e	
b. Economic and political impact of the Great Depression (1929): collapse of the world market and responses by various governments		**6**:244e–246a/ **3**:277c–h/ **3**:743g–744f/ **18**:988h–989d/ **19**:973g–974a	7:673d–h
c. The establishment of Nazi Germany and economic recovery based on rearmament; Germany's alignment with Italy and Japan; the New Deal policy in the U.S.; War Communism and the New Economic Policy in Soviet Russia		**6**:246a–248g/ **8**:118f–120d/ **16**:71d–75f/ **18**:989e–991e	**8**:967g–968d/**10**:85c–e/ **12**:751d–f/**19**:974b–975g
B. World War II (1939–45)	WORLD WARS **19**:979–1013		
1. German conquest of Poland (1939) and France (1940): the German–Soviet pact (1939) and subsequent German invasion of the Soviet Union (1941); the Battle of Britain (1940) and the war in North Africa (1940–42)		**19**:979c–988h/ **16**:78e–79f	**2**:675f–676a/**3**:278d–g/ **4**:598b–599c/**7**:674c–e/ **8**:120f–121a/**11**:159f/ **14**:652f–653b/**15**:1135c–e
2. The war in Asia and the Pacific (1937–45)		**10**:85c–86e	
a. Further Japanese aggression in China from 1937: the clash between U.S. and Japanese interests in the Pacific; the attack on Pearl Harbor (1941) and U.S. entry into the war		**19**:988h–992d	**4**:372h–375h *passim*/ **10**:85c–86a/**18**:991h–992c
b. Japanese conquests in the western Pacific and Southeast Asia (1941–42); the Allied counteroffensive from 1942, resulting in Japanese defeat (1945)		**19**:994b–995d/ **19**:1000b–d/ **19**:1003g–1005e/ **19**:1012c–1013d/ **19**:1008h–1010b/ **2**:420e–g	**10**:86a–e/**11**:220c–e/ **12**:945g–h
3. The war in Europe and North Africa (1942–45)			
a. Beginning of U.S. active participation (1942); Allied progress against the Axis Powers in North Africa and Europe		**19**:992d–994b/ **19**:995d–999a/ **4**:903d–904h/ **18**:992c–993c	**4**:599a–c/**15**:1141a–f
b. Collapse of the German Eastern Front (1943) and Soviet conquest of eastern Europe (1943–44); Allied invasions of Italy (1943) and France (1944), and the defeat of Germany (1945)		**19**:999b–1000a/ **19**:1000e–1003g/ **19**:1005e–1008g/ **19**:1010c–1012c/ **9**:1169g–1170c/ **16**:79d–81c	**8**:121b–f/**12**:752b–e/ **14**:653b–g
4. The leadership, industrial strength, strategic plans and goals, and tactical and logistical procedures of the Axis Powers		**19**:581c–g	**15**:929a–g/**19**:564g–565b
5. Allied wartime leadership and diplomacy: the Atlantic Charter; industrial strength, strategic plans and goals, and tactical and logistical procedures		**19**:991h–992h/ **19**:999d–g/ **19**:1008b–g/ **3**:744h–745b/ **8**:491h–492e/ **11**:80e–83f/ **12**:87b–e/ **18**:993a–c/ **19**:581g–582e	**15**:1141c–f/**19**:565b–566f
6. The burgeoning of military technology; *e.g.*, developments in communications devices, naval ships and aircraft, ground weapons and missiles, atomic bombs		**19**:998h–999d/ **19**:1007g–1008b/ **19**:1012c–1013d/ **7**:553b–554h/ **12**:894g–896e	**2**:530c–e/**6**:865c–866a/ **13**:324g–326c/**15**:928c–930a/ **16**:900g–901h/ **17**:749h–750e/**17**:1021b–f
C. International relations	INTERNATIONAL RELATIONS **9**:751–778		

	articles	article sections	other references
1. International relations before and during World War II		**9**:751–754h	
a. The Eurocentric world and its collapse		**9**:751c–752c	
b. Ideologies in World War II		**9**:752c–754h	
i. The Nazi–Soviet pact		**9**:752c–753c	**16**:78a–e
ii. Roosevelt, Churchill, and the Atlantic Charter		**9**:752c–754b	
iii. Soviet expansion, Stalin and the Nazis, annexations		**9**:754b–h	**16**:78e–81c
2. The postwar years, 1945–57		**9**:754h–765c	**19**:555c–556d/**19**:569a–d
a. The end of the war and the early UN		**9**:754h–755e	**8**:1185f–1187b
i. The atomic bombs		**9**:754h–755a	**19**:566f–h
ii. Truman's fundamental principles		**9**:755b–c	**18**:993e–h
iii. The UN as a Western organization		**9**:755c–e	
b. Reconstruction and European political instability		**9**:755e–756a	
c. The beginnings of the Cold War		**9**:756a–757h	**16**:82g–83b
i. Consolidation of Soviet power in eastern Europe: the "iron curtain"		**9**:756a–e	
ii. The Cold War as *Realpolitik* and as ideology		**9**:756e–757b	
iii. The confrontation in Germany: the Berlin blockade		**9**:757b–g	
iv. The formation of NATO		**9**:757g–h	
d. East, South, and Southeast Asia, 1945–57		**9**:757h–760a	**10**:86e–89b
i. The colonial territories of Asia		**9**:757h–758d	
ii. Civil war in China and Communist rule		**9**:758d–g	**4**:375h–378f/**4**:390a–393c
iii. The Korean War: its meaning, course, and consequences		**9**:758g–759g	**10**:513b–514c
iv. The transformation of the American role in Southeast Asia		**9**:759g–760a	
e. The Middle East, 1945–57		**9**:760a–761f	
i. The U.S. in the Middle East		**9**:760c–d	
ii. The Iranian and Turkish cases		**9**:760d–e	
iii. Palestine: Israel and the Arabs		**9**:760e–761b	**17**:960e–961b/**9**:1059c–e
iv. Nasser and the Suez crisis		**9**:761b–f	**6**:499e–500d
f. The continuing Cold War		**9**:761f–765c	
i. The U.S. policy of containment		**9**:761g–762a	
ii. The late Truman administration		**9**:762a–c	**18**:994f–995a
iii. The Eisenhower years and McCarthyism		**9**:762c–g	**18**:995b–996b
iv. De-Stalinization in the Soviet Union		**9**:762g–h	**16**:84d–h
v. Unrest among the satellites		**9**:762h–763b	
vi. NATO and European economic recovery		**9**:763b–d	
vii. Soviet responses		**9**:763d–f	
viii. The problem of nuclear energy: the balance of terror; France as a nuclear power		**9**:763g–765a	**19**:569a–g
ix. The Austrian treaty and the German problem		**9**:765a–c	
3. The period since 1957		**9**:765c–778b	
a. The Great Powers and the world		**9**:765c–771b	**18**:996e–f/**19**:551f–553d
i. Postwar economic growth: U.S. economic dominance		**9**:765e–766e	
ii. Decolonization		**9**:766e–h	
iii. The Soviet Union and "national liberation"		**9**:766h–767b	
iv. The new states: nonalignment and domestic problems; aid programs		**9**:767b–768a	
v. The Third World as a zone of conflict in the Cold War		**9**:768a–e	
vi. Latin America in the Cold War: Fidel Castro		**9**:768e–769f	
vii. The Berlin Wall and the Cuban Missile Crisis: consequences		**9**:769b–f	**16**:85c–d
viii. Sino–Soviet relations: the consequences of their rift		**9**:769f–771b	**16**:85d–h/**4**:1024h–1025d

	articles	article sections	other references
b. The lesser powers		9:771b–773h	
i. Peace in postwar Europe		9:771b–e	
ii. Integration movements in western Europe; Gaullism		9:771e–772f	
iii. The new Europe: regional separatism		9:772f–h	
iv. Eastern Europe: the Soviet variety of imperialism		9:772f–773h	
c. Areas of conflict		9:773h–776b	19:130a–131b
i. Southeast Asia: the Indochina War		9:773h–774h	18:996h–997f
ii. The Middle East: the Arab–Israeli wars; the new role of petroleum		9:774h–776b	6:500c–g/17:961h–965b
d. Détente, the superpowers, and the new structure of world politics		9:776b–778b	
i. Peaceful coexistence		9:776d–g	
ii. The U.S. view of détente		9:776g–777a	18:999c–d
iii. Resolution of the German problem: two Germanys		9:777a–e	
iv. The Helsinki conference (1973) and after		9:777e–778b	

Section 972. Europe since c. 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 972 deal with three main subjects: A, the nations of western Europe since *c.* 1920; B, eastern and central Europe since *c.* 1920; and C, the arts and intellectual life in Europe since 1920.

The articles referred to in subject A separately treat the histories since *c.* 1920 of Great Britain and Ireland, France, Germany, Italy, Spain and Portugal, Scandinavia, the Low Countries, and Switzerland.

The articles referred to in subject B separately treat the Soviet Union from the establishment of the Communist state; Austria since 1918; Hungary since 1918; Czechoslovakia since 1914; Poland since 1918; the Baltic states; and the history since *c.* 1919 of the Balkan states of Greece, Yugoslavia, Bulgaria, Romania, and Albania.

The outline of subject C covers new developments in the natural and social sciences and in technology; the rise of popular culture; developments in the arts and in philosophy; and the influence of cultural exchanges in 20th-century world civilization.

	articles	article sections	other references
A. The nations of western Europe since *c.* 1920			
1. Great Britain and Ireland			
a. Developments in Great Britain	BRITAIN AND IRELAND, HISTORY OF 3:276–282		4:648g–649c
i. Economic depression, labour unrest, and domestic politics in the interwar period: formation of the first Labour government under MacDonald (1923); Baldwin's government (1924–29) and the General Strike of 1926; the National Government (1931–39)		3:276a–277h	2:529g–h/4:597c–f/ 10:448a–c
ii. British colonial and Commonwealth relations (1920–39): division of Ireland into the Irish Free State (after 1937 named Eire) and Northern Ireland (1922); the Indian problem		3:292b–293a/ 3:304h–305f/ 9:418e–420g/ 11:995d–996f	3:743d–g/5:1073a–c/ 10:430g–431c/19:737d–g/ 19:1118d–1119a
iii. Interwar foreign policy (1931–39); Churchill's government (1940–45) and Britain's stand against the Axis Powers in World War II		3:277h–279c/ 11:997d–f	4:597h–599g/13:326b–c/ 19:980f–1013e *passim*

iv. The Labour government (1945–51) and the welfare state; role in NATO and relationship to the European Economic Community (Common Market); the Conservative government (1951–64); disintegration of the British Empire; Labour government (1964–70); Conservative government (1970–74); Labour government after 1974; entrance into the Common Market (1973); developments in Scotland and Wales

b. Developments in Ireland since *c.* 1920

i. Division of Ireland and establishment of the Irish Free State and Northern Ireland (1922); the Cosgrave and De Valera governments; neutrality in World War II; entrance into the Common Market (1973); postwar domestic politics; death of De Valera (1975)

ii. Northern Ireland since 1922: growing antagonism between Roman Catholics and Protestants; economic stagnation; continuing violence

2. France since 1920

a. From 1920 to the end of World War II

i. Developments in the interwar period: internal financial crises and German reparations; collective security; the Great Depression; political instability and conflicts between right and left in the 1930s

ii. Social, cultural, and economic developments under the Third Republic

iii. World War II: defeat by Germany (1940) and the Vichy government; de Gaulle, the Free French, and Resistance movements; French participation in the Allied victory (1944–45)

b. The postwar period

i. The Fourth Republic (1946–58): constitution of the Fourth Republic; the realignment of parties; colonial independence movements; the French Indochina War, the Algerian War, and the crisis of 1958; de Gaulle's return to power

ii. The Fifth Republic: de Gaulle's settlement of the Algerian question; recognition of independence of the French African colonies; Common Market activities; the student revolt of 1968; de Gaulle's retirement and continued rule by the Gaullist coalition

3. Germany since 1920

a. From 1920 to the end of World War II

i. The German Republic (1919–33): the Weimar Constitution; reaction to the Treaty of Versailles and reparations payments; opposition from the left and the right; attempts to stabilize the republic and re-establish Germany's international position; the rise to power of National Socialists (Nazis) and the end of the republic

ii. The Third Reich (1933–45): the Nazi revolution and establishment (1934–39) of the totalitarian police state by Hitler; persecution of the Jews; rearmament, expansion in eastern Europe, and formation of Axis alliance; World War II conquests throughout Europe; defeat by Allies (1945)

b. The postwar period

i. Germany after World War II (1945–49): occupation by the Allies; partition between west and east zones

articles	article sections	other references
	3:279d–282e/ **3**:305g–306g/ **5**:385b–c/ **9**:421f–423e	**4**:599g–600f/**18**:876a–893a
	3:292c–294a	
	3:292c–293f	**5**:624d–625a/**9**:884c–889a
	3:293g–294a	**13**:237e–g/**13**:238g–242f
FRANCE, HISTORY OF **7**:672–680		
	7:672e–677b	
	7:672e–674e	**6**:177c–h
	7:674e–676a	**6**:379f–g
	7:676b–677b	**14**:153a–c/ **19**:980f–1007d *passim*/ **19**:1010c–e
	7:677c–680c	
	7:677c–678f/ **9**:759f–760e/ **19**:129b–g	**6**:379h–380d/**8**:982f–983a/ **13**:164g–166a
	7:678f–680c/ **4**:650c–651c	**3**:748a–f/**5**:89e–f/ **7**:592c–611a/**7**:963g–965f/ **9**:774f–775d
GERMANY, HISTORY OF **8**:116–125		
	8:116e–121f/ **7**:185h–186d	**2**:850b–d
	8:116e–119b/ **19**:971b–973e	**6**:379a–f/**7**:672f–g/ **8**:223g–224a/**8**:254d–g/ **8**:888a–c/**8**:966e–967e/ **11**:205h–206a/ **16**:970e–971a/**17**:733a–f/ **19**:974b–975g
	8:119c–121f/ **2**:1196f–1197g/ **6**:246a–e/ **9**:40d–41f/ **16**:300c–g/ **16**:863h–864c/ **19**:977g–988h	**2**:478c–h/**2**:635g–636a/ **2**:850c–d/**4**:647f–g/ **6**:376a–b/**8**:224a–c/ **8**:254g–255e/**8**:888c–d/ **8**:967g–969h/**10**:540h–541c/ **11**:602e–g/**15**:118d–e/ **15**:929a–g/**19**:550h–551b/ **19**:980f–1012c *passim*
	8:121f–125g	
	8:121f–122d	**2**:850d–g/**19**:555f–h

	articles	article sections	other references
ii. The formation of the Federal Republic of Germany and the leadership of Chancellor Adenauer; role in NATO; relations with the Soviet Union; economic recovery; continued Christian Democratic Union rule under Erhard and Kiesinger; Social Democratic Chancellor Willy Brandt		**8**:122d–125a	**1**:87a–f/**4**:647g–648c/ **8**:55d–68g/**9**:775d–g/ **15**:569e–f/**16**:971g–h
iii. The German Democratic Republic: the Ulbricht government; crises caused by the refugee problem and the Berlin Wall; economic recovery and the beginning of rapprochement with the West; beginning of collective leadership under Erich Honecker (1971)		**8**:125a–g	**8**:10d–15g
4. Italy since 1920	ITALY AND SICILY, HISTORY OF **9**:1167–1173		**6**:380d–g
a. The Fascist era		**9**:1167d–1170f/ **7**:185b–g/ **10**:1237f–1238b	
i. The postwar cabinets; foreign relations and the Fiume affair; the Fascist Party's rise to power (1922); Mussolini and the Fascist dictatorship; the Lateran Treaty (1929)		**9**:1167d–1169a	**12**:750c–751d
ii. Rapprochement with Germany; conquest of Ethiopia; effects of the Great Depression; Italian participation in World War II; the resistance movement and the fall of Mussolini; Parri's coalition government		**9**:1169b–1170f/ **6**:1011a–c/ **19**:975h–977a	**12**:751d–752e/**14**:486e–487b/ **19**:1001h–1011h *passim*
b. Postwar Italy: the politics of the republic; the De Gasperi era (1947–53); ministerial instability; economic recovery; parliamentary shift to the centre-left		**9**:1170f–1173c	**4**:651d–f/**5**:88d–e/ **9**:1096g–1114c
5. Spain and Portugal			
a. Spain since 1920	SPAIN, HISTORY OF **17**:440–443		
i. The military government of Primo de Rivera and establishment of the republic: the Civil War, German and Italian intervention, and Franco's victory; Spain's neutralism in World War II		**17**:440c–442g/ **19**:976d–977a	**1**:811b–g/**7**:689h–690e
ii. Rapprochement with the NATO powers in the postwar era: the Franco regime		**17**:442g–443d	**7**:690e–h/**17**:388h–400d
b. Portugal: military revolt (1926); the Salazar regime (1928–68); the constitution of 1933; neutralism in World War II; the effort to maintain the Portuguese colonial empire in the 1950s and 1960s		**14**:873b–f/ **17**:298a–g	**10**:1032b–d/**12**:592f–g/ **14**:859c–864e
6. Scandinavia since *c.* 1900	SCANDINAVIA, HISTORY OF **16**:329–336		
a. Denmark since *c.* 1900		**16**:329e–331d	
i. Foreign policy, World War I, and economic effects of the war; the Great Depression; German occupation in World War II		**16**:329e–330g	
ii. The postwar period: military, economic, and social policies		**16**:330g–331d	**5**:584b–587h
b. Sweden since *c.* 1900		**16**:331d–333b	
i. Political reforms and defense policies prior to World War I; neutrality during the war		**16**:331d–g	
ii. Politics in the interwar period: economic reforms and foreign policy; neutrality in World War II		**16**:331h–332e	
iii. Social and political reforms and establishment of the welfare state; foreign policy		**16**:332e–333b	**17**:847d–854e
c. Norway since *c.* 1900		**16**:333b–334f	
i. Separation from Sweden (1905); World War I, the Great Depression, and gradual economic recovery; foreign policy and German occupation during World War II		**16**:333b–334c	
ii. Political and social developments in the postwar period; foreign policy		**16**:334d–f	**13**:265c–270f

	articles	article sections	other references
d. Finland and Iceland since *c.* 1900			
i. Finland: liberation from Russia (1918); parliamentary government; agrarian reform; growth of political parties; language problems; foreign policy and activities during World War II; domestic and foreign policies in the postwar period		**16**:334g–336h	
ii. Iceland: political developments (in union with Denmark) in the interwar period; aid to the Allies in World War II; establishment as an independent republic (1944)		**16**:334g–336c	7:303h–309h
7. The Low Countries since 1920: Belgium, The Netherlands, and Luxembourg in the interwar period; German occupation in World War II; postwar loss of colonial possessions and integration in the European Economic Community; the Walloon Popular Movement; Benelux membership in NATO		**16**:336d–h	9:172h–175d
8. Switzerland since 1920: Swiss neutrality in World War II; immigration and economic policies		**11**:153g–154f/ **11**:159d–160d/ **5**:380b–e/ **8**:642b–643e	**2**:820e–824g/**6**:380g–381a/ **7**:187d–f/**11**:186d–h/ **11**:203g–204h/ **12**:1062d–1066d/**17**:783g–h
B. Eastern and central Europe		**17**:887b–f	**17**:875c–878f
1. The Soviet Union from the establishment of the Communist state	RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:68–88	**4**:652a–653a/ **6**:159g–160d/ **18**:1044a–d	
a. From 1917 to the end of World War II		**16**:68a–81c/ **6**:247b–248c/ **17**:314a–315c	**2**:673d–674c *passim*/ **12**:375b–e/**16**:864c–f/ **18**:797d–f
i. The governments of 1917; the October Revolution and establishment of the Soviet government; Civil War, War Communism, and the New Economic Policy; the struggle for succession after Lenin's death (1924), and the rise of Stalin		**16**:68a–73c/ **4**:1020b–1021c/ **16**:969d–970a/ **19**:968b–969g	**10**:794f–797b/**17**:577f–g/ **18**:718b–720a
ii. Foreign policy, society, and culture under the New Economic Policy: purges and consolidation of Stalinism; Soviet foreign policy in the 1930s		**16**:73c–78e/ **4**:1021c–1022b/ **6**:248d–g/ **6**:256c–h/ **11**:558g–559e	**4**:669c–f/**6**:385h–386f/ **17**:577h–578d/**18**:720a–d
iii. World War II: consolidation in eastern Europe; the German offensive (1941) and the Battle of Stalingrad; Soviet advance into Europe; resurgent nationalism and strengthening of the regime; Soviet military and political position in 1945		**16**:78e–81c/ **9**:41a–f	**4**:1022b–f/**13**:326c–e/ **17**:578e–f/ **19**:987g–1012c *passim*
b. The postwar period		**16**:81c–88e/ **2**:676a–f/ **6**:257a–h/ **9**:41f–43e	**1**:319b–c/**11**:438f
i. Soviet economic recovery after the war: Stalin's monopoly of power until his death (1953); Cold War relations with the U.S. and other countries; deterioration of relations with the People's Republic of China		**16**:81c–83f/ **2**:636h–638c/ **4**:1022e–1024a/ **6**:248g–249c/ **9**:761f–762e	**17**:578g–h
ii. De-Stalinization and the Khrushchev era (1957–64): ideological disputes with China; economic problems		**16**:83g–86b/ **4**:1024b–1026a/ **9**:764e–767e/ **9**:769a–771b	**2**:638e–g/**4**:390g–391a/ **5**:358c–d/**6**:386g–387c/ **10**:456e–457f/ **11**:467f–469b *passim*
iii. The Brezhnev–Kosygin era after 1964, and collective leadership: agricultural problems and achievements in industrial production; foreign policy and space exploration; continued censorship, and discontent among intellectuals		**16**:86c–88e/ **2**:1200a–h/ **4**:1025h–1026a/ **6**:276d–g/ **9**:767f–773f/ **18**:52g–53f	**4**:395h–396d/**4**:399f–g/ **6**:387c–e/**15**:930h–931f/ **16**:94d–100f
2. The states of central Europe			
a. Austria since 1918	AUSTRIA, HISTORY OF **2**:476–480		
i. Establishment of the First Republic (1918); economic reconstruction and political strife; association with Italy; authoritarian rule of the Dollfuss and Schuschnigg governments; the *Anschluss* (annexation by Germany) and participation in World War II		**2**:476d–478h/ **19**:977g–979a	**8**:120d–e/**8**:535f–g

	articles	article sections	other references
ii. The Second Republic: independence in 1945; Allied occupation to 1955; restoration of sovereignty and establishment as a neutral state (1955)		**2**:478h–480b	**2**:444g–447h
b. Hungary since 1918	HUNGARY, HISTORY OF **9**:39–43	**18**:1024g–1025c	
i. Establishment of the republic (1918); Béla Kun's "soviet republic"; loss of Transylvania, Slovakia, and Croatia by the Treaty of Trianon (1920); the Horthy regency (1920–45); financial crisis and the rise of the radical right; reacquisition of Slovakian territory in partnership with Germany; World War II; restoration of the Trianon frontiers (1947)		**9**:39a–41f	**7**:187b–c
ii. The postwar People's Republic: the reaction against Soviet domination in the Revolution of 1956; suppression of the revolt; the Kádár regime		**9**:41f–43e/ **6**:258b–d	**4**:1024f–h/**9**:25h–29h/**9**:763d
c. Czechoslovakia since 1914	BOHEMIA AND CZECHOSLOVAKIA, HISTORY OF **2**:1194–1200		
i. The struggle for independence under Tomáš Masaryk; establishment of the republic (1918); consolidation of internal affairs		**2**:1194h–1196a	**11**:572d–h
ii. Discontent among Sudeten German and Slovak minorities: attempts at rapprochement with Germany; the Munich agreement (1938) and German takeover of Czechoslovakia; participation in World War II		**2**:1196a–1197g/ **19**:977g–979a	
iii. The restoration of Czechoslovakia in 1945; the dominant role of the Communists; Jan Masaryk; Communist rule from 1948		**2**:1197g–1198d	
iv. Developments since 1948: the People's Democracy (1948–60); collectivization of land and adjustments to the Soviet pattern; attempts at liberalization and reform; "Prague Spring" under Dubček (1968); invasion by five Warsaw Pact countries and partial return to the Soviet line since 1968		**2**:1198d–1200h/ **4**:1025f–h	**5**:414g–420d
d. Poland since 1918	POLAND, HISTORY OF **14**:650–654		
i. Establishment of the Second Polish Republic (1918); the "Polish Corridor"; Polish-Soviet War of 1920–21; the Piłsudski regime; social and economic problems; German invasion and joint German-Soviet partition (1939); permanent loss of territory to the Soviet Union and annexation of German territory (1945)		**14**:650g–653g/ **19**:979c–980c	**8**:120f–g/**14**:464f–465c/ **19**:608e–g
ii. Postwar developments: relations with the Roman Catholic Church; agricultural and industrial growth; the 1956 uprising; the Gomułka and Gierek governments; foreign relations		**14**:653g–654g/ **4**:653a–d	**8**:253g–254a/**9**:763c/ **14**:629h–637c
e. The establishment (1918) of Latvia, Estonia, and Lithuania as independent states following the breakup of the Russian Empire; political and economic development in the interwar period; incorporation into the Soviet Union (1940); German occupation (1941–44); collectivization and industrialization in the postwar period	BALTIC STATES, HISTORY OF THE **2**:673–676	**19**:980d–f	**6**:967d–968g/**10**:706g–708a/ **10**:1265d–1267d
3. The Balkans: Greece, Yugoslavia, Bulgaria, Romania, and Albania since *c.* 1919	BALKANS, HISTORY OF THE **2**:633–639		
a. Settlement of the borders of Balkan states (1919–26): continued dislocation of nationality groups; growth of peasant political parties and Communism		**2**:633h–634e	**13**:1044c–f/**19**:76h–77a
b. Government reactions to civil unrest in the interwar period: land reform and industrialization; police repression; foreign relations; the Great Depression; political instability		**2**:634e–635f	

	articles	article sections	other references
c. German invasion and Axis occupation (1940–45): resistance movements and Communist leadership of the partisans		**2**:635f–636h	**18**:463c–f/ **19**:984e–1012c *passim*
d. Postwar developments: establishment of Communist governments in Yugoslavia, Albania, Romania, and Bulgaria; Yugoslav break with the Soviet Union (1948); Greek military dictatorship (1967–74) and repudiation of the monarchy (1974); Albanian alignment with China (1961); Romanian nationalism against the Soviet Union		**2**:636h–639f/ **2**:705e–706a/ **5**:408d–409e/ **6**:258a–b/ **6**:276g–277b	**1**:419f–422a/**3**:472e–474h/ **4**:1023e–g/**8**:321d–322d/ **15**:1051g–1054a/ **18**:463f–464b/ **19**:1103d–1107a
C. The arts and intellectual life in Europe since 1920: increasing concern with the problems of alienation and despair; the importance of popular culture		**1**:574e–576f/ **6**:1080b–1081c/ **10**:205e–g/ **15**:1016g–1017d/ **16**:986f–988a	**6**:411a–e
1. New views of the universe: developments in technology, science, and the social sciences		**6**:86c–90d/ **6**:1078d–1080b/ **16**:374h–375e	**18**:22c–24e *passim*
2. The influence on art and thought of the two World Wars		**6**:1080b–1080e/ **8**:963h–964b/ **10**:1216a–1260f/ **11**:602e–603c	
3. The rise of popular culture: radio, television, motion pictures, and popular music; popular journalism and literature		**3**:314g–316g/ **3**:916c–917g/ **3**:921f–922e/ **6**:1080e–1081c/ **7**:873g–874c/ **12**:523d–529f/ **12**:534d–539d/ **12**:697d–699c/ **14**:810b–811g/ **15**:255h–256f	**15**:231e–233e/**15**:744f–745a
4. Developments in the arts: formal experimentation in music and in the visual arts; the literature of social protest; the theatre of the absurd		**12**:696b–697c/ **12**:699c–700e/ **18**:229d–234e/ **19**:464h–473g/ **19**:480d–484c	**1**:1d–2c/**4**:19d–20g/ **10**:378f–379b/**12**:274h–275g/ **12**:433b–435c/**14**:442f–444e/ **15**:1166g–1167b/ **16**:256d–257e/**18**:22c–g
5. The bifurcation of philosophy into logical or linguistic analysis and Existentialism		**1**:802d–806h/ **6**:411e–f/ **8**:736h–738e/ **14**:213c–215b/ **14**:272g–274b	**3**:925d–926f/**19**:901h–902c/ **19**:902h–903e
6. The legacy of European culture in 20th-century world civilization; the cultural influence of the U.S. and other non-European cultures on Europe		**14**:272a–274c/ **14**:802g–803e	**10**:198f–199e/**14**:811f–g

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ADENAUER, KONRAD **1**:86
CHURCHILL, SIR WINSTON **4**:595
CURZON, LORD **5**:374
DE VALERA, EAMON **5**:624
FRANCO, FRANCISCO **7**:689
GAULLE, CHARLES DE **7**:962
GOEBBELS, JOSEPH **8**:222
GOMUŁKA, WŁADYSŁAW **8**:252
GÖRING, HERMANN **8**:254
HINDENBURG, PAUL VON **8**:887
HITLER, ADOLF **8**:965
KHRUSHCHEV, NIKITA SERGEYEVICH **10**:455
KRUPP FAMILY **10**:539
LENIN **10**:791
LUDENDORFF, ERICH **11**:174
MASARYK, TOMÁŠ **11**:572
MUSSOLINI, BENITO **12**:749
PÉTAIN, PHILIPPE **14**:152
ROMMEL, ERWIN **15**:1134
STALIN, JOSEPH **17**:576
STRESEMANN, GUSTAV **17**:731
TITO **18**:462
TROTSKY, LEON **18**:717
VENIZÉLOS, ELEUTHÉRIOS **19**:76

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

ALBANIA **1**:417
AMSTERDAM **1**:710
ANDORRA **1**:864
ANTWERP **1**:1001
ATHENS **2**:262
AUSTRIA **2**:440
BADEN-WÜRTTEMBERG **2**:577
BARCELONA **2**:719
BAYERN **2**:774
BELGIUM **2**:816
BELGRADE **2**:825
BELORUSSIAN SOVIET SOCIALIST REPUBLIC **2**:830
BERLIN **2**:849
BIRMINGHAM **2**:1062
BONN **3**:34
BREMEN **3**:155
BRUSSELS **3**:347
BUCHAREST **3**:362
BUDAPEST **3**:365
BULGARIA **3**:468
COLOGNE **4**:861
COPENHAGEN **5**:143
CORSICA **5**:191
CRETE **5**:252
CZECHOSLOVAKIA **5**:410
DENMARK **5**:580
DUBLIN **5**:1070
EDINBURGH **6**:303
ENGLAND **6**:866
ESTONIAN SOVIET SOCIALIST REPUBLIC **6**:966
FALKLAND ISLANDS AND DEPENDENCIES **7**:153
FINLAND **7**:302
FLORENCE **7**:419
FRANCE **7**:582
FRANKFURT AM MAIN **7**:691
GENEVA **7**:1010
GERMAN DEMOCRATIC REPUBLIC **8**:6
GERMANY, FEDERAL REPUBLIC OF **8**:44
GIBRALTAR **8**:156
GREECE **8**:311
GREENLAND **8**:411
HAGUE, THE **8**:543
HAMBURG **8**:580
HELSINKI **8**:753
HESSEN **8**:831
HUNGARY **9**:21
ICELAND **9**:170
IRELAND **9**:880
ITALY **9**:1085
KIEV **10**:468
LATVIAN SOVIET SOCIALIST REPUBLIC **10**:706
LEIPZIG **10**:789
LENINGRAD **10**:797
LIECHTENSTEIN **10**:891

LISBON 10:1028
LITHUANIAN SOVIET SOCIALIST REPUBLIC 10:1264
LIVERPOOL 10:1275
LONDON 11:90
LUXEMBOURG 11:202
LYON 11:216
MADRID 11:286
MALTA 11:391
MANCHESTER 11:431
MARSEILLE 11:530
MILAN 12:189
MOLDAVIAN SOVIET SOCIALIST REPUBLIC 12:301
MONACO 12:335
MOSCOW 12:474
MUNICH 12:617
NAPLES 12:827
NETHERLANDS, THE 12:1058
NIEDERSACHSEN 13:75
NORDRHEIN-WESTFALEN 13:142
NORTHERN IRELAND 13:237
NORWAY 13:263
NOVOSIBIRSK 13:299
NÜRNBERG 13:393
OSLO 13:756
PARIS 13:1004
POLAND 14:625
PORTUGAL 14:855
PRAGUE 14:944
RHEINLAND-PFALZ 15:797
ROMANIA 15:1045
ROME 15:1066
ROTTERDAM 15:1163
RUSSIAN SOVIET FEDERATED SOCIALIST REPUBLIC 16:89
SAARLAND 16:113
SAN MARINO 16:223
SARDINIA 16:244
SCHLESWIG-HOLSTEIN 16:346
SCOTLAND 16:404
SICILY 16:727
SOFIA 16:1008
SOVIET UNION 17:321
SPAIN 17:381
STOCKHOLM 17:695
SWEDEN 17:845
SWITZERLAND 17:867
TURKEY 18:782
UKRAINIAN SOVIET SOCIALIST REPUBLIC 18:833
UNITED KINGDOM 18:864
VATICAN CITY 19:36
VENICE 19:70
VIENNA 19:115
WALES 19:525
WARSAW 19:606
YUGOSLAVIA 19:1098
ZÜRICH 19:1171

Section 973. The United States and Canada since 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 973 deal with two main subjects: A, the U.S. since 1920; and B, Canada since 1920.

The outline of subject A begins with the post-World War I Republican administrations. It goes on to the effects of the New Deal and of World War II. Dealing with the United States after World War II, the outline covers the Truman, Eisenhower, Kennedy, Johnson, and Nixon administrations and the intensification of government activity and social tensions in the 1960s and 1970s. Finally, it treats cultural developments in the United States since the 1920s.

The outline of subject B deals with Canada between the World Wars, with the Canadian participation in World War II, and with Canada since 1945, treating postwar foreign policy, involvement in British Commonwealth affairs, and social, economic, and political developments.

articles	article sections	other references
UNITED STATES, HISTORY OF THE 18:987–999		
A. The United States since 1920		
1. The post-World War I Republican administrations	**18**:987h–989d	
a. Politics and economics under Harding and Coolidge (1921–29): favouritism toward big business; restriction of immigration; "Coolidge prosperity"	**18**:987h–988e	**2**:529d–e/ **6**:243d–244e *passim*
b. Social conditions in the 1920s: Prohibition, growth of organized crime, and the jazz age	**18**:988e–h	**3**:541h–542d/ **10**:121g–123e *passim*/ **10**:326f–h/**10**:991h–992b/ **14**:810c–811b
c. Hoover's administration (1929–33) and the Great Depression: the stock market crash; domestic and international repercussions; Hoover's attempts to effect economic recovery	**18**:988h–989d/ **6**:244e–245c	**19**:973h–974a
2. The effects of the New Deal and World War II: the presidency of Franklin D. Roosevelt (1933–45)	**18**:989e–993c	**15**:1138f–1141g
a. Comprehensive New Deal measures for economic recovery, relief, and reform	**18**:989e–990d/ **6**:246e–247b	**2**:710h–711b/**13**:222d–f/ **15**:1138f–1140a
b. Reform measures of the second New Deal and the election of 1936	**18**:990d–991f	**4**:672h–673a/**15**:1140b–h
i. Judicial invalidation of New Deal legislation: power struggle between Supreme Court and President	**18**:990f–h/ **15**:217g–h	**5**:91b–c/**8**:698a–b/ **15**:218b–d/**15**:1140b–c
ii. Labour legislation and union activity: strengthening of the Democratic coalition	**18**:990h–991f	**15**:1140c–e
c. Foreign policy between the World Wars: isolationism and neutrality; opposition to Japanese expansionism in Asia and economic sanctions against Japan; Lend-Lease aid to Britain (1940–41); the "good neighbor" policy in Latin America	**18**:991f–992c/ **12**:86g–87e	**4**:374a–b/**10**:85f–h/ **14**:243e–g/**15**:1140e–1141a/ **19**:550f–h/**19**:977a–d/ **19**:989a–g/**19**:991h–992c
d. The U.S. in World War II: wartime mobilization; regulation of production and manpower; the role of U.S. forces in defeating the Axis powers in Europe and the Pacific; U.S. military occupation of Japan and participation with the Allies in occupation of Germany	**18**:992c–993c/ **10**:512a–c/ **14**:243g–244c/ **19**:989g–991h/ **19**:994b–995d	**3**:1117b–d/**4**:374b–375b/ **6**:514g–515a/ **10**:86a–88h *passim*/ **11**:220c–e/**13**:324g–326a/ **15**:928e–g/**15**:1141a–g/ **19**:992c–h/**19**:996c–e/ **19**:996e–1013d *passim*
3. The U.S. after World War II: the era of the Cold War	**18**:993d–996c	

	articles	article sections	other references
a. The Truman administrations (1945–53)		**18**:993d–995b	**18**:725d–726a
i. Foreign policy aimed at the containment of Communism: the Truman Doctrine and the Marshall Plan (1947); the Point Four Program (1949); the creation of NATO; U.S. support of Nationalist China		**18**:993d–994a/ **9**:754d–756a/ **10**:512g–513c	**2**:638g–639b/**3**:745e–g/ **4**:376d–377c/**4**:905c–e/ **7**:523a–f/**7**:525b–d/ **9**:756g–757c/**9**:773h–774c/ **11**:535e–f/**18**:725g–h
ii. Programs of the Fair Deal: the conversion to a peacetime economy; labour disputes and inflation; the Taft-Hartley Act (1947); the Social Security Act (1950)		**18**:994a–d	
iii. McCarthyism and the emergence of the radical right		**18**:994d–f	**9**:759d–f
iv. The Korean War (1950–53): wartime mobilization of the U.S. economy; peace and bilateral security treaties with Japan (1951); the election of 1952		**18**:994f–995b/ **10**:513d–514d	**5**:91c–d/**9**:758g–759d/ **10**:88g–89b/**18**:725h–726a
v. Maintenance of a large postwar military establishment: collaboration of science and industry		**12**:896e–897e	**2**:988e–989c/**9**:754g–h/ **13**:327a–c/**18**:657d–f
b. The Eisenhower administrations (1953–61)		**18**:995b–996c	**6**:515c–516e
i. Intensification of the civil rights movement and innovative decisions of the Warren Court; passage of the Civil Rights acts of 1957 and 1960		**18**:995b–d	**1**:405g–h/**4**:1003f–g/**5**:92f–g/ **10**:472c–f/**12**:276e–g/ **13**:222h–223a/**13**:850h–851a
ii. Foreign policy during the Eisenhower years: John Foster Dulles and the Suez crisis (1956); the U.S. in the space race (1958); intervention in Lebanon (1958); continued support of Nationalist China; the U-2 affair		**18**:995d–996b/ **9**:764d–766b	**3**:1117e–1118a/**4**:400h–401b/ **5**:1081e–1082b/**6**:515g–516e/ **9**:759h–760e/ **9**:761a–764c *passim*/ **9**:774c–g/**19**:130a–c
iii. Social and economic problems: recessions (1953–54 and 1957–58); growing racial unrest; unemployment; labour strikes and the Landrum-Griffin Act (1959)		**18**:995e–g	**6**:515f–g
4. Intensification of government activity and social tensions in the 1960s and 1970s		**18**:996c–999g/ **1**:318c–f	**18**:926h–931b/**18**:939e–940d/ **5**:68f–69a/**5**:184a–e
a. The election of 1960 and the Kennedy administration (1961–63): the Cuban missile crisis (1962); the nuclear test ban treaty (1963); military aid to South Vietnam; the assassination of John F. Kennedy (1963)		**18**:996c–h/ **5**:378f–379a	**3**:994a–b/**5**:358b–d/ **9**:766b–767a/**10**:417c–418d/ **10**:472f–h
b. The Lyndon B. Johnson administrations (1963–69)		**18**:996h–997e	
i. Civil Rights acts of 1964 and 1968; the 1964 election; Medicare and other social welfare legislation; inflation and increased governmental economic activity		**18**:997a–b/ **5**:733b–c	**8**:699h–700c/**10**:472h–473b
ii. Increasing alienation among the youth and minority groups: protests in cities and on campuses; the assassinations of Robert F. Kennedy and Martin Luther King, Jr. (1968); the anti-Vietnam War movement; the election of 1968		**18**:997b–e/ **12**:176c–g/ **12**:939d–940a/ **15**:365f–h/ **17**:309c–e	**10**:473c–g/**13**:195g–196a/ **18**:928c–931a/**18**:940g–941c/ **19**:1097b–c
iii. Johnson's foreign policy: expansion of U.S. involvement in the Vietnam War from 1965; commencement of Paris peace talks (1968); U.S. military and economic aid to Middle Eastern and Latin-American countries		**18**:997c–d	**3**:1118a–d/**7**:522c–f/ **9**:767e–g/**9**:771h–772d/ **19**:130c–131a/**19**:596a–d
c. The Nixon administrations (1969–74)		**18**:997e–998e	
i. Nixon's foreign policy: the continuing Vietnam War and the Paris peace talks; the Cambodian invasion (1970); rapprochement with the People's Republic of China; Vietnam War cease-fire agreement (1973)		**18**:997e–g	**4**:402c–f/**9**:773f–h/ **19**:130a–b
ii. Inflation, high unemployment, and temporary price and wage controls; cabinet reorganization; anti-war demonstrations; the election of 1972		**18**:997g–998b	**6**:251d–e/**18**:935f–936b
iii. The Watergate scandal; the resignation (1973) of Vice Pres. Spiro T. Agnew and appointment of Gerald R. Ford; the resignation (1974) of Nixon		**18**:998b–e	
d. The Ford administration (1974–77)		**18**:998e–999d	
i. Continuance of foreign policy under Secretary of State Henry A. Kissinger: détente with the Soviet Union; conclusion of the Vietnam War; continuing Strategic Arms Limitation Talks (SALT)		**18**:998h–999b	
ii. Presidential pardon of Nixon; continuing inflation and unemployment; financial crisis in New York City; scandal centred on intelligence-gathering agencies		**18**:998e–h	

	articles	article sections	other references
iii. Celebration of the bicentennial of the Declaration of Independence (1976); the election of 1976		**18**:999b–d	
e. The Carter administration, from 1977		**18**:999d–g	
i. Carter's foreign policy: human rights and conduct of foreign affairs; Panama Canal treaties (1977–78)		**18**:999d–f	
ii. Presidential pardon of Vietnam draft evaders; presentation to Congress of programs on energy and on reform of the federal bureaucracy and of electoral, federal welfare, and Social Security systems; continuing inflation and unemployment		**18**:999f–g	
f. Scientific advances in the 1960s and 1970s: nuclear weapons technology and space exploration		**7**:485c–g/ **12**:420c–g	**13**:327d–f/ **17**:366e–375f/**18**:52g–53f
5. Cultural developments since the 1920s			**18**:940e–944f
a. The influence of the mass media on popular arts; *e.g.*, radio, television, motion pictures, popular music, theatre		**3**:321f–332c/ **10**:121a–126h/ **12**:494c–496a/ **12**:520d–523b/ **12**:529f–532e/ **12**:533b–534d/ **14**:803c–e/ **18**:234f–235e/ **18**:250g–251b	**3**:309f–h/ **3**:314g–316g *passim*/ **3**:913e–g/ **3**:916c–917g *passim*/ **3**:920b–921f/**5**:896f–897f/ **12**:526g–527h/**12**:694f–695f/ **12**:697d–698c *passim*/ **14**:810c–811e/ **18**:106d–108a *passim*
b. Developments in literature, philosophy, and the visual arts: the continuing legacy of European culture and traditions		**1**:806h–807d/ **9**:725c–727a/ **10**:1224h–1228e	**6**:1080e–1081b/ **10**:198c–199e *passim*/ **13**:291g–292b/**14**:215b–c/ **14**:322h–326h *passim*/ **14**:704a–f/ **15**:253c–256e *passim*/ **19**:496b–473g *passim*/ **19**:482a–484c *passim*
B. Canada since 1920	CANADA, HISTORY OF **3**:743–751		**3**:728b–729h
1. Canada between the World Wars		**3**:743d–744h	
a. The Liberal government under King (1921–30): Commonwealth relations; nationalism and the return to isolationism		**3**:743d–g	**10**:474d–e
b. The Great Depression and relief measures of the Conservative government (1930–35): return of the Liberal government (1935); foreign trade, welfare legislation, financial reforms; minor political parties		**3**:743g–744h	
2. Canadian participation in World War II: mobilization of manpower and production; development of armed forces		**3**:744h–745b	
3. Canada since 1945		**3**:745c–751c	**6**:383c–384d
a. Postwar foreign policy: North American continentalism and collective security; participation in NATO, the UN, and the Korean War; U.S.–Canadian economic relations		**3**:745c–747c	**3**:726e–727a
b. Involvement in British Commonwealth affairs: relations with Third World nations		**3**:747c–748a	
c. Franco-Canadian relations and French separatism in Quebec: conflicts between French- and English-speaking Canadians		**3**:748a–749f	**3**:318b–c
d. Postwar prosperity: expansion of manufacturing and mining industries; economic nationalism; relations with Indians, Eskimos, and Métis		**3**:749f–750g/ **1**:697d–h	**1**:1130h/**3**:721d–722a/ **3**:725e–726d/**13**:200a–b/ **13**:200h–201g
e. Internal politics since 1945: Liberal Party control (1945–57); the Progressive-Conservative coalition (1957–63); Liberal government after 1963		**3**:750h–751c	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BYRD, RICHARD E. **3**:541
DULLES, JOHN FOSTER **5**:1081
EISENHOWER, DWIGHT D. **6**:514
KENNEDY FAMILY **10**:415
KING, MARTIN LUTHER, JR. **10**:471
KING, W.L. MACKENZIE **10**:473
LINDBERGH, CHARLES A. **10**:991
MACARTHUR, DOUGLAS **11**:219
MARSHALL, GEORGE C. **11**:534
ROOSEVELT, FRANKLIN D. **15**:1137
TRUMAN, HARRY S. **18**:724

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

ALABAMA 1:404
ALASKA 1:409
ALBERTA 1:423
ARCTIC ISLANDS 1:1115
ARIZONA 2:1
ARKANSAS 2:5
BOSTON 3:55
BRITISH COLUMBIA 3:296
CALIFORNIA 3:614
CANADA 3:713
CHICAGO 4:207
COLORADO 4:906
CONNECTICUT 5:9
DELAWARE 5:567
DETROIT 5:620
FLORIDA 7:424
GEORGIA 7:1127
HAWAII 8:673
IDAHO 9:186
ILLINOIS 9:235
INDIANA 9:303
IOWA 9:816
KANSAS 10:382
KENTUCKY 10:419
LOS ANGELES 11:107
LOUISIANA 11:125
MAINE 11:353
MANITOBA 11:452
MARYLAND 11:565
MASSACHUSETTS 11:590
MICHIGAN 12:104
MINNESOTA 12:257
MISSISSIPPI 12:276
MISSOURI 12:284
MONTANA 12:397
MONTREAL 12:411
NEBRASKA 12:922
NEVADA 12:1076
NEW BRUNSWICK 12:1080
NEWFOUNDLAND 12:1084
NEW HAMPSHIRE 12:1092
NEW JERSEY 12:1095
NEW MEXICO 13:2
NEW ORLEANS 13:6
NEW YORK (STATE) 13:21
NEW YORK (CITY) 13:27
NORTH CAROLINA 13:230
NORTH DAKOTA 13:234
NORTHWEST TERRITORIES 13:260
NOVA SCOTIA 13:274
OHIO 13:517
OKLAHOMA 13:542
ONTARIO 13:573
OREGON 13:672
OTTAWA 13:766
PANAMA CANAL 13:945
PENNSYLVANIA 14:25
PHILADELPHIA 14:215
PRINCE EDWARD ISLAND 14:1049
PUERTO RICO 15:259
QUEBEC (PROVINCE) 15:330
QUEBEC (CITY) 15:336
RHODE ISLAND 15:807
SAN FRANCISCO 16:216
SASKATCHEWAN 16:258
SOUTH CAROLINA 17:211
SOUTH DAKOTA 17:214
TENNESSEE 18:128
TEXAS 18:164
TORONTO 18:520
UNITED STATES OF AMERICA 18:905
UNITED STATES OUTLYING TERRITORIES 18:1003
UTAH 18:1101
VERMONT 19:87
VIRGINIA 19:153
VIRGIN ISLANDS 19:157
WASHINGTON 19:617
WASHINGTON, D.C. 19:621
WEST VIRGINIA 19:800
WISCONSIN 19:891
WYOMING 19:1051
YUKON TERRITORY 19:1108

Section 974. Latin American and Caribbean nations since c. 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 974 deal with eight main subjects.

Subject A is the history of Mexico since 1920.

Subject B is Central America and the Caribbean since *c.* 1920. The outline first deals with the Central American republics—Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama. It next treats the island states of the Caribbean since the end of U.S. occupation, covering Haiti since 1934; the Dominican Republic since 1930; Cuba since 1934, including the Cuban revolution of 1959 under Fidel Castro; the new nations of the Caribbean region; and U.S. and European territories and possessions in the Caribbean region.

Subject C is Venezuela and Colombia since *c.* 1930.

Subject D is Ecuador, Peru, and Bolivia since *c.* 1930.

Subject E is Chile since 1920.

Subject F is Argentina, Uruguay, and Paraguay since *c.* 1930.

Subject G is Brazil since 1930.

Subject H is developments in Latin American literature, music, and visual arts in the 20th century with emphasis on the intermingling of European, Indian, and African cultures.

A. Mexico since 1920

1. Obregón's coup and Carranza's execution (1920); land reforms during Obregón's (1920–24) and Calles' (1924–28) regimes; rule by Calles' National Revolutionary Party (1928–34)
2. Cárdenas' Six Year Plan (1934–40): social and economic reforms; reorganization of the National Revolutionary Party; expropriation of foreign industry (1938); election of Avila Camacho (1940)
3. Mexico during World War II: economic and military cooperation with the United States; wartime industrialization
4. Mexico since 1945
   a. Economic and social development: the Party of Institutionalized Revolution and peaceful presidential successions; female suffrage (1958); foreign trade and industrialization
   b. Urbanization and educational advancements; relations with the U.S. and other countries; social and economic planning in the 1970s

B. Central America and the Caribbean since *c.* 1920

1. The Central American republics since *c.* 1920

articles	article sections	other references
MEXICO, HISTORY OF 12:86–89		
	12:86b–e	3:874f–h
	12:86f–87b	3:874h–875c
	12:87b–e	
	12:87e–89a	
	12:87e–88c/ 3:319d–f	3:875c–e
	12:88c–89a	12:72a–77c
CENTRAL AMERICAN STATES, HISTORY OF 3:1110–1118		

	articles	article sections	other references
a. Guatemala since 1920		3:1110h–1111h	9:757a–b
i. Successive presidential governments in the 1920s; Ubico's dictatorship (1931–44); social reforms of Arévalo's regime (1945–50)		3:1110h–1111d	
ii. Growth of Communist influence during Arbenz Guzmán's regime (1951–54); military coup (1954); anti-Communist activity in Castillo Armas' regime (1954–57); presidential succession since 1958; civil disorders		3:111d–h	8:456c–458e
b. Honduras since 1920: political unrest in the 1920s; Carías Andino's dictatorship (1932–49); administrations of Gálvez (1949–54), Lozano Díaz (1954–56), Villeda Morales (1957–63), López Arellano (1963–71), and Cruz since 1971		3:1112c–f	8:1056h–1059h
c. El Salvador since 1930: military dictatorships to 1944; governments of Castaneda Castro (1945–48), junta rule (1948–50), Osorio (1950–56), and Lemus (1956–60); junta rule (1960–62); subsequent regimes of Rivera (1962–67) and Sánchez Hernández after 1967; war with Honduras (1969–70)		3:1113b–1114a	6:733h–734g
d. Nicaragua since 1920: continued U.S. military presence until 1933; Sacasa's regime (1933–36); Somoza family's administrations (1936–63 and after 1967)		3:1114f–1115c	13:59d–63e
e. Costa Rica since 1920: border disputes with Panama until 1941; orderly presidential succession; industrialization and urbanization		3:1116c–f	5:211d–213c
f. Panama since 1920: unstable local politics and the U.S. presence; participation in World War II; economic development; reduction of U.S. power over Canal Zone (1963 and 1967); civil disorders		3:1117b–1118d	13:943a–944g/13:946b–947g
2. The island states of the Caribbean since the end of U.S. occupation		3:906c–g	
a. Haiti since 1934: internal struggle for power (1934–57); presidency of "Papa Doc" Duvalier (1957–71) and succession by his son in 1971; relations with Dominican Republic; social and economic problems		8:551g–552e	8:548b–550f
b. Dominican Republic since 1930: Trujillo's dictatorship (1930–61); economic and social services development; later repression ending with Trujillo's assassination; alternating elected governments and military juntas, the 1965 revolution, and U.S. intervention in the 1960s		5:949g–950a	5:945c–948e
c. Cuba since 1934	CUBA, HISTORY OF 5:357–358		
i. Fulgencio Batista's first dictatorship (1933–44); weaknesses of his successors; Batista's return to power (1952); growth of the military and middle classes; the sugar industry		5:357g–h	
ii. The Cuban Revolution of 1959: origins of Fidel Castro's anti-Batista movement; Castro's program for Cuban Socialism		5:357h–358a	3:993d–994a/8:464e–h/ 10:641b–d
iii. Cuba under Castro's premiership: nationalization of foreign-owned property; massive Cuban emigration; close relations with the Soviet Union; the 1962 missile crisis; the effort to form a Socialist society		5:358b–f	3:994a–c/5:353b–356c/ 9:765g–h/9:766g–767a
d. The new nations of the Caribbean region: the Bahamas; Guyana (formerly British Guiana); Jamaica; Trinidad and Tobago			2:591d–592f/8:508c–509a/ 8:509f–512f/10:18f–19d/ 18:713d–f
e. U.S. and European territories and possessions in the Caribbean region: Puerto Rico and the Virgin Islands; Belize (British Honduras) and other British insular possessions; French Guiana and French insular possessions; Surinam (formerly Dutch Guiana)			2:858a–859b/3:308b–h/ 7:715a–g/15:260b–d/ 15:261c–265c/17:825h–827g/ 19:159h–160a
C. Venezuela and Colombia since *c.* 1930			
1. Venezuela since 1935	VENEZUELA, HISTORY OF 19:69–70		

a. Abortive attempts at democratic government amid renewed military dictatorships (1935–58); the Acción Democrática party's economic reforms

b. Social and economic development during administrations of Betancourt (1959–64), Leoni (1964–69), and Caldera (from 1969)

2. Colombia since 1930

a. Liberal Party rule (1930–46): social and land reforms during López' administrations (1934–38 and 1942–45)

b. Re-emergence of Conservative rule under Ospina Pérez (1946–50); civil unrest and political repression (1948–53); military dictatorships to 1958; coalition of Conservatives and Liberals in National Front government

c. Economic problems in the early 1960s; return to stable government under Lleras Restrepo (1966–70); administration of Pastrana Borrero; contemporary social and economic problems

D. Ecuador, Peru, and Bolivia since *c.* 1930

1. Ecuador since 1925

a. Economic development and participation in World War II; loss of territory to Peru (1942)

b. Various administrations of Velasco Ibarra and other presidents after 1945; social and economic problems of the 1970s

2. Peru since 1930

a. The overthrow of Leguía (1930); Sánchez Cerro's administration (1931–33); the Aprista uprising and Sánchez Cerro's assassination; Benavides' administration (1933–39), social reforms, and the outlawing of the Apristas

b. Prado's first administration (1939–45); wartime cooperation with the U.S., and economic prosperity; legalization and re-outlawing of the Apristas during Bustamante's administration (1945–48); Odría's military dictatorship (1948–56) and suppression of Apristas

c. Re-legalization of Apristas and economic prosperity during Prado's second term (1956–62); military seizure of power (1962); social reforms of Belaúnde-Terry's administration (1963–68); military rule after 1968; economic nationalism

3. Bolivia since 1930

a. The revolt of 1930; Salamanca's presidency (1930–36); the effect of the Great Depression on the mining industry; the Chaco War (1932–35) and loss of territory to Paraguay

b. Military coup (1936); rise of MNR and PIR political parties; 1943 military coup and the Villaroel dictatorship (1943–46); political instability to 1951; military junta (1951–52)

c. The Bolivian National Revolution (1952); nationalization of the tin industry; electoral and land reforms; Paz Estenssoro's administrations (1952–56 and 1960–64); U.S. economic aid; civil disorders; military governments in the 1960s and early 1970s

E. Chile since 1920

1. Chile from 1920 to 1938

articles	article sections	other references
	19:69h–70c	
	19:70c–f	**19**:65h–67e
COLOMBIA, HISTORY OF **4**:876–877		
	4:876a–c	
	4:876c–g	
	4:876g–877d	**4**:870d–874g
ECUADOR, HISTORY OF **6**:292–293		
	6:292d–f	
	6:292f–293b	**6**:287h–290f
PERU, HISTORY OF **14**:135–136		
	14:135d–g	
	14:135g–136a	
	14:136a–f	**10**:976g–979e/**14**:131d–133b
BOLIVIA, HISTORY OF **3**:11–12		
	3:11h–12b	
	3:12b–d	
	3:12d–h	**3**:6h–9d
CHILE, HISTORY OF **4**:257–259		
	4:257c–f	

	articles	article sections	other references
a. The presidency of Alessandri Palma (1920–24, 1925); military coup (1924); return to civilian rule (1925); constitution of 1925 and reduction of legislative power; political instability; military dictatorship under Ibáñez del Campo (1927–31)		**4**:257c–e	
b. Economic crises during the 1930s: brief return to civilian rule under Montero Rodríguez; military coup and 100-day rule of Socialist Republic; Alessandri Palma's second administration (1932–38)		**4**:257e–f	
2. Chile from 1938 to 1952: the era of the Radical Party presidencies		**4**:257f–258b	
a. The administrations of Cerda (1938–41) and Ríos (1942–46): agrarian reforms; Chilean neutrality until 1942; economic prosperity		**4**:257f–h	
b. González Videla's administration (1946–52): strengthened economic ties with the U.S.; return of Conservative Party influence		**4**:257h–258b	
3. Chilean politics since 1952		**4**:258b–259e	
a. Ibáñez del Campo's administration (1952–58) and strong presidential leadership; administration of Alessandri Rodríguez (1958–64); social and economic problems; proliferation of leftist political parties and realignment of conservative parties		**4**:258b–g	
b. Frei's administration (1964–70) and nationalization of the economy; Allende's Marxist administration (1970–73); military coup (1973)		**4**:258g–259e	**4**:251c–254h
F. Argentina, Uruguay, and Paraguay since *c.* 1930			
1. Argentina since 1930	ARGENTINA, HISTORY OF **1**:1148–1151		
a. The conservative restoration (1930–43): economic ties with Great Britain; electoral fraud and violence in the 1930s; neutrality in World War II		**1**:1148g–1149d	
b. The Perón era (1943–55): his rise and fall from power; economic policies		**1**:1149d–1150a	**7**:188c–d/**14**:101g–102b
c. Argentina since 1955: attempts to restore constitutionalism; military dictatorships; civil wars and Peronista resurgence; return (1973) and death (1974) of Perón		**1**:1149g–1151a/ **3**:317d–f	**1**:1139e–1143f/**14**:102c–e
2. Uruguay since 1929	URUGUAY, HISTORY OF **18**:1099–1100		
a. The Great Depression; dictatorship of Gabriel Terra (1933–38); election of Alfredo Baldomir (1938); Uruguayan neutrality until 1945; economic boom and social reforms		**18**:1099d–f	
b. Post-World War II developments: the constitution of 1951 and the plural executive; recession (1954–58); 1958 election of Nationalists (Blancos); return of Colorado Party and restoration of presidential powers (1966); social and political problems in the 1970s		**18**:1099f–1100a	**18**:1096h–1098c
3. Paraguay since 1924	PARAGUAY, HISTORY OF **13**:991		
a. The Great Depression; victory over Bolivia in Chaco War (1932–35); Allied alignment in World War II		**13**:991d–e	
b. Political instability and economic retardation: Stroessner's dictatorship since 1954		**13**:991e–f	**13**:987c–989f
G. Brazil since 1930: the Second Republic	BRAZIL, HISTORY OF **3**:147–151		
1. The Getúlio Vargas dictatorship (1930–45): the revolution of 1930; the constitutions of 1934 and 1937; Vargas' consolidation of power (1937); social and economic legislation; Allied participation in World War II; Vargas' forced resignation (1945)		**3**:147e–g	**19**:27c–e

	articles	article sections	other references
2. Political, social, and economic developments in Brazil since 1945		3:147g–151g	3:120c–122b/15:362g
a. Election of Eurico Gaspar Dutra (1945) and the constitution of 1946: restoration of civil and personal liberties and representative government; outlawing of Communist Party (1947)		3:147g–h	
b. Re-election of Vargas (1950); economic crises and governmental corruption; Vargas' forced resignation and suicide (1954)		3:147h–148c	19:27d–e
c. Interim presidency of João Café Filho (1954); election of Juscelino Kubitschek as president and João Goulart as vice president (1955); economic development and inflation		3:148c–g	
d. Election of Jânio Quadros as president and Goulart's re-election as vice president (1960); Quadros' resignation (1961); governmental opposition to Goulart; parliamentary experiment with figurehead president and prime minister as head of state; 1963 plebiscite giving Goulart full presidential powers		3:148g–149d	
e. Social and economic unrest: re-emergence of Communist Party; nationalization of oil refineries; revolution and exile of Goulart (1964); Pascoal Ranieri Mazzilli as interim president		3:149d–f	
f. Castelo Branco's presidency (1964–67): the First, Second, and Third Institutional acts; suspension of existing political parties; creation of artificial two-party system; constitution of 1967		3:149f–150e	3:141g–142a
g. Costa e Silva's presidency after 1967: economic progress and reduction of inflation; Fifth Institutional Act (1968) and suspension of all legislative bodies		3:150e–f	3:142a–b
h. Social developments since 1945: urbanization and education; increased electorate; role of the church and the military in national politics		3:150f–151g/ 3:317h–318b	3:141c–h
H. Development of Latin American literature, music, and visual arts in the 20th century: the intermingling of European, Indian, and African cultures		1:668b–669b/ 1:672c–d/ 10:1240c–1242g	1:676b–d/3:41b–e/ 12:967d–968b/14:803f–g/ 17:95h–97d *passim*/ 19:472g–473a

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CÁRDENAS, LÁZARO 3:874
CASTRO, FIDEL 3:993
GUEVARA, "CHE" 8:464
PERÓN, JUAN 14:101
VARGAS, GETÚLIO 19:26

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

ACRE 1:58
ALAGOAS 1:408
AMAZONAS 1:649
ARGENTINA 1:1134
BAHAMAS 2:590
BAHIA 2:592
BARBADOS 2:717
BERMUDA 2:857
BOGOTÁ 2:1183
BOLIVIA 3:1
BRASÍLIA 3:120
BRAZIL 3:123
BRITISH HONDURAS (BELIZE) 3:307
BUENOS AIRES 3:445
CARACAS 3:811
CEARÁ 3:1034
CHILE 4:246
COLOMBIA 4:863
COSTA RICA 5:208
CUBA 5:348
DOMINICAN REPUBLIC 5:943
EASTER ISLAND 6:130
ECUADOR 6:285
EL SALVADOR 6:731
ESPÍRITO SANTO 6:964
FRENCH GUIANA 7:713
GALÁPAGOS ISLANDS 7:826
GOIÁS 8:236
GRENADA 8:423
GUADELOUPE 8:451
GUATEMALA 8:453
GUYANA 8:506
HAITI 8:546
HAVANA 8:668
HONDURAS 8:1056
JAMAICA 10:15
LIMA 10:976
MARANHÃO 11:484
MARTINIQUE 11:547
MATO GROSSO 11:702
MEXICO 12:65
MEXICO CITY 12:89
MINAS GERAIS 12:222
MONTEVIDEO 12:406
NICARAGUA 13:58
PANAMA 13:940
PANAMA CANAL 13:945
PARÁ 13:978
PARAGUAY 13:984
PARAÍBA 13:993
PARANÁ 13:997
PERNAMBUCO 14:100
PERU 14:127
PIAUÍ 14:440
PUERTO RICO 15:259
RECIFE 15:543
RIO DE JANEIRO (STATE) 15:852
RIO DE JANEIRO (CITY) 15:853
RIO GRANDE DO NORTE 15:861
RIO GRANDE DO SUL 15:861
SANTA CATARINA 16:226
SANTIAGO 16:231
SANTO DOMINGO 16:234
SÃO PAULO (STATE) 16:236
SÃO PAULO (CITY) 16:238
SERGIPE 16:558
SURINAM 17:824
TRINIDAD AND TOBAGO 18:711
URUGUAY 18:1093
VENEZUELA 19:58
VIRGIN ISLANDS 19:157

Section 975. East Asia: China in revolution, the era of Japanese hegemony, and the influence of the United States in the 20th century

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 975 deal with three main subjects: A, China since 1912; B, Japan since *c.* 1910; and C, Korea since 1910.

The outline of subject A begins with the development of the Chinese Republic (1912–20). Dealing with the interwar years (1920–37), the outline treats the early cooperation between the Kuomintang and the Chinese Communist Party; the later struggles within the two-party coalition; the Nationalist government from 1928 to 1937; the war against Japan (1937–45); and the development of Kuomintang and Chinese Communist ideologies. Dealing with the emergence of the People's Republic of China, the outline treats the Civil War (1945–49); economic, social, and political reforms in the period from 1949 to 1957; the period of the Great Leap Forward; and the Great Proletarian Cultural Revolution (1965–68). Finally, the outline deals with the Nationalist government on Taiwan since 1949.

The outline of subject B begins with Japan's political, economic, and social development in the early 20th century. It goes on to the rise and fall of militaristic Imperial Japan (*c.* 1920–45). Finally, it deals with postwar Japan, treating political and constitutional developments during the U.S. military occupation (1945–51); international relations and politics, especially the relations with China and the United States; the restoration of Japanese independence (1952); Japan's great economic growth; its admission to the United Nations (1956); and subsequent political and economic developments.

The outline of subject C begins with the history of Korea during the period of Japanese rule (1910–45). Dealing with Korea since 1945, the outline treats the division of South and North Korea (1948); the North Korean invasion (1950) of the South, and the Korean War (1950–53); South Korea since the armistice, including its relations with the U.S. and Japan; North Korea since the armistice, including its relations with the Soviet Union and the People's Republic of China.

A. China since 1912

1. The development of the republic (1912–20)
   a. Early power struggles: Chinese involvement in World War I
      i. Japanese gains in the early part of the war: Yüan Shih-k'ai's attempts to become emperor
      ii. Conflict over entry into the war; formation of a rival southern government; changes brought about by the war
   b. Modernization and the growth of nationalism: emergence of a new intelligentsia; riots and protests
2. The interwar years (1920–37)
   a. The beginnings of a national revolution: the Kuomintang; the Chinese Communist Party; cooperation between the two parties
   b. Reactions to warlords and foreigners: militarism in China; the continued presence of foreign interests; reorganization of the Kuomintang
   c. Struggles within the two-party coalition: influence of Soviet Russia
      i. Outbreak of clashes with foreigners: Kuomintang opposition to the radicals
      ii. The Northern Expedition: peasant uprisings leading to the expulsion of the Communists from the Kuomintang; Communist movement into the hills and plains of central China
   d. The Nationalist government from 1928 to 1937: Chiang Kai-shek's attempts to eliminate the Communists
      i. Attempts at economic reform and failure in agriculture; educational reform; economic competition with the Japanese in Manchuria
      ii. Renewal of Japanese aggression: war between the Communists and Nationalists; the Long March; formation of the United Front against Japan
3. The war against Japan (1937–45)
   a. Communist–Nationalist cooperation in the early stages of the war; renewed conflict between the two groups
   b. International alliance against Japan: U.S. military aid; internal conflicts; the crisis of 1944 and Nationalist deterioration; Communist growth and international efforts to prevent civil war

articles	article sections	other references
CHINA, HISTORY OF **4**:366–402		
	4:366h–368g	**12**:375a–c
	4:366h–368d/ **19**:960a–c	
	4:367c–g	**10**:81d–e/**19**:1098d–g
	4:367g–368d	**17**:811c–d
	4:368d–g	**4**:194d–g/**6**:388b–f/ **9**:66g–67c/**10**:1058c–g/ **11**:465g–466b
	4:368h–372h	**4**:457c–f
	4:368h–369f	**4**:194g–195a/**11**:466b–e
	4:369f–370g	**10**:1014b–c/**17**:811d–f
	4:370h–372a	
	4:370h–371c	
	4:371c–372a	**11**:466f–h
	4:372a–h	**4**:206d–h
	3:372b–d	**6**:388f–389b/**11**:437g–438a
	4:372d–h/ **11**:438a–e/ **19**:973e–g	**10**:84h–85c/**10**:1014c–e/ **11**:466h–467c
	4:372h–375h	**12**:375e–g
	4:373a–374a	**11**:467c–468a
	4:374a–375h/ **19**:977a–g/ **19**:1009f–1010b	**18**:992b–c

	articles	article sections	other references
4. The development of Kuomintang and Chinese Communist ideologies		4:378f–389b	
a. Origins and background of modern ideologies: social and political conditions; China's ideological heritage		4:378f–380h/ 4:1097b–e/ 4:1103c–g	
b. The political ideas of Sun Yat-sen: nationalism, democracy, and livelihood		4:380h–382g	17:811f–g
c. The political ideas of Chiang Kai-shek: idealization of Chinese tradition		4:382h–384b	
d. The development of Maoist ideology: the role of peasants; the "people's war"; the border regions		4:384b–389b/ 11:559e–560b	4:421f–g/8:460f–461g *passim*/ 11:466c–g/11:467d–f
5. Emergence of the People's Republic of China		4:389b–402g	4:457g–458a/10:1014e–1015a/ 11:438g–439c
a. The Civil War (1945–49): the race for territory; Communist successes and ultimate victory		4:375h–378f	9:758d–g
b. Economic reforms and reforms in the traditional Chinese social structure (1949–57)		4:389b–393g	17:315f–g
i. Reconstruction and consolidation of power (1949–52): participation in the Korean War; agrarian reform		4:390a–391a/ 10:513g–h	11:468a–e
ii. The transition to socialism (1953–57): rural collectivization; urban nationalization		4:391a–393g	6:389c–g/18:382d–e
c. The period of the Great Leap Forward and the transition to the Cultural Revolution		4:393g–400f/ 4:1024h–1025d/ 9:768b–773h/ 11:811g–812a	4:273g–296g/10:1268c–d/ 11:468e–469e
i. New directions in national policy (1958–61): literature and arts for the masses; rural communes		4:393g–395b/ 19:206a–207c	4:421b–f/6:389h–390a/ 10:1059b–d/18:382f–g
ii. Readjustment and reaction (1961–65): restoration of order; China as a nuclear power		4:395b–396h/ 16:85d–h	
iii. The Great Proletarian Cultural Revolution (1966–69): attacks on cultural leaders and party members; resistance to Peking		4:396h–399a	4:294a–295e/6:390a–e/ 10:1014g–h/11:469b–e
iv. Reconstruction (1969–71): the Chinese challenge to Soviet authority in the Communist world; the Ninth Congress of the Chinese Communist Party (April 1969) and the position of Mao Tse-tung		4:399a–g	11:469e–f
d. International relations after the Cultural Revolution: UN representation (1971); rapprochement with the U.S. and Japan (1972); continuing friction with the Soviet Union		4:402a–f	18:999c–e/9:773f–h
e. Internal affairs after the Cultural Revolution: the 10th Congress of the CCP (August 1973) and the fourth National People's Congress and new national constitution (January 1975); death of Chou En-lai (January 1976) and factional strife; death of Mao Tse-tung (September 1976) and leadership of Hua Kuo-feng		4:399g–400f	
6. The Nationalist government on Taiwan since 1949: initial repression and consolidation; leadership of Chiang Kai-shek until his death; alliance with the U.S. and economic growth; loss of UN representation (1971); Taiwanese separatism		4:400f–401h	4:206h–207b/10:640d–f/ 17:998e–1001d
B. Japan since *c.* 1910	JAPAN, HISTORY OF 10:81–91		
1. Japan's political, economic, and social developments in the early 20th century		10:81g–83b	
a. Constitutional government: party politics; participation by bureaucrats and business elites		10:81g–82d	10:503d–h
b. Social and economic changes: attempts to organize labour; cultural trends; growth of educated classes		10:82d–83b/ 10:108d–109b	6:391c–392a/7:418g–419a/ 16:973b–c/19:241g–242b
2. The rise and fall of Imperial Japan (*c.* 1920–45)		10:83b–86e	19:242b–f
a. The rise of the militarists; growth of anti-government sentiment		10:83b–f/ 10:1072f–1073a	
b. Anti-government acts: the seizure of initiative in foreign policy by the military; the outbreak of war with China (1937); Axis leanings		10:83f–84g/ 11:437e–g	4:372d–e/ 4:372h–375h *passim*/ 7:187h–188c

	articles	article sections	other references
c. Japan's proclamation of the Greater East Asia Co-prosperity Sphere (1938), official alignment with the Axis powers (1940), and deterioration of relations with the other Western powers: Tōjō's cabinet and outbreak of war with the U.S. (1941)		**10**:84h–85h/ **19**:977a–g/ **19**:988h–989g	**10**:504a–c/**18**:992b–c
d. Initial Japanese successes in Southeast Asia and the South Pacific; the Allied counterattack culminating in the fire and atomic bombing of Japanese cities; Japan's unconditional surrender (1945)		**10**:86a–e/ **9**:488f–489a/ **14**:243g–244b	**12**:375f–g/ **19**:989g–1013e *passim*
e. Postwar Japan: political reform; economic and social changes; international relations and cultural developments		**10**:86e–91c/ **10**:114f–115c/ **12**:690f–691d	**6**:392a–g/**19**:242g–243d
i. Japan under U.S. military occupation (1945–51): democratization of Japanese society; constitutional, land, and labour reforms; increased rights for women		**10**:86e–88f/ **10**:639g–640a	**4**:649d–650b/**4**:665c–f/ **4**:669h–670b/**19**:911e–912a
ii. International relations and politics: loss of Korea and other territories; relations with China and the U.S.; growth of radical political movements in the 1960s; politics of moderation		**10**:88f–90e	**9**:778a–c
iii. Restoration of Japanese independence (1952): great economic growth; admission to the UN (1956); the Satō and Tanaka governments; return of the Bonins and Ryukyus		**10**:90e–91c	**10**:44h–57a
C. Korea since 1910	KOREA, HISTORY OF **10**:511–516	**19**:214g–215d	
1. Japanese rule (1910–45): military control; the March 1st independence movement and formation of a provisional Korean government in exile (1919); resistance movements and the end of Japanese rule		**10**:511c–512a/ **10**:1064a–g	
2. Korea since 1945		**10**:512a–516b	
a. Division into South and North Korea (1948): U.S. and Soviet military aid to and disputes over the two Korean republics		**10**:512a–513b	
b. North Korean invasion (1950) of South Korea, and the Korean War (1950–53): U.S. and UN intervention; Chinese participation; armistice (1953)		**10**:513b–514c	**4**:390a–c/**9**:758g–759c/ **18**:994g–h
c. South Korea since the armistice: policies of the authoritarian Rhee regime to its fall (1960); the Park regime after 1961; economic growth and relations with the U.S.; attempts at rapprochement with Japan		**10**:514d–515f	**10**:523a–527g
d. North Korea since the armistice: consolidation of Communist government power under Kim Il-sung; industrialization; relations with the Soviet Union and the People's Republic of China		**10**:515f–516b	**10**:520a–522d

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

CH'EN TU-HSIU **4**:194
CHIANG KAI-SHEK **4**:206
CHOU EN-LAI **4**:456
HU SHIH **9**:66
KONOE FUMIMARO **10**:503
LIN PIAO **10**:1013
LIU SHAO-CH'I **10**:1267
MAO TSE-TUNG **11**:465
SUN YAT-SEN **17**:810
YÜAN SHIH-K'AI **19**:1098

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

ANHWEI **1**:900
CANTON **3**:781
CHEKIANG **4**:69
CHINA **4**:259
CHUNGKING **4**:586
FUKIEN **7**:772
HARBIN **8**:631
HEILUNGKIANG **8**:741
HONAN **8**:1052
HONG KONG **8**:1060
HOPEH **8**:1067
HUNAN **9**:11
HUPEH **9**:55
INNER MONGOLIA **9**:601
JAPAN **10**:34
KANSU **10**:387
KIANGSI **10**:458
KIANGSU **10**:462
KIRIN **10**:490
KOREA, NORTH **10**:516
KOREA, SOUTH **10**:522
KWANGSI **10**:550
KWANGTUNG **10**:553
KWEICHOW **10**:558
KYŌTO **10**:561
LHASA **10**:841
LIAONING **10**:843
MACAU **11**:220
MONGOLIAN PEOPLE'S REPUBLIC **12**:362
MUKDEN **12**:612
NAGOYA **12**:809
NANKING **12**:822
NINGSIA HUI **13**:117
ŌSAKA-KŌBE METROPOLITAN AREA **13**:751
PEKING **14**:1
P'YŎNGYANG **15**:313
SEOUL **16**:555
SHANGHAI **16**:641
SHANSI **16**:647
SHANTUNG **16**:649
SHENSI **16**:664
SINKIANG UIGHUR **16**:794

SOVIET UNION 17:321
SZECHWAN 17:976
TAIPEI 17:993
TAIWAN 17:995
TIBET 18:372
TIENTSIN 18:395
TOKYO–YOKOHAMA METROPOLITAN AREA 18:476
TSINGHAI 18:731
VLADIVOSTOK 19:495
WU-HAN 19:1047
YUNNAN 19:1113

Section 976. South and Southeast Asia: the late colonial period and the emergence of new nations since 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 976 deal with three main subjects.

Subject A involves the history of British India from *c.* 1920 to 1947; of independent India, Pakistan, and Bangladesh since 1947; of Ceylon from 1920 (Sri Lanka since 1972); of Tibet since *c.* 1904; and of Nepal after the British withdrawal (1947).

Subject B is mainland Southeast Asia. The outline treats the history of Burma from 1920; of Malaya from 1920; of Thailand since 1920; of Vietnam, covering the period of French direct administration, the Geneva Agreements and the division of Vietnam (1954), and South Vietnam and North Vietnam since 1955; of Laos since 1950; and of Cambodia since independence (1953).

The outline of subject C first deals with the history of Indonesia, covering Dutch administration of Indonesia from 1920 to the granting of independence in 1949, and the history of Indonesia since 1949. It next deals with the Philippines since 1920, covering the economic and social policies of U.S. administration in the 1920s and 1930s; the Japanese occupation (1941–45); the establishment of the Republic of the Philippines (1946); and the subsequent modernization and economic growth.

A. India, Pakistan, Ceylon, Tibet, and Nepal since 1920

1. India since *c.* 1920: nationalism and the decline of the raj
   a. Dyarchy and the conflict between British policy and the aims of Indian nationalism: the Congress and Gandhi's technique of active, nonviolent revolution; Round Table Conferences
   b. The Government of India Act (1935); the political and economic effects of World War II; partition and independence (1947); Hindu–Muslim polarization and violence
2. India since 1947
   a. Domestic policies: the constitution and the reorganization of the states under Nehru and the Congress Party (1947–64); administrations of Shastri (1964–66) and Indira Gandhi; social legislation; problems of overpopulation and mass poverty
   b. Foreign policy: conflicts with Pakistan over Kashmir (1948–49 and 1965–66) and over East Pakistan (Bangladesh) in 1971; hostile relations with the People's Republic of China (1962); general neutralist position
3. Pakistan (1947–71); Pakistan and Bangladesh since 1971
   a. National consolidation (1947–51) under Jinnah and Liaquat Ali Khan: economic and political instability
   b. Military government of Ayub Khan (1958–69); economic and political reforms; relations with India and the Western and Socialist powers; administration of Yahya Khan after 1969; civil war between East and West Pakistan; establishment of Bangladesh (formerly East Pakistan) in 1971
4. Ceylon since 1920 (Sri Lanka after 1972)
   a. Nationalism and the demand for constitutional reform (1920–31); the 1931 constitution; effect of World War II
   b. Dominion status (1947) and rule by United National Party government (1948–56 and 1965–70); Sri Lanka Freedom Party leadership and administrations of S.W.R.D. Bandaranaike (1956–59) and Sirimavo Bandaranaike (1960–65 and after 1970)
5. Tibet since *c.* 1911: Tibetan independence (1911); relations with Britain and China; Chinese invasion (1949) and hegemony re-established; complete Chinese governmental control after 1959

articles	article sections	other references
INDIAN SUBCONTINENT, HISTORY OF THE **9**:418–428		
	9:418d–423e	
	9:418d–420d	**3**:53b–e/**7**:876h–877f/**8**:918h–919d/**12**:944g–945d/**13**:850b–g/**13**:1070d–g
	9:420d–423e	**3**:53e–f/**7**:877f–878a/**12**:945d–h
	9:423f–426b	
	9:423f–424f/**6**:252f–h	**5**:88b–c/**6**:394b–f/**8**:919d–920a/**9**:287h–302c/**9**:425e–426a/**12**:805h–806b/**12**:946a–c/**15**:285d–e/**19**:786e–h
	9:424f–426b	**4**:395f–g/**10**:30e–g/**12**:946c–f
	9:426c–428f	**13**:899a–905b
	9:426c–427b	**10**:224f–g
	9:427c–428f	**2**:692d–694a/**6**:404e–g/**9**:771c–d
CEYLON, HISTORY OF **4**:8–9		
	4:8g–9a	
	4:9b–g	**6**:404b–d/**17**:521f–525c
	18:381h–382g	**18**:374d–378c

6. Nepal: British withdrawal (1947) and revival of Nepalese royal control under Tribhuvan (1951–55) and Mahendra (1955–72); domestic politics

B. Mainland Southeast Asia since 1920

1. Burma since 1920

   a. Emergence of Burmese nationalism and the British response (1920–37); limited constitutional government (1937–42); the Japanese occupation (1942–45)

   b. Postwar British rule and independence (1948) under U Nu's leadership: adoption of leftist-neutralist position; internal conflict and military government after 1962; continued economic problems

2. Malaya and Singapore since 1920

   a. British economic policies in Malaya; Japanese occupation (1941–45); British return to power (1945) and progress toward self-government

   b. Suppression of Communist insurgents (1948–60); creation of Federation of Malaya (1957) and re-establishment as Malaysia (1963); Singapore's withdrawal (1965) from Malaysia and creation of independent Republic of Singapore

3. Thailand since 1920

   a. Post-World War I escape from unequal treaties; problems of kingship and repression; the coup d'etat of 1932 and the establishment of constitutional monarchy; militaristic and pro-Japanese nationalism; the Japanese occupation during World War II

   b. Loss of wartime gains and political instability; military government (1957–63); growth of U.S. military presence since 1965

4. Indochina since 1920: emergence of independent states and continued strife

   a. French direct administration of Vietnam and indirect administration of Cambodia and Laos: growth of Vietnamese nationalistic movements and Ho Chi Minh's formation of the Indochina Communist Party (1930); French administration during Japanese occupation in World War II; postwar French administration in southern Vietnam and Cambodia

   b. Ho Chi Minh's government in northern Vietnam and the French attempt to reconquer the north (1946–54); the Geneva Agreements and legal "temporary" division of Vietnam (1954); French withdrawal and U.S. limited intervention

   c. South Vietnam since 1955: civil war and suppression of political dissent by U.S.-sponsored governments; formation of National Liberation Front (1960); U.S. military intervention; cease-fire agreement (1973)

   d. North Vietnam since 1955: industrialization; relations with other Socialist and other Asian countries; war with South Vietnam; U.S. military intervention; cease-fire agreement (1973)

   e. Laos since 1950: civil war to 1954; Geneva Conference (1954) and creation of Laos as a neutral state; domestic instability and continued civil war between Communist-neutralist coalition and rightists; military involvement of the U.S. and North Vietnam

articles	article sections	other references
	12:957h–958b	**12**:953h–956g
BURMA, HISTORY OF **3**:514–515		
	3:514f–515c/ **19**:1009f–1010b	**19**:1005d–e
	3:515c–g	**3**:504b–510a/**6**:403h–404b
MALAYA, HISTORY OF **11**:367–368		
	11:367c–368c	
	11:368c–e	**6**:404d–e/**10**:640g–641a/ **10**:772d–h/**11**:376d–377b/ **11**:378e/**16**:784d–f/ **16**:786c–789a
SIAM AND THAILAND, HISTORY OF **16**:722–723		**6**:405c–d
	16:722f–723a	
	16:723a–c	**18**:202b–205e
VIETNAM, HISTORY OF **19**:127–131		**6**:405d–g
	19:127a–129b/ **10**:678c–d	**3**:688b–d/**7**:678a–c/ **8**:981h–982d
	19:129b–130a/ **9**:759f–760e	**8**:982e–983a/**10**:678d–f
	19:130a–131b/ **19**:596a–597a	**9**:767e–g/**18**:997f–998a/ **19**:138b–e/**19**:140a–144f
	19:130f–131b	**8**:628g–h/**8**:983b–f/ **19**:131f–h/**19**:132e–138a
LAOS, HISTORY OF **10**:678–679		**10**:674a–676h

	articles	article sections	other references
f. Cambodia since independence (1953): Sihanouk's domestic politics and severing of relations with the U.S. (1965); deposition of Sihanouk (1970), pro-Western realignment; and increased U.S. and South Vietnamese military intervention	CAMBODIA, HISTORY OF **3**:688–689		**3**:677a–681b
C. Indonesia and the Philippines			
1. Indonesia since 1920	INDONESIA, HISTORY OF **9**:488–491		**6**:404g–405a
a. Dutch administration of Indonesia from 1920 to independence in 1949		**9**:488a–489d	
i. Dutch administrative suppression of nationalist and Communist revolts in the 1920s and 1930s; accommodation with moderate nationalist parties; Japanese occupation in World War II		**9**:488a–489a	**19**:990h–991b
ii. Sukarno's proclamation of Indonesian independence (1945); Dutch attempt to regain control and UN intervention; formal granting of independence in 1949		**9**:489a–d	**9**:758b–c/**17**:783g–h
b. Constitutional democracy (1950) and Guided Democracy (1957–65) under Sukarno; military coup (1965), purge of Communists, and Sukarno's loss of influence; administration of Suharto after 1966		**9**:489d–491f	**9**:467c–476g/**9**:771d–g/ **17**:783h–784d
2. The Philippines since 1920	PHILIPPINES, HISTORY OF THE **14**:242–245		**6**:405a–c
a. Economic and social policies of U.S. administration in the 1920s and 1930s; growth of nationalist political parties; establishment as a commonwealth (1935); Japanese occupation (1941–45); return of U.S. control and commonwealth status		**14**:242h–244c/ **19**:1008h–1009f	
b. Establishment of the Republic of the Philippines (1946); U.S.–Philippine relations; modernization and economic growth; social and political problems		**14**:244c–245b/ **17**:227g–228h	**14**:235f–240f

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

BOSE, SUBHAS CHANDRA **3**:53
GANDHI, MAHATMA **7**:874
HO CHI MINH **8**:981
JINNAH, MOHAMMED ALI **10**:223
LEE KUAN YEW **10**:772
NEHRU, JAWAHARLAL **12**:944
PATEL, VALLABHBHAI JHAVERBHAI **13**:1069
SUKARNO **17**:783

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

AFGHANISTAN **1**:164
ANDHRA PRADESH **1**:861
ASSAM **2**:207
BALUCHISTAN **2**:677
BANGKOK **2**:684
BANGLADESH **2**:687
BHUTAN **2**:876
BIHĀR **2**:984
BOMBAY **3**:13
BRUNEI **3**:341
BURMA **3**:502
CALCUTTA **3**:586
CAMBODIA **3**:675
COLOMBO **4**:877
DELHI **5**:570
DJAKARTA **5**:920
GUJARĀT **8**:478
HANOI **8**:628
HARYANA **8**:663
HIMACHAL PRADESH **8**:880
HYDERĀBĀD **9**:75
INDIA **9**:276
INDONESIA **9**:457
JAMMU AND KASHMIR **10**:29
KARĀCHI **10**:398
KERALA **10**:433
LAHORE **10**:598
LAOS **10**:672
MADHYA PRADESH **11**:279
MADRAS **11**:283
MAHĀRĀSHTRA **11**:344
MALAYSIA **11**:368
MANILA **11**:447
MANIPUR **11**:451
MEGHALAYA **11**:858
MYSORE **12**:776
NĀGĀLAND **12**:805
NEPAL **12**:951
NORTHWEST FRONTIER PROVINCE **13**:255
ORISSA **13**:739
PAKISTAN **13**:892
PHILIPPINES **14**:231
PUNJAB (INDIA) **15**:285
PUNJAB (PAKISTAN) **15**:287
RĀJASTHĀN **15**:495
RANGOON **15**:503
SAIGON **16**:153
SEYCHELLES **16**:610
SIKKIM **16**:747
SIND **16**:780
SINGAPORE **16**:784
SRI LANKA (CEYLON) **17**:519
TAMIL NADU **17**:1014
THAILAND **18**:197
TRIPURA **18**:714
UTTAR PRADESH **19**:7
VIETNAM, NORTH **19**:131
VIETNAM, SOUTH **19**:138
WEST BENGAL **19**:786

Section 977. Australia and Oceania since 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 977 deal with three main subjects.

Subject A is international developments in the Pacific since 1920. The outline covers the situation of the occupying powers in Oceania after World War I; the effects of World War II on the indigenous island peoples; and the postwar reorganization.

Subject B is Australia since 1920. The outline treats social, economic, political, and military developments up to the end of World War II, and since then.

Subject C is New Zealand since *c.* 1920. Again, developments up to and since the end of World War II, including participation in the conflict, and since then are dealt with separately.

	articles	article sections	other references
A. International developments in the Pacific and the disposition of the dependent territories in Oceania since 1920	OCEANIA, HISTORY OF **13**:447–448		
1. The post-World War I situation of the occupying powers in Oceania: the League of Nations mandate system		**13**:447d–g	
2. World War II in the Pacific: the rise and fall of Japanese power; effects of the war on indigenous peoples		**13**:447g–h/ **19**:989g–991h/ **19**:994b–995d/ **19**:1000b–d/ **19**:1003g–1004g/ **19**:1008h–1009f/ **19**:1012c–1013d	**2**:988b–989c *passim*/ **10**:86a–c
3. Post-World War II reorganization: economic and social effects of UN trusteeship administrations; movements toward autonomy among the indigenous peoples		**13**:447h–448e	**2**:434e–436d *passim*/ **12**:1090h–1091g/**13**:471b–g
B. Australia since 1920	AUSTRALIA, HISTORY OF **2**:419–423		
1. Developments to 1945: decline of the Labor Party and the Nationalist–Country coalition; industrial and rural development; the Great Depression; formation of the United Australia Party and Lyons' administrations (1931–39); Allied participation in World War II		**2**:419e–421c	**6**:384d–g
2. Social, economic, and political development since 1945: European immigration; Labor Party government to 1949, and Liberal-Country alternation with Labor thereafter; lessening of ties with Britain and greater emphasis on Asia; affluent society and laissez-faire attitude; cultural contributions		**2**:421d–423h/ **2**:429b–e	**2**:404f–405c/**2**:405f–411c/ **2**:434e–436d *passim*/ **6**:384h–385a/ **12**:1090h–1091g/**13**:12h–14f/ **15**:339b–341a/ **17**:209g–211a/ **17**:1072h–1075a/ **19**:111h–114a
C. New Zealand since *c.* 1920	NEW ZEALAND, HISTORY OF **13**:54–55		
1. Developments to 1945: United (Liberal)–Reform coalition governments; the Great Depression; Labour Party victory (1935) and social welfare programs; participation with Allies in World War II		**13**:54b–55a	
2. New Zealand since 1945: National and Labour governments; increased participation in Pacific and Asian affairs		**13**:55b–f	**6**:385a–f/**13**:46f–50e

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

AUSTRALIA, COMMONWEALTH OF **2**:399
AUSTRALIAN EXTERNAL TERRITORIES **2**:431
BIKINI **2**:988
FIJI **7**:295
FRENCH POLYNESIA **7**:715
MELBOURNE **11**:870
NEW GUINEA, TRUST TERRITORY OF **12**:1090
NEW SOUTH WALES **13**:11
NEW ZEALAND **13**:43
NORTHERN TERRITORY **13**:242
PACIFIC ISLANDS **13**:826
PACIFIC ISLANDS, TRUST TERRITORY OF THE **13**:831
QUEENSLAND **15**:338
SAMOA **16**:205
SOUTH AUSTRALIA **17**:209
SYDNEY **17**:887
TASMANIA **17**:1071
UNITED STATES OUTLYING TERRITORIES **18**:1003
VICTORIA **19**:110
WESTERN AUSTRALIA **19**:792

Section 978. Southwest Asia and Africa: the late colonial period and the emergence of new nations in the 20th century

[for Part Nine headnote see page 563
for Division VII headnote see page 662]

The articles and parts of articles referred to in Section 978 deal with five main subjects.

Subject A is Turkey since 1919 and Cyprus since 1920. The outline first deals with the War of Independence (1919–23) and the development of the Turkish nation under the leadership of Mustafa Kemal Atatürk. It then treats the developments in Turkey during World War II; Turkey under the Democrats (1950–60); and developments in Turkey since the army coup (1960).

Subject B is the development of the Arab states and Israel in Southwest Asia and in Egypt. The outline covers the Arab lands of Southwest Asia under the mandate system; Egypt from 1922 to 1945; the Arab states in the Fertile Crescent; Egypt; Israel since 1945; and the Arabian Peninsula since *c.* 1920.

Subject C is Iran since 1925 and Afghanistan since independence (1921).

Subject D is North Africa since 1920. The outline first deals with the final decades of European rule—of the French in Morocco, Algeria, and Tunisia, and of the Fascist Italian government in Libya (1922–43). It then deals with the establishment of independent states in the Maghrib: in Libya (1951), in Tunisia (1956), in Morocco (1956), and, after the Algerian War (1954–62), in Algeria (1962).

Subject E is sub-Saharan Africa since 1920. The outline first deals generally with the maturation and the decline of the European colonial system, extending to the rise of African nationalist parties after World War II; the establishment of independent African countries from 1957; the continuing influences of the Great Powers; and the Organization of African Unity. It then separately treats West Africa since *c.* 1920; Ethiopia and Nilotic Sudan since *c.* 1917; East Africa and Madagascar since *c.* 1920; Central Africa after World War II; and southern Africa since *c.* 1920.

A. Turkey since 1919; Cyprus since 1920

1. The War of Independence (1919–23) and the development of the Turkish nation under the leadership of Mustafa Kemal Atatürk
2. Atatürk's one-party government: secularization; social and economic reforms
3. Turkey since 1938: World War II and the postwar period; the republic since 1961
   a. Wartime neutrality until alignment (1945) with the Allies: postwar problems with the Soviet Union; political developments
   b. Turkey under the Democrats (1950–60): economic growth and political repression
   c. The army coup (1960) and political, economic, and social developments: foreign policy
4. Cyprus since 1920: British administration to 1960; the Republic of Cyprus; political disunity over the *énosis* question

B. Development of the Arab states and Israel in Southwest Asia and Egypt

1. The Arab lands of Southwest Asia under the mandate system
   a. Lebanon and Syria under the French mandate (1920–41): Arab demands for independence; the Druze revolt in Syria (1925–27); establishment of the Lebanese Republic (1926) and internal crises resulting in suspension of the constitution (1932); the Franco-Syrian Treaty (1936); Allied occupation in World War II; Syrian and Lebanese independence (1945)
   b. Iraq from 1918 to 1945: British occupation and mandate; independence (1932); political unrest and the role of the military; World War II and British intervention (1939–45)
   c. Palestine and Transjordan under British mandate (1920–48): the Balfour Declaration and the acceleration of Jewish settlement and conflicts with the Arabs; the Palestine Revolt (1936–39) and the Peel Commission; the Biltmore Resolution (1942); the partition of Palestine, the Palestine War, and the emergence of Israel (1948) and Jordan (1946)

articles	article sections	other references
OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE 13:790–795		
	13:790f–791c	2:256e–257e
	13:791c–h	2:257b–d
	13:792a–795e	
	13:792a–f	
	13:792f–793b	
	13:793c–795e	18:786c–791e
CYPRUS, HISTORY OF 5:408–409		5:403c–405g
SYRIA AND PALESTINE, HISTORY OF 17:955–965		
	17:955g–960g	
	17:956h–957h/ 17:959a–960a	5:448d–e
	11:995d–997f	
	17:957h–959a/ 17:960a–961b	2:836g–837b

	articles	article sections	other references
2. Egypt from 1922 to 1945: Wafd-led opposition to the continued British presence; politics in the early Farouk regime; participation in World War II		**6**:498c–499c/ **19**:995d–h	
3. The Arab states in the Fertile Crescent, Egypt, and Israel since 1945			
a. Lebanon: the multireligious political system; the Khuri regime (1943–52); the presidency of Chamoun and the 1958 crisis; later regimes and the civil war of 1974–76		**17**:961d–962a/ **17**:963g–965a	**6**:400c–e/**10**:766a–769a
b. Syria: political instability in the postwar decade; temporary union with Egypt (1958–61); the secessionist regime (1961–63); Ba'thist Syria after 1963; conflicts with Israel; role in the Lebanese civil war		**17**:960c–961d	**17**:923b–926a
c. The League of Arab States (1945), the partition of Palestine, and the establishment of the State of Israel (1948) and the Hashemite Kingdom of Jordan (1950)		**17**:959c–960c/ **17**:962a–963g	
i. The establishment of Israel (1948) and resultant conflicts with the Arabs: immigration and politics; foreign aid and economic development; renewed hostilities with the Arab states in the Suez War (1956); the Six-Day War (1967) and the diplomatic stalemate; the war of October 1973; role in the Lebanese civil war		**17**:962c–965b/ **9**:685e–g/ **9**:762f–763a	**2**:837a–f/**3**:359g–h/ **6**:400h–401b/**9**:776f–777a/ **9**:1062h–1066h
ii. Economic and political problems in Jordan under King Hussein: ambivalent foreign policy; Israeli annexations (1967) and the Palestine Liberation Movement; Black September (1970) for the Palestinians		**17**:962a–c	**10**:272g–274h
d. Iraq: postwar reconstruction and social upheavals (1945–58); the revolution of 1958; politics under the republic; military coups (1963–68); oil and the economy; the Kurdish question		**11**:997g–1001b	**9**:877d–879h
e. Egyptian politics in the last years of Farouk's regime; the Egyptian revolution (1952) and Nasser's rise to power; the Suez crises (1956); the Six-Day War (1967); Sadat's presidency (1970); Yom Kippur War (1973)		**6**:499d–500g/ **9**:762f–763a/ **10**:640a–d/ **16**:972g–h	**6**:451f–458c/**9**:776b–777a/ **12**:844f–845d/**17**:768c–f
4. The Arabian Peninsula since *c.* 1920: the political, economic, and social effects of the discovery of oil, and the resultant influx of wealth; British and other great power influences		**11**:577f–578d	**14**:107e–h/**18**:862f–863h
a. Emergence of the Kingdom of Saudi Arabia under Ibn Sa'ūd (1924); oil discoveries and exploitation; the government under Faisal (1964–75) and Khalid; foreign relations		**1**:1050d–1051d	**9**:149h–150g/**16**:277h–281d
b. The other Arabian states: Bahrain and Qatar; Kuwait; Oman; the United Arab Emirates; Yemen (Aden) and Yemen (Ṣan'ā')			**1**:1050h–1051d/ **10**:547h–548a/ **18**:862b–863h *passim*/ **19**:1081a–1083g/ **19**:1086e–1088g
C. Iran and Afghanistan since *c.* 1920			
1. Iran since 1925	IRAN, HISTORY OF **9**:860–861		**9**:821a–d
a. The regime of Reza Shah (1925–41): economic and social reforms; relations with Germany and invasion by Allies during World War II		**9**:860h–861b	**15**:793e–h
b. Postwar Iran: regime of Mohammad Reza Pahlavi (from 1943); nationalization of oil resources (1951); land reform (from 1962); expansion of economy from petroleum revenue		**9**:861c–g/ **9**:866a–867b	**9**:761a–c/**9**:824b–828h
2. Afghanistan since independence (1921): civil disorders, attempts at reform, and economic improvements; constitutional revisions; relations with neighbouring states and the great powers; the republic from 1973		**1**:176d–177a	**1**:164f–h/**1**:168e–172e
D. North Africa since 1920	NORTH AFRICA, HISTORY OF **13**:164–173		
1. The final decades of European rule		**13**:164c–166a	

	articles	article sections	other references
a. French colonial policies and the socio-economic status of colonialists in relationship to the indigenous Muslim population: the French protectorate over Morocco; the administration of Algeria and the Algerian War; the beginning of nationalist movements in Tunisia		**13**:169a–g/ **13**:171d–172b/ **19**:996d–997g	**6**:399d–g/**13**:164c–g/ **13**:167f–168a
b. Libya under the domination of the Fascist Italian government (1922–43)		**13**:172e–f/ **19**:993a–h	
2. Establishment of independent states in the Maghrib		**13**:173a–b/ **11**:297a–f	
a. Postwar British and French occupation of Libya; independence (1951); subsequent domestic politics and foreign relations		**13**:172f–h	**10**:879a–882b
b. The emergence of independent Tunisia (1956) under Bourguiba: subsequent domestic politics and foreign relations		**13**:167f–168d	**3**:84d–85f/**18**:744c–745c/ **18**:747a–749c
c. The emergence of independent Morocco (1956) under Sultan Sidi Muhammad: subsequent domestic politics and foreign relations		**13**:170g–171d	**12**:448d–451e
d. The Algerian War (1954–62), French evacuation and the emergence of independent Algeria (1962): subsequent domestic politics and foreign relations		**13**:164g–166e	**1**:563c–570f/**2**:833h–834c/ **7**:678c–679b
E. The maturation of the European colonial system and the nationalist movements in sub-Saharan Africa since 1920			
1. Completion of effective occupation by the European powers: the post-World War I division of former German colonies among other colonial powers; the mandate system		**4**:902d–903d	
2. Administrative policies and attitudes of each colonial power: economic development; effects of colonialism on the societies and institutions of the African peoples		**1**:283b–284a/ **6**:114e–115e	**4**:904f–905c/**6**:397a–c/ **6**:397g–398a/**6**:398d–e/ **6**:398g–h
3. World War II and postwar changes in colonial policies: decline of the colonial system and rise of African nationalist parties; establishment of independent African countries from 1957; continuing influences of the Great Powers; the Organization of African Unity; the assertiveness of white-settled Africa		**6**:253d–g/ **16**:972d–g	**6**:397d–f/**6**:398a–f/ **6**:398h–399a/**9**:757e–g
4. West Africa since *c.* 1920	WEST AFRICA, HISTORY OF **19**:780–785		
a. Colonial rule from *c.* 1920 until independence; independent Liberia's economic ties to the U.S.		**19**:780b–782e	**10**:853g–856b
i. Economic developments in French West Africa: Senegal, French Sudan, Upper Volta, and Niger		**19**:781a–f	**7**:679b–c
ii. Economic developments in British colonies: The Gambia, Sierra Leone, Gold Coast, and Nigeria		**19**:781f–782e	**13**:91e–93d
b. Decolonization and independence (1957–65)		**19**:782f–785f	**13**:83c–85a
i. Emergence of African leaders: rise of a new class of educated Africans		**19**:783c–h	**13**:136c–f
ii. Formation of African independence movements in Ghana (Gold Coast), The Gambia, Sierra Leone, Nigeria, Togo (French Togo), Senegal, Guinea, Portuguese Guinea, and Mali (French Sudan); the Biafran independence movement		**19**:784a–785f/ **13**:172h–173b	**5**:436g–437d/**7**:864b–865b/ **8**:142e–144e/**8**:468g–471f/ **11**:382e–384h/**13**:94b–96f/ **13**:136g–137d/ **14**:875g–876g/**16**:531e–g/ **16**:535b–540a/ **16**:541e–542b/**16**:736b–739f/ **18**:472d–474e
5. Ethiopia and the Nilotic Sudan since *c.* 1917		**6**:1010f–1012b	**6**:1000b–1005e/**6**:1016d–g/ **19**:975h–976d
a. Ethiopia and Eritrea since 1917: internal division, and the rise of Haile Selassie; the Italian conquest (1936); Eritrea under Italian rule; federation (1952) and union (1962) with Ethiopia; Haile Selassie's domestic policies and international role after World War II; the establishment of the military government (1974) and the abolition of the monarchy and death of Haile Selassie (1975)			
b. The Anglo-Egyptian Sudan: growth of national consciousness and creation of the independent republic (1956); military coup (1958) and the Abboud government (1958–64); revolt in the southern provinces; return to civilian rule		**13**:114d–116a	**17**:757g–765e

	articles	article sections	other references
6. East Africa and Madagascar since *c.* 1920	EAST AFRICA, HISTORY OF **6**:101–109		
a. The European colonies in East Africa from *c.* 1920 to the beginning of independence (1960)		**6**:101f–103e	
i. The colonial economies: growth of export trade (cotton, cloves, and coffee); extension of the railroads		**6**:101f–102d	
ii. Somalia as an Italian trust territory (1950); problems in British Somaliland		**6**:102d–f	**10**:431c–d/**16**:1061g–1062a
iii. Crises of colonial rule in the 1950s: Mau Mau resistance in Kenya; independence movements in Uganda, Tanganyika, and Zanzibar		**6**:102f–103e	
b. Developments since independence		**6**:103e–109c	**1**:240h–241a
i. The Somali Republic: independence (1960); internal tensions and territorial disputes; conflict with Ethiopia; military takeover (1969)		**6**:103h–104g	**6**:1011h–1012a/**6**:1013c–d/ **6**:1016g–1017b/ **16**:1058e–1062f
ii. Economic cooperation among the East African nations: problems and prospects		**6**:104g–105c	
iii. Tanzania (formerly Tanganyika and Zanzibar): revolt against Arab control in Zanzibar (1964); Nyerere and introduction of Ujamaa (Familyhood) Socialism		**6**:105d–107a	**13**:427f–428b/**17**:1025c–f/ **17**:1029f–1034c
iv. Uganda: independence (1962) and economic growth; the Obote and Amin governments		**6**:107a–108d	**18**:828a–832b
v. Kenya: independence (1963) and subsequent domestic politics and foreign relations under Kenyatta's leadership		**6**:108d–109c	**10**:426b–430b/**10**:431e–f
c. Malagasy Republic (Madagascar): the French administration; independence (1960) and subsequent domestic politics and foreign relations		**11**:278f–279a	**11**:272e–276d
7. Central Africa after World War II: the intensification of nationalist movements and the acquisition of independence by the former European colonies	CENTRAL AFRICA, HISTORY OF **3**:1099–1101	**4**:1123a–f	
a. The emergence of French and Belgian colonies as republics: internal divisions and the fate of the republics		**3**:1099d–1101c	
i. The Democratic Republic of the Congo (Republic of Zaire since 1971): the Congolese nationalist movement and independence (1960); secession of Katanga province and UN intervention (1960–64); further unrest		**3**:1098a–e/ **3**:1099e–1100d	**6**:398f/**11**:186c–h/ **19**:1122d–1126g
ii. Central African Republic: independence (1960); subsequent domestic politics and foreign relations		**3**:1100d–f	**3**:1104g–1106d
iii. The People's Republic of the Congo: independence (1960); ethnic rivalries; domestic politics and foreign relations		**3**:1100f–1101a	**4**:1115h–1118e
iv. Gabon Republic: independence (1960); subsequent domestic politics and foreign relations		**3**:1101a–c	**7**:819g–822f
b. Republic of Equatorial Guinea: the Spanish administration; independence (1968)			**6**:949f–951e
8. Southern Africa since *c.* 1920	SOUTHERN AFRICA, HISTORY OF **17**:290–298		
a. Southern Africa from *c.* 1920 to *c.* 1945		**17**:290a–295a	
i. Political and economic developments in white-settler controlled Union of South Africa: the Hertzog administration (1924–33) and the Hertzog–Smuts coalition (1933–39); political disunity and Allied participation in World War II		**17**:290d–291b	**16**:910d–e
ii. White-settler control of Southern Rhodesia: relations with Northern Rhodesia and Nyasaland; colonial government economic, social and political discrimination against black Africans; Portuguese rule in Angola and Mozambique		**17**:291b–293f	

	articles	article sections	other references
iii. Indian, coloured, and black African responses to colonial government-sanctioned discrimination: growth of local political organizations, separatist church movements, and mass nationalist movements		17:293f-295a	
b. Southern Africa since 1945: political developments in white-controlled colonies and nations; emergences of black nations		17:295a-298g	6:394e-h/17:300c-e/ 17:302f-304g
i. Republic of South Africa (formerly the Union of South Africa): Afrikaner National Party administrations since 1948; government-sanctioned social, political, and economic apartheid; independence as republic (1960); liberal white and black African, coloured, and Indian anti-apartheid movements		17:295d-296f/ 1:241a-d	11:202c-f/15:362h-363b/ 17:67c-73f
ii. The High Commission Territories: Botswana (formerly Bechuanaland), Lesotho (formerly Basutoland), and Swaziland; the British colonial administrations; independence (1966 and 1968); relations with the Republic of South Africa		17:296f-h	3:71a-b/3:73h-75f/ 10:834c-f/10:835d-836h/ 17:843d-844h
iii. Rhodesia (formerly Southern Rhodesia), Zambia (formerly Northern Rhodesia), and Malawi (formerly Nyasaland): participation in Federation of Rhodesia and Nyasaland (1953–63); independence of Zambia and Malawi (1964) under black control; Rhodesian independence (1965) under white control		17:296h-298a	10:406e-407c/11:361h-365b/ 15:815a-d/15:818a-822c/ 19:1133d-1138a
iv. Developments in the Portuguese colonies of Angola and Mozambique: economic advances; nationalist movements; local uprisings in Angola (1961) and Mozambique; subsequent colonial political, educational, and economic reforms		17:298a-g	1:891f-897g/12:595d-600d

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ATATÜRK, KEMAL **2**:255
BEN BELLA, AHMED **2**:833
BEN-GURION, DAVID **2**:836
BOURGUIBA, HABIB **3**:84
IBN SAʿŪD **9**:149
KAUNDA, KENNETH **1**:406
KENYATTA, JOMO **10**:430
LUMUMBA, PATRICE **11**:185
LUTULI, ALBERT **11**:201
NASSER, GAMAL ABDEL **12**:844
NKRUMAH, KWAME **13**:136
NYERERE, JULIUS **13**:427
REZA SHAH PAHLAVI OF IRAN **15**:793
SENGHOR, LÉOPOLD **16**:541
SMUTS, JAN **16**:909
WEIZMANN, CHAIM **19**:736

Geographical articles in the *Macropædia*
(Additional geographical entries may also be found in the *Micropædia*)

ACCRA **1**:43
ADDIS ABABA **1**:81
AFARS AND ISSAS **1**:163
ALEXANDRIA **1**:479
ALGERIA **1**:558
ALGIERS **1**:570
ANGOLA **1**:890
ANKARA **1**:924
ARMENIAN SOVIET SOCIALIST REPUBLIC **2**:24
AZERBAIJAN SOVIET SOCIALIST REPUBLIC **2**:543
BAGHDAD **2**:585
BAHRAIN **2**:594
BEIRUT **2**:815
BOTSWANA **3**:71
BURUNDI **3**:528
CAIRO **3**:580
CAMEROON **3**:694
CAPE OF GOOD HOPE **3**:791
CAPE TOWN **3**:794
CAPE VERDE ISLANDS **3**:797
CASABLANCA **3**:976
CENTRAL AFRICAN REPUBLIC **3**:1101
CHAD **4**:13
CONGO (BRAZZAVILLE) **4**:1113
CYPRUS **5**:402
DAHOMEY **5**:420
DAKAR **5**:436
DAMASCUS **5**:447
EGYPT, ARAB REPUBLIC OF **6**:445
EQUATORIAL GUINEA **6**:948
ETHIOPIA **6**:998
GABON **7**:818
GAMBIA, THE **7**:863
GEORGIAN SOVIET SOCIALIST REPUBLIC **7**:1132
GHANA **8**:136
GUINEA **8**:466
IBADAN **9**:140
IRAN **9**:821
IRAQ **9**:872
ISRAEL **9**:1059
ISTANBUL **9**:1068
IVORY COAST **9**:1180
JERUSALEM **10**:138
JOHANNESBURG **10**:230
JORDAN **10**:270
KAZAKH SOVIET SOCIALIST REPUBLIC **10**:407
KENYA **10**:422
KINSHASA **10**:474
KIRGIZ SOVIET SOCIALIST REPUBLIC **10**:489
KUWAIT **10**:547
LAGOS **10**:594
LEBANON **10**:764
LESOTHO **10**:834
LIBERIA **10**:851
LIBYA **10**:875
MADAGASCAR **11**:268
MALAWI **11**:360
MALI **11**:381
MAURITANIA **11**:710
MAURITIUS **11**:714
MECCA **11**:753
MOROCCO **12**:444
MOZAMBIQUE **12**:592
NAIROBI **12**:812
NATAL **12**:845
NIGER **13**:79
NIGERIA **13**:85
OMAN **13**:566
ORANGE FREE STATE **13**:638
PORTUGUESE GUINEA **14**:874
RHODESIA **15**:814
RWANDA **16**:108
SAUDI ARABIA **16**:275
SENEGAL **16**:531
SIERRA LEONE **16**:734
SOMALIA **16**:1057
SOUTH AFRICA **17**:60
SOUTH WEST AFRICA **17**:300
SOVIET UNION **17**:321
SUDAN, THE **17**:756
SWAZILAND **17**:842
SYRIA **17**:919
TADZHIK SOVIET SOCIALIST REPUBLIC **17**:985
TANZANIA **17**:1025
TEHRĀN **18**:57
TEL AVIV-YAFO **18**:63
TOGO **18**:471
TRANSVAAL **18**:685
TUNIS **18**:743
TUNISIA **18**:745
TURKEY **18**:782
TURKMEN SOVIET SOCIALIST REPUBLIC **18**:798
UGANDA **18**:825
UNITED ARAB EMIRATES **18**:862
UPPER VOLTA **18**:1018
UZBEK SOVIET SOCIALIST REPUBLIC **19**:10
YEMEN (ADEN) **19**:1079
YEMEN (ṢAʿNAʾ) **19**:1084
ZAIRE, REPUBLIC OF **19**:1119
ZAMBIA **19**:1128

Introduction to Part Ten:

Knowledge become self-conscious

by Mortimer J. Adler

The words "universe" and "encyclopaedia" have an obvious similarity of meaning. Both come from words—in the one case, Latin, in the other, Greek—that mean a totality or all-inclusive whole. Whether the universe is finite or infinite, and however it is constituted or organized, it embraces everything that is. Nothing lies outside it; everything that happens occurs within it. Can one say, with equal assurance, that the encyclopaedia is a similar totality or whole? Perhaps we cannot say that of any actual, historic encyclopaedia. But that is the ideal which all encyclopaedias attempt to embody.

It is not just the similarity of the universe and the encyclopaedia as totalities or wholes that interests us, but also how these two wholes are related to each other. One of them, the universe, embraces not only everything that is, but also everything that is knowable. The other, the encyclopaedia, sets for itself the goal of reporting everything that is and can be known about the universe. The one is mirrored or reflected in the other—the macrocosm in the microcosm.

The universe includes man—man a moving body, man a living organism, man a social animal, and man not only as a doer and seeker but also as a maker and knower of things. Among the things that man seeks to know and understand is his own knowledge—his abilities, efforts, and achievements in the sphere of knowing itself. Whether or not Aristotle was correct in saying that the highest form of intellectual activity is thinking about thinking itself, it is certainly true that "knowledge become self-conscious" is a distinctive characteristic of the human enterprise of knowing. We not only seek to know whatever can be known, but we also, reflexively, turn our knowing back upon itself when we pay attention to how we know what we know, the various ways in which we know, and the divisions or branches of our knowledge.

The organization of the encyclopaedia—the way in which the branches of knowledge have been distinguished from one another and related to one another—has changed remarkably from age to age. In antiquity, before there were any real encyclopaedias, learned men envisaged the whole of human knowledge as having a certain structure of related parts or subdivisions. The organization of knowledge in medieval encyclopaedias exhibited quite a different pattern. Later encyclopaedias introduced still other changes in the picture; and that picture has changed in important respects during the last century and is undergoing further changes today.

The new *Britannica* presents us with an outline of knowledge that is radically different in its fundamental framework and its organizational scheme from the outlines that might have been constructed for an ancient encyclopaedia—if there had been any such thing—or a medieval one. The Outline of Knowledge set forth in this *Propædia* volume is divided into ten parts, each of which is broken down into divisions and sections. Division by division, from Part One through Part Nine, the outline covers what we know about the universe with the help of such sciences as physics, chemistry, astronomy, geology, meteorology, biology, medicine, psychology, anthropology, sociology, political science, economics, and technology. It also covers what we know as a result of systematic study and scholarship in such fields as education, law, the arts, religion, and history.

The knowledge of the universe that we possess by means of the disciplines mentioned above is outlined in Parts One through Nine and expounded in the articles to which the outline refers. What about Part Ten—the part to which this essay is an introduction? Where and how does that fit into the picture?

To some extent the answer has already been given. Here in Part Ten we are concerned with "knowledge become self-conscious"—with knowledge about knowledge—with our knowing turned, reflexively, back upon itself. Here it is not the knowable universe we are considering. It is, instead, the world of knowledge itself: its diverse disciplines, modes of inquiry, fields of scholarship or systematic study—in short, as the title of Part Ten indicates, the branches of knowledge. Whereas the other nine parts of the Outline of Knowledge cover *what we know* about the knowable universe, the outline of Part Ten covers what we know about the sciences or other disciplines *whereby we know* that which we know.

The answer just given is not the whole answer to the question provoked by the special character of Part Ten. What we know about the various sciences and the diverse disciplines that comprise the world of knowledge almost always includes an account of the methods of inquiry, verification or demonstration, and argument employed by scientists or scholars in a particular field of knowledge. While interest in such matters does not exhaustively represent the concerns of logic, the science of logic does provide the underpinnings for our study of the methodology of the other learned disciplines, including history and philosophy as well as the various sciences. What we know about logic itself as a science—its history and, as it were, the philosophy of it—therefore properly belongs in the outline of Part Ten, together with an indication of the scope and content of the science itself.

For a somewhat different reason mathematics is also treated here in the same way as logic. The knowledge attained by the mathematician has extraordinarily wide and diverse applicability in other spheres of inquiry and branches of knowledge—in most, if not all, of the natural sciences and in many of the social sciences. Like logic, mathematics belongs here not only for its usefulness in other sciences, but also for its own sake as a science. We are concerned with its content as well as with its method, history, and philosophy.

In addition to logic and mathematics, two other disciplines occupy a special place in any consideration of the branches of knowledge. One is history; the other, philosophy.

History as a field of study includes more than the history of peoples, of nations, of cultures, and of social institutions. It includes the history of human learning itself, of all the branches of knowledge. It includes not only the history of the natural and social sciences, but also the history of logic, of mathematics, of philosophy, and of history itself as one of the learned disciplines. And, in addition to there being a history of the study of history (*i.e.*, historiography), there is also a logic of history (its methodology) and a philosophy of history.

Like history, philosophy is operative in the study of all the other disciplines as well as of itself. Philosophy become self-conscious is concerned with questions about the nature and scope of philosophy, about whether it has a method or methods and a subject matter or subject matters peculiarly its own. Philosophy is also concerned about its own historical development and, in that history, about its changing rela-

tionship to other disciplines, especially to religion and to the sciences. As there is a history of history and a philosophy of history, so there is a philosophy of philosophy and a history of philosophy—a statement which probably cannot be made about any other two disciplines in the entire range of the branches of knowledge.

In addition, as each of the other disciplines has a history, so there is a philosophy of each of the other disciplines. We have already noted that there is a philosophy of logic and of mathematics. So, too, there is a philosophy of science in general and of the different sciences in particular; and also a philosophy of education, of law, of art, and of religion.

All of this, however, does not exhaust the content of philosophy, any more than the history of all the branches of knowledge exhausts the content of history, or any more than the application of logic and mathematics to other disciplines exhausts their content as disciplines with knowledge to offer. But in the case of philosophy, as not in the case of logic and mathematics, it is sometimes questioned whether it can rightly claim to offer us knowledge of the universe as well as knowledge about knowledge itself and an understanding of the various branches of knowledge. That question, together with the question of how the knowledge that philosophers claim to have, stands in relation to other forms of knowledge, constitutes what is, perhaps, the most fundamental problem dealt with by philosophers when they philosophize about philosophy itself. Whether or not the knowledge they claim to have is comparable in its validity to the knowledge achieved in other spheres of inquiry, philosophy, like science, covers a wide range of subject matters and involves a large number of distinct subdivisions, each with its own problems and controversies (*e.g.*, metaphysics, philosophy of nature, epistemology, philosophy of mind, philosophy of man, ethics, political philosophy, and aesthetics).

Concerning the whole range of disciplines that are represented in an exhaustive inventory of the branches of knowledge, three questions stand out as the most challenging. Of these, the first two have been debated over and over again—in earlier epochs as well as in our own century, and in the context of organizations of knowledge quite different from that which prevails or is acceptable today.

One is the question about whether the various branches of knowledge can or should be arranged in a hierarchical order, in an ascending scale from lower to higher, or from less to more fundamental. In antiquity they were so arranged; as, for example, in Aristotle's ordering of the speculative sciences, beginning with physics and rising through mathematics to metaphysics as the science of first principles and ultimate causes; and in his characterization of politics as the architectonic or controlling discipline in the sphere of practical knowledge, directive of human action. So, too, in the Middle Ages, a hierarchical organization prevailed, in which theology was regarded as queen of the sciences, philosophy as its handmaiden, with all the other disciplines contributing their portions of knowledge for the greater glory of God and for the better understanding of man's destiny under Divine Providence. If, in accordance with the prevailing view today, a hierarchical order is rejected, is there any other order to replace it, and in terms of what criteria or principles can such an alternative be constructed? Is there, as the introductory essay in this volume suggests, a circle of learning instead of a hierarchy of the branches of knowledge—a circle in which no point is either a beginning or an end, and lines can be drawn from any point to any other?

The second question, to which different answers have been given at different times and to which conflicting answers are still being given today, asks about the coherence of the world of knowledge as a whole. Do all its constituent parts—its various component disciplines or branches of knowledge—adhere together harmoniously, each somehow complementing the other? Or, on the contrary, is the world of knowledge torn asunder by irremediable conflicts—by territorial disputes, by conflicting claims to sovereignty, by assertions and denials of legitimacy? Underlying whatever answers may be given to these questions, a deeper difference of opinion may exist concerning the unity of truth itself. If, for example, there is some truth in science and some truth in philosophy or in religion, must these diverse approximations of whatever truth man can possess be consistent with one another? Or, on the contrary, can there be some truth in science and some in philosophy or in religion, even though the truth of the one stands in sharp conflict to the truth of the other? Can there be, in short, a multiplicity of truths, each of which deserves that name, but each of which must be kept out of contact with the others, by being isolated in logic-tight compartments?

Unlike the two preceding questions, the third is one that has come to the forefront only recently. It concerns what many contemporary commentators regard as an unfortunate rift in the realm of knowledge—the chasm between the sciences, on the one hand, and the humanities, on the other. In the long history of the latter term, different disciplines have been grouped together on the side of the humanities and in contradistinction to the sciences. Today, the humanities group is generally thought to include language and literature, the fine arts, history, philosophy, and religion.

It is assumed that there are fundamental differences, in method or approach and in criteria of validity, between the humanistic disciplines, on the one hand, and the sciences, both natural and social, on the other. Of course there are, but they are not entirely clear. By reference to methodology or to criteria of validity, certain of the disciplines called humanistic closely resemble those called scientific. For example, mathematicians and logicians do their work by sitting still and thinking, not by undertaking experiments or by going out into the field to collect data or do research. Philosophy is like them in this respect; but mathematics and logic are usually regarded as sciences, whereas philosophy is grouped with the humanities. Furthermore, the criteria of validity thought to be applicable to philosophy do not operate as criteria for judging the excellence of literature or of other fine arts, yet all three are classified as humanities.

Supposing that some line can be clearly drawn to divide the humanities from the sciences, the problem that agitates those who contemplate the world of learning is whether it is one world or two—whether the rift or chasm that separates the sciences from the humanities involves an iron curtain that prevents communication between them. It is not within the purpose or the province of this essay to provide an answer to that question. Nevertheless, an answer would appear to be suggested by the conception of the encyclopaedia as a totality, as an organized whole. That conception would seem to favour the view that, in the circle of learning, there are no impenetrable barriers to communication or unbridgeable breaks in continuity. Underlying it is the faith that the whole world of knowledge is a single universe of discourse.

Part Ten. The branches of knowledge

Part Ten is concerned in each of its five divisions with historical and analytical studies that have intellectual disciplines of inquiry as their object. The outlines, and the articles and parts of articles referred to, in the five divisions and seventeen sections of this part treat logic, mathematics, science, history and the humanities, and philosophy.

Several points should be noted about the relations of this part to the preceding parts.

The results of investigations in the natural and social sciences, and in medicine and technology—their content or knowledge—are set forth in Parts One through Five, and in Part Seven. Accordingly, the outlines and articles referred to in the seven sections of Division III in this part are confined to questions about the history of these disciplines, and about their nature, scope, structure, methods, and principal problems or tasks. Direct historical accounts of the peoples and civilizations of the world are set forth in Part Nine. Accordingly, Section 10/41 in Division IV of this part is confined to historical and analytical studies of the discipline of history itself, treating the history of historical writing, the methods of modern historical investigation and research, speculative philosophies of history, and philosophical analyses of the specific character of historical knowledge.

The case is different with Divisions I, II, and V—on logic, mathematics, and philosophy. The results of these disciplines have not been dealt with in previous parts. In the history of each of these disciplines, substantive developments have persistently involved, and issued from, positions taken not only *within them,* but also from positions taken *about them.* Accordingly, the outlines and the articles referred to in the sections of Divisions I, II, and V treat the substantive results of logical, mathematical, and philosophical inquiry, on the one hand, and the historical and analytical studies of the nature, scope, branches, methods, and principal problems of logic, mathematics, and philosophy, on the other.

In Part Six on the arts and Part Eight on religion, the outlines and articles referred to include historical and analytic studies of knowledge and inquiry concerning the arts and religion. Such studies, then, are not included separately in Part Ten. However, they are treated in Section 10/42 of this part, insofar as the study of the arts and of religion are, together with the study of language, history, and philosophy, component disciplines of the humanities—a group of disciplines traditionally distinguished from the natural and social sciences, and traditionally considered to have, taken together, a special educational and cultural role. Section 10/42 sets forth a historical review of the changing conceptions of the humanities and of humanistic scholarship, and treats issues about the definition and scope of the humanities, about their distinction from the sciences, and about their role in education and culture.

Division I. Logic 694
II. Mathematics 699
III. Science 725
IV. History and the humanities 753
V. Philosophy 760

Division I. Logic

The outlines, and the articles and parts of articles referred to, in the two sections of Division I deal with the history and philosophy of logic, and with the content of the disciplines of formal logic, metalogic, and applied logic.

The outline and the articles referred to in Section 10/11 first treat the history of logic in the West, and the history of Indian and Chinese logic; and then treat differing conceptions of the field and scope of logic, problems in the philosophy of logic concerning meaning, truth, and ontology, and the place of logic among the sciences and disciplines.

Section 10/11. History and philosophy of logic 695
10/12. Formal logic, metalogic, and applied logic 697

Section 10/12 deals first with formal logic, treating the propositional calculus, the predicate calculus, the theory of the syllogism, modal logic, and set theory and natural-number arithmetic. It goes on to the nature and elements of metalogic, which studies the syntax and semantics of formal languages, formal systems, and logical calculi. Finally, it deals with the applications of logic in different domains of inquiry and discourse.

Section 10/11. History and philosophy of logic

[for Part Ten headnote see page 694
for Division I headnote see page 694]

The articles and parts of articles referred to in Section 10/11 deal with two main subjects: A, the history of logic; and B, the philosophy of logic.

The treatment of ancient logic begins with the precursors and then goes on to Aristotle's founding of the logic of predicates, to later developments in that logic, and to the founding of the logic of propositions by Theophrastus, the Megarians, and the Stoics. The outline of subject A next deals with medieval logic, covering stages in its development, medieval theories of language in relation to logic, and medieval developments in formal logic. It goes on to treat the altered status and character of logic in the Renaissance, the rise of mathematical logic during the Enlightenment, and the further development of it in the 19th century. The treatment of logic in the 20th century covers the conflict of Logicism (the view that mathematics is a continuation of logic) with Intuitionism and Formalism; developments in the logic of propositions and in the logic of predicates; and the appearance of metalogical studies. The outline concludes with accounts of the history of logic in the East—in both India and China.

Subject B is the philosophy of logic. The outline begins with the organization of logic as a discipline, covering differing conceptions of its field and scope, the varieties of logical symbolism, logical semantics as a tool for clarifying the concepts of logic, and the limitations of logic. It goes on to such issues in the philosophy of logic as problems of meaning and truth, problems of ontology concerning individuation and existence, and problems arising from the existence of alternative logics. Finally, it deals with the place of logic among the sciences and disciplines, treating the relations of logic to mathematics and to computer sciences; the role of logic in the methodology of the empirical sciences; the interrelations of logic and linguistic theory; the role of logic in psychology; the role of logic in legal and practical reasoning; diverse views about the place of logic in the educational curriculum; and diverse views about the relation of logic to metaphysics and to other branches of philosophy.

A. History of logic

1. Ancient logic
   - a. Precursors of ancient logic: contributions of the Sophists, Socrates, and Plato to theories of language and the axiomatic method
   - b. Aristotle and the logic of predicates: theories of the structure of language; theories of opposition and conversion; development of syllogistic and modal logic
   - c. Later developments in the logic of predicates: contributions of Theophrastus and Galen
   - d. Founding of the logic of propositions: contributions of Theophrastus and the Megarians; Stoic logic
2. Medieval logic
   - a. Development of medieval logic: Arabic contributions; disputes between the "old logic" and the "new logic" after the translation of Aristotle's *Organon;* summations by William of Sherwood and Peter of Spain
   - b. Medieval theories of language and their relation to the development of logic: the theory of categorematic and syncategorematic terms; the theory of supposition
   - c. Medieval developments in formal logic: the logic of predicates, of propositions, and of modal expressions; logical fallacies and paradoxes
3. Modern logic from the Renaissance to the 20th century
   - a. Logic in the Renaissance: the influence of Neoplatonism and of the rise of the natural sciences; the logics of Petrus Ramus and of Port-Royal
   - b. The rise of mathematical logic during the Enlightenment: contributions of Leibniz (*e.g.*, his general calculus of reasoning and general methodology); the search for clarity and the use of diagrams

articles	article sections	other references
LOGIC, HISTORY OF 11:56–72		
	11:57c–60e	6:526g–527c *passim*/ 16:1004d–e
	11:57c–g	
	11:57g–59c/ 1:1155f–1156c/ 17:890f–g	1:1167a–g
	11:59c–f	
	11:59f–60d	1:1156d–e/ 17:698d–699e *passim*
	11:60f–62e	10:1175b–e/ 14:257b–261a *passim*
	11:60f–61b/ 9:1021a–1022d	1:1156e–1159h *passim*/ 16:352g–357a *passim*
	11:61b–e/ 15:801b–c	
	11:61f–62e	
	11:64a–69a	1:801e–g
	11:64a–d	2:565a–e
	11:64d–65g/ 11:643d–644b	

	articles	article sections	other references
c. Development of mathematical logic in the 19th century: expansions of syllogistic; Boole's algebra of logic; refinements of the calculus; the study by Frege and Cantor of the relation between logic and the foundations of mathematics		**11**:65g–69a/ **16**:569b–d	**1**:521c–522c *passim*/**3**:38g–h/ **7**:712f–713d/**13**:1109a–f
4. Logic in the 20th century		**11**:69a–72d/ **11**:632c–639e/ **12**:31f–32h/ **14**:272g–273d/ **14**:879a–882h	**1**:802d–807g *passim*/ **6**:943b–c
a. The conflict of Logicism, the view that mathematics is a continuation of logic, with Intuitionism and Formalism: Russell's Logicism and the theory of types; Brouwer's Intuitionism; Hilbert's Formalism		**11**:69a–70a/ **11**:633a–639b	**11**:645h–646d/**16**:35e–h/ **19**:816f–g
b. Developments in the logic of propositions and in the logic of predicates		**11**:70a–71g/ **17**:898b–d	**10**:833a–h
c. Metalogical studies: the study of the properties of axiomatized systems; syntax and semantics as metalogical disciplines		**11**:71g–72d/ **16**:506h–507e	**3**:925d–926f *passim*/ **11**:1078c–1085g *passim*
5. Logic in the East		**11**:62e–64a/ **3**:431a–c	
a. Indian logic: its origins in the commentaries on the scriptural texts called *sūtras*; special problems in grammar and special types of inference; interest in the logical implications of the notion of negation		**11**:62e–63f/ **9**:315g–316d	**9**:322d–e/**9**:327d–328a
b. Chinese logic: its origins in reflections on the characteristics of controversies between the major philosophies of Confucianism, Taoism, and Moism; its neglect after the establishment of Neo-Confucianism in the 11th century AD		**11**:63f–64a	
B. Philosophy of logic	LOGIC, PHILOSOPHY OF **11**:72–77		
1. The organization of logic as a discipline		**11**:73a–74e/ **11**:56d–57c/ **12**:26d–f	
a. The nature and varieties of logic: differing conceptions of its field and scope; varieties of logical symbolism		**11**:73a–g/ **6**:944h–945e/ **11**:28b–c/ **11**:55g–h/ **11**:1078c–f/ **17**:891c–892d	**6**:929h–931c *passim*
b. Features and problems of logic: concerns with logical semantics or model theory; questions of the limitations of logic; Gödel's incompleteness theorems; the question of logic and computability		**11**:73g–74e/ **11**:1079a–d/ **17**:890f–g	
2. Issues and developments in the philosophy of logic		**11**:74f–76a	
a. Problems in meaning and truth: logical semantics of modal concepts; logic and informativeness		**11**:74f–75b	
b. Problems of ontology: problems concerning individuation and existence		**11**:75b–g/ **12**:16h–17f	
c. Alternative logics: extensions of the classical first-order logic—*e.g.*, modal logics; nonclassical logics—*e.g.*, intuitionistic logic		**11**:75g–76a/ **11**:43b–44d/ **11**:51f–53a	
3. The place of logic among the sciences and disciplines		**11**:72d–f/ **11**:76b–77c	**11**:38f–g
a. The relation of logic to mathematics		**11**:76b–d/ **11**:54b–55b/ **11**:630h–639e/ **17**:898b–d	**11**:68c–69e/**19**:816f–g
b. The relation of logic to computer science: the connection between automata theory and the logical study of formal languages; mechanical theorem proving		**11**:76d–e/ **4**:1006g–1007b	**2**:497a–502c *passim*

	articles	article sections	other references
c. The role of logic in the methodology of the empirical sciences		**11**:76f-h/ **4**:693b-g/ **11**:35b-37e/ **16**:384f-385f/ **16**:993b-e	**14**:879h-880e/**16**:380g-381d
d. The interrelations of logic and linguistic theory		**11**:76h-77a/ **4**:1006g-1007b/ **10**:1000h-1004b/ **16**:506g-510c	**1**:802a-d/**14**:879e-h/ **14**:881h-882a
e. The role of logic in psychology; *e.g.*, as a conceptual framework for psychological theorizing		**11**:77a-b	
f. The role of logic in legal and practical reasoning		**11**:77b-c/ **11**:28d-29g/ **13**:356b-357f/ **15**:803c-805d	**10**:714h-715b/**10**:718d-g
g. Diverse views about the place of logic in the educational curriculum: logic as a humanistic study		**11**:77c	**8**:1180c-d/**8**:1181h-1182a/ **11**:72e-f
h. Diverse views about the relation of logic to metaphysics and to other branches of philosophy		**6**:926d-e/ **11**:29g-32b/ **12**:14c-f/ **12**:29a-30a/ **14**:272g-273d	**1**:803c-805a *passim*/ **6**:979c-d/ **14**:879a-882h *passim*

Section 10/12. Formal logic, metalogic, and applied logic

[for Part Ten headnote see page 694
for Division I headnote see page 694]

The articles and parts of articles referred to in Section 10/12 deal with three main subjects: A, formal logic; B, metalogic; and C, applied logic.

The outline of subject A begins with the propositional calculus—the logic of unanalyzed sentences in combination. It treats both general features of the propositional calculus and special systems of the propositional calculus. The outline goes on to the predicate calculus—the logic of quantified functions of terms. It treats general features of the predicate calculus; the lower predicate calculus—the logic of individual variables; and higher order predicate calculi—the logics of classes of variables. The outline then deals with syllogistic. It treats the nature and elements of syllogistic; the procedures of immediate inference; the rules and laws of the syllogism; the interpretation of syllogistic as an axiomatic deductive system; and extensions of syllogistic. The outline next deals with modal logic—the logic of necessity, possibility, and contingency; and finally with set theory, or the logic of classes; and with the concept of arithmetic as a logical system.

Subject B is metalogic—the study of the syntax and the semantics of formal languages, formal systems, and logical calculi. The outline treats the nature and elements of metalogic; the nature of a formal system and of a formal language; discoveries about formal mathematical systems and about logical calculi; and model theory.

The outline of subject C, applied logic, begins with logic as yielding criticism of the forms of reasoning, and with the analysis of material, verbal, and formal fallacies. It goes on to epistemic logic—the logic of belief, of knowing, and of questions. It next treats practical logic—the logic of preference, the logic of commands, and the logic of obligation. It further deals with logics of physical application—the logic of time-related propositions and the logic of parts and wholes. Finally, it deals with hypothetical reasoning and with counterfactual conditionals.

	articles	article sections	other references
A. Formal logic	LOGIC, FORMAL **11**:38-56		
1. The propositional calculus: the logic of unanalyzed sentences in combination		**11**:40b-45a/ **11**:70a-g	**11**:1082a-c
a. General features of the propositional calculus: symbols employed for propositional connectives or operators (*i.e.*, "not," "and," "or," "if . . . then," "is equivalent to"); propositional variables		**11**:40b-43b	
i. Formation rules: rules specifying sequences of symbols for well-formed formulas (*wff*'s)		**11**:40h-41b	
ii. Validity: decision procedures using truth tables		**11**:41b-42b	
iii. Interdefinability of operators		**11**:42b-d	
iv. Axiomatization: the construction of an axiomatic system using transformation rules		**11**:42e-43b	
b. Special systems of the propositional calculus		**11**:43b-45a/ **11**:75g-76a	
i. Partial systems: systems expressing a narrower range of truth functions; *e.g.*, the pure implicational calculus		**11**:43b-e	

	articles	article sections	other references
ii. Systems rejecting the requirement of either truth or falsity for variables: three-valued and many-valued logics		**11**:43e–44b	**11**:633h–634c
iii. Intuitionistic calculus		**11**:44b–d	**11**:75g–h
iv. Natural deduction method		**11**:44e–45a	
2. The predicate calculus: the logic of quantified functions of terms		**11**:45b–50e/ **11**:70h–71g	**11**:1082d–f
a. General features of the predicate calculus: individual variables and predicate variables; universal and existential quantifiers (*i.e.*, "any" or "all," "some" or "one")		**11**:45b–f	
b. The lower predicate calculus: the logic of individual variables		**11**:45f–50d	
i. Validity: the impossibility of a generally applicable decision procedure		**11**:45h–46c	
ii. Algebraic manipulations: the finding of prenex normal form of a well-formed formula		**11**:46c–47d	
iii. Classification of dyadic relations: symmetrical, asymmetrical, or nonsymmetrical; transitive, intransitive, or nontransitive; reflexive, irreflexive, nonreflexive, or quasi-reflexive		**11**:47e–h	
iv. Axiomatization: the construction of an axiomatic system using transformation rules		**11**:48a–d	
v. Special systems of the lower predicate calculus: systems restricting or extending the range of well-formed formulas—*e.g.*, the lower predicate calculus with identity		**11**:48d–50d/ **11**:36f–37e	
c. Higher order predicate calculi: the logics of classes of variables		**11**:50d–e	
3. Syllogistic: the theory of the syllogism	SYLLOGISTIC **17**:890–898	**11**:50e–51e	**11**:58a–59c
a. The nature and elements of syllogistic: singular and general terms; extension and intension of terms; the four forms of propositions		**17**:890g–891b	
b. Procedures of immediate inference: relations among propositions		**17**:891c–892d	
c. Rules and laws of the syllogism: categorical and noncategorical syllogistic inferences		**17**:892d–894h	
d. Interpretation of syllogistic as an axiomatic deductive system		**17**:895a–896b	
e. Extensions of syllogistic: singular and negative terms; empty terms and existential import; modal and other special operators		**17**:896c–898b	
4. Modal logic: the logic of necessity, possibility, and contingency; systems of and validity in modal logic		**11**:51f–53a/ **11**:33g–35b	**11**:59a–b/**11**:74f–h
5. Set theory and natural-number arithmetic		**11**:53b–55b	**11**:76b–d/ **11**:630h–639e *passim*
a. Set theory: the logic of classes		**11**:53b–54b/ **4**:691f–h/ **11**:632a–633a/ **16**:569b–571d	
b. Arithmetic as a logical system		**11**:54b–55b	**11**:631f–h
B. Metalogic: the study of the syntax and the semantics of formal languages, formal systems, and logical calculi	METALOGIC **11**:1078–1085	**11**:71g–72d/ **11**:635c–639b	
1. The nature and elements of metalogic		**11**:1078c–1080a	
a. Syntax and semantics in formal languages and formal systems		**11**:1078c–f/ **16**:507f–512b	
b. The axiomatic method		**11**:1078g–1079a/ **11**:659c–g	
c. The relation of logic to metalogic		**11**:1079a–d	
d. Semiotic: the general science of signs and languages		**11**:1079d–g	
2. The nature of a formal system and of a formal language		**11**:1080a–f/ **1**:801e–802d	

	articles	article sections	other references
3. Discoveries about formal mathematical systems: completeness and consistency; decidability and undecidability		11:1080f–1082a	
4. Discoveries about logical calculi		11:1082a–1083d	
a. The consistency, completeness, and decidability of the propositional calculus		11:1082a–c/ 11:41b–42b	
b. The consistency, completeness, and undecidability of the predicate calculus		11:1082d–f/ 11:45h–46c	
5. Model theory: the study of the interpretations, or models, that satisfy the axioms of a given formal system		11:1083d–1085g	
C. Applied logic	LOGIC, APPLIED 11:28–38	11:55c–g	18:356d–f
1. The critique of forms of reasoning		11:28d–29g	15:38d–f
a. Theory of argumentation: the new rhetoric	RHETORIC 15:803–805		
b. Analysis of logical fallacies		13:348c–g	11:62c–e
i. Material fallacies: fallacies involving a misstatement of facts		11:28e–29c	
ii. Verbal fallacies: fallacies involving an incorrect use of terms		11:29d–e	
iii. Formal fallacies: fallacies involving an improper process of inference		11:29f–g	
2. Epistemic logic: logic dealing with the concepts of belief, knowledge, assertion, doubt, and question		11:29g–32b	6:928e–931c *passim*
a. The logic of belief		11:29h–31a	6:929b–h *passim*
b. The logic of knowing		11:31a–f/ 6:926g–927a	
c. The logic of questions		11:31f–32b	
3. Practical logic: logic dealing with the concepts of choosing, planning, commanding, and permitting		11:32b–35b	6:979c–d/15:528b
a. The logic of preference: prohairetic logic		11:32b–33c	
b. The logic of commands		11:33c–g	6:987e–988a
c. The logic of obligation: deontic logic		11:33g–35b/ 6:981g–982f/ 6:990h–992d	6:989f–990b/11:55d–e
4. Logics of physical application		11:35b–37e	
a. Temporal logic: the logic of time-related propositions		11:35c–36f	11:55e–f
b. Mereology: the logic of parts and wholes		11:36f–37e	
5. Hypothetical reasoning and counterfactual conditionals: logic involving consequents whose antecedents are known to be false		11:37e–38b	6:989f–h

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ARISTOTLE 1:1162
BOOLE, GEORGE 3:38
CANTOR, GEORG 3:784
CARNAP, RUDOLF 3:925
FREGE, GOTTLOB 7:712
HILBERT, DAVID 8:872
LEIBNIZ, GOTTFRIED WILHELM 10:785
LEŚNIEWSKI, STANISŁAW 10:832
MILL, JOHN STUART 12:197
PEIRCE, CHARLES SANDERS 13:1108
RUSSELL, BERTRAND 16:34
WHITEHEAD, ALFRED NORTH 19:816

Division II. Mathematics

[for Part Ten headnote see page 694]

The outlines, and the articles and parts of articles referred to, in the three sections of Division II treat the history and foundations of mathematics, the branches of mathematics, and the applications of mathematics.

Section 10/21 deals first with the general history of mathematics, with the development of representative non-proba-

Section 10/21. History and foundations of mathematics 700
10/22. Branches of mathematics 703
10/23. Applications of mathematics 719

bilistic areas of mathematics, and with the historical development of probabilistic areas. The treatment of the foundations of mathematics covers the axiomatic method, the genetic method, 20th-century rival formulations of the foundations of mathematics, and current investigations of the foundations of mathematics.

Section 10/22, the branches of mathematics, first treats set theory, arithmetic, elementary multivariate algebra, linear and multilinear algebra, and algebraic structures, including the subjects of homological algebra and universal algebra. It goes on to deal with Euclidean and non-Euclidean geometry, projective geometry, analytic and trigonometric geometry, differential geometry, and algebraic geometry. It then deals with the subdivisions of mathematical analysis: real analysis, complex analysis, differential equations, functional analysis, Fourier analysis, the theory of probability, and vector and tensor analysis. The outline next deals with combinatorics and combinatorial geometry, and with number theory. Finally, it treats topology—general topology, topological groups and differential topology, and algebraic topology.

Section 10/23, applications of mathematics, first treats mathematics as a calculatory science and then goes on to deal with statistics, numerical analysis, definitions and examples of automata and the development of automata theory, the mathematical theory of optimization, information theory, and the mathematical aspects of physical theories.

Section 10/21. History and foundations of mathematics

[for Part Ten headnote see page 694
for Division II headnote see page 699]

The articles and parts of articles referred to in Section 10/21 deal with two main subjects: A, the history of mathematics; and B, the foundations of mathematics.

The outline of subject A begins with the development of mathematics in general, through ancient, medieval, and modern times. For the ancient and medieval periods, it treats ideas and methods originating or developing in Mesopotamia and Egypt; Greek and Hellenistic mathematics; and Islāmic mathematics and its transmission to the West. Dealing with the modern period, it treats the discovery of logarithms and of analytic geometry, and the development of calculus in the 17th century; advances in geometry, algebra, and analysis in the 18th century; and, in the 19th and 20th centuries, the development of non-Euclidean geometry, contributions to the theories of groups, functions, and complex variables, and the development of algebraic geometry. The outline next deals with the historical development of representative non-probabilistic areas of mathematics. Here it treats numerals and numeral systems, the introduction of symbolic notations, calculatory science, geometry, and algebra. Finally, the outline deals with the historical development of probabilistic areas of mathematics. Here, it first deals with the development of the mathematical theory of probability. It then deals with the development of mathematical statistics, treating the history of the theory of stochastic processes and the origins of control theory.

Subject B is the foundations of mathematics. The outline first deals with the axiomatic method. Here it treats Euclidean geometry, non-Euclidean geometry, and the formal axiomatic method, which proceeds on the assumption that the primitive undefined terms of an axiomatic analysis are meaningless and may later be given any logically consistent interpretation. The outline next deals with the genetic method—mathematical analysis based upon the orderly construction or generation of objects with unknown properties from objects with known properties. Here it treats the extension of the concept of number from the natural numbers to negative, rational, and real numbers; and the concept of cardinal numbers and the theory of sets. The outline next deals with the crisis in the foundations of mathematics after 1900, covering reformulations of the foundations in terms of the three alternative philosophical positions of Intuitionism, Logicism, and Formalism. Finally, the outline deals with current Intuitionistic studies, and with current non-Intuitionistic studies of the foundations of mathematics.

articles	article sections	other references
A. History of mathematics		
MATHEMATICS, HISTORY OF 11:639–670		
1. The development of mathematics in general, through ancient, medieval, and modern times	11:639h–646c	
a. Ancient and medieval periods	11:640b–642f/ 11:672b–673f/ 11:673h–674c	1:1175b–1176d/7:1082a–g
i. Ideas and methods originating or developing in Mesopotamia and Egypt	11:640b–h/ 11:672b–673a	12:917d–e

	articles	article sections	other references
ii. Greek and Hellenistic mathematics		**11**:640h–642a/ 1:773c–f/ 1:783a–d/ **14**:252d–f/ **15**:323e–324e	**1**:1088c–g/**6**:1019h–1020h/ **6**:1021d–g/**7**:1079a–h/ **14**:538d–f/**16**:377e–f
iii. The Middle Ages: Islāmic mathematics and its transmission to the West		**11**:642a–f	**10**:817g–818b
b. The modern period		**11**:642g–646c/ 1:740f–h	**1**:507c–g
i. The 17th century: discovery of logarithms and analytic geometry; development of calculus by Newton and Leibniz		**11**:642h–643h/ 1:783d–784d	**5**:738b–f/**7**:234h–235h/ **7**:1120e–f/**12**:826e–h/ **13**:17f–g/**19**:533c–g
ii. The 18th century: advances in geometry, algebra, and analysis; contributions of the Bernoulli family, Euler, Lagrange, Laplace, and others		**11**:644a–e	**1**:464d–f/**1**:722f–g/ **2**:867e–868c/**5**:738f–h/ **6**:1027a–e/**7**:966d–967f/ **10**:598b–f/ **10**:680f–681d *passim*
iii. The 19th and 20th centuries: development of non-Euclidean geometry by Bolyai, Lobachevsky, and others; contributions to the theories of groups, functions, and complex variables; development of algebraic geometry; influence of physical science on analysis; study of the foundations of mathematics		**11**:644e–646c/ 1:723g–724d/ 1:730f–732b/ 1:752f–753a/ 1:773h–774b/ 1:784e–787d/ **11**:631b–d/ **13**:360c–361d/ **18**:500b–g	**1**:9h–10b/**1**:722g–h/ **1**:791h–792d/**3**:38g–h/ **3**:784e–785b/**3**:1033e–g/ **5**:549h–550d/**5**:738h–739a/ **7**:577f–g/**7**:712f–713d/ **7**:857h–858b/**7**:1120f–1121a/ **8**:589d–g/**8**:872c–g/ **10**:501d–503a/**11**:9c–h/ **11**:632c–639e *passim*/ **12**:1066h–1067e/**14**:605d–g/ **14**:881d–h/**15**:840e–841a/ **16**:382g–h/**19**:816f–g
2. Historical development of representative nonprobabilistic areas of mathematics		**11**:646d–666e	
a. Numerals and numeral systems [see also 10/23.A.1.]		**11**:646g–648h/ **11**:671h–673h	
i. Simple grouping systems: ancient Egyptian, Babylonian, Greek, and Roman numerals		**11**:646g–647h/ **11**:672b–673c	
ii. Development of multiplicative, ciphered, and positional numeral systems		**11**:648a–h/ **11**:673c–f	
b. Introduction of symbolic notations to represent mathematical quantities, operations, and relationships		**11**:648h–649d	
c. Calculatory science [see also 10/23.A.]		**11**:649d–654a	
i. The history of mathematical tables, including tables of logarithms		**11**:649d–651f	**12**:826e–g
ii. The evolution of analogue devices: origins of harmonic analyzers, differential analyzers, and the slide rule		**11**:651g–654a	
iii. The evolution of digital devices: development of computational aids from the abacus to the modern electronic digital computer [see 10/23.A.7.]			
d. Geometry [see also 10/22.C.]		**11**:654b–661h	
i. Egyptian, Babylonian, and Greek geometry		**11**:654b–656a/ **11**:673h–674c	**1**:1088c–g/**6**:1019h–1020h/ **6**:1021d–g/**7**:1079a–h/ **15**:324d–e
ii. The algebraic approach: development of analytic geometry		**11**:656b–g/ 1:773g–h	7:234h–235f
iii. Development of projective geometry		**11**:656g–657f	7:1120e–1121a
iv. Development of non-Euclidean geometry		**11**:657g–658e/ 7:1113d–1114e/ **11**:631b–d	7:967c–d/**11**:9c–h
v. Philosophical aspects of geometry		**11**:658f–659c	
vi. Modern ideas and topics in geometry: the axiomatic method, geometrical transformations, the concept of space, differential geometry, and topology		**11**:659c–661h/ **18**:500b–g	

	articles	article sections	other references
e. Algebra [see also 10/22.B.]		11:661h–666e/ 1:499c–f/ 11:680g–681c	
i. Babylonian, Egyptian, and Greek contributions		11:662a–e	
ii. Contributions from the Orient, India, and the Islāmic world		11:662e–g	
iii. Medieval and modern European developments		11:662g–664a	
iv. Evolution of the theory of algebraic equations of one variable: solutions prior to and after Galois		11:664a–666e	7:857h–858b/7:966d–h
3. Historical development of probabilistic areas of mathematics [see also 10/22.D.6.]		11:666e–670g	
a. Development of the mathematical theory of probability		11:666f–669h/ 7:867h–868b	
i. The abstract calculus of probability: the common structure of theories of probability		11:667a–d	
ii. Alternative views of probability: the frequency theory of probability; the range theory of probability and the principle of indifference; the belief theory of probability; subjective and objective notions of probability		11:667d–668g	
iii. Bernoulli's theorem, inverse probability, and asymptotic probabilities		11:668g–669h	
b. Development of mathematical statistics: the history of the theory of stochastic processes; origins of control theory		11:669h–670g	10:502b–503a
B. Foundations of mathematics	MATHEMATICS, FOUNDATIONS OF 11:630–639		
1. The axiomatic method: mathematical analysis based upon a set of axioms, or unproved statements		11:630h–631f/ 11:54b–d/ 11:659c–g	
a. Euclidean geometry: the deductive method by which theorems are derived from primitive concepts and propositions [see also 10/22.C.1.]		11:630h–631b/ 7:1100a–1101c	
b. Non-Euclidean geometry: the discovery that other logically consistent geometries can be constructed and that Euclid's geometry is not the only possible model of physical space [see also 10/22.C.2.]		11:631b–d	
c. The formal axiomatic method: the system of mathematical deduction that proceeds on the assumption that the primitive undefined terms are meaningless and may later be given any logically consistent interpretation		11:631d–f/ 11:1078g–1079a	7:1101c–g
2. The genetic method: mathematical analysis based upon the orderly construction or generation of objects with unknown properties from objects with known properties		11:631f–632c	
a. Arithmetic and analysis: the extension of the concept of number from the natural numbers to the negative numbers, rational numbers, and real numbers [see also 10/22/B.1.]		11:631f–632a	
b. The concept of cardinal number and the theory of sets: definition of cardinal number in terms of one-to-one correspondence; transfinite cardinal numbers, or the cardinal numbers of infinite sets [see also 10/22.A.2.]		11:632a–c/ 16:570h–571d	3:784f–785b
3. The crisis in the foundations of mathematics after 1900: reformulations in terms of the three alternative philosophical positions of Intuitionism, Logicism, and Formalism		11:632c–639b/ 11:68c–70a	11:76b–d/11:645h–646d
a. The paradoxes: the discovery of contradictions within set theory; the transformation of the theory of sets from a genetic into a formal axiomatic theory		11:632c–633a/ 13:356g–h/ 16:571c–575a	11:53e–f/11:68h–69e/ 11:71c–f

	articles	article sections	other references
b. Intuitionism: the view that mathematical objects are constructions of the mind and are governed by self-evident laws		11:633a–635c	
i. Historical development and basic features of Intuitionism: Kant and other early exponents of intuitionistic ideas; modern formulation of Intuitionism by Brouwer		11:633c–h	
ii. Intuitionistic criticisms of Realism and Formalism		11:633h–634c	
iii. Redevelopment of mathematics on intuitionistic foundations		11:634c–g	
iv. Intuitionistic logic		11:634g–635c	
c. Logicism, Formalism, and the metamathematical method		11:635c–639b/ 11:69a–70a/ 11:1080f–1082a	
i. Logicism: the view that mathematics is a branch of logic and discovers inherent truths about abstract objects that are independent of the mind		11:635d–g	
ii. Formalism: the view that mathematical deductions result from the manipulation of essentially meaningless symbols according to prescribed rules		11:635g–636d	
iii. Turing's computing machine and formal systems: decision and computation problems; demonstration of the existence of a theoretical procedure for determining which functions are computable		11:636e–637c	2:497c–499b *passim*/ 11:54g–h/11:74c–e
iv. Church's theorem: proof of the existence of logical systems without decision procedures		11:637c–e	
v. The effect of Gödel's theorems on Formalism: proof that a formal system embodying classical mathematics will contain undecidable statements and that if such a system is consistent, its consistency is unprovable using only statements expressible within the system		11:637f–638h/ 11:1081a–d/ 16:574b–e	11:54h–55b/11:71g–72b/ 11:74a–c
vi. Degrees of decidability in arithmetic: proof by Kleene and Mostowski that the decidable and undecidable properties in arithmetic exist in a hierarchical arrangement		11:638h–639b	
4. Current directions in investigations of the foundations of mathematics		11:639b–e	
a. Intuitionistic studies of the foundations of mathematics: application of formalistic procedures to Intuitionism		11:639b–d	
b. Non-Intuitionistic studies of the foundations of mathematics: trends in recursion theory, proof theory, model theory, and set theory		11:639d–e	

Section 10/22. Branches of mathematics

[for Part Ten headnote see page 694
for Division II headnote see page 699]

The articles and parts of articles referred to in Section 10/22 deal with six main subjects: A, set theory; B, algebra; C, geometry; D, analysis; E, combinatorics and number theory; and F, topology.

The outline of subject A, set theory, treats the fundamental set concepts; the essential features of Cantorian set theory; axiomatic set theories; and the limitations of axiomatic set theory as revealed in Gödel's theorem.

The outline of subject B begins with arithmetic, covering the fundamental definitions and laws of arithmetic; the theory of divisors leading to the extension of natural number concepts to non-integers; number systems and notation; arithmetic calculation with decimals; and logarithms. It goes on to elementary multivariate algebra—a generalization and extension of arithmetic. It here treats the basic algebraic properties of numbers, polynomials and rational functions, and the solution of equations. The outline next treats the concepts and operations of linear algebra and of multilinear algebra. Finally, it deals with modern abstract algebra. Here, dealing with algebraic structures of major importance, it treats lattices, groups, fields, rings, and categories. It further treats homological algebra, and finally universal algebra, the generalized study of algebraic systems.

The outline of subject C, geometry, treats Euclidean geometry, non-Euclidean geometry, projective geometry, analytic and trigonometric geometry, differential geometry, and algebraic geometry. Combinatorial geometry is covered in subject E, combinatorics and number theory.

Subject D is analysis, the largest in extent of the main divisions of mathematics, which developed in historical stages that reflected its greater or lesser intimacy with mechanics and theoretical physics. Articles are referred to that treat the subdivisions of analysis—real analysis, complex analysis, differential equations, functional analysis, Fourier analysis, the theory of probability, and vector and tensor analysis.

The first article referred to on subject E, combinatorics and number theory, treats both combinatorics in general, a branch of mathematics concerned with arrangements, operations and selections within a finite or a discrete system; and combinatorial

geometry, which is concerned with relations among members of finite systems of geometric figures subject to various conditions and restrictions. The other article referred to treats elementary number theory, algebraic number theory, analytic number theory, geometric number theory, and probabilistic number theory.

A. Set theory

1. Origins of set theory and the definitions of a set and a set element, or member
2. Introduction to set theory
   a. Fundamental set concepts
      i. Operations on sets; *e.g.*, union of sets, intersection of sets
      ii. Logical relations between sets; *e.g.*, "is a subset of," "is in one-to-one correspondence with"
   b. Essential features of Cantorian set theory
      i. The principles of extension and abstraction: definition of a set by enumeration or by description of its members
      ii. The concept of equivalent sets
      iii. Cardinality and transfinite numbers: Cantor's discovery of the existence of nonequivalent infinite sets; Cantor's theorem; discovery of paradoxes, or internal contradictions, within set theory
3. Axiomatic set theory: formal analyses of set theory based upon certain fundamental assumptions or undefined notions called axioms
   [see also 10/21.B.3.a.]
   a. Postulates of axiomatic set theory: the Zermelo–Fraenkel axioms; the von Neumann–Bernays–Gödel axioms
   b. Limitations of axiomatic set theory: failure of attempts to prove the consistency of axiomatic set theory; Gödel's theorem
   c. The present status of axiomatic set theory: profound changes in axiomatic set theory as a result of recent discoveries

B. Algebra

1. Arithmetic
   a. Fundamental definitions and laws: the concepts of natural number and integer; the binary operations of addition and multiplication; the commutative and associative laws of addition; the commutative, associative, and distributive laws of multiplication
   b. Theory of divisors: extension of natural number concepts to non-integers; fractions resulting from the binary operation of division
      i. The fundamental theorem of arithmetic: rational numbers comprising the integers and fractions; operations with fractions
      ii. Irrational numbers: numbers that cannot be expressed as rational fractions
   c. Number systems and notation: use of the positional principle and the symbol zero to specify magnitude in sequences of digits; number systems having different bases—*e.g.*, binary, decimal, and sexagesimal systems
   [see also 10/23.A.1.]
   d. Arithmetic calculation with decimals: binary operations with decimals; divisibility rules; calculation of square, cube, and higher roots

Subject F is topology—the study (in a simple if not entirely accurate definition) of those properties that an object retains under deformation—specifically under bending, stretching, and squeezing, but not under breaking or tearing. The articles referred to treat general topology, topological groups and differential topology, and algebraic topology.

articles	article sections	other references
SET THEORY **16**:569–575	**11**:53b–54b	
	16:569b–d	
	16:569d–571d	**11**:53b–f
	16:569d–570c	
	16:569e–g	
	16:569g–570c	
	16:570c–571d	
	16:570c–f	
	16:570f–g	
	16:570h–571d/ **1**:776c–f/ **11**:632a–633a	**11**:68f–69a
	16:571d–575a	**11**:53f–54b/**11**:71c–g
	16:571e–574b	
	16:574b–e	
	16:574f–575a	
ARITHMETIC **1**:1171–1178		
	1:1171g–1172h	**1**:499d–h
	1:1172h–1174h/ **1**:774b–775c	
	1:1173b–1174a/ **1**:774f–g	
	1:1174b–h/ **1**:774h–775c	
	1:1174h–1176e	
	1:1176e–1178c	

	articles	article sections	other references
e. Logarithms: formal definition of logarithms; use of logarithms to reduce the operations of multiplication and division to the simpler operations of addition and subtraction [see also 10/23.A.4.b.]		1:1178c–g	11:681c–682d
2. Elementary and multivariate algebra	ALGEBRA, ELEMENTARY AND MULTIVARIATE 1:499–506		
a. History and basic concepts: algebra as an extension and generalization of arithmetic		1:499b–f/ 11:661h–664a	
b. Basic algebraic properties of numbers		1:499f–501c	
i. The elementary operations of algebra: addition, subtraction, multiplication, and division		1:499f–500a	
ii. The operation of root extraction: the introduction of complex numbers		1:500a–e	
iii. Geometric representation of numbers: geometrical constructions that represent the elementary algebraic operations in the real number plane; representation of complex numbers in the Argand diagram		1:500f–501c	
c. Polynomials and rational functions		1:501c–503g	
i. Polynomials: sums of terms composed of a variable raised to a power multiplied by a number called the coefficient		1:501c–f	
ii. Rational functions: extension of the concept of polynomial		1:501f–502b	
iii. Elementary properties of polynomials and rational functions: the division algorithm for polynomials; reducible and irreducible polynomials; the unique factorization theorem		1:502b–503b	
iv. Symmetric polynomials and their properties		1:503b–g	
d. Solution of equations: the principal problem of elementary algebra [see also B.4.c.vi., below]		1:503g–506h/ 11:664a–666e	
i. Existence of solutions: the fundamental theorem of algebra		1:504d–g/ 1:537c–d	
ii. Extraction of the roots of a polynomial		1:504h–505d	
iii. Common roots of two polynomials		1:505d–506b	
iv. Solution of two simultaneous equations		1:506c–d	
v. Solution of linear systems of equations		1:506d–h	13:388g–389b
3. Linear and multilinear algebra	ALGEBRA, LINEAR AND MULTILINEAR 1:507–518		
a. Linear algebra [see also 10/23.C.3.c.]		1:507a–516c	
i. Historical and conceptual introduction: the origin of linear algebra in the study of systems of linear equations; the introduction of matrices and the concept of a vector space		1:507c–509a/ 1:506d–h	
ii. Vector spaces: their definition and properties; the concept of linear dependence		1:509a–h	
iii. Matrices: their definition and properties; matrix operations and matrix transformations; matrix representation of systems of linear equations		1:509h–511d	13:388g–389b
iv. Linear transformations and linear operators: eigenvalues and eigenvectors; rational and Jordan canonical form of a matrix		1:511d–514a	13:389b–c
v. Linear functionals and their relation to linear transformations		1:514a–f	
vi. Inner products and inner product spaces: self-conjugate, or Hermitian, matrices; unitary and orthogonal matrices		1:514g–515f	

	articles	article sections	other references
vii. Linear operators in an inner product space: self-adjoint, or Hermitian, operators; unitary and orthogonal operators; the spectral theorem for normal operators		1:515f–516c	
b. Multilinear algebra		1:516c–518e	
i. The tensor product of vector spaces: existence and uniqueness of the tensor product		1:516c–517a	
ii. The tensor algebra of a vector space: the universal mapping property; covariant and contravariant tensors		1:517b–g	
iii. The exterior algebra of a vector space constructed from the *r*th exterior power of a vector space		1:517g–518e	
4. Algebraic structures	ALGEBRAIC STRUCTURES 1:518–557		
a. Lattices		1:519d–524c	
i. Definitions and examples of lattices		1:519e–521b	
ii. Boolean algebra: the theory of complemented distributive lattices		1:521c–522c	
iii. Distributive lattices: switching circuits and their relation to free distributive lattices; finite distributive lattices		1:522d–523a	
iv. Modular and geometric lattices		1:523a–f	
v. Other lattice-ordered structures: relation algebras; vector lattices		1:523f–524c	
b. Groups		1:524c–532g/ 1:752e–755b	
i. Definition of a group: groups of mappings; semigroups; isomorphic groups		1:524d–525a/ 1:753a–b	
ii. Examples of groups: symmetries of a cube; symmetries of the regular octahedron; collineations of the Euclidean plane		1:525b–g	
iii. Elementary group structure		1:525h–526a	
iv. Subgroups and their relation to the groups to which they belong: cosets; the index of a subgroup; the theorem of Lagrange; Sylow's theorems		1:526b–g	
v. Homomorphisms and factor groups		1:526h–527g	
vi. Direct products and Abelian groups		1:527h–528d	1:750e–751c
vii. Automorphisms of groups and semidirect products		1:528d–h	
viii. Permutation groups		1:528h–529c	
ix. Group representation		1:529d–530g/ 1:753b–755b	
x. The classical groups and continuous groups		1:530h–531c	
xi. Free groups, the word problem, and the Burnside problem		1:531c–532a	
xii. Simple groups		1:532a–g	
c. Fields		1:532g–541d	
i. Definition and familiar examples of fields: the field of rational numbers, the field of real numbers, and the field of complex numbers		1:532g–534b/ 1:776a–b	
ii. Elementary theory of fields: the field postulates; the procedure of Gaussian elimination		1:534b–h	
iii. General field concepts: commutative rings and integral domains; fields of quotients; ideals and quotient-rings; morphisms of rings; subrings and subfields; characteristics of a ring		1:535a–536b	
iv. Field extensions: simple algebraic extensions, finite fields, transcendental extensions, and Pythagorean numbers; the fundamental theorem of algebra		1:536b–537d	
v. Application of field theory to the problem of designing error-detecting and error-correcting codes		1:537d–538b	

	articles	article sections	other references
vi. Galois theory: application of the theory of groups and fields to the problem of finding roots of polynomials		1:538b–539a	11:666a–e
vii. Ordered fields: the concept of positivity and the definition of an ordered field; Archimedean fields; limits and convergence; completeness		1:539b–540d	
viii. Valuations: underlying ideas and the definition of the *p*-adic valuation; completing fields		1:540f–541d	
d. Rings		1:541d–547c	
i. Definition and examples of rings: fundamental ring concepts and properties		1:542b–543h	
ii. Definition and examples of algebras: quadratic algebras; the algebra of quaternions; group algebras		1:543h–544g	
iii. Matrix representations of rings		1:544h–545b	
iv. Rings as modules		1:545b–f	
v. Some special classes of rings: domains, rings of integers, Noetherian rings, and division rings		1:545f–547c	
e. Categories		1:547c–550h	
i. Formal definition and examples of categories: the category of sets		1:547g–548e	
ii. Functors and natural transformations		1:548f–550a	
iii. Universal constructions and the duality principle		1:550a–f	
iv. The role of category theory in mathematics		1:550g–h	
f. Homological algebra		1:550h–554b	
i. Homology groups of groups		1:551c–h	
ii. Derived functors		1:551h–552c	
iii. Homology of Lie algebras and applications of homology theory to algebra		1:552c–h	
iv. Other aspects of homological algebra: spectral sequences; Hopf algebras		1:552h–554b	
g. Universal algebra		1:554b–557g	
i. Basic notions of universal algebra: generalizations of algebraic structures		1:554f–555e	
ii. The connection between mathematical logic and universal algebra		1:555f–556d	
iii. Varieties of algebras: the notion of a free algebra		1:556d–557d	
iv. The relation between universal algebra and category theory		1:557d–g	
C. Geometry			
1. Euclidean geometry	GEOMETRY, EUCLIDEAN 7:1099–1112		
a. Introduction: the change in status of Euclidean geometry from the only geometry to one among a number of abstract geometries; the transmission of Euclid's work via Arabic translations		7:1099e–h	
b. Euclid's work: Euclid's definitions, axioms, and common notions; a survey of Euclid's *Elements*		7:1100a–1101c/ 11:630h–631b	11:655d–h
c. Geometry as an abstract doctrine: the axiomatization of the foundations of geometry; axioms of order, incidence, congruence, parallels, and continuity and results derived from them		7:1101c–1106f/ 11:631d–f	
d. The measure of polygons and polyhedra: the theories of equivalence and measure and their relation; Euclid's contribution and its modern extension and generalization		7:1106f–1107f	
e. Transformation geometry: reflection, rotation, and translation of geometric figures; homotheties and similitudes		7:1107f–1108f/ 11:659h–660e	

	articles	article sections	other references
f. Geometric constructions: the equivalence between Euclidean constructions and existence theorems; gauge constructions; ruler and compass constructions; construction with compass only		7:1108g–1110b/ 1:500f–501c	
g. Geometry of more than three dimensions: the generalization of Euclidean geometry		7:1110b–c	
h. The concept of convexity and convex sets		7:1110c–1112e	
i. The concept of convexity in Euclidean geometry		7:1110c–g	
ii. Basic concepts of convexity in the development of Euclidean point set topology		7:1110g–1111g	
iii. Convexity in Minkowskian geometry as compared to that in Euclidean geometry		7:1111g–1112c	
iv. Quantitative aspects of convexity: geometric inequalities		7:1112d–e	
2. Non-Euclidean geometry [see also 10/21.B.1.b.]	GEOMETRY, NON-EUCLIDEAN 7:1112–1120		
a. Distinction between Euclidean and non-Euclidean geometry: hyperbolic geometry and elliptic geometry		7:1112h–1113c	
b. History of non-Euclidean geometry: the development of hyperbolic geometry by Bolyai and Lobachevsky; the development of elliptic geometry by Schläfli, Riemann, and Klein		7:1113d–1114e/ 11:631b–d/ 11:657g–658e	
c. Geometric representations of the hyperbolic plane and hyperbolic space		7:1114e–1118c	
i. Projective models: Beltrami's Euclidean model of the hyperbolic plane and its generalization in terms of projective geometry		7:1114e–1115f	
ii. Inversive models: the representation of planes in hyperbolic space by circles in the inversive plane; the angle of parallelism and the definition of hyperbolic distance		7:1115g–1116g	
iii. Comparison of the inversive and projective models		7:1116g–1117b	
iv. The representation of hyperbolic points, lines, circles, and planes in terms of the inversive models: horocycles and horospheres		7:1117c–1118c	
d. Coordinates in spherical and elliptical space: interpretations of four-dimensional Euclidean space		7:1118c–1119d	
e. Coordinates in the hyperbolic plane and hyperbolic trigonometry		7:1119d–g	
f. Transformations: hyperbolic geometry as characterized by its group of reflections		7:1119g–1120c	
3. Projective geometry	GEOMETRY, PROJECTIVE 7:1120–1125		
a. History and basic character of projective geometry: the seminal work of Pappus of Alexandria and Desargues; the development of projective geometry by Poncelet and later contributors		7:1120d–1121a/ 11:656g–657f	
b. The procedure of projection as the foundation of projective geometry		7:1121b–1122d	
i. Perspective projection: projection of one plane onto another from a point not lying on either		7:1121b–c	
ii. Points at infinity: the concept of ideal points, which permits general formulation of the projective axioms, or axioms of incidence		7:1121c–g	
iii. Projective theorems: Desargues' theorem and Pappus' (Pascal's) theorem		7:1121g–h	
iv. The concept of duality: duality between points and lines in a plane and between points and planes in space		7:1121h–1122b	
v. Projectively generated loci, or curves		7:1122c–d	
c. Homogeneous coordinates: location of points in space		7:1122d–1123g	

	articles	article sections	other references
i. Comparison of homogeneous and Cartesian coordinates: transformation of coordinates		7:1122d–1123b	
ii. Geometry of one dimension: homogeneous coordinates of the line		7:1123b–c	
iii. The fundamental theorem of projective geometry and the concept of harmonic pairs of points		7:1123d–g	
d. Complex geometry: introduction of complex numbers as homogeneous coordinates		7:1123g–1124d	
i. Definition and properties of projective mappings		7:1124b–c	
ii. Group properties of the set of all projective mappings of a plane on itself		7:1124c–d	
e. Abstract geometries: extension and generalization of projective geometry to space of any number of dimensions		7:1124e–1125a	
4. Analytic and trigonometric geometry	GEOMETRY, ANALYTIC AND TRIGONOMETRIC 7:1076–1093		
a. Plane analytic geometry: fundamental procedures and concepts		7:1077b–1081h	
i. Cartesian coordinates: location of points in space with respect to perpendicular axes		7:1077b–c	1:500e–501a
ii. Representation of straight lines by means of algebraic equations		7:1077c–1078f	
iii. Equation of a circle in Cartesian coordinates		7:1078f–1079a	
iv. Conic sections: the group of curves obtained by the intersection of a right circular cone and a plane—the circle, ellipse, hyperbola, and parabola		7:1079a–1081g	
v. Equations of tangents and normals to curves		7:1081g–h	
b. Trigonometry		7:1081h–1086b	
i. History: the origin of trigonometry as a computational science used to calculate angles and distances in plane and spherical triangles		7:1082a–g	
ii. Trigonometric functions: measurement of angles in terms of degrees and radians; the sine, cosine, tangent, cotangent, secant, and cosecant functions; tables of natural functions		7:1082h–1084b	
iii. Plane trigonometry: solution of plane triangles		7:1084c–e	
iv. Spherical trigonometry: solution of spherical triangles		7:1084g–1085e	
v. Analytic trigonometry: trigonometric functions of real variables; power series representation of trigonometric functions; inverse trigonometric functions		7:1085e–1086b	
c. Coordinates and transformation of coordinates		7:1086b–1087c	11:685d–f
i. Polar coordinates		7:1086b–c	
ii. Transformation of coordinates: change from one coordinate system to another		7:1086c–f	
iii. Discriminant of a conic: criteria for determining the form of a conic section		7:1086h–1087b	
iv. Barycentric and areal coordinates		7:1087b–c	
d. Projective and solid analytic geometry: extensions of analytic geometry to the projective plane and to three or more dimensions		7:1087c–f	
e. Special curves: named curves that have been studied with regard to problems in mathematics or the physical sciences; *e.g.*, the folium of Descartes, the lemniscate of Bernoulli, the cardioid, the cycloid, the catenary, the brachistochrone		7:1087f–1093f	
5. Combinatorial geometry [see E.1.d., below]			
6. Differential geometry [see also F.2.e., below]	GEOMETRY, DIFFERENTIAL 7:1093–1099		

	articles	article sections	other references
a. Origin and basic concepts of differential geometry: quadratic differential forms; manifolds		7:1093h–1094b/ **11**:660h–661e	
b. Properties of manifolds and tensor bundles		7:1094c–1095a	
c. Operations on tensor fields: connections		7:1095a–g	
d. De Rham and Hodge theorems: the relation between local and global properties of manifolds		7:1095h–1096b/ **18**:498b–d	
e. The Gauss–Bonnet formula and characteristic classes		7:1096b–1097a/ **18**:498d–f	
f. Elliptic differential operators: global invariants of manifolds		7:1097a–c	
g. Isometric imbedding, submanifolds, and recent developments in surface theory		7:1097c–1098d	
h. Complex manifolds: manifolds in which the local coordinates are complex numbers		7:1098d–1099b/ **18**:498g–499a	
i. Local and global problems in differential geometry		7:1099c	
7. Algebraic geometry [see also F.3., below]	GEOMETRY, ALGEBRAIC 7:1070–1076		
a. Basic concepts: the definition of algebraic geometry as the study of algebraic varieties in projective space; fundamental properties of algebraic varieties		7:1070d–1071d	
b. Projective and abstract varieties: construction of projective varieties from affine varieties; irreducible varieties; equivalent varieties		7:1071g–1073h	
c. Sheaves and schema: definitions of sheaves and ringed spaces; representation of an algebraic variety as a ringed space; schema as generalizations of algebraic varieties; the cohomology group of a sheaf		7:1073h–1075d/ **1**:539h–540c/ **18**:507d–h	
d. Applications of sheaf theory to algebraic geometry		7:1075d–1076f	
D. Analysis			
1. Real analysis	ANALYSIS, REAL 1:772–791		
a. Origins and concepts of real analysis		**1**:772e–774b	
i. The meaning of real analysis: its relation to science; the basic concepts of derivative, real number, and magnitude		**1**:772e–773c	
ii. Stages of development of real analysis: evolution of irrational numbers, concepts of area and volume, set theory, and analytic geometry		**1**:773d–774b	
b. Number systems and their properties		**1**:774b–777e	
i. The real-number system: number as quantity and number as ratio; rational and irrational numbers		**1**:774b–775c/ **1**:1173f–1174h	
ii. Generalizations of real numbers; *e.g.*, complex numbers, quaternions, transcendental numbers, infinite cardinal numbers, infinite ordinal numbers		**1**:775c–777e/ **16**:570h–571d	
c. Functions and differential calculus		**1**:777e–782g	
i. Functions: geometric interpretation of functions and their derivatives; general and piecewise analytic functions; Fourier series, analytic theory of numbers, and least-square approximation of functions		**1**:777e–780g/ **1**:720g–721a/ **1**:738e–739a	**1**:740h–741f
ii. Differential calculus: formal definition of the derivative; use of derivatives to determine maxima and minima of functions; formulas for the computation of derivatives		**1**:780g–782g	**13**:388b–c
d. Measure and integral calculus		**1**:782g–791a	
i. Historical development of the concept of measure from the study of such problems as the determination of the length of a curve, the area of a surface, or the volume of a solid		**1**:782g–787d	

	articles	article sections	other references
ii. Integral calculus: definitions of the Riemann, or definite, integral and of integrable and nonintegrable functions; the fundamental theorem of calculus and conditions for the existence of the Riemann integral; applications of integral calculus in geometry and mechanics		1:787d–791a	13:388d–g
2. Complex analysis	ANALYSIS, COMPLEX 1:719–735		
a. Theory of analytic functions of one complex variable		1:720b–723g	
i. Foundational concepts: complex numbers and their representation in the complex plane; complex-valued functions; power series and the concept of analytic continuation		1:720b–721d/ 1:500a–e/ 1:775c–f/ 1:778c–f	1:501a–c
ii. The Cauchy theory: Cauchy's integral theorem; representation theorems and the residue theorem		1:721d–722d	
iii. Properties of entire and meromorphic functions		1:722d–e	
iv. Elliptic functions: their origin, properties, and relation to theta functions; the Weierstrass theory		1:722e–723g	
b. Theory of analytic functions of several complex variables		1:723g–730e	
i. History: development of complex analysis from the theory of analytic functions of one or more complex variables		1:723g–724d	
ii. Properties of holomorphic functions of several complex variables: the concept of a homeomorphism, or bicontinuous map		1:724d–h	
iii. Conformal maps: origin of the study of conformal maps in the problem of constructing maps of the Earth; the Riemann mapping theorem		1:724h–725d	
iv. Definition and properties of complex manifolds and analytic spaces		1:725d–726b	
v. The cohomology of an n-dimensional complex analytic manifold with coefficients in the sheaf of holomorphic functions		1:726c–e	
vi. Complex line bundles and complex vector bundles		1:726e–g	
vii. The Riemann–Roch theorem		1:726h–727c	
viii. Analytic continuation and domains of holomorphy: Oka's theorems; Runge's theorem; the Cousin problems		1:727c–728e	
ix. The theory of deformations of complex structures: basic concepts and recent results		1:728e–729g	
x. Automorphisms of analytic spaces and automorphic functions		1:729h–730e	
c. Potential theory		1:730f–735e	
i. Historical survey of problems and concepts: origin of potential theory in problems of electrostatics and gravitation; the Dirichlet problem; application of concepts from the theories of measure and integration, topology, and probability		1:730f–732b	5:740b–d
ii. Basic concepts and results of classical potential theory: harmonic, polyharmonic, sub- and superharmonic functions; polar sets, capacity, and fine topology; the Dirichlet problem; Green function and Green space; the general classical convergence theorem; the principle of energy and Martin boundaries		1:732b–734f	
iii. Axiomatizations of potential theory and relations of potential theory to probability theory		1:734f–735e	
3. Differential equations	DIFFERENTIAL EQUATIONS 5:736–767		
a. Introduction: examples of natural laws and physical phenomena that can be expressed mathematically in terms of differential equations		5:736g–737g	

	articles	article sections	other references
b. Ordinary differential equations		**5**:738a–752c	
i. Historical background: origins of the theory of differential equations within the development of differential calculus; investigations of the existence and uniqueness of solutions		**5**:738b–739a	
ii. Types of problems solvable with the aid of ordinary differential equations; *e.g.*, problems in mechanics and other areas of physics; problems in control theory, chemical kinetics, and physiology		**5**:739b–742c	
iii. Types of solutions: general solutions and particular solutions		**5**:742c–743c	
iv. Existence and uniqueness of solutions: the Lipschitz condition		**5**:743d–744a	
v. Forms of solutions: closed form solutions, series solutions, and integral forms; approximate methods of solution, including iteration, Taylor series, and Runge–Kutta methods		**5**:744a–745a	
vi. First-order equations: equations with separable variables, homogeneous equations, and exact equations; integrating factors and their application to linear equations; Bernoulli's equation, Riccati's equation, equations of higher degree, and Clairaut's equation		**5**:745a–746g	
vii. Linear differential equations: *n*th-order equations, equations with constant coefficients, and second-order equations		**5**:746h–748d	
viii. Nonlinear differential equations: examples and methods of solution		**5**:748d–g	
ix. Boundary value problems: initial value problems and two-point boundary value problems		**5**:748h–750b/ **13**:390a–391a	
x. Systems of differential equations: the problems of two simultaneous differential equations in two variables and of *n*-simultaneous equations in *n* variables		**5**:750b–751b	
xi. Perturbation methods for deriving approximate solutions: the Lindstedt–Poincaré and Krylov–Bogolyubov methods		**5**:751b–d	
xii. The concept of stability of solutions of a system of differential equations: Lyapunov's methods		**5**:751e–752c	
c. Partial differential equations		**5**:752d–760e	
i. Introduction: physical problems that give rise to partial differential equations; origin of the study of partial differential equations		**5**:752d–753b	
ii. Partial differential equations of special interest: Poisson's equation, Laplace's equation, the wave equation, the diffusion equation, the Fokker–Planck equation, birth-and-death equations, Poincaré's telegraphy equation, Schrödinger's equation, and higher order equations in physics		**5**:753d–755d/ **10**:933b–c/ **19**:668f–g	**11**:797h–798b
iii. Classification of partial differential equations: first-order equations, linear equations with constant coefficients, and semi-linear equations of the second order with variable coefficients		**5**:755e–757a	
iv. Initial value and boundary value problems: initial value problems, Cauchy problems, Dirichlet problems, Neumann problems, and Robin problems		**5**:757a–g	
v. Systems of partial differential equations: hyperbolic and elliptic systems of equations		**5**:757g–758a	
vi. Techniques of solution of partial differential equations: separation of variables, integral transform solutions, variational methods, perturbation methods, and methods for obtaining approximate solutions		**5**:758b–759d/ **1**:748g–750c/ **13**:391b–392b	
vii. Existence and uniqueness of solutions to partial differential equations: the Cauchy–Kovalevskaya theorem		**5**:759d–760a	
viii. Generalized theory of partial differential equations		**5**:760a–e	

	articles	article sections	other references
d. Special functions that arise as solutions to differential equations; *e.g.*, the hypergeometric function, Legendre polynomials, spherical harmonics, Bessel functions		5:760e–762f/ 6:20g–h	6:5d–6a
e. Dynamical systems on manifolds		5:762f–767e	
i. Representation of dynamical systems in terms of state spaces: examples of state spaces from problems in economics, mechanics, and circuit theory; state spaces as manifolds		5:762h–764b	
ii. General properties and examples of dynamical systems		5:764c–765b	
iii. Gradient dynamical systems: definition of the gradient in three-dimensional and general *n*-dimensional Euclidean space; Riemannian manifolds		5:765c–766e	
iv. Hamiltonian mechanics: Hamilton's equations, Liouville's theorem, and the Legendre transformation		5:766e–767e	
4. Functional analysis	ANALYSIS, FUNCTIONAL 1:757–771		
a. General features of functional analysis		1:757e–762e	
i. Early development of functional analysis: origins and refinement of the concept of a space of functions		1:757g–758d	
ii. Linear functional analysis and the theory of distributions: the concepts of functional operators, linear functionals, and dual space; introduction of generalized functions		1:758d–759b	
iii. Geometric interpretation of functional analysis and the analysis of linear operators		1:759c–760a	
iv. Hilbert space and spectral analysis: self-adjoint operators; the spectral theorem		1:760a–h	
v. The technique of linearization: ergodic theory; classical and generalized harmonic analysis		1:760h–761g	
vi. Functional algebra: the Neumann–Murray theory		1:761h–762c	
vii. Nonlinear functional analysis: application of concepts and techniques of global topology		1:762c–e	
b. Calculus of variations		1:762e–764h	
i. Introduction: problems that may be solved by variational methods		1:762e–h	
ii. Mathematical formulation of variational problems		1:762h–763b	
iii. Euler's equation and problems involving the determination of a minimizing or maximizing arc		1:763b–764a	
iv. Multiple-integral problems: Dirichlet's principle; the Plateau problem		1:764a–f	
v. Morse's theory of critical points		1:764g–h	
c. Generalized functions: the theory of distributions		1:765a–771e	
i. Historical background: extension of functional analysis beyond its classical limitations; contributions of Lebesgue, Heaviside, Dirac, Schwartz, and others		1:765a–766c	
ii. Definitions and basic properties of distributions		1:766c–768a	
iii. Regularization and convolution of distributions		1:768a–769a	
iv. Locally convex spaces and their duals		1:769a–770f	
v. Fourier transformation of distributions		1:770g–771e	
5. Fourier analysis	ANALYSIS, FOURIER 1:735–757		
a. The theory of series		1:736c–740h	
i. Introduction: definitions of sequences and series; series notation; convergence and divergence of series		1:736c–737b/ 1:539h–540c	
ii. Examples of series and their properties: geometric series, harmonic series, and positive series		1:737b–h	
iii. Series with complex terms and double sequences and series		1:737h–738e	
iv. Series of functions		1:738e–739a	

	articles	article sections	other references
v. Power series		**1**:739a–c/ **1**:721a–d/ **1**:778c–f	
vi. Divergent series		**1**:739c–740d	
vii. History of the theory of series		**1**:740f–h	
b. Fourier series		**1**:740h–744a/ **1**:779a–780a	
i. Introduction: definitions of trigonometric and Fourier series; the role of Fourier series in the development of mathematics		**1**:740h–741g	**7**:577f–g/**19**:670e–g
ii. Basic concepts and properties of Fourier series: convergence and divergence of Fourier series; summability of Fourier series; conjugate series and functions; Parseval's formula; uniqueness of representation of a function by trigonometric series; trigonometric interpolation		**1**:741g–743b	
iii. Generalizations of Fourier series in terms of orthogonal series: Fourier integrals and multiple Fourier series		**1**:743e–744a	
c. Harmonic analysis and integral transforms		**1**:744a–752e	
i. Introduction: integral transforms as a class of operators		**1**:744a–f	
ii. The operation of convolution		**1**:744f–g	
iii. The Fourier transform: definitions and basic properties; the Plancherel formula and the Fourier inversion formula		**1**:744h–747b/ **1**:770g–771e/ **11**:684f–685a	
iv. Examples of Fourier transforms: Fourier transforms of the unitary function, triangular function, normal distribution function, and other functions		**1**:747b–d	
v. Variants of the Fourier transform: the Laplace, Hankel, and Mellin transforms		**1**:747g–748c	**5**:747c–e
vi. The relation between convolutions and Fourier transforms		**1**:748c–g	
vii. Applications of convolutions and Fourier transforms to the solution of partial differential equations		**1**:748g–750c	
viii. Generalizations of the Fourier transform: abstract harmonic analysis; Fourier transforms on Abelian groups		**1**:750c–752e	
d. Representations of groups and algebras: Fourier analysis on non-Abelian groups		**1**:752e–757a/ **1**:529d–530g	
i. Historical development of representation theory		**1**:752f–753a	
ii. Definition and basic properties of a group: Abelian and non-Abelian groups		**1**:753a–b	
iii. Definition and properties of group representations: unitary and finite-dimensional representations; group algebra; methods for constructing a new representation from one or more given representations		**1**:753b–h	
iv. Irreducible representations: Schur's lemma and its implications		**1**:753h–755b	
v. Application of the theory of group representations to the study of topological groups, including Lie groups		**1**:755c–757a	
6. Theory of probability	PROBABILITY, THEORY OF **14**:1104–1115		
a. Heuristic introduction to probability: the need for a mathematically precise definition of probability		**14**:1104c–f	
b. Probability on finite dimensional spaces		**14**:1104f–1109e/ **11**:666f–669h	
i. Elementary problems: the principle of statistical independence; coin tossing, dice rolling, and other simple games of chance; the "birthday problem"		**14**:1104f–1105d/ **11**:668g–669a	**7**:868b–f/ **17**:615e–616d *passim*

	articles	article sections	other references
ii. Basic concepts of probability: mathematical expectation, the additivity assumption, and conditional probability		14:1105d–1107f	
iii. Foundations of 20th-century probability theory: measure-theoretic and quantum-theoretic reasoning		14:1107f–1109e	
c. Probability on infinite dimensional spaces		14:1109f–1115e	
i. Advanced probability and stochastic process theory: probability spaces, random variables, and distribution functions; the extension of probability measure to infinite dimensional spaces		14:1109g–1113a	3:333c–h
ii. Markovian and non-Markovian processes: the electron-photon shower problem and the diffusion equation; general definitions of stochastic processes; functions of Markovian processes		14:1113a–1115e	
7. Vector and tensor analysis	ANALYSIS, VECTOR AND TENSOR 1:791–799		
a. Introduction: scalars, vectors, tensors, and the physical quantities that give rise to them		1:791c–g/ 7:293e–295b	5:554h–556e
b. Vector algebra and analysis		1:791h–795h	
i. Vector space: history and basic ideas; representation of vectors by ordered *n*-tuples of numbers		1:791h–792h/ 1:509a–h	
ii. Scalar and vector products: ways of defining the length of a vector and the angle between two vectors		1:792h–794a	1:514g–515a
iii. Vector algebras: nonassociative, noncommutative, and other types of algebras		1:794b–795c	
iv. Theory of scalar and vector fields: gradient of a scalar field; divergence and curl of a vector field		1:795c–h	12:868c–h
c. Tensor algebra and analysis		1:795h–799d	1:516c–518e *passim*
i. Algebra of tensors: construction and properties of tensor algebra; tensor products and tensor fields; associated algebras		1:796b–797e	
ii. Tensor analysis: differentiation and the integration of tensors; geodesics and null lines; parallel displacement of vectors; Riemann's four-index symbols and curvature		1:797e–799d	
E. Combinatorics and number theory			
1. Combinatorics and combinatorial geometry	COMBINATORICS AND COMBINATORIAL GEOMETRY 4:942–953		
a. The nature and scope of combinatorics: the definition of combinatorics as the branch of mathematics concerned with arrangements, operations, and selections within a finite or a discrete system		4:943a–b	
b. History: development of combinatorics as a separate discipline; combinatorics during the 20th century		4:943b–h	
c. Methods, results, and unsolved problems of combinatorial theory, exclusive of geometric considerations		4:943h–950f	
i. Problems of enumeration: permutations and combinations; recurrence relations and generating functions; partitions; derangements; the necklace problem and Polya's theorem; the Möbius inversion theorem; special problems of enumeration		4:943h–946b	
ii. Problems of choice: systems of distinct representatives and König's theorem; Ramsey's theorem		4:946b–e	
iii. Designs, Latin squares, arrays, and coding: BIB (balanced incomplete block) designs and PBIB (partially balanced incomplete block) designs; orthogonal Latin squares; orthogonal arrays and the packing problem		4:946e–948e	

	articles	article sections	other references
iv. Graph theory: definition of a graph; enumeration of graphs; characterization problems of graph theory; planar graphs; the four-colour problem; Eulerian cycles and the Königsberg bridge problem; directed graphs and the travelling salesman problem		4:948e–950f/ 13:352b–353e	
d. Combinatorial geometry		4:950f–953h	
i. The nature and scope of combinatorial geometry		4:950f–951b	
ii. Some historically important topics of combinatorial geometry: packing and covering; polytopes; incidence problems; Helly's theorem		4:951b–952e	7:1111b–c
iii. Methods of combinatorial geometry: exhausting the possibilities; use of extremal properties, figures with special properties, and transformations between different spaces		4:952f–953h	
2. Number theory	NUMBER THEORY 13:358–380		
a. Elementary number theory: properties of the whole numbers, or integers		13:358b–360e	
i. Simple arithmetic operations with integers [see B.1.a., above]			
ii. Prime numbers: the concepts of divisibility and primality; the sieve of Eratosthenes; Fermat and Mersenne primes		13:358b–h/ 13:349f–h	
iii. Bernoulli numbers and Fermat's last theorem		13:358h–359d	
iv. Relatively prime numbers: residue classes and congruence; quadratic residues		13:359d–360b	
v. Continued fractions: convergence and divergence; representation of real numbers as simple continued fractions		13:360b–e	
b. Algebraic number theory: properties of algebraic numbers		13:360e–364b	
i. Early history: contributions of Gauss, Kummer, and Dirichlet		13:360f–361d	7:966d–h
ii. Foundations of algebraic number theory: the concepts of field and ring; unique factorization and ideals		13:361d–f	
iii. Class group and class number: a measure of the extent of departure from unique factorization of an algebraic number field		13:361f–362b	
iv. Units and their properties: Dirichlet's formula for the number of independent units in an algebraic number field		13:362c–d	
v. The discriminant of an algebraic number field		13:362d–f	
vi. 20th-century work on algebraic number theory: the Zahlbericht and Hilbert's problems; Hensel's *p*-adic numbers; quadratic forms and the Hasse principle; class field theory and reciprocity; the class field tower; Abelian fields; properties of algebraic functions; application of analytic methods		13:362f–364b	
c. Analytic number theory		13:364b–373c	
i. The scope of analytic number theory: classes and examples of problems in analytic number theory		13:364b–365a	
ii. Methodology of analytic number theory: historical development; techniques for investigating the additive and multiplicative properties of numbers		13:365b–366c	
iii. Specific topics in analytic number theory; *e.g.*, the distribution of prime numbers, primes in arithmetic progressions, application of the Circle method		13:366c–372c	
iv. Results obtainable from elementary methods		13:372c–g	
v. Unsolved problems in analytic number theory; *e.g.*, the question of whether there exist infinitely many Fermat primes		13:372g–373c	
d. Geometric number theory		13:373c–377a	

	articles	article sections	other references
i. Early history and basic concepts: work of Lagrange and Seeber; Gauss's reinterpretation of the theory of quadratic forms in terms of a discrete array of points, or lattice		**13**:373c–g	
ii. Definition and properties of a convex body: Minkowski's first fundamental theorem in three-dimensional and in general *n*-dimensional space; Minkowski's second fundamental theorem		**13**:373h–375a	
iii. Definition and properties of a star body: the Minkowski–Hlawka theorem		**13**:375a–b	
iv. The theory of packings and lattice packings by convex bodies: densest packings of spherical balls in three-dimensional space		**13**:375c–g	
v. The theory of coverings and lattice coverings with convex bodies; coverings with spherical balls		**13**:375g–h	
vi. Results concerning quadratic forms derived from the theory of lattice packings		**13**:376a–d	
vii. Nonhomogeneous problems: Macbeath's results; Minkowski's conjecture; Euclid's algorithm		**13**:376d–g	
viii. Recent general results: work of Mahler, Swinnerton-Dyer, and others		**13**:376g–377a	
e. Probabilistic number theory		**13**:377a–380e	
i. Application of probability theory to the problem of the number of prime divisors		**13**:377b–h	
ii. Application of the concept of independence in probabilistic reasoning		**13**:377h–378f	
iii. Application of probability theory to the investigation of the Euler ϕ-function, the number of integers less than or equal to n and relatively prime to n		**13**:378f–379b	
iv. Theorems of probabilistic number theory		**13**:379b–380e	
F. Topology			
1. General topology	TOPOLOGY, GENERAL **18**:509–514		
a. Introduction: definition and basic concepts of topology; the subject matter and applications of topology as exemplified by certain simple topological problems and their solutions		**18**:509f–510f/ **11**:661e–h/ **11**:678f–g	
b. Topological spaces: methods for constructing topological spaces; Euclidean *n*-dimensional space, Hilbert space, Cartesian-product space, and other examples of topological spaces		**18**:510f–511f	
c. Topological properties		**18**:511f–514a	
i. Mappings and their effect on topological properties: homeomorphisms and the concept of topological equivalence		**18**:511g–512a	
ii. Kinds of topological properties; *e.g.*, connectedness, separability, the Hausdorff property and other separation properties, compactness		**18**:512a–514a	
d. Topological problems of current interest; *e.g.*, the planar fixed-point problem, the polyhedral Schoenflies problem		**18**:514b–e	
2. Topological groups and differential topology	TOPOLOGICAL GROUPS AND DIFFERENTIAL TOPOLOGY **18**:489–504		
a. Introduction: interaction between analysis and topology		**18**:489g–490a	
b. The theorems of Tikhonov and Ascoli: embedding of a topological space as a subspace of a compact space		**18**:490b–f	
c. Continuous groups		**18**:490f–497b/ **1**:755c–757a	
i. Topological groups: definition and basic properties; Lie groups		**18**:490h–491d	**1**:755c–756d

	articles	article sections	other references
ii. The theory of Lie groups: infinitesimal transformations and local (pseudo-) groups of transformations; the Lie algebra of a Lie group; the topological structure of Lie groups; exterior differential calculus; representations as transformation groups; Hilbert's fifth problem		**18**:491d–495c	**1**:756d–757a
iii. Algebraic linear groups: the relation between a Lie group and the set of all its finite-dimensional linear representations		**18**:495d–g	
iv. Invariants of an exterior differential system: application of continuous groups to the solution of differential equations		**18**:495g–496b	
v. The Poincaré invariant integral and Cartan's associated form; Poisson parentheses and contact transformations		**18**:496b–497b	
d. Analysis on manifolds: topological implications of problems in global analysis		**18**:497b–500b	
i. Morse theory and Hodge–de Rham theory		**18**:497b–498d	
ii. The notions of curvature and of characteristic classes: topological aspects of Riemannian geometry		**18**:498d–f	
iii. Complex manifolds, sheaf theory, and elliptic operators		**18**:498g–500b/ **7**:1098d–1099b	
e. Differential topology [see also C.6., above]		**18**:500b–504c	
i. Introduction: the subject matter and origins of differential topology		**18**:500b–g	
ii. Basic concepts: the notion of a jet; embedded manifolds and intrinsic manifolds; manifolds with boundaries; isomorphisms of differentiable structures; the fundamental theorems of Whitney		**18**:500h–502a	
iii. Problems and methods of differential topology: problems concerning differentiable manifolds and the morphisms; the technique of transversality and the idea of the universal object; surgery techniques; cobordant manifolds		**18**:502b–503c	
iv. Results on the classification of manifolds: cobordism; classification up to homotopy; classification up to diffeomorphism		**18**:503c–504c	
3. Algebraic topology [see also C.7., above]	TOPOLOGY, ALGEBRAIC **18**:504–509		**1**:550h–554b *passim*
a. Introduction: the nature and scope of algebraic topology and its context within general topology; the basic concepts of topological spaces and maps		**18**:504f–505a	
b. Invariants: unchanging quantities that play a central role in the classification of spaces and maps		**18**:505b–e	
c. Homotopy theory: homotopy classes and the concept of homotopy-equivalent spaces		**18**:505e–h	
d. Homology and cohomology theory: definition of a simplex; axiomatic homology theory		**18**:505h–506c	
e. Homotopy groups: stability and suspension		**18**:506c–507a	
f. Definition and properties of fibres, fibre bundles, and fibrings		**18**:507a–d	
g. Sheaf cohomology		**18**:507d–f/ **1**:726c–e	
h. Spectral sequences: Serre, Rothenberg-Steenrod, and Eilenberg–Moore spectral sequences		**18**:507f–508b	
i. Further developments in homotopy theory: Eilenberg–MacLane spaces; the methods of killing homotopy groups; Serre's C-theory		**18**:508b–e	
j. Generalized homology and cohomology theory: K-theory; the spectral sequence of G.W. Whitehead–Atiyah–Hirzebruch		**18**:508f–h	
k. Present outlook: areas of recent advances in algebraic topology		**18**:509c–e	

Section 10/23. Applications of mathematics

[for Part Ten headnote see page 694
for Division II headnote see page 699]

The articles and parts of articles referred to in Section 10/23 deal with seven main subjects: A, mathematics as a calculatory science; B, statistics; C, numerical analysis; D, automata theory; E, the mathematical theory of optimization; F, information theory; and G, mathematical aspects of physical theories.

The outline of subject A first deals with the history and comparative usefulness of systems of numerical notation, and with the applications of geometry and geometrical instruments to problems of terrestrial and celestial measurement. It goes on to treat the materials and methods employed in the construction of mathematical models, and the applications of models. It further treats the calculatory aspects of algebra; calculations using tables and graphs; analogue computation and analogue computers; and digital computation and digital computers (programmed machines).

The outline of subject B, statistics, begins with the basic principles of statistical inference, in which the concepts and techniques of probability theory are applied to the analysis of data. It then treats estimation, the techniques for approximating the parameters of families of distributions of random variables; the statistical problems involved in hypothesis testing; and the use of regression analysis to discover systematic patterns in data.

Subject C is numerical analysis—the branch of mathematics concerned with methods of finding numerical solutions to problems. After dealing with basic concepts of numerical analysis, the outline deals with such uses of it as are involved in finite difference analysis and in interpolating approximate values between known values of a function, in the solutions of nonlinear, ordinary differential, partial differential, and integral equations.

The outline of subject D begins with definitions and examples of automata, and with the development of the basic concepts of automata theory. It then treats neural nets and automata; questions about random effects in the operation of automata; and the classification of automata.

The outline of subject E, the mathematical theory of optimization, begins with the theory of games, which analyzes the strategic features of conflict situations. It goes on to mathematical programming, describable in terms of the broad class of important decision problems which can be formulated as the maximization or minimization of a function of several variables that are subject to a system of constraints. It next deals with cybernetics—the science of control of complex systems. Finally, it treats control theory—the branch of system theory concerned with changing the behaviour of a given complex system by external actions.

Subject F is information theory, which deals with the effects of encoding on the efficiency of signal transmissions and of communication between men, between men and machines, and between machines. The outline covers the origins, the central problems, the principles, and the diverse applications of information theory.

The article referred to in subject G discusses some fundamental mathematical aspects of physical theories. It treats the mechanics of particles and systems, fluid mechanics, the mechanics of solids, statistical mechanics, electromagnetic theory, relativity theory, Riemannian geometry, quantum mechanics, and dimensional analysis.

articles	article sections	other references
A. Mathematics as a calculatory science		
MATHEMATICS AS A CALCULATORY SCIENCE **11**:671–696		
1. Numerical notations	**11**:671h–673h	
a. Aggregations, or units used to assist counting or grouping of objects; *e.g.*, counting by fives or tens; the dozen, score, and other aggregational units	**11**:671h–672b	
b. Ancient numerical notations; *e.g.*, Babylonian, Egyptian, Greek, and Roman systems	**11**:672b–673c/ **11**:646g–648h	**11**:640b–f
c. Decimal notation and modern notational developments	**11**:673c–h	
2. Geometrical aids	**11**:673h–677b	
a. Early applications of geometry: development of Egyptian and Greek geometry in response to practical problems in geography and astronomy	**11**:673h–674c	
b. Instruments for observation and navigation; *e.g.*, quadrants, sextants	**11**:674d–675c	**12**:904b–g
c. Mapping: applications of geometry to problems of terrestrial measurement	**11**:675c–f/ **11**:475h–476e	**12**:902g–h
d. Applications of geometry to celestial measurement: spherical trigonometry, stereographic mapping of the celestial sphere, and the astrolabe	**11**:675g–676g/ **2**:224c–225e/ **7**:1084g–1085e	
e. Optical instruments; *e.g.*, verniers, theodolites, transit telescopes	**11**:676g–677a/ **17**:830d–h	**18**:101a–c
f. Drawing instruments; *e.g.*, straight edges, rules, compasses, T-squares	**11**:677a–b	
3. Mathematical models: physical constructions used to aid the visualization of mathematical ideas or relationships	**11**:677b–680g	
a. Materials and methods employed in the construction of mathematical models	**11**:677c–f	
b. Applications of models; *e.g.*, representation of polyhedra and other three-dimensional geometric figures; use of models to illustrate identities; use of models to illustrate topological concepts	**11**:677g–680g	
4. Calculatory aspects of algebra	**11**:680g–684a	

	articles	article sections	other references
a. Algebraic notation: use of letters and symbols to denote algebraic variables and operations		11:680g–681c/ 11:648h–649d	
b. Logarithms: basic principles; common and natural logarithms; history of logarithms; calculation of logarithms and logarithm tables		11:681c–683c/ 1:1178c–g	11:650c–651c/12:826e–g
c. Slide rules		11:683c–684a	11:653e–654a
5. Calculation using tables and graphs		11:684a–687h	
a. Mathematical tables; *e.g.*, integral tables, random number tables, tables of functions		11:684a–685d/ 11:649d–651f	
b. Graphs and graphical procedures; *e.g.*, Cartesian and polar graphs, use of logarithmic and other types of scales, alignment charts, graphical integration		11:685d–687h	
6. Analogue computation [see also 735.D.]		11:687h–691c	
a. Types of problems solvable by analogue computation		11:687h–688b	
b. Analogue computers		11:688b–691c	
i. Principles of mechanical analogue devices		11:688b–g	
ii. Types of mechanical analogue devices; *e.g.*, resolvers, multipliers, harmonic analyzers		11:688g–689h/ 11:651g–654a	
iii. Application of automatic controls to analogue devices		11:689h–690d	
iv. Electromechanical and direct current analogue computers		11:690d–h	
v. Hybrid computer systems composed of interconnected analogue and digital components		11:690h–691c	
7. Digital computation [see also 735.D.]		11:691c–696a	
a. Digital calculators; *e.g.*, the abacus, registers, adders		11:691c–692b	
b. Punched cards		11:692b–f	
i. Representation of data on punched cards		11:692b–e	
ii. Early punched card machines; *e.g.*, electromechanical tabulators, sorters, and collators		11:692e–f	
c. Programmed machines (digital computers)		11:692g–696a	
i. Development of the digital computer		11:692g–693a	
ii. The major elements of an electronic data-processing system and their operation: the central processing unit, storage for data and instructions, and input–output devices		11:693a–695b	
iii. Organization of modern data-processing systems		11:695b–e	
iv. Applications of electronic computers [see 735.D.5.]			
B. Statistics	STATISTICS	17:615–623	
1. The basic principles of statistical inference: application of the concepts and techniques of probability theory to the analysis of data		17:615e–618c/ 11:669h–670g	
a. The concept of a statistical experiment: mathematical description of experiments in terms of random variables		17:615e–616d	
b. Distribution functions and their properties: the median, mean, variance, and standard deviation of a distribution; the Gaussian or normal distribution		17:616d–618c	11:744a–d
2. Estimation: techniques for approximating the parameters of families of distributions of random variables		17:618d–621e	
a. Point estimation: the method of moments; the method of maximum likelihood		17:618d–619g	
b. Interval estimation		17:619h–620d	
c. Robust estimation		17:620d–g	
d. Bayesian methods		17:620g–621e	
3. Hypothesis testing: techniques for determining the correctness of alternative hypotheses concerning given data and an assumed probability model		17:621e–623a	

	articles	article sections	other references
4. Structure in data: use of regression analysis to discover systematic patterns		17:623b–h	
C. Numerical analysis	NUMERICAL ANALYSIS 13:381–392		
1. Introduction: definition, origins, and basic concepts of numerical analysis		13:381b–h	
2. Finite differences		13:381h–387b	
a. Types of differences and their application to the problem of interpolation		13:381h–384b	
i. Successive differencing of functions		13:381h–382c	
ii. Divided differences: Newton's interpolation formula; Lagrange's interpolation formula		13:382d–383d	
iii. Reciprocal differences: Thiele's interpolation formula		13:383e–384a	
iv. Interpolation formulas with ordinary differences: the Gregory–Newton and Newton–Gauss formulas		13:384a–b	
b. Analysis with finite differences: numerical differentiation; numerical integration; summation of series		13:384c–385a	
c. Difference and differential-difference equations		13:385a–386b	
i. Basic properties of functional equations		13:385a–b	
ii. Difference equations: linear equations of order n with constant coefficients; the characteristic function; the gamma function		13:385b–386b	
iii. Operational methods in the solution of difference and differential-difference equations		13:386b–387b	
3. Applications of numerical analysis		13:387c–392d	
a. Approximation of a function: definition and properties of approximating functions		13:387c–388b	
b. Methods of numerical differentiation and integration		13:388b–g	
c. Computational methods in linear algebra: direct and iterative methods for solving systems of linear equations; procedures for finding the eigenvalues and eigenvectors of a matrix		13:388g–389c	
d. Solution of nonlinear equations: iterative methods for single equations and systems of equations		13:389c–390a	
e. Solution of ordinary differential equations: Runge–Kutta and predictor-corrector methods for solving initial value problems; shooting methods for solving boundary value problems		13:390a–391a/ 5:744f–745a	
f. Solution of partial differential equations: finite difference methods for elliptic, parabolic, and hyperbolic equations; the finite element methods for elliptic equations		13:391b–392b/ 5:759c–d	
g. Solution of integral equations: methods for solving Fredholm and Volterra equations		13:392b–d	
D. Automata theory [see also 712.A.5.e.iii.]	AUTOMATA THEORY 2:497–505		
1. Introduction: definition and examples of automata; development of the basic concepts of automata theory; the analogy between automata and the nervous systems of living organisms		2:497a–g	11:74c–e/11:76d–e
2. Neural nets and automata		2:497h–499e	
a. The finite automata of McCulloch and Pitts: the neurophysiological model and its description in mathematical terms		2:497h–498c	
b. The basic logical organs: elementary automata that correspond to the binary operations of disjunction and conjunction and the unary operation of negation or complementation		2:498c–d	
c. The generalized automaton and Turing's machine		2:498d–499b	11:636e–637e
d. Input: events that effect an automaton		2:499d–e	

	articles	article sections	other references
3. Probabilistic questions: random effects in the operation of automata		2:499e–502c	
a. The relation between an automaton and its environment, or input and output: the problem of predicting the future state of a system with random components		2:499h–501c	
b. The problem of reducing errors resulting from the failure of automata components		2:501c–d	
c. Automata with random components: the question of whether a machine with random elements can do anything that a completely deterministic machine cannot		2:501d–g	
d. Computable probability spaces: the question of whether an automaton can generate a sequence of random numbers		2:501g–502c	
4. Classification of automata		2:502c–505b	
a. Acceptors: Turing, finite state, pushdown, and linear bounded acceptors		2:502d–503g	
b. Finite transducers		2:503g–505a	
c. Post machines		2:505a–b	
E. Mathematical theory of optimization	OPTIMIZATION, MATHEMATICAL THEORY OF 13:621–637		
1. The theory of games: analysis of the strategic features of conflict situations		13:622c–628c	
a. Classification of games		13:622e–623b	
i. Classification of games according to the number of players: singular, dual, and plural games		13:622e–f	
ii. Extensive and normalized forms of games: the concept of pure strategy		13:622f–623a	
iii. Games with finite and infinite numbers of strategies		13:623a–b	
b. The concept of utility: the problem of identifying the methods by which a player can obtain the most favourable result		13:623b–e	
c. Normalized dual games: analysis of strategies for matrix games, symmetric games, and games on a square; the minimax theorem		13:623e–625h	19:547a–b
d. Extensive games: pure strategies and behaviour strategies; simplified poker as an example of extensive games		13:625h–627b	
e. Plural games: noncooperative and cooperative solutions; simple games		13:627b–h	
f. Game playing programs: application of computers to game theory		13:627h–628c	4:205b–f
2. Linear and nonlinear programming (mathematical programming)		13:628d–632e	
a. General observations: definition of mathematical programming as a technique for determining the optimum solution to problems of planning, scheduling, and organization		13:628d–g	
b. Origins and influence of linear and nonlinear programming		13:628g–629d	
c. Linear programming theory		13:629d–631b	
i. Basic ideas: the fundamental problem of finding the maximum (or minimum) value of a function subject to certain constraints		13:629d–630b	
ii. The simplex method of solution		13:630b–h	
iii. The dual of a linear program		13:631a–b	
d. Nonlinear programming theory		13:631b–632e	
i. Classification of the problems		13:631b–g	
ii. Methods of solution; *e.g.*, methods based on the Kuhn–Tucker conditions, the method of steepest descent		13:631g–632e	

	articles	article sections	other references
3. Cybernetics		13:632f–634f	
a. Definitions of cybernetics: the view of cybernetics as the science of control of complex systems; the broader view that includes control theory and all forms of information processing		13:632f–h	
b. Principles of cybernetics		13:632h–634c	
i. Application to cybernetics of concepts from information theory		13:632h–633b	
ii. Automata as information converters: use of the theory of algorithms and mathematical modelling in cybernetics		13:633c–634c	
iii. Cybernetic systems: self-teaching mechanisms; biocybernetic systems		13:634c–f	2:497a–505b *passim*
4. Control theory		13:634f–637f	
a. General aspects: origins and definition of control theory; examples of modern control systems		13:634f–635e/ 5:741a–b	
b. Principles of control: mathematical formulation and solution of problems concerning the behaviour of complex systems in response to external actions		13:635e–636b	
c. Control of linear systems with constant coefficients: the determination of the explicit form of the controllability condition		13:636b–637a	
d. Optimal control, optimal filtering, and state estimation		13:637a–c	
e. Nonlinear control systems		13:637d–f	
F. Information theory	INFORMATION THEORY 9:574–580		
1. Origins and definition of information theory		9:574f–h	
2. Central problems of information theory		9:575a–d	
3. Principles of information theory		9:575e–580d/ 4:1005g–1006d	
a. Measurement of information: the meaning of information from the point of view of the communication engineer		9:575e–576e	
b. Encoding of information: determining the most efficient form in which to transmit a message		9:576e–g	
c. Transmission of information: the capacity and other characteristics of a communication channel		9:576g–577d	4:1007a–b
d. Coding for error correction: techniques for coding messages that permit errors to be detected and corrected		9:577d–578a/ 1:537d–538b	
e. Band limited channels: characteristics of a communication channel restricted to a given frequency band		9:578b–579a	
f. Information sources with distortion measures		9:579b–g	
g. The filtering and prediction problems: eliminating noise and predicting the future value of a signal		9:579h–580d	
4. Applications of information theory to cryptography, linguistics, and other fields		9:580d–f/ 2:358b–359a	
G. Mathematical aspects of physical theories	PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF 14:392–423		
1. Mechanics of particles and systems [see also 126.A.]		14:392e–396a/ 5:739b–h	
a. Newton's laws and their mathematical formulation		14:392f–393d/ 11:769h–770d	
b. The principles of conservation of linear and angular momentum		14:393d–394b/ 11:773b–f/ 11:774d–f	
c. Formal definition of work and energy and their relation		14:394c–395a/ 6:849c–f/ 11:773f–774d	

	articles	article sections	other references
d. Dynamics of a system of particles		**14**:395a–396a	
2. Fluid mechanics [see also 126.E.]		**14**:396b–398g	
a. Mathematical description of three-dimensional flow		**14**:396e–f/ **11**:789f–h	
b. Velocity and acceleration of a fluid: the difference between local and convective acceleration		**14**:396f–h	
c. Equation of continuity: the relation that expresses the principle of conservation of a mass of a fluid		**14**:396h–397c	**11**:786h–787a
d. Dynamic equation for an inviscid fluid: the expression of Euler's three scalar equations in terms of a single vector equation		**14**:397c–h	**11**:787c–e
e. Steady flow of an inviscid fluid: Bernoulli's equation		**14**:398a–c	**11**:787f–g
f. Velocity potential and stream function: application of the theory of complex variables to the problem of fluid flow		**14**:398c–g	
3. Mechanics of solids [see also 126.C.]		**14**:398h–402b	
a. Fundamental concepts of the theory of elasticity		**14**:399a–400f/ **6**:36b–c/ **6**:520c–521a	
i. The concept of stress: definition of stress; equilibrium conditions; tensile and compressive stress; triaxial and plane stress		**14**:399a–400b/ **5**:556a–e	**6**:520e–521a
ii. The concept of strain: Poisson's ratio; shear strain and general deformations; compatibility conditions		**14**:400b–f/ **5**:555b–556e	**6**:520c–e
b. The relation between stress and strain		**14**:400f–401c/ **5**:556h–557b/ **6**:36c–e	
c. Principal stresses and strains: applications of tensor analysis to solid mechanics		**14**:401d–402b	**6**:521h–522b
4. Statistical mechanics [see also 124.A.8.]		**14**:402b–408b	
a. Basic definitions and concepts of statistical mechanics: specification of the state of a thermodynamic system		**14**:402b–f/ **6**:852e–h/ **18**:311b–g	
b. The role of probability concepts in statistical mechanics		**14**:402g–403a	
c. Pressure and energy density of a perfect gas		**14**:403a–d	
d. Maxwell–Boltzmann distribution law for the probability density of molecules in three-dimensional velocity space [see also 124.B.3.]		**14**:403d–404f	
e. Gibbs ensembles and the concept of ensemble average: the microcanonical ensemble and the grand canonical ensemble		**14**:404f–405c	
f. The Hamiltonian: expression of the energy of a system in terms of generalized coordinates and momenta		**14**:405d–g/ **5**:766e–767e	**11**:779d–e
g. Liouville's theorem		**14**:405g–406d	
h. Equations for ensemble probability densities		**14**:406d–407g	
i. Quantum statistics: Fermi–Dirac and Bose–Einstein statistics [see also 111.H.3.b.]		**14**:407g–408b/ **18**:311g–315b	
5. Electromagnetic theory [see also 127.E.]		**14**:408c–410e	
a. Origin of the electromagnetic wave concept		**14**:408d–f/ **6**:646b–648c	**11**:718g–719a
b. Maxwell's field theory: basic concepts and Maxwell's equations		**14**:408f–410b/ **6**:657e–658g/ **10**:942g–943b	
c. Theoretical determination of the velocity of electromagnetic waves		**14**:410b–e	
6. Relativity theory: space and time as a four-dimensional continuum [see also 131.D.]		**14**:410e–414a	**15**:584d–e
7. Riemannian geometry [see also 10/22.C.6.]		**14**:414a–416c	

	articles	article sections	other references
a. Basic properties: the Riemannian metric; Riemannian curvature		14:414b–415c/ 15:585c–g	12:867h–868a
b. The Lorentz transformation and Lorentz invariance: the postulate of equivalence of special relativity [see also 131.D.1.]		14:415c–416a	12:869g–h
c. Lorentz-contraction and time-dilation		14:416a–c/ 15:582g–583d	
8. Quantum mechanics [see also 112.A.4.c.]		14:416c–422a	
a. The transition from classical mechanics to quantum mechanics: Planck's quantum hypothesis; development of self-consistent formulations of quantum mechanics		14:416c–f/ 11:793b–794b	
b. Wave mechanics: de Broglie waves; the Schrödinger wave equation; general form of the wave equation		14:416f–418e/ 11:795h–796f/ 11:797f–799d	5:740e–f
c. The matrix form of quantum mechanics: the theory of Born and Heisenberg and its relation to the wave theory		14:418e–419d	
d. The transformation theory of Jordan and Dirac		14:419d–h	
e. Statistical significance of the wave function		14:419h–420b	
f. Probability distribution in momentum space: the uncertainty principle		14:420b–e/ 11:794b–795a	12:870b–f
g. The theory of relativistic quantum fields: quantum electrodynamics [see also 127.F.]		14:420f–422a	11:801e–f
9. Dimensional analysis		14:422a–423f	11:742d–h
a. General considerations: dimensional and dimensionless quantities; selection of a system of units to express a physical law		14:422a–f	
b. The pi theorem: mathematical statement of the independence of a physical law from the particular system of units employed to express it		14:422f–h	
c. Applications of dimensional analysis in developing an equation and in changing units		14:422h–423f	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ABEL, NIELS HENRIK **1**:9
ALEMBERT, JEAN LE ROND D' **1**:464
ARCHIMEDES **1**:1087
BERNOULLI FAMILY **2**:867
BOOLE, GEORGE **3**:38
CANTOR, GEORG **3**:784
CAYLEY, ARTHUR **3**:1033
DEDEKIND, RICHARD **5**:549
DESCARTES, RENÉ **5**:597
EUCLID **6**:1019
EUDOXUS OF CNIDUS **6**:1021
EULER, LEONHARD **6**:1026
FERMAT, PIERRE DE **7**:234
FOURIER, JEAN-BAPTISTE-JOSEPH, BARON **7**:577
FREGE, GOTTLOB **7**:712
GALOIS, ÉVARISTE **7**:857
GAUSS, CARL FRIEDRICH **7**:966
HAMILTON, SIR WILLIAM ROWAN **8**:588
HILBERT, DAVID **8**:872
KOLMOGOROV, A.N. **10**:501
LAGRANGE, JOSEPH-LOUIS, COMTE DE **10**:597
LAPLACE, PIERRE-SIMON, MARQUIS DE **10**:680
LEIBNIZ, GOTTFRIED WILHELM **10**:785
LEONARDO OF PISA **10**:817
LOBACHEVSKY, NIKOLAY IVANOVICH **11**:9
MONGE, GASPARD **12**:361
NAPIER, JOHN **12**:826
NEUMANN, JOHN VON **12**:1066
NEWTON, SIR ISAAC **13**:16
POINCARÉ, HENRI **14**:604
RIEMANN, BERNARD **15**:840
RUSSELL, BERTRAND **16**:34
WALLIS, JOHN **19**:533
WHITEHEAD, ALFRED NORTH **19**:816
WIENER, NORBERT **19**:823

Division III. Science

[for Part Ten headnote see page 694]

The results of investigations in the natural, social, and medical sciences and the achievements of technology are dealt with in Parts One through Five and in Part Seven. The outlines, and the articles and parts of articles referred to, in the seven sections of Division III are concerned with inquiries that have viewed those sciences and technology as the objects of historical and analytical studies.

Section 10/31 deals with science taken generally. It first presents a synoptic history of Western and Eastern science. It then deals with the nature and scope of the philosophy of science, and with analyses of the empirical procedures and

Section 10/31. History and philosophy of science 726
10/32. The physical sciences 729
10/33. The Earth sciences 735
10/34. The biological sciences 738
10/35. Medicine and affiliated disciplines 741
10/36. The social sciences and psychology 746
10/37. The technological sciences 751

formal structures of science, of science's modes of discovery, and of validating concepts and theories.

Section 10/32 is on the physical sciences. The outline first deals with the historical evolution of astronomy and astrophysics, of physics, and of chemistry. Then, for each of them, it treats issues about the nature, scope, component disciplines, methods, and principal problems of the discipline.

Similarly, Section 10/33 first deals with the history of the several complementary Earth sciences, and then with studies of the nature, scope, methods, and principal problems of the geological, hydrologic, and atmospheric sciences.

Section 10/34 is first concerned with the historical development of the biological sciences, and with issues about the methodology, scope, and conceptual structure of biology as a whole. It then sets forth the work done at four levels of biological research—the molecular, cellular, organismic, and population levels. Finally, it treats issues in the philosophy of biology—issues about the nature of biological systems, issues concerning evolution and evolutionary theory, and biological issues with ethical implications.

Section 10/35 treats the history of medicine; the many specialized fields of medical practice and research; and such affiliated disciplines as dentistry, osteopathy, nursing, and pharmacy.

Section 10/36 is on the social sciences and psychology. It first deals with the general historical development of the social sciences. It then separately treats the development, nature, scope, and methods of the particular social sciences—anthropology, sociology, economics, and political science. Finally, it deals with the history, scope, and methods of psychology.

Section 10/37 treats the history of the technological sciences; the academic and professional aspects of engineering; the nature and scope of agricultural sciences; and the nature and scope of such recently developed interdisciplinary fields as bionics, systems engineering, and cybernetics.

Section 10/31. History and philosophy of science

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/31 deal with two main subjects: A, the history of science; and B, the philosophy of science.

The outline of subject A begins with the difficulties in tracing the development of science that arise from changing conceptions of science and of the natural world. The outline then covers science in ancient and medieval Western civilization; science in the Islāmic world, in India, and in China and Japan; European science in the early modern period; science in the age of modern revolutions; science in the 19th and early 20th centuries; and contemporary problems and prospects of science.

The outline of subject B begins with the nature, scope, and historical development of the philosophy of science. Dealing with the empirical procedures of science, it covers the theory of measurement, the design of experiments, and the theory of classification. It then treats the formal structures of scientific theory; the processes of conceptual change in the development of science; the processes of scientific discovery and of the validation of theories; efforts at the unification of science; and diverse views about the philosophical status of scientific concepts and propositions. Finally, it treats the relevance of scientific knowledge to other spheres of human experience and concern, and questions about the differences between scientific and humanistic methodologies.

A. History of science

articles	article sections	other references
SCIENCE, HISTORY OF **16**:366–375		
	16:366a–d	
	16:366d–367h	
1. Introduction: problems and difficulties of tracing the development of science	**16**:366d–367c/ **2**:1017c–1018f/ **14**:384f–385e	
2. Science in ancient and medieval Western civilization		
a. Science in Greek civilization		

	articles	article sections	other references
i. Protoscience in Greece before the age of Pericles: empirical versus religious or mythological explanations of natural phenomena		**16**:366d–f/ **8**:333e–f/ **14**:250e–252f	**2**:346h–347g/**2**:1017c–e/ **4**:114c–d/ **6**:525d–527c *passim*/ **13**:951f–h/**16**:377c–d
ii. Development of scientific attitudes: the beginning of disciplined observation, inference, definition, and classification; the Platonic versus the Aristotelian view of nature		**16**:366f–367b/ **12**:23d–24c/ **15**:323e–324g	**1**:1163c–d/**1**:1167g–1168g/ **2**:349d–f/**2**:1017g–1018b/ **6**:1021g–1022b/**14**:537e–g/ **16**:377d–378a
iii. Science during the Hellenistic Age: the emergence of Alexandria as the foremost centre of scientific research			**1**:1087g–1088g *passim*/ **8**:389d–f/ **8**:940h–942f *passim*
b. Science in Rome: the contrast between Roman success in law and technology and Roman failure in science		**16**:367c–e	**7**:849c–850a/**11**:174a–e/ **14**:572a–h/**15**:179d–180d
c. Medieval science		**16**:367f–h/ **2**:1018f–1019c	
i. The reception and development of Aristotelian science: Arab contributions to the development of medieval science		**14**:385f–386a	**2**:349g–h/**2**:567b–568a/ **2**:1018f–h/ **14**:258e–260d *passim*/ **16**:355e–356b
ii. The theological context of medieval science		**16**:367g–h/ **4**:514b–515a	**14**:259b–c
3. Science in other civilizations		**16**:367h–368g	
a. Islāmic science		**16**:368a–c/ **11**:642a–f	**2**:540h–541d/**3**:644d–g/ **14**:258e–g/**14**:385e–f/ **16**:355g–h
b. Science in India, China, and Japan		**16**:368c–g/ **17**:1043h–1044a	**9**:360g–h
4. European science in the early modern period		**16**:368h–371h/ **2**:1019d–1022a	
a. The rebirth of science in the Renaissance		**16**:368h–369g/ **15**:669h–670h/ **18**:35c–g	**2**:1019d–e/ **5**:145b–146h *passim*/ **10**:815g–817a/ **19**:94d–95c *passim*
i. The state of science in Europe in the early 15th century		**16**:368h–369c	**15**:669h–670c
ii. The influence of advances in printing, mining, metallurgy, and other areas of technology: the demands placed upon science by increases in trade and exploration		**16**:369c–f/ **15**:670d–h	
iii. The coexistence of new scientific discoveries and old philosophical views		**16**:369f–g	
b. The revolution in natural philosophy		**16**:369h–371d/ **6**:888a–e/ **14**:386b–388b	**2**:349h–350c
i. The radical reformulation of the objects, methods, and functions of natural knowledge: the work of Bacon, Descartes, and Galileo [see also 10/42.A.3.]		**16**:369h–370e/ **3**:968b–e/ **12**:24h–25d	**2**:564h–565f/**5**:599c–601e/ **6**:888a–d/**7**:852a–853f/ **12**:21a–c/**14**:263a–g/ **14**:264f–265a/**16**:378c–g
ii. Results of the new philosophy: establishment of scientific societies; progress in particular fields of science		**16**:370f–371d/ **2**:1020d–f	**2**:350c–e/**6**:888d–e/**13**:17c–g/ **16**:378g–379a
c. Characteristics of European science: features of European society that permitted science to flourish; development of a spirit of cooperation and the recognition of a research ethic		**16**:371d–h	
5. Science in the age of modern revolutions		**16**:371h–373c	
a. Science during the Industrial Revolution		**16**:372b–c/ **18**:35g–36b	
b. Intellectual origins of revolution: the spirit of the Enlightenment		**16**:372d–e/ **7**:643e–644c	**14**:267f–h
c. The institutional organization of science under the French Revolution		**16**:372f–373a	**19**:730c–f
d. Romantic reaction and science: the proponents of *Naturphilosophie*		**16**:373a–c	**6**:1072a–f/**8**:229e–230a
6. Science in the 19th century		**16**:373c–374h	**6**:1074f–g/**16**:983h–984a

	articles	article sections	other references
a. Differences in styles of research		**16**:373e–374b	
b. Progress in physics, chemistry, and biology		**16**:374b–h/ **2**:1023c–1025b	**2**:790f–791d/ **5**:439f–440g *passim*/ **5**:492f–495b/**7**:173h–174h/ **8**:751h–753a *passim*/ **11**:718a–719b *passim*/ **11**:898e–899f *passim*/ **11**:899g–900e/**12**:615a–g/ **14**:389d–391b *passim*/ **19**:530d–531c *passim*
7. Science in the early 20th century: the social organization and style of science; the common pattern of advance in scientific research		**16**:374h–375e/ **2**:1025c–1026a/ **11**:832h–833c/ **14**:391c–e/ **14**:416d–f	**2**:1203c–1204a/**6**:510h–512f/ **6**:1078f–g/**8**:745g–746d/ **11**:218f–219g *passim*/ **11**:793b–799f *passim*/ **12**:441b–f/**14**:490e–491c
8. Contemporary problems and prospects: the moral, political, and environmental difficulties facing science		**16**:375e–f/ **9**:508g–509g/ **16**:391f–393a	
B. Philosophy of science	SCIENCE, PHILOSOPHY OF **16**:375–393		
1. The nature and scope of the philosophy of science and its relation to other disciplines: the diverse concerns of and methods of approach to the philosophy of science		**16**:376b–377b/ **1**:800d–801e/ **12**:797c–g	**12**:224c–d
2. Historical development of the philosophy of science		**16**:377c–382b	
a. Classical and medieval periods: the alternative viewpoints of the Stoics and Epicureans and of the Platonists and Aristotelians		**16**:377c–378c/ **14**:250e–252f/ **14**:253f–256c	
b. The 17th century: the debate about scientific methodology; Bacon's inductive approach and Descartes's deductive approach		**16**:378c–379a	**14**:263h–265d
c. The 18th century: Empiricist, Rationalist, and Kantian interpretations of Newtonian physics		**16**:379b–e/ **14**:268g–269b	**14**:267f–h
d. From the beginning of the 19th century through World War I: the influence of Kant's belief in the unique rationality of the classical synthesis of Euclid and Newton		**16**:379e–380f/ **1**:802d–f/ **14**:877d–879a	**14**:270d–f
e. The 20th-century debate: responses to relativity, quantum mechanics, and other profound changes in the natural sciences; Logical Positivism versus Neo-Kantianism		**16**:380g–382b/ **14**:879a–882h	**1**:802f–807g *passim*/ **14**:272g–273b
3. Elements of the scientific enterprise		**16**:382d–386f	
a. Empirical, conceptual, and formal elements and their theoretical interpretation: diverse views of the relative importance of observation, theory, and mathematical formulation		**16**:382d–383f	**14**:879e–f
b. Empirical procedures of science		**16**:383g–384f	
i. Measurement: theory of and philosophical problems concerning the determination of quantitative relationships	MEASUREMENT, THEORY OF **11**:739–745	**16**:383g–h/ **11**:735b–736c	
ii. Design of experiments: application of inductive logic and other theoretical principles to practical procedures		**16**:384a–b/ **4**:78a–g	
iii. Classification: the problem of taxonomy	CLASSIFICATION THEORY **4**:691–694	**16**:384c–d/ **10**:869d–870a	
c. The formal structures of science: the problem of constructing a purely formal analysis of scientific inference; the distinction between scientific laws and empirical generalizations		**16**:384f–385f	
d. Conceptual change and the development of science: historical problems concerning the changing theoretical organization of science		**16**:385f–386f	
4. Movements of scientific thought: the basic procedures of intellectual development in science		**16**:386g–389f	

	articles	article sections	other references
a. Scientific discovery: the extreme positions of formalism, which emphasizes the rational elements of scientific discovery, and of irrationalism, which emphasizes the role of intuition, guesswork, and chance		16:386g–387h/ 18:356a–357a	
b. Validation and justification of new concepts and theories: the view that prediction is the crucial test of scientific validity; the view that coherence, consistency, and comprehensiveness are the essential requirements of a scientific theory		16:387h–388f/ 1:804e–805a	14:879h–880f
c. Unification of the theories and concepts of separate sciences: attempts to construct an axiomatic system for all of natural science; the reductionist problem of achieving a consistent conceptual basis for two or more sciences		16:388g–389f	
5. The philosophical status of scientific theory		16:389g–391e/ 2:350g–351g	
a. The status of scientific propositions and concepts of entities: diverse views of the epistemological status of scientific propositions and of the ontological status of scientific concepts		16:389g–390e	
b. The relationship between philosophical analysis and scientific practice: the application of different philosophical doctrines and approaches to different sciences		16:390f–391e	
6. The relevance of scientific knowledge to other spheres of human experience and concern: the social significance of science and of scientific attitudes; limitations on the scientific endeavour		16:391f–393a	
7. The relation between science and the humanities: questions of differences between scientific and humanistic methodologies [see 10/42.B.3.]			

Section 10/32. The physical sciences

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/32 deal with four main subjects: A, the history of the physical sciences; B, the nature and scope of astronomy and astrophysics; C, the nature and scope of physics; and D, the nature and scope of chemistry.

The outline of subject A covers separately the history of astronomy, of physics, and of chemistry. In each case, it treats not only decisive discoveries and major changes in theory, but also such topics as the invention of new experimental instrumentation, the expanding range of problems confronted, the development of specialized branches, and present trends of research and theory.

The outline of subject B begins with the methods of study in astronomy and goes on to treat the component disciplines of astronomy and the investigation of the scale of the universe and of the distribution of objects within it. The treatment of astrophysics covers such topics as the study of stellar structure and stellar atmospheres; the study of interstellar material; and the study of galactic structure and evolution.

The outline of subject C first deals with the nature and scope of physics, and with its experimental and theoretical methods. It then treats the relationship of physics to other disciplines; the interdisciplinary fields of physics; and philosophical problems in physics at the formal, quantum, macrophysical, and cosmological levels.

The outline of subject D begins by covering the nature and scope of chemistry. It then goes on to treat the subdivisions of chemistry; the theoretical approaches and experimental methods of chemistry; the study of chemical transformations; and the interdisciplinary fields of chemistry.

	arucies	article sections	other references
A. History of the physical sciences: the evolution of astronomy, physics, and chemistry	PHYSICAL SCIENCES, HISTORY OF 14:384–391		
1. History of astronomy		14:384e–385b/ 14:386c–h/ 14:388c–389d/ 11:757c–759d/ 12:40b–f/ 18:1012h–1013g/ 19:77e–g	18:1007a–d
a. Ancient astronomy		14:384e–385b	11:757c–e

	articles	article sections	other references
i. Time reckoning and astronomical prediction: development of lunar and solar calendars; prediction of eclipses and of first appearances of the New Moon		**14**:384e–f/ **3**:595g–602a/ **3**:604f–611g/ **6**:195d–197a	**15**:1061c–e
ii. Early cosmologies		**14**:384f–385a/ **2**:550c–d/ **8**:216d–f	**1**:1168b–c/**6**:1021g–1022b/ **8**:929b–c/**11**:720g–h/ **18**:1012h–1013c
iii. Ancient astronomical records, treatises, and star catalogs: the work of Hipparchus and Ptolemy; the *Almagest;* Ulūgh Beg's catalog		**14**:385a–b/ **2**:225e–227f	**8**:941a–942d/**15**:179d–180a
b. Medieval astronomy: European and Islāmic contributions			**2**:227f–h/**2**:228g–h/ **11**:642d–e
c. Astronomy in the 16th and 17th centuries		**14**:386c–h/ **8**:286h–288d	**2**:227h–228c/**3**:103d–104b/ **4**:969h–970b/ **8**:556c–557d *passim*/ **18**:1013c–e
i. Copernicus and his contemporaries: the geocentric and heliocentric world systems		**14**:386c–e	**5**:145f–146h
ii. Kepler: the discovery of the laws of planetary motion		**14**:386f–g	**10**:432b–433b/**11**:757e–758a
iii. Galileo and his contemporaries: the invention and use of the telescope		**16**:272h–273b	**2**:231g–232a/**6**:888b–d/ **7**:852a–b/**11**:520c–d/ **18**:97b–e/**18**:98g–h
iv. Newton: the theory of universal gravitation [see 2.c.i., below]			
d. Astronomy in the 18th century		**14**:388c–g	**8**:824g–826c/**12**:40c–f
i. Development of celestial mechanics: the calculation of orbits; the three-body problem; the dynamical stability of gravitational systems		**18**:1037d–f	**4**:970b–g/**10**:680g–681c
ii. Improvements in telescope design and increased accuracy of measurements: the discovery of the aberration of light		**10**:949f–950b	**3**:101a–e/**8**:824g–825b/ **18**:98b–99a
iii. Speculations concerning the origin of the solar system, the nature of nebulae, and the structure of the universe			**7**:834c–f/**8**:825d–826c/ **12**:927b–c
e. Astronomy in the 19th century		**14**:388g–389d	**4**:970h–971b/**11**:520e–f/ **11**:917f–918a
i. Further advances in celestial mechanics: the discovery of Neptune and the asteroids; the search for a planet within the orbit of Mercury		**14**:388g–389a/ **12**:963b–h	**7**:966h–967a/**8**:288d–e/ **12**:1083f–1084a/ **14**:491g–492b/**14**:605e–f
ii. Systematic sky surveys: improved determinations of stellar positions and magnitudes; the first measurements of stellar parallax; the compilation of catalogs of nebulae, stars, and star clusters		**12**:927c–d	**2**:230a–c/**2**:870c–d/**7**:834f–h/ **8**:826f–827b/**13**:995e–g/ **14**:347c–f
iii. Improvements in telescope design and the development of new astronomical tools: first applications of photography and spectroscopy		**2**:234h–235h/ **12**:927d–g	**6**:192g–h/**9**:791c–d/ **17**:799e–800g/**18**:98f–g
f. Astronomy in the 20th century			
i. Bigger and better optical instruments: improvements in precision; the giant California telescopes		**12**:927g–928c/ **18**:99b–101d	
ii. The beginnings of statistical studies of stars, nebulae, and galaxies		**2**:230c–231f/ **7**:834h–835e	**2**:239d–e/**7**:828e–g/ **9**:791d–792a/**14**:347f–h/ **16**:37e–g
iii. Theories of stellar structure: new theories of the sources of stellar energy		**13**:309e–310c	**2**:871d–g/**6**:298a
iv. Astronomical tests of general relativity: the gravitational red shift; the deflection of light; the precession of the perihelion of Mercury; the cosmological red shift		**11**:916g–917a	**6**:193e–f/**6**:297f–g
v. Detection of radio emissions from the Sun and the Milky Way: development of radio telescopes; radio signals from stars and galaxies, quasi-stellar radio sources, and pulsars		**9**:794f–795a/ **15**:327f–h/ **15**:467d–f/ **18**:101e–103g	**11**:131c–g/**15**:266d–f/ **15**:433g–h
vi. Refinements in spectroscopic methods: the use of low- and high-resolution spectroscopy; spectroscopic studies of stars, galaxies, nebulae, and the Sun		**2**:236f–244c/ **12**:927g–928g	**17**:802a–c

	articles	article sections	other references
vii. Theories of the origin and evolution of the universe: contemporary speculation on the nature of gravitation		**8**:289b–290h/ **12**:871g–872d/ **18**:1007d–1008d/ **18**:1015f–1018a	**15**:584f–586e *passim*
g. Recent developments and emerging trends; *e.g.*, use of satellites and space probes, development of X-ray and infrared astronomy		**2**:244d–245d/ **17**:366a–367g/ **18**:104e–105a/ **19**:1064c–f	**9**:581d–e/**17**:373g–374f
2. History of physics		**14**:385b–386a/ **14**:386h–387g/ **14**:389d–390e	
a. Greek physics: speculations concerning the nature of space, matter, and motion		**14**:385b–e/ **8**:701f–h	**2**:349d–f/**4**:114c–d/**4**:118b–d
b. Medieval physics: the influence of Aristotle		**14**:385f–386a	**11**:762e–f
c. Physics in the 16th and 17th centuries		**14**:386h–387g/ **2**:655a–g	**3**:969d–f/**9**:74g–75e
i. Discoveries and theories in mechanics: Newton's laws of motion and the law of universal gravitation; Galileo's studies of the motion of falling bodies		**14**:386h–387d/ **8**:286h–288d/ **11**:762e–763c	**6**:849f–h/**6**:888b–e/**7**:853a–f/ **11**:758b–c/**11**:780e–f/ **13**:19a–g/**15**:581h–582c
ii. Discoveries and theories in optics: the study of lenses, colour, and the nature of light		**14**:387d–g/ **10**:928g–929b	**6**:646b–647a/**10**:432e–g/ **13**:17h–19a/**13**:608f–h
d. Physics in the 18th and 19th centuries		**14**:389d–390e	**5**:554d–g/**10**:414d–415d/ **11**:780g–781a/**16**:374c–d/ **16**:379b–380d *passim*/ **17**:20a–e
i. Development of theories of light: the wave theory versus the corpuscular theory; the search for the ether		**14**:389d–h/ **6**:646f–647d/ **10**:929b–f	
ii. Development of the theories of electricity, magnetism, and electromagnetic waves		**14**:389h–390e/ **6**:638e–g/ **6**:665e–666a/ **6**:647d–648c/ **11**:311d–h	**3**:1019e–g/**5**:371c–e/ **6**:540c–541f/**6**:678d–f/ **6**:687e–f/**7**:174b–g/ **7**:859g–860e/**8**:752g–h/ **11**:333a–f/**11**:718g–719a/ **15**:426c–f/**15**:582c–g/ **18**:287a–c
iii. Developments in thermodynamics: theories of heat; the laws of thermodynamics; the impossibility of perpetual motion; the kinetic theory of gases		**8**:702g–705b/ **12**:305a–c	**6**:850a–b/**18**:291c–f
iv. Development of the atomic theory of matter: the discovery of the electron; the discovery of radioactivity and X-rays; the discovery of spectral regularities		**2**:332g–335h/ **4**:114g–116c/ **17**:457g–458b	**2**:346e/**2**:350d–e/ **2**:790h–791d/ **5**:371g–372a/**6**:652f–g/ **13**:334d–g/**16**:107c–f/ **18**:349c–d
e. Physics in the 20th century		**5**:200d–201b/ **14**:297b–f/ **18**:315h–316c	**11**:781a–c/ **16**:380d–381e *passim*
i. Development of the theory of relativity		**15**:582g–583d	**5**:33h–34c/**6**:193e–f/ **6**:511e–h/**11**:744f–g/ **12**:867a–b
ii. Development of the quantum theory, wave mechanics, statistical mechanics, and related theories		**6**:648c–e/ **6**:667b–e/ **10**:929f–930b/ **11**:312a–c	**5**:33h–34c/**5**:826a–b/ **6**:541g–542a/**8**:745g–746f/ **11**:744g–745a/**11**:796b–f/ **12**:866h–867a/ **14**:490e–491c/**16**:360f–g/ **16**:390f–h
iii. Development of theories and laws concerning atomic structure, nuclear interactions, and elementary particles		**11**:703h–704e	**2**:1203d–1204a/**3**:323d–f/ **5**:372b–f/**6**:666d–g/ **7**:236e–237a/**12**:1071b–e/ **13**:302c–f/**13**:334h–335a/ **13**:1022e–1026c/ **16**:106g–108c/ **19**:1072b–c
iv. Development of plasma physics		**14**:505b–e	
v. Development of electronics and related fields of study		**6**:536e–537a/ **15**:369d–372e	**6**:678f–679a/**6**:687f–g/ **15**:426f–427b

	articles	article sections	other references
vi. Development of solid-state physics and related fields of study		**11**:1086g–1087a/ **14**:461d–462a/ **16**:523b–e/ **17**:811h–812d	**3**:101h–102a/**16**:1032f–g
vii. Emerging trends in physics: development of atomic beam methods, nuclear magnetic resonance, and electron spin resonance methods; development of nonlinear optics; the development of lasers and masers		**11**:306a–e	**10**:686b–689g *passim*/ **11**:801e–f/**12**:135b–e/ **12**:304c–e/ **12**:491a–493b *passim*
3. History of chemistry		**14**:387h–388b/ **14**:390e–391b	
a. Chemistry before 1700			
i. The rise of alchemy: the goal of the alchemists—to prolong life and to transmute base metals to gold		**14**:387h–388a/ **1**:431g–432d/ **1**:435h–436d/ **8**:701h–702a	**17**:1040b–c
ii. The influence of the new mechanical philosophy on chemistry: the work of Boyle		**14**:388a–b/ **8**:702a–c	**3**:97b–d
b. Chemistry in the 18th century		**14**:390e–g	
i. Studies of combustion and respiration: the phlogiston theory; the work of Lavoisier and Cavendish		**14**:390f–g/ **8**:702g–703g	**2**:993e–f/**4**:143d–f/ **4**:954f–955c/**10**:714c–e/ **13**:804a–c/**14**:1013f–1014b
ii. Laboratory discoveries: isolation and identification of gases; discoveries of new elements, compounds, and chemical reactions		**1**:589e–g/ **9**:93e–f/ **13**:121e–122d/ **13**:810f–811a	**4**:114f–g/**14**:1013d–e
c. Chemistry in the 19th century		**14**:390g–391b/ **4**:854a–855b	**5**:440c–e
i. Development of the periodic table of the elements: the work of Mendeleyev and Meyer		**14**:75c–77b	**2**:334a–c/**11**:900c–e
ii. Discoveries of new elements, isotopes, and radioactive elements		**8**:560g–561b/ **15**:515e–516e/ **18**:678e–h/ **18**:1034f–h	**1**:580e–g/**3**:839a–c/ **13**:138c–g/**15**:539a–b
iii. Development of more accurate methods of analysis			**4**:77d–g/**7**:968e–h
iv. Development of theories of molecular structure and chemical reaction		**4**:143d–144d/ **12**:309d–g	**2**:332h–333h/**3**:1000e–1001a/ **4**:138h–139a
v. Development of organic chemistry: introduction of the concept of valence; the study of aromatic compounds; development of the structural theory		**13**:714f–h	**2**:993f–994a/**9**:89g–90b/ **10**:889a–b
vi. Development of electrochemistry: the theory of chemical affinity in electrical terms		**6**:638e–g	**1**:46a–e/**5**:523g–524a
vii. Development of industrial chemistry: the application of chemical principles and reactions to industrial processes		**14**:183h–184e/ **14**:511g–512c	**3**:1001a–c/**5**:1106d–1107f
d. Chemistry in the 20th century		**4**:165e–h/ **9**:1055a–b	
i. Development of instrumental methods of chemical analysis		**4**:80h–83h/ **4**:565d–566e/ **12**:316d–318b	**4**:170f–g
ii. Explanation of chemical phenomena by principles of atomic and molecular structures		**2**:350e–f/ **15**:589c–e	**4**:84d–85d/**5**:1106f–h/ **13**:1094g–1095c
iii. Application of quantum mechanics to chemical bending		**4**:88d–93c/ **11**:799g–800b	**12**:309g–h
B. The nature and scope of astronomy and astrophysics: the major subject matters and principal problems	ASTRONOMY AND ASTROPHYSICS **2**:245–254		
1. The nature of astronomy: its concern with all objects outside the Earth and its immediate environment, including the Moon, Sun, planets, stars, galaxies, interplanetary and interstellar matter, and the universe as a whole; the relation between astronomy and astrophysics		**2**:245e–246c	
a. Methods of study		**2**:246h–247d/ **9**:581e–582a	

	articles	article sections	other references
i. Equipment: use of telescopes, spectroscopes, and other astronomical apparatus [see 723.G.6.]			
ii. Types of observational information; *e.g.*, positional, structural, photometric, spectral		**2**:232h–234h/ **2**:244h–245d/ **2**:247a–d/ **4**:119c–120g/ **7**:835e–836g/ **13**:994a–997d/ **14**:347b–352a/ **17**:801h–802c/ **18**:103g–104e	**6**:192d–195c *passim*/ **6**:852f–g/**18**:1011h–1012g
b. Component disciplines and their relationship to other sciences		**2**:247d–249b	
i. Planetary sciences: planetology and the study of planetary atmospheres		**2**:241c–242a/ **2**:247d–248a	**17**:374c–d
ii. Meteoritics: the study of meteorites and meteors		**2**:242c–e/ **2**:248a–d	**12**:37d–39f *passim*
iii. The study of comets and minor planets		**2**:242a–c/ **2**:248d–f/ **4**:971b–g	**14**:492a–g
iv. Lunar sciences		**2**:248f–249a	**17**:374a–b
v. The study of the origin of the solar system		**2**:249b/ **18**:1010d–1011a	
c. Investigation of the scale of the universe and of the distribution of objects within it		**2**:249c–250c	
i. The determination of positions		**2**:249c–f/ **2**:224c–225e	
ii. The measurement of distances		**2**:249f–250c/ **7**:829b–d/ **12**:933b–c/ **13**:995e–997c/ **15**:328f–329c	**17**:592g
d. Orbit theory: its role in astronomy		**2**:250d–g/ **11**:757c–761g	
2. Astrophysics		**2**:250g–253g	
a. The study of the stars		**2**:250g–252b/ **18**:1009f–1010d	**6**:852f–g/**17**:374d–f
i. The study of stellar structure		**2**:250h–251f	
ii. The study of stellar atmospheres		**2**:251f–252a/ **2**:239b–241c	
iii. The study of supernovae		**2**:252a–b	**19**:1065h–1067a *passim*
b. The study of galaxies and of the universe		**2**:252b–253g/ **2**:244a–d/ **18**:1007d–1009f	**7**:828d–833d *passim*
i. The study of interstellar material		**2**:252b–253a/ **12**:927g–928g	**9**:790d–791b
ii. The study of galactic structure and evolution		**2**:253a–e/ **7**:828g–829b/ **18**:1008h–1009f	
iii. Cosmology and cosmogony		**2**:253e–g/ **18**:1007d–1008h/ **18**:1015f–1018e	
3. Trends in modern astronomical investigations; *e.g.*, extension of observations to invisible portions of the electromagnetic spectrum, use of satellites and space probes		**2**:253h–254c/ **9**:580h–581e/ **18**:1018c–e/ **19**:1064c–f	**17**:373g–374f
C. The nature and scope of physics: its major subject matters and problems	PHYSICS **14**:424–429		
1. The nature of physics: its concern with matter and energy and their interactions		**14**:424b–e/ **12**:865h–866f	
2. The scope of physics: mechanics, thermodynamics, heat, electricity, magnetism, sound, optics, quantum mechanics, states of matter, and nuclear and atomic physics		**14**:424e–427g/ **5**:554h–555a/ **15**:401d–f	**11**:779g–780a/**11**:793b–e

	articles	article sections	other references
3. The experimental and theoretical methods of physics		**14**:427g–428e/ **2**:237d–g/ **5**:344a–347b/ **6**:852h–853b/ **6**:853f–854a/ **8**:292h–294h/ **11**:744d–745a/ **18**:324f–327g	**15**:400b–e/ **17**:455f–476g *passim*
4. The relationship of physics to other disciplines		**14**:428e–h/ **1**:772e–773c	
a. The influence of physics on mathematics, technology, other sciences, and philosophy		**14**:428e–g/ **2**:1035e–1036g/ **4**:124d–125b	**7**:542d–h/**11**:645e–g
b. The influence of mathematics, computer science, technology, and other sciences on physics		**14**:428g–h	**2**:659e–f
5. Interdisciplinary fields of physics			
a. Astrophysics		**2**:250g–253g	
b. Biophysics	BIOPHYSICS **2**:1034–1037		
c. Geophysics		**7**:1059e–1060c	**6**:74c–e
6. Philosophical problems in physics	NATURE, PHILOSOPHY OF **12**:869–872	**12**:869e–872d	
a. Problems at the formal level: topological properties of space; symmetry properties of the four-dimensional space-time manifold		**12**:869e–h/ **12**:21f–22d/ **14**:426g–427b/ **18**:417f–418d	**6**:656d–g/**11**:744f–g/ **15**:584d–e
b. Problems at the quantum level: the elementary particle theory; Heisenberg's uncertainty principle; the validity and limitations of the laws of conservation and symmetry		**12**:869h–870g/ **5**:37a–d/ **13**:1023b–g/ **14**:427c–f/ **18**:419b–e	**14**:426f–g
c. Problems at the macrophysical level: theories of inertia, kinematics, and dynamics; temporal asymmetry; the increase of entropy with the positive direction of time		**12**:870h–871g/ **6**:854a–b/ **18**:419f–420a	**14**:425a–c
d. Problems at the cosmological level: models and theories of the evolution of the universe; functional dependence of the mass on the radius of curvature of the universe; nil mass-energy		**12**:871g–872d/ **4**:121h–122d/ **11**:705c–f/ **15**:588b–h/ **18**:1007d–1008d	
D. The nature and scope of chemistry: its major subject matters and problems	CHEMISTRY **4**:166–175		
1. The nature of chemistry: its concern with the composition, properties, and changes of matter		**4**:166a–f	
2. The subdivisions of chemistry: inorganic, organic, analytical, and physical chemistry		**4**:166f–168d	
3. The methods of chemistry		**4**:168d–173f	
a. Theoretical approaches: quantum mechanical, valence-bond, and molecular orbital approach [see also 122.A.2. and 122.B.]		**4**:168e–170f/ **11**:799g–800b/ **12**:309g–310c	
b. Experimental methods: instrumentation, separation of mixtures, measurements of physical properties, and interpretation of physical measurements [see also 122.A.6.]		**4**:170f–173f/ **1**:53c–f/ **4**:141e–142b/ **11**:609b–610b	**4**:76h–84a *passim*/ **12**:304c–309a *passim*/ **19**:925e–g
4. The study of chemical transformations		**4**:173g–175f/ **4**:142f–144d/ **4**:954c–f	
a. Studies of chemical equilibria		**4**:173h–174b	
b. Studies of the energy changes in chemical reactions		**4**:174b–f	
c. Studies of the kinetics of chemical reactions		**4**:174f–175e/ **4**:138d–139a	**3**:1000d–e
d. Studies of the mechanisms of chemical reactions		**14**:368a–369b	**4**:147b–f/**11**:609f–g
5. Interdisciplinary fields of chemistry			
a. Biochemistry	BIOCHEMISTRY **2**:993–997		

	articles	article sections	other references
b. Geochemistry		7:1057f–1059c	6:74c–e
c. Chemical engineering	CHEMICAL ENGINEERING 4:124–125		

Section 10/33. The Earth sciences

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/33 deal with two main subjects: A, the nature and history of the Earth sciences; and B, the nature, scope, and methods of the particular Earth sciences.

The outline of subject A begins with the general characteristics, origins, and central ideas of the Earth sciences. The outline then divides the history of the Earth sciences into periods: from antiquity to the 16th century; the 16th, 17th, and 18th centuries; the 19th century; and the 20th century. The outline treats the emergence, in these periods, of particular subjects for inquiry, of particular subdisciplines, of major problems and controversies, and of major concepts and principles. At the end, it deals with such emerging trends in the Earth sciences as the use of computers in numerical modelling, and the involvement in social goals.

The outline of subject B deals with the Earth sciences nonhistorically. It begins with physical geography—the study of the distribution and spatial patterns of various Earth features. It goes on to the geological sciences, covering the subdisciplines that have for their field of study the composition of the Earth; the subdisciplines that study the structure of the Earth; those that study surface features and processes; and those that study Earth history. The outline next treats hydrology, which studies the occurrence, circulation, and distribution of the Earth's waters, their physical and chemical properties, and their interaction with the environment. It deals separately with limnology, the study of lakes; with glaciology; and with oceanography. The treatment of the atmospheric sciences covers the study of the physical characteristics and processes of the nonionized and of the ionized regions of the Earth's atmosphere; the study of the Earth's climate; the study of the atmospheres of other planets; and the technology and the applications of the atmospheric sciences.

	articles	article sections	other references
A. The nature and history of the Earth sciences	EARTH SCIENCES 6:73–90		
1. The nature and origins of the Earth sciences		6:73h–76b	
a. Physical, historical, and applied aspects of the Earth sciences		6:73h–74e	
b. Foundations of the Earth sciences in myth and legend		6:74e–75b	19:705h–707b
c. Central ideas of the Earth sciences that have transformed man's understanding of nature: the mobility of the Earth, the antiquity of the Earth, and the development of life on Earth		6:75c–76b	
2. The Earth sciences from antiquity to the 16th century		6:76b–78h	
a. Geological sciences		6:76h–77e	6:26g–27a
i. Knowledge of Earth composition and structure: speculations about earthquakes and volcanic eruptions		6:76b–g	6:1g–2c
ii. Knowledge of Earth history: speculations about fossils		6:76g–77a	
iii. Knowledge of landforms and land-sea relations		6:77b–e	
b. Hydrologic and atmospheric sciences		6:77e–78h	
i. Knowledge of the hydrologic cycle: theories of groundwater circulation and precipitation		6:77f–78a	9:102h–103d
ii. The origin of the Nile and the cause of its floods		6:78a–c	
iii. Knowledge of the tides		6:78d–e	
iv. Prospecting for groundwater		6:78e–h	8:433d–g
3. The Earth sciences in the 16th, 17th, and 18th centuries		6:78h–81d	
a. Geological sciences		6:78h–79h/ 6:2c–3c	
i. The beginnings of mineralogy: the study of ore deposits		6:78h–79b	1:315a-b/5:340b–d
ii. The development of paleontology and stratigraphy		6:79b–e/ 17:716d–717f	7:7e–8a
iii. The controversy between the Neptunists and Plutonists: Earth history according to Genesis, Werner, and Hutton		6:79e–h	7:1066d–1067a/9:70f–71a/ 10:624b–d/17:716h–717e/ 18:858e–f
b. Hydrologic sciences		6:79h–80g	

	articles	article sections	other references
i. The rise of subterranean water: theories of spring discharge		**6**:79h–80e	
ii. Evaporation from the sea: the earliest quantitative investigations of the global water balances		**6**:80e–g	
c. Atmospheric sciences		**6**:80g–81d	**5**:440a–c
i. The study of water vapour in the atmosphere		**6**:80g–81a	
ii. The study of atmospheric pressure, temperature, and circulation		**6**:81a–d	**12**:55b–f
4. The Earth sciences in the 19th century		**6**:81d–85e/ **16**:489b–g	**8**:1189h–1191f
a. Geological sciences		**6**:81d–83c/ **5**:108g–109c	**3**:689g–690a/**5**:671g–672a/ **6**:700g–701a/**9**:201c–d/ **16**:458f–g
i. Crystallography and the classification of minerals and rocks		**6**:81d–f	**5**:450h–451b
ii. The concept of faunal succession and organic evolution: contributions of William Smith, Charles Darwin, and others		**6**:81f–82a/ **7**:1067a–1068b/ **17**:717g–719f	**5**:389h–390a/**5**:493e–494e/ **7**:8a–f/**10**:354c–e/ **10**:617d–h/**14**:1015d–h/ **16**:907d–908b/**18**:151b–d/ **18**:859a–c
iii. The concept of uniformitarianism: contributions of Charles Lyell and others		**6**:82b–c/ **18**:857b–859c	**11**:208f–209b
iv. Evidence for an Ice Age: the work of Louis Agassiz		**6**:82c–e	**1**:290b–f
v. The concept of geological time and estimates of the age of the Earth		**6**:82e–g	**10**:415c–d/ **18**:857h–859c *passim*
vi. Concepts of landform evolution		**6**:82g–83a/ **10**:626f–630e	**8**:873h–874d
vii. The study of gravity, isostasy, and the Earth's figure		**6**:83a–c	**6**:3c–4a/**13**:1108c–h
b. Hydrologic sciences		**6**:83c–84b	
i. The study of groundwater flow and surface water discharge: Darcy's law		**6**:83c–e/ **8**:437h–438e	
ii. Foundations of oceanography		**6**:83e–84b/ **18**:843h–844d	
c. Atmospheric sciences		**6**:84b–85e	
i. The study of the composition of the atmosphere		**6**:84b–d	
ii. The study of clouds, fog, dew, and storms		**6**:84d–85a	**5**:679h–680a
iii. The study of weather and climate: the origin of synoptic meteorology		**6**:85a–e	**12**:55f–h
5. The Earth sciences in the 20th century		**6**:85e–90d	**1**:963g–964d
a. Geological sciences		**6**:85e–86h	**6**:4a–8a *passim*/**6**:701a–b/ **16**:464d–h/**17**:372e–f
i. Development of radiometric dating		**6**:85e–f	**1**:1082b–d/**5**:507d–508b/ **19**:32d–33e
ii. The experimental study of rocks: experimental petrology		**6**:85g–h/ **8**:870h–871h	**3**:85h–86e/**3**:191h–192a/ **9**:217c–h
iii. Development of seismology: the study of the internal structure of the Earth		**6**:85h–86a	**6**:48c–49a/**6**:70h–71b
iv. Lunar studies: the application of the Earth sciences to the investigation of the Moon		**6**:86b–c/ **5**:513d–g	
v. Advances in paleontology: the development of paleoecology and micropaleontology; the study of Precambrian life		**6**:86c/ **14**:1025e–h	**8**:999d–g/**15**:1134c–g/ **16**:778e–h
vi. The theories of continental drift and sea-floor spreading: evidence from studies of rock magnetism		**6**:86d–h/ **5**:109c–110e/ **5**:513b–d	**12**:580d–581g/**15**:845a–f/ **16**:442h–444a
b. Hydrologic sciences		**6**:86h–88b/ **18**:844e–f	
i. The study of water resources and seawater chemistry		**6**:86h–87b	**6**:709d–710e *passim*
ii. The exploitation of oceanic resources: desalinization, tidal power, and minerals from the sea		**6**:87b–c/ **13**:501d–504b	
iii. The charting of the ocean floors: progress in bathymetry		**6**:87c–e/ **9**:98f–h	**2**:300b–c/**13**:433d–f/ **13**:472a–e

	articles	article sections	other references
iv. The study of ocean circulation, currents, and waves		**6**:87e–h	**6**:518a–f/**12**:825d–e/ **13**:439b–d
v. The study of glacier motion and high-latitude ice sheets		**6**:87h–88b	
c. Atmospheric sciences		**6**:88c–89e	
i. The application of modern technology to meteorology: atmospheric probes, satellites, and data transmission		**6**:88c–d/ **12**:58f–59g	**9**:64a–b/**17**:372b–e/ **18**:365d–h/**19**:698e–h
ii. Advances in weather forecasting and cloud physics		**6**:88d–g	**19**:700d–e
iii. The study of the properties and structure of the atmosphere		**6**:88g–89b	**5**:393g–h/**19**:869b–g
iv. The development of weather modification methods		**6**:89c–d/ **19**:709f–710c	**19**:707g–708c
v. The classification of climate		**6**:89d–e	
d. Emerging trends in the Earth sciences; *e.g.*, increasing specialization, growth of team research, use of computers in numerical modelling, involvement in social goals		**6**:89e–90d/ **15**:873b–874e	**17**:373d–g/**19**:700d–f
B. The nature, scope, and methods of the particular Earth sciences		**6**:73f–74e	
1. Physical geography: the study of the distribution and spatial patterns of soils, water, climate, landforms, and other Earth features	GEOGRAPHY **7**:1045–1052		
2. The geological sciences	GEOLOGICAL SCIENCES **7**:1053–1065		
a. The study of the composition of the Earth: mineralogy, petrology, economic geology, and geochemistry		**7**:1054d–1059c/ **5**:344a–346c/ **7**:1022f–1023b/ **7**:1028b–f/ **12**:95f–g/ **13**:666g–667b	**9**:201c–e/**12**:236b–c
b. The study of the structure of the Earth: geodesy, geophysics, structural geology, and volcanology		**7**:1059d–1062a/ **6**:7a–f/ **6**:70h–73e	**6**:48c–49c/**15**:914a–b
c. The study of surface features and processes: geomorphology and glacial geology; engineering, environmental, and urban geology		**7**:1062a–1062d/ **12**:247h–248e	**7**:1050g–1051a
d. The study of Earth history: historical geology, paleontology, stratigraphy, sedimentology, and astrogeology		**7**:1063d–1065g/ **16**:461d–463e/ **17**:719h–726b	**6**:30a–f/**7**:10d–f/**14**:734c–f/ **14**:738e–739d *passim*/ **15**:944e–945b
3. The hydrologic sciences	HYDROLOGIC SCIENCES **9**:116–125		
a. The study of the occurrence, circulation, and distribution of the Earth's waters, their physical and chemical properties, and their interaction with the environment: hydrology		**9**:117g–121f/ **8**:439f–440f/ **16**:475b–g	**7**:441e–h/ **9**:102e–114g *passim*/ **10**:610g–611h *passim*/ **14**:960d–f
b. The study of lakes: limnology		**9**:121g–122e	
c. The study of glaciers and other forms and modes of occurrence of ice: glaciology		**9**:122f–123b/ **9**:182e–183c	
d. The study of the oceans: oceanography		**9**:123c–125f/ **8**:482d–483d/ **13**:441g–442g/ **18**:384f–385c/ **18**:844f–853b	**2**:300b–c/**2**:778h–779b
4. The atmospheric sciences	ATMOSPHERIC SCIENCES **2**:320–330		
a. The study of the physical characteristics and processes of the non-ionized regions of the atmosphere: meteorology		**2**:320h–324b/ **10**:969e–970a/ **19**:707f–708c	**4**:757d–f/**12**:54g–55a
b. The study of the Earth's climate: climatology		**2**:324b–325a/ **4**:737d–f/ **8**:177e–g	**7**:1051a–b/**14**:960e–f
c. The study of the physical characteristics and processes of the ionized regions of the Earth's atmosphere: aeronomy		**2**:325a–326g	
d. The study of the atmospheres of other planets		**2**:326g–327d	

articles	article sections	other references
	2:327d-329f/ **1**:357f-358a/ **19**:708c-711g	**9**:63g-64b

e. Applications of the atmospheric sciences: weather predictions and forecasts, weather modification, air quality management, and information services

f. Technology of the atmospheric sciences
[see 723.G.5.]

Section 10/34. The biological sciences

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/34 deal with three main subjects: A, the development of the biological sciences; B, the nature, scope, and methodology of biology; and C, the philosophy of biology.

The outline of subject A, extending from the earliest views of life to the biological sciences in the 20th century, treats major discoveries such as the discovery of the circulation of the blood or the deciphering of the genetic code; the advances made possible by new instruments, such as the microscope; the formulation of new theories, such as the theory of the cell and the theory of evolution; the rise of new biological disciplines, such as cell physiology, ecology, and population biology; and the application to biology of the concepts and techniques of physics and chemistry.

The outline of subject B begins with certain common principles that unify the apparently disparate manifestations of life and with a treatment of the general scope of biology. It then reflects the contemporary organization of the biological sciences by reference to four levels of research. It deals first with the molecular level, separate articles being referred to that treat the main component disciplines of molecular biology—biochemistry, biophysics, and genetics. The treatment of cell biology involves separate attention to such component disciplines as microbiology, radiation biology, tissue culture, and transplantation biology. The outline next deals with organismic biology—the study of the whole organism in relation to its constituent parts. It covers the subdivisions: botany, ecology, embryology, ethology, eugenics, genetics, gnotobiology, morphology, paleontology, physiology, psychology, and zoology. The final level of biological research is that of population biology—the study of the interactions of groups of organisms that inhabit a given area. The outline covers the several disciplines that contribute to population biology, such as biogeography, population genetics, and taxonomy. An article referred to gives a separate treatment of ecology—the study of the interactions of the populations of a biological community.

Subject C is the philosophy of biology. The outline begins with the range of topics in this discipline. It goes on to issues concerning the nature of biological systems, treating speculations on the origin and definition of life; traditional philosophical positions and controversies about the nature of life; and the current concept of an organism as a cybernetic, or automatic control, system. It next deals with issues concerning evolution. It treats issues about the character and source of directedness in the evolutionary process; about the reality of species; about the theory of evolution; and about the use of the concept of evolution as a framework for viewing all knowledge and experience. Finally, the outline treats issues in the biological order having ethical implications. It covers issues about the theory of innate aggressiveness in man; about the connection between evolution and human values; about the ethical responsibility of the biologist in the discovery and development of new ideas; about the possibility of producing significant genetic changes in nonhuman species and in man; and about population control.

articles	article sections	other references
BIOLOGICAL SCIENCES **2**:1016-1026		
	2:1016g-1020b/ **4**:684f-685a	
	2:1016h-1017c	**14**:115d-e
	2:1017c-1018f	**1**:1168e-g/**3**:66a-c/**4**:684f-h/ **7**:849f-h/**14**:572c-g/ **19**:1163h
	2:1018f-1019c	
	2:1019c-1020b	**4**:684h-685a/ **8**:131b-132a *passim*/ **10**:816c-f/ **19**:94d-95c *passim*
	2:1020b-1025c	
	2:1020b-1023c	
	2:1020c-d	**8**:662a-c/**11**:388d-389e
	2:1020d-f	
	2:1020f-1021h/ **12**:127g-128d	**3**:66e-f/**3**:1058e-g/ **10**:773b-g/**12**:109f

A. Development of the biological sciences

1. Origin and early development of biological ideas

a. Early views of life and living things; *e.g.*, Assyria, Babylonia, Egypt, China, India

b. Biology in the Greco-Roman world: theories about man and the origin of life; Aristotelian concepts of classification, reproduction, heredity, and descent; botanical investigations; initial anatomical discoveries

c. Biology in the Middle Ages: the influence of Arabian biologists; the development of botany and zoology as separate disciplines; further discoveries in anatomy

d. Biology in the Renaissance: the influence of the craft of printing and artists' illustrations on the dissemination of botanical knowledge; the beginning of the scientific study of anatomy through the use of dissection

2. Developments in the biological sciences in the 17th, 18th, and 19th centuries

a. Biology in the 17th and 18th centuries

i. The discovery of the circulation of blood

ii. The establishment of scientific societies

iii. The development of the microscope: the classical microscopists

	articles	article sections	other references
iv. The rise of modern taxonomy: the systematic classification of plants and animals		**2**:1021h–1022c/ **4**:685a–c	**3**:66g–67a/**10**:617e–f/ **10**:1013b–e/ **15**:535c–536c *passim*/ **17**:444d–445b
v. The emergence of comparative biological studies		**2**:1022c–e	
vi. Experimental approaches to the origin of life: the theory of spontaneous generation		**2**:1022f–1023c	7:7e–8e/**13**:1067d–e
b. Biology in the 19th century		**2**:1023c–1025c/ **4**:685c–h	**2**:993f–994c/ **5**:389c–390b *passim*/ **8**:1066g–1067g *passim*/ **12**:615a–h/**14**:436c–437a/ **19**:1164b–c
i. The effect of geographical explorations on the development of the biological sciences		**2**:1023c–f	**5**:492f–493f *passim*/ **19**:530d–531a
ii. The development of cell theory: the establishment of cellular biology		**2**:1023f–h/ **3**:1058g–1060b	**19**:150c–151b
iii. The theory of evolution: the impact of the concept of natural selection		**2**:1023h–1024c/ **6**:1072a–d	**5**:493e–494e/**6**:1074e–g/ **7**:8e–f/**8**:541h–542e/ **14**:1015d–h/**17**:492h–493a/ **19**:530d–531c *passim*
iv. The rise of embryology: discoveries concerning reproduction and development of organisms		**2**:1024c–e	**2**:581h–582g *passim*/ **5**:1040d–h/**12**:440e–441a
v. The emergence of genetics: the study of heredity and its mechanisms		**2**:1024e–1025c/ **7**:981d–982f/ **8**:802g–804b	7:12b–d/**11**:898g–899c
3. Biology in the 20th century		**2**:1025c–1026a/ **3**:67a–c	**11**:219a–g/**12**:441b–h/ **12**:614b–h *passim*/ **13**:577g–578e/**16**:374d–g
a. The establishment of molecular biology		**2**:1025c–d	**2**:994c–e/**7**:994d–e/ **13**:1095a–b
i. The one-gene, one-enzyme theory and its effects		**7**:987g–988e	
ii. The discovery of the genetic significance of DNA and RNA: deciphering the genetic code		**7**:984a–991c	**2**:1035h–1036a
b. The emergence of intradisciplinary specialties; *e.g.*, cell physiology, cytochemistry, ecology, population biology		**2**:1025d–g/ **6**:197f–198a	
c. The application to biology of the concepts and techniques of other sciences: the development of biochemistry and biophysics; the importance of biological discoveries to medicine and agriculture		**2**:1025g–1026a	**2**:994c–996e *passim*/ **2**:1035e–1036g *passim*
B. The nature, scope, and methodology of the biological sciences	BIOLOGICAL SCIENCES **2**:1014–1016		
1. Common principles that unify the apparently disparate manifestations of life; *e.g.*, homeostasis, unity, evolution		**2**:1015a–h	**10**:895e–899h *passim*
2. The scope of biology: the study of structure and function, including the physicochemical aspects of life		**2**:1015h–1016e/ **2**:994f–996e/ **2**:1035e–1036g/ **3**:67c–g/ **6**:198c–h	
3. Molecular biology: the branch of biology that seeks to interpret biological phenomena in terms of the molecules within the cell *with special attention to*			
a. Biochemistry: the study of substances found in living organisms and of the changes they undergo during the life of the organism	BIOCHEMISTRY **2**:993–997		
b. Biophysics: the study of biological problems in terms of the concepts of physics and other physical sciences	BIOPHYSICS **2**:1034–1037	**12**:974c–975a	
c. Genetics: the study of the way in which genes operate and the way in which they are transmitted from parents to offspring	GENETICS **7**:994–996	**2**:996c–e	**7**:981d–991c *passim*/ **8**:805d–808h *passim*/ **19**:168e–169e *passim*
4. Cell biology: the study of the fundamental structural unit of living things, the cell, and its functions in living organisms *with special attention to*			

	articles	article sections	other references
a. Cancer research; *e.g.*, the development of drugs to combat cancer, investigations of the properties of cancer cells, identification of carcinogens		**3**:770b–771c	
b. Microbiology: the study of micro-organisms, including their identification, structure, and function	MICROBIOLOGY **12**:109–114	**8**:128f–130a	**3**:1059g–h/ **4**:820h–821g *passim*/ **12**:137g–138d *passim*
c. Radiation biology: the study of the biological effects of radiation		**15**:447c–h	**15**:379h–391d *passim*/ **15**:417a–420g *passim*/ **15**:458c–e
d. Tissue culture: the maintenance of cells, tissues, or organs under precisely controlled artificial conditions within the laboratory		**8**:444a–c/ **18**:438a–441g/ **18**:443b–h	
e. Transplantation biology: the transfer of an organ or section of tissue from its natural site to a new position; the problem of graft rejection		**18**:631c–632b	**18**:627g–628c
5. Organismic biology: the study of the whole organism in relation to its constituent parts *with special attention to*			
a. Botany: the study of plant life	BOTANY **3**:65–70		
b. Ecology: the study of the interrelationships of organisms with their environment and each other	ECOLOGY **6**:197–200	**3**:68d–g/ **6**:283g–285a/ **19**:1167f–h	
c. Embryology: the study of the developmental patterns of organisms		**12**:455b–e/ **19**:1165h–1166d	
d. Ethology: the study of animal behaviour		**19**:1167h–1168b	**16**:934b–936d *passim*
e. Eugenics: the study of human improvement by genetic means	EUGENICS **6**:1023–1026	**7**:1005g–1007h	
f. Genetics: the study of inheritance and variation in organisms and the mechanisms by which these processes operate and are controlled	GENETICS **7**:994–996	**1**:341a–343e/ **5**:941e–h	**5**:925h–926f/**8**:801c–804c/ **8**:816f–819e *passim*/ **11**:219b–g/**19**:1167a–b
g. Gnotobiology: the study of germfree plants and animals		**8**:127a–130a	
h. Morphology: the study of biological form and the arrangement of the parts of a plant or animal	MORPHOLOGY **12**:451–456	**3**:67h–68b/ **19**:1164g–1165b	**3**:1061c–d
i. Paleontology: the study of life as it existed in past geological times through fossils		**6**:79b–e/ **6**:81f–82c/ **7**:1064b–1065c	
j. Physiology: the study of the causes and mechanisms of the activities of living things	PHYSIOLOGY **14**:435–440	**3**:68c–d/ **19**:1165e–h	
k. Psychology: the science of behaviour in man and other animals	PSYCHOLOGY **15**:149–151		
l. Zoology: the study of animal life	ZOOLOGY **19**:1163–1169		
6. Population biology: the study of groups of organisms that inhabit a given area, of their interactions, and the dynamics of maturation, steady state, and decline *with special attention to*		**14**:825b–826b	
a. Anthropology: the study of man		**1**:969a–g/ **8**:1043g–1044f	
b. Biogeography: the study of the distribution and dispersal of plants and animals		**2**:1001a–c	**5**:908d–e/**7**:1051b–c
c. Comparative psychology: the comparison of behaviour in different animals			**2**:804b–d/**17**:672b–c
d. Ecology: the study of the interactions of the populations of a community with each other and with their environment	ECOLOGY **6**:197–200	**3**:68d–g/ **4**:1032g–1035g/ **6**:283g–285a	**6**:734h–735f *passim*
e. Population genetics: the study of the frequency and fate of gene differences within populations of individuals		**7**:1007h–1010a/ **8**:1150d–1151e/ **14**:826h–827b	**5**:925h–926f/**8**:811h–812c/ **19**:1166g–h
f. Sociology: the study of social relationships		**16**:994a–d	**16**:943e–945f *passim*
g. Taxonomy: the theory and practice of classifying organisms		**3**:68g–69b/ **4**:685h–689e/ **17**:449g–450g/ **19**:1165b–e	

	articles	article sections	other references
C. Philosophy of biology	NATURE, PHILOSOPHY OF 12:872–876	2:1026a–1027c/ 16:373a–c	1:1168g–h
1. The range of topics in biophilosophy; *e.g.*, old questions investigated anew in the light of biological advances and new standards of philosophical rigour		12:872e–873c	
2. Issues concerning the nature of biological systems		12:873c–874d	
a. Speculations on the origin and definition of life: the problem of the detection of life in space exploration; deliberation over the definitive features of living systems		12:873d–e/ 10:893c–894f/ 10:900a–904b/ 14:377c–h	2:994f–996e *passim*/ 2:1015b–d/3:1059a–g/ 13:578b–e
b. Traditional philosophical positions regarding the biological nature of life: conflicts between vitalism, mechanism, and organicism		12:873e–874a/ 2:1026c–1027a/ 10:894g–895b/ 12:21a–e	8:752d–f
c. The concept of an organism as a cybernetic (automatic control) system: holism and emergence; general systems theory; functions and purpose in biological systems		12:874b–d/ 7:546b–e	
3. Issues concerning evolution		12:874d–875c	4:685e–h
a. The role of determinism (directedness toward an end) versus natural selection in giving direction to evolution		12:874d–e	7:7h–8c/7:14b–g
b. The question of the reality of species; *e.g.*, subjective versus objective existence		12:874e–g/ 7:8f–10f/ 8:816d–e/ 17:453b–455d	
c. Viewpoints regarding evolutionary theory; *e.g.*, neo-Darwinism		12:874g–875b/ 5:650d–f/ 7:23a–c/ 7:428b–c	
d. The concept of evolution as a framework for viewing all knowledge and experience; *e.g.*, the process of cosmic evolution, implications for beliefs and attitudes such as the belief in the uniqueness of man		12:875b–c/ 11:418g–419a/ 14:383e–h/ 17:492h–493a	5:649c–650f *passim*
4. Issues with ethical implications		12:875c–876g	
a. The theory of innate aggression in man: genetic and environmental factors and the consequences of man's actions with respect to them		12:875c–876b	1:297b–298c *passim*/ 6:763d–765f *passim*/7:21d–f/ 11:107b–d
b. The connection between evolution and human values; *e.g.*, social Darwinism		12:876b–g/ 7:21h–22e	16:994e–f
c. The role of the scientist and the question of his ethical responsibility in the discovery and development of new ideas		2:1027a–c	
d. The possibility of producing significant genetic changes		8:818b–819e	
i. In nonhuman species		1:907d–h/ 5:941e–h/ 8:818b–e/ 14:497e–500c	
ii. In man		6:1026d–g/ 7:22g–23a/ 7:1006h–1007h/ 8:818f–819e	6:1025a–c/ 7:858g–859f *passim*
e. Issues related to population control		7:1007h–1010a	14:827d–f/ 14:818e–823h *passim*

Section 10/35. Medicine and affiliated disciplines

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/35 deal with three main subjects: A, the history of medicine; B, the fields of specialized medical practice or research; and C, disciplines affiliated with medicine.

The outline of subject A begins with the medicine of prehistoric peoples, with the practice of medicine among the Babylonians, ancient Egyptians, and the Hebrews, and with medicine and surgery in the Orient. It goes on to the beginnings of systematic medicine in the Greco-Roman world, to medicine from the fall of Rome through the Middle Ages, and to medicine in the Renaissance. The treatment of medicine in the 17th century covers discoveries concerning the circulation of the blood, the use of

experimental methods in medicine, and the appearance of schools of medicine that used physics or chemistry in explanations of disease. The treatment of medicine in the 18th century covers such things as the beginnings of medical specialties and the genesis of the medical school and the hospital. Dealing with the rise of scientific medicine in the 19th century, the outline treats such things as new doctrines, laws, and concepts; the establishment of bacteriology; the discovery and use of anesthesia; the discovery of X-rays; and the development of medical instrumentation. The treatment of medicine in the 20th century covers advances in chemotherapy, immunology, endocrinology, nutrition, cancer research, tropical medicine, and medical technology. Finally, the outline deals with the history of surgery and with 20th-century advances in surgery.

Subject B is the fields of specialized medical practice or research. The outline deals first with the many hospital residency specialties. It then deals with other clinical specialties, covering aerospace medicine, medical jurisprudence, occupational medicine, public health, endocrinology, immunology, toxicology, and tropical medicine. It next deals with medical physiology, nutritional science, and pharmacology and experimental therapeutics. Finally, it treats various technologies ancillary to medical practice.

The outline of subject C, disciplines affiliated with medicine, treats the history and practice of dentistry, of osteopathy, of nursing, and of pharmacy.

articles	article sections	other references
MEDICINE, HISTORY OF 11:823-840		5:684c-685a
A. History of medicine	11:823c-831d	14:607b-g
1. Early medicine: Western medicine before 1800; Oriental medicine before *c.* 1900		
a. The medicine of prehistoric people	11:823c-e	
b. The practice of medicine among the Babylonians, the ancient Egyptians, and the Hebrews	11:823f-g/ 15:202f-g	
c. Medicine and surgery in the Orient: the beginning of systematized medicine	11:823h-826f	
i. Medicine in India: the Vedic and Brahmanistic heritage; the influence of religious and magical beliefs; surgical practices	11:823h-824g	
ii. Medicine in China: the influence of the cosmic theory of Yin and Yang; the use of herbals, drugs, and acupuncture	11:824g-825h	17:1047a-b
iii. Medicine in Japan: assimilation of Chinese and European practices	11:825h-826f	
d. The beginning of systematic medicine in the Greco-Roman world	11:826f-827h	14:436a-b
i. Early influences: mythological beliefs; the investigations and theories of early philosophers	11:826f-h	14:115d-e
ii. The work of Hippocrates: theories on the nature and treatment of disease; the charter of medical conduct	11:827a-e	8:942g-943d
iii. The spread of Greek teachings to Rome: the acceptance of Galen as a medical authority	11:827e-h	7:849c-850b *passim*
e. Medicine from the fall of Rome through the Middle Ages	11:828a-g/ 15:202g-203b	8:1114d-f
i. Reservoirs of medical learning: the role of medieval monasteries in preserving the medical heritage of Greece and Rome; contributions of Arabian medicine	11:828a-f	2:540d-541d *passim*/ 4:517c-d
ii. Establishment of the first organized medical school at Salerno	11:828f-g	
f. Medicine in the Renaissance	11:828h-829f	
i. Improvements in anatomical theory and surgery	11:828h-829b	19:94d-95c *passim*
ii. The control of medical practice in Britain	11:829c-d	
iii. The work of Paracelsus and Fracastoro	11:829e-f	13:982h-984c
g. Medicine in the 17th century	11:829f-830c	
i. Discoveries concerning the circulation of the blood: use of the experimental method; importance of the microscope to medical studies	11:829f-830a	8:662a-c/ 10:772h-773g *passim*/ 11:388g-389e/12:109f
ii. The iatrochemical and iatrophysical theories: the view of life as a series of chemical processes versus the view of life as a mechanism governed by physical laws	11:830a-c	
h. Medicine in the 18th century	11:830d-831d	7:859g-860f *passim*
i. Genesis of the medical school and the hospital	11:830e-f	8:1114f-h/11:809d-f
ii. The beginning of medical specialties: emergence of surgery, obstetrics, and pathology as separate disciplines	11:830g-831a	

	articles	article sections	other references
iii. Improvement in techniques of vaccination and in the treatment of disease: the rise and decline of systems of animism and mesmerism		**11**:831b–d	**9**:134c–g/ **10**:132h–134a *passim*
2. The rise of scientific medicine in the 19th century		**11**:831e–832g	**18**:43b–c/ **19**:735h–736f *passim*
a. New doctrines, laws, and concepts; *e.g.*, the cell and cellular pathology, natural selection, homeostasis, pathogenesis, the Mendelian laws			**8**:802g–804b *passim*/ **8**:1014e–f/**11**:898g–899c/ **19**:151a–151d
b. Further advances in physiology		**11**:831e–g	**2**:859d–860e *passim*/ **12**:615c–e/**14**:436c–437a
c. Establishment of bacteriology: verification of the germ theory; the identification of disease-producing organisms; the introduction of antisepsis		**11**:831g–832b	**10**:497h–498f/ **10**:1033g–1034a/**12**:110d–g/ **13**:1067f–1068a/ **15**:546c–547b/**17**:816e–f
d. The discovery and use of anesthesia		**11**:832c–e/ **1**:867b–d	
e. Other advances: the discovery of the transmission of disease by insects; initial measures to control typhoid; the discovery of X-rays; the development of the ophthalmoscope and the stethoscope		**11**:832e–g	**15**:457g–h
3. Medicine in the 20th century		**11**:832g–836h	
a. Advances in chemotherapy: the discovery, development, and use of antibiotics and synthetic drugs in the treatment of bacterial diseases		**11**:832h–833g/ **18**:278h–279c	**1**:986d–e/**4**:188h–189b/ **18**:43b–c
b. Advances in immunology		**11**:833g–835b	
i. Improvements in vaccines that control bacterial diseases; *e.g.*, typhoid, diphtheria, tetanus, tuberculosis		**11**:833h–834f	
ii. The introduction and use of vaccines to control viral diseases; *e.g.*, yellow fever, influenza, poliomyelitis, measles		**11**:834f–835b	
c. Developments in endocrinology: the discovery of insulin and the control of diabetes; the use of cortisone as an anti-inflammatory agent; the study and use of sex hormones		**11**:835b–g	
d. Advances in other fields		**11**:835g–836h/ **15**:208g–209g	
i. Nutrition: the treatment of deficiency diseases through the discovery and identification of vitamins		**11**:835g–836b/ **13**:405h–406e/ **13**:425d–e	
ii. Cancer research: the treatment of malignant disease through the application of radiation therapy		**11**:836b–d/ **15**:461c–467a	**3**:769e–g/**15**:447c–e
iii. Tropical medicine: the treatment of yellow fever, malaria, and leprosy through the discovery and application of synthetic organic compounds derived from quinine and other sources; the application of insecticides to control malaria and yellow fever		**11**:836e–h	
iv. Medical technology and biomedical instrumentation: the use of electronic devices to monitor physiological processes, to conduct automatic laboratory analyses, and to perform other diagnostic and therapeutic procedures		**1**:146f–h/ **5**:693f–695a/ **9**:639g–641b	**5**:1128f–1129f
4. Surgery in the 20th century		**11**:836h–840h/ **17**:816c–823f	**3**:519b–d
a. The state of surgery prior to 1900: the importance of antisepsis, asepsis, and anesthesia to the development of modern surgery		**11**:837a–e	**17**:816c–f
b. The emergence of surgical specialties: the development of new surgical and diagnostic techniques		**11**:837f–838d/ **17**:820h–823f	
c. Improvements in the treatment of wounds; *e.g.*, the development of plastic surgery, postsurgical rehabilitation		**11**:838d–g/ **17**:819f–820a	**17**:821e–g
d. The use of blood transfusions and other intravenous techniques to reduce shock, treat fluid loss, and restore electrolyte balance		**11**:838g–839a	**2**:1143f–h
e. The introduction of inhalation anesthetic procedures; *e.g.*, improvements in thoracic surgery		**11**:839b–f	

	articles	article sections	other references
f. Recent advances extending the scope of surgery; *e.g.*, the use of new materials in replacement surgery; the introduction of the operating microscope; organ transplant and open-heart surgical techniques		**11**:839f–840h/ **5**:320c–g/ **17**:817h–819f	**18**:632f–h
B. Fields of specialized medical practice or research			
1. Hospital residency specialties			
a. Radiology	RADIOLOGY **15**:457–467		
i. Development of radiology		**15**:457g–458e/ **15**:447c–h	
ii. Professions associated with radiology		**15**:458e–459a/ **5**:694d–695a/ **18**:286b–e	
b. Surgery	SURGERY **17**:816–823		
i. Development of surgery		**17**:816c–g/ **5**:320c–g	
ii. General care of the injured: surgical therapy and monitoring		**17**:816h–818c	
iii. Techniques and instruments of operative surgery: basic and specialized		**17**:818c–819h/ **5**:695b–c	
iv. Major categories of operative surgery; *e.g.*, wound treatment, extirpative surgery		**17**:819h–820d/ **18**:282a–c	**3**:769b–e/ **18**:628d–631a *passim*
v. Preoperative and postoperative care		**17**:820d–h	
vi. Specialization in surgery; *e.g.*, plastic surgery, obstetrics, thoracic surgery		**17**:820h–823f	
c. Obstetrics and gynecology		**17**:822a–d	**5**:688a–b/**5**:692c–d
d. Urology		**17**:822f–h	**5**:692g–h/**5**:693c–d
e. Ophthalmology and otolaryngology		**7**:124d–125a/ **17**:822d–f/ **17**:822h–823a	
f. Neurology		**12**:1041a–1043f/ **17**:823a–c	**5**:687h–688a/**5**:692d–e
g. Psychiatry		**5**:692e–g	**15**:141h–142g
h. Other hospital specialties; *e.g.*, anesthesiology, pathology		**4**:217h–219b/ **5**:695b–c/ **11**:832c–e/ **18**:286e–h	**12**:843g–h
2. Other clinical specialties			
a. Aerospace medicine	AEROSPACE MEDICINE **1**:142–147		
i. The nature and scope of aviation and space medicine		**1**:142e–g	
ii. Aviation medicine: history of its development; certification of airline pilots; medical guidelines for in-flight patient care; medical training of flight crews		**1**:144h–146c	
iii. Space medicine: history of its development; the role of physicians in selecting astronauts, monitoring in-flight physiological responses, evaluating manned space flight experiences; certification of aerospace physicians		**1**:146d–147d	
b. Medical jurisprudence	MEDICAL JURISPRUDENCE **11**:812–815	**2**:537b–d/ **5**:529c–g/ **16**:779h–780b	**14**:676g–677b
i. Growth of medical jurisprudence		**11**:813a–e	
ii. Medical evidence in courts of law: expert medical testimony		**11**:813e–814f/ **2**:1146g–1147a	**8**:816f–g/**14**:674d–f
iii. Medical certification		**11**:814g–h	**11**:851c–d
iv. Licensing regulations and professional ethics		**11**:814h–815d/ **5**:593f–594d/ **11**:849g–851b	**11**:811a–b
c. Occupational medicine		**9**:528a–g/ **11**:846d–847a	

	articles	article sections	other references
d. Public health		11:847a–g/ 15:202f–204f	8:691e/15:208g–209g *passim*
e. Endocrinology		11:835b–g	
f. Immunology		11:833g–835b	
g. Toxicology		14:606h–607h/ 14:618d–h/ 14:622c–g	5:692a–b
h. Tropical medicine		11:836e–h	
3. Nonclinical specialties and the basic medical sciences			
a. Medical physiology and pathological physiology		14:437a–c/ 14:439f–g	5:684a–685a/6:509g–510f
b. Nutrition	NUTRITION AND DIET, HUMAN 13:417–427	2:995d–e/ 11:835g–836b/ 19:492c–493c	13:401b–406e *passim*
c. Pharmacology and experimental therapeutics		11:848f–849c	14:203c–204d *passim*/ 18:278h–279c
d. Gerontology		1:299f–h	
4. Ancillary medical disciplines			
a. Cytotechnology		12:455e–456a	
b. Medical records		5:695d–f	
c. Medical technology		2:997c–d/ 2:1120d–1121c/ 2:1144h–1145f/ 9:640g–641a	5:692h–694d *passim*/ 15:461c–467b *passim*
d. X-ray technology		5:694d–695a	
C. Disciplines affiliated with medicine			
1. History and practice of dentistry	DENTISTRY 5:592–597		
a. The origin and development of dentistry		5:592b–593f	
b. The practice of dentistry		5:593f–597b	
i. Licensure requirements		5:593f–594d	
ii. Types of practice: private, hospital, public health, and military		5:594d–595f	
iii. Dental specialties and subspecialties; *e.g.*, orthodontics, periodontics, oral surgery		5:595f–596f	
iv. Ancillary fields: dental hygienists, nurses, assistants, and technicians		5:596f–597b	
2. History and practice of osteopathy	OSTEOPATHIC MEDICINE 13:765–766		
a. The origin and development of osteopathy		13:765g–766c	
b. The practice of osteopathy: legal status and research		13:766d–f	
3. History and practice of nursing	NURSING 13:395–400		
a. The history of nursing		13:395g–396g	13:99f–100e
b. The practice, education, and organization of nursing		13:396g–400h	
i. Kinds of nursing: *e.g.*, hospital, public health, military, and government nursing		13:396g–398a	
ii. The education of nurses		13:398a–g	
iii. The organization of nursing: licensing and registration practices; the role of national and international organization		13:398h–400h	
4. History and practice of pharmacy	PHARMACY 14:203–204		
a. The nature and history of pharmacy; *i.e.*, the preparing, compounding, and dispensing of drugs		14:203c–e	14:191b–g/ 14:196g–199b *passim*
b. Education and licensing in pharmacy		14:203e–204a	

Section 10/36. The social sciences and psychology

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/36 deal with six main subjects: A, the development of the social sciences generally; B, anthropology; C, sociology; D, economics; E, political science; and F, psychology.

The outline of subject A first deals with the origins of the social sciences in earlier periods, and with influences in the Renaissance and in the Enlightenment. It goes on to the influence of new concepts in social, political, economic, and scientific theories of the 19th century that led to the development of the separate disciplines of social science. Dealing with 20th-century developments, the outline treats the influence of social upheaval in the non-Western world; the influence of Marxist and of Freudian ideas; the changing character of the separate disciplines; and major theoretical influences in the social sciences.

The outline of subject B first deals with the 19th-century origins and 20th-century developments of the discipline of anthropology. It then treats the scope and methods of the two major branches of anthropology—cultural anthropology and physical anthropology.

The outline of subject C treats the background and the methodology of contemporary sociology; the professional, scientific, and social status of sociology; and emergent trends in sociology. Articles are then referred to that separately treat cognate disciplines—criminology, prisons and penology, social psychology, demography, and geography.

The outline of subject D begins with the development of economic theories from the late 18th to the 20th century. It goes on to the scope and methods of economics, covering microeconomics, macroeconomics, and the major contemporary fields of economics. Dealing with cognate disciplines, the outline treats mathematical economics, econometrics, the use of statistical methods in economics, and the principles of accounting.

The outline of subject E first deals with the relationship of political science to political philosophy, and with the status of the former as an empirical science. After a review of 19th- and 20th-century developments in political science, the outline treats contemporary political science methodology; the major fields of study in political science, including the study of international relations; and current trends in political science.

The outline of subject F first deals with the history of psychology. After reference to the tradition of philosophical psychology from antiquity to the 19th century, it treats 19th- and early 20th-century developments—the influences of biological and physiological theories, the development of schools of scientific psychology, and the emergence of the fields of psychiatry and psychoanalysis. It then treats such mid-20th-century trends as the declining influences of the schools of psychology; the growing influence of quantification and mathematical models; and the increasing interdependence of psychology and other disciplines. The outline next treats the scope of the modern study of psychology, the methods of psychological research, and psychology as a profession. Articles are then referred to that separately treat cognate disciplines—physiological psychology and social psychology.

A. Development of the social sciences	articles	article sections	other references
	SOCIAL SCIENCES, HISTORY OF	**16**:980–990	
1. Origins of the social sciences		**16**:980g–982c	
a. Precursors of the social sciences in the Middle Ages and the Renaissance		**16**:980h–981g/ **1**:976d–977a/ **14**:258d–266d/ **15**:663h–665c/ **16**:354e–355e	**12**:163f–164a
b. Heritage of the Enlightenment: social reforms and revolution		**16**:981g–982c/ **1**:976d–977a/ **6**:264f–h/ **6**:892a–893h/ **14**:690a–691e	**5**:282h–283a
2. 19th-century developments in the social sciences		**16**:982d–986f/ **7**:21h–22c/ **14**:691e–693e	
a. The influence of new concepts in social, political, economic, and scientific theories		**16**:982g–984d/ **1**:1079b–e/ **6**:264h–266a/ **6**:1071c–1072f/ **14**:702h–704a/ **15**:154c–155a	**1**:969g–970d/**1**:970h–971b/ **5**:283a–c/**5**:366a–d/ **5**:576c–e/ **6**:1074c–1075f *passim*/ **10**:719d–f/**12**:557a–c/ **14**:269d–271g *passim*/ **16**:994d–f/**19**:2g–3b/ **19**:715h–716b
b. Development of the separate disciplines; *e.g.*, economics, political science, anthropology, sociology, social statistics, social geography		**16**:984d–986f/ **1**:977a–b/ **14**:818g–819d/ **15**:155a–157g/ **15**:629d–h	**1**:970d–h/**6**:1078f–1079b/ **16**:955e–956d/**16**:994b–d
3. 20th-century developments in the social sciences		**16**:986f–990e/ **14**:819d–f/ **15**:157g–h	
a. The influence of social upheaval in the non-Western world: the revolution of rising expectations		**16**:986f–987c/ **7**:22d–e/ **7**:23a–c	
b. The influence of Marxism		**16**:987d–g/ **14**:272e–f	**10**:719b–d

	articles	article sections	other references
c. The influence of Freudian ideas		**16**:987h–988a/ **15**:157g–158f	**7**:739b–741h *passim*/ **8**:1136c–1137f *passim*/ **12**:796f–h/ **15**:146a–147b *passim*
d. The changing character of the disciplines		**16**:988a–989b/ **6**:266b–267f/ **14**:728d–f	**14**:730c–e
i. Specialization and cross-disciplinary approaches		**16**:988a–d/ **6**:926a–b/ **10**:721d–722a/ **14**:728h–729a/ **15**:592d–593b	**6**:980a–c/**9**:782d–f
ii. The increasing professionalism of social scientists as consultants and decision makers in government and business		**16**:990b–e/ **1**:973c–h/ **9**:784f–785c/ **15**:39b–h	**6**:264d–e/**15**:166a–c/ **16**:988d–e
iii. The introduction of mathematical and other quantitative methods: the use of computers		**16**:988g–h/ **6**:201b–g/ **7**:1049b–1050e/ **11**:669h–670g/ **11**:745a–g/ **13**:628d–629d/ **13**:632f–634f/ **15**:157h–158f/ **15**:164a–c/ **16**:993b–e/ **16**:996e–h/ **16**:1000f–g	**9**:784b–e/**14**:705c–e
iv. The influence of empiricism: the collection of data, use of surveys and polls, and testing of theories		**16**:988h–989b/ **5**:368b–d/ **16**:992h–993b/ **16**:996c–e/ **19**:996h–997g	**5**:284a–b
e. Major theoretical influences: developmentalism; the social-systems approach; structuralism and functionalism		**16**:989b–990a/ **16**:991g–992c	**9**:782g–784b/**16**:948d–g
B. The nature of anthropology	ANTHROPOLOGY **1**:968–975		
1. The background of anthropology		**1**:969g–973c/ **4**:657c–660e/ **5**:66a–d/ **11**:301b–h/ **14**:1041a–f	**14**:1033a–f
a. 19th-century origins: evolutionary theories; the influence of Marxism		**1**:970d–971d/ **1**:922c–h/ **8**:1152a–e/ **16**:985d–f	**1**:973h–974c/**8**:1157e–f/ **14**:1041c–d/**15**:618g–619e/ **18**:808e–g
b. 20th-century developments in cultural anthropology: cultural, historical, and sociological schools; functionalism and structuralism; neo-Marxism and neo-evolutionism		**1**:971d–972f/ **1**:922h–923d/ **12**:795g–796e/ **15**:619f–620a/ **16**:989c–h/ **18**:531e–533f	**2**:1156d–h/**11**:386a–h/ **14**:1041d–f/**15**:864b–e
2. The scope and methods of anthropology: the division between cultural and physical anthropology		**1**:972f–975b	
a. The current status of cultural anthropology and related disciplines; *e.g.*, ethnography, social and applied cultural anthropology		**1**:972f–973h/ **7**:461f–462a/ **14**:984e–985c/ **15**:618f–620a/ **15**:629d–h	**1**:981c–h/**5**:367b–h/ **8**:268d–g/**14**:1033a–f
b. Physical anthropology and related disciplines; *e.g.*, primatology, genetics, anthropometry		**1**:973h–975b/ **6**:1024d–g/ **8**:1043g–1044f/ **8**:1150d–1151e/ **15**:351g–353a/ **15**:360a–d	**8**:1030d–g
C. The nature of sociology	SOCIOLOGY **16**:994–1001		
1. The background of contemporary sociology		**16**:994d–996b	**15**:605b–h

	articles	article sections	other references
a. Early schools of social thought: social Darwinism; various types of determinism; early functionalism		**16**:994d–995b/ **4**:657c–659e/ **7**:21h–22e/ **9**:195b–197e/ **15**:620b–e/ **16**:985g–986b	**5**:282h–283c/**16**:955e–956d/ **16**:956h–957d
b. Modern directions of interest: functionalism and structuralism; symbolic interactionism; determinism; mathematical models		**16**:995c–996b/ **15**:620f–621a/ **16**:993b–e	**16**:948d–g/**16**:956d–g
2. The methodology of contemporary sociology		**16**:996c–998c/ **7**:1049e–f	
a. The use of inductive research techniques; *e.g.*, the mapping of various spatial distributions; interviews and case studies; statistical measurements		**16**:996d–h/ **17**:779c–780e	**5**:283h–284g/**11**:745f–g
b. The application of experimental methods to sociology		**16**:996h–997a/ **16**:992h–993e	**15**:42f–43e
c. Methods and problems of data collection; *e.g.*, the control of variables in questionnaires and interviews; sociometric methods		**16**:997a–g/ **15**:214e–215h	
d. Ecological pattern methods: the determination of social relationships from the distribution of nonsocial urban characteristics		**16**:997g–h	
e. Methodological issues: the control of bias; national methodological technique preferences		**16**:997h–998c	
3. The status of contemporary sociology		**16**:998c–1000b	
a. Professional and scientific status		**16**:998c–999g	
b. Various views of the role of sociology in contemporary society		**16**:999h–1000b/ **5**:282c–f	**10**:1040e–g
4. Emergent trends in sociology		**16**:1000b–1001a	**16**:961c–f
5. Cognate disciplines			
a. The study of causes, correction, and prevention of crime: criminology	CRIMINOLOGY **5**:282–285	**5**:266f–267c/ **5**:281b–e	**14**:668b–e
b. The study of penal practices and the rationales of punishment: penology	PRISONS AND PENOLOGY **14**:1097–1103	**5**:282a–f	
c. The study of the behaviour of individuals in their social and cultural setting: social psychology	PSYCHOLOGY, SOCIAL **15**:163–166	**16**:986b–d	
d. The study of the structure of human populations and population movements: demography	DEMOGRAPHY **5**:575–577	**14**:819f–821d	**7**:1050d–e
e. The study of the distribution and spatial patterns of economic, political, and social units: human geography	GEOGRAPHY **7**:1045–1052		**5**:366e–367a/**5**:367h–368b
D. The nature of economics	ECONOMICS **6**:264–273		
1. Development of theories of economics		**6**:264f–267f/ **3**:801h–802d/ **10**:847a–g/ **14**:818g–819f/ **16**:984g–985a	
a. The origin of economic thought in the late 18th century		**6**:264f–h/ **14**:818g–819d	**6**:893f–h/**11**:395a–f/ **14**:936d–f/**16**:905e–906f
b. 19th-century economic thought		**6**:264h–266a/ **3**:799h–800c/ **14**:819d–f	**11**:554d–556b/**14**:936f–h/ **15**:825c–g/ **18**:553a–554g *passim*
c. 20th-century economic thought		**6**:266b–267f/ **3**:800d–e/ **9**:268f–269e/ **16**:987d–g	**10**:447f–448e/**18**:554g–555e/ **19**:39d–40a
2. Economics as a science: the scope and methods of the study of economics		**6**:267f–272c	
a. Microeconomics: factors of production, the allocation of resources, and the behaviour of individual markets in the economy		**6**:268g–270a/ **6**:200d–h	**11**:745a–c

	articles	article sections	other references
b. Macroeconomics: taxation, national income determination, and national monetary policy		**6**:270b–271a/ **3**:536h–538a/ **6**:201b–g/ **6**:203e–204c	**6**:773a–e
c. Contemporary fields of economics *with special attention to*		**6**:271a–272f	
i. The study of international trade		**6**:271a–c/ **6**:206h–207g/ **18**:553a–555e	
ii. The study of labour economics		**6**:271c–f/ **3**:491b–494b/ **9**:495d–496c/ **19**:939e–940c	
iii. The study of industrial and agricultural growth and development		**6**:271f–272c/ **1**:315f–317c/ **6**:207h–208h/ **6**:229e–230a	7:1049h–1050a
3. Cognate disciplines			
a. Mathematical economics: utility, equilibrium, and growth theory		**6**:272c–273a/ **6**:203e–h/ **6**:219a–e/ **9**:265e–266c/ **15**:19c–22a/ **19**:675b–679h	**6**:267a–c/**11**:745a–c/ **16**:988g–h
i. The use of game theory in solving economic and managerial problems		**13**:627b–g	**13**:622c–623e *passim*
ii. The use of linear and nonlinear programming in solving economic and managerial problems		**4**:1005g–1006d/ **13**:628d–629d	
b. The use of econometrics in studying various economic relationships and in forecasting income and employment levels	ECONOMETRICS **6**:200–201		**6**:213b–d/**6**:273b–d/ **12**:849e–850g *passim*
c. The use of statistical methods in solving economic problems		**6**:200d–201a	**6**:212h–213b/**9**:784b–e/ **19**:675b–679h *passim*
d. The nature of accounting: the purpose of company financial statements; principles of asset measurement; managerial accounting procedures	ACCOUNTING, PRINCIPLES OF **1**:36–42	**3**:37f–38c/ **7**:298e–299f/ **17**:1085f–1087a	
E. Political science	POLITICAL SCIENCE **14**:702–706		
1. The nature of political science: its relationship to political philosophy; its status as an empirical science		**14**:702c–h	**1**:1169h–1170d/ **14**:684h–685b
2. 19th- and 20th-century developments in political science: the sociological and legalist schools		**14**:702h–704g/ **14**:729a–730e/ **16**:985b–c	
3. The scope and methods of contemporary political science		**14**:704h–706e	**9**:784b–e/ **16**:988c–989f *passim*
a. The analysis of political behaviour: conceptual and methodological convergences with sociology, anthropology, social psychology, and jurisprudence [see also B. and C., above]		**14**:704h–705a/ **4**:1005g–1006f/ **6**:534h–535e/ **9**:780e–782f/ **10**:714g–715h/ **10**:721d–722a/ **14**:693f–694e/ **14**:697e–699g/ **14**:728h–730e	**7**:1049f–h
b. General systems analysis: the study of governmental policy and decision-making processes; input–output theory; the use of models and game theory		**14**:705b–e/ **9**:782g–784e/ **13**:627g–h/ **14**:728e–g/ **16**:992d–993e	**19**:547a–b
c. The study of various political entities; *e.g.*, interest groups, elites, and political parties		**14**:705e–f/ **11**:603c–g/ **16**:946e–947a/ **16**:950h–951f/ **16**:992d–g	**11**:600g–601c/**14**:694d–e/ **14**:713g–714b/**16**:948c

	articles	article sections	other references
d. The study of public opinion as a factor affecting political decision: political attitudes and voting behaviour		**14**:705g/ **15**:39b–h/ **15**:213d–215h	**4**:1009c–g/**15**:42f–43e *passim*/ **16**:962h–963g
e. The study of public law		**4**:1036e–1038a	**14**:729d–e
f. The study of public administration		**1**:91b–92e/ **1**:1022d–1023f/ **15**:186d–g	
g. The study of international relations	INTERNATIONAL RELATIONS, THEORIES OF **9**:780–785		
i. Formulation of theories of political idealism, realism, or power politics, and political behavioralism		**9**:780e–782f/ **14**:704d–705a/ **9**:744e–745a/ **19**:544g–545e	**9**:762a–e/**9**:1146f–1147c/ **14**:700d–f
ii. Comparative foreign policy and international systems analyses: political scientists as foreign policy decision makers		**9**:782g–785c	**16**:988d–f/**19**:547a–b
h. Current trends in the study of political science: conflicts between traditionalists and behavioralists	POLITICAL SYSTEMS **14**:728–730	**14**:705h–706e	**15**:213d–216e *passim*
F. History and methods of psychology			
1. The history of psychology	PSYCHOLOGY, HISTORY OF **15**:151–158		**15**:141h–142c
a. Development of psychology from antiquity to the 19th century: philosophical and religious roots of psychology		**15**:152b–154c/ **1**:1168g–h/ **3**:430d–431a/ **6**:926a–b/ **14**:115c–f/ **14**:262d–267h	**12**:796f–h/**13**:1099g–1100a/ **15**:605a–b
b. 19th- and early 20th-century advances in psychology		**15**:154c–157g	
i. The influences of biological and physiological theories		**15**:154c–155a/ **6**:757h–758a/ **12**:557a–g	
ii. The development of the fields of psychiatry and psychoanalysis		**15**:155a–g/ **5**:1012a–c/ **6**:757f–758a/ **15**:621d–622a/ **18**:8b–c	**7**:739b–741h *passim*/ **9**:134f–g/**14**:116a–f/ **15**:145b–148d *passim*
iii. The recognition of psychology as a scientific discipline: development of schools of functionalism, structuralism, Behaviourism, and Gestalt psychology		**15**:155h–157g	**13**:1100e–1101g *passim*/ **18**:6a–c
c. Mid-20th-century trends in psychology		**15**:157g–158f/ **8**:1137b–f	
i. The declining influence of the schools of psychology		**15**:157g–h/ **14**:117d–e	
ii. The growing influence of quantification and mathematical models: the use of human factors engineering and cybernetics		**15**:157h–158a/ **4**:1006g–1007b/ **9**:679e–f	**11**:745d–e
iii. The increasing interdependence of psychology and other disciplines; *e.g.*, biological sciences, sociology, psychiatry, engineering, the humanities		**15**:158b–f/ **2**:1007b–d/ **6**:372f–373a/ **8**:1168a–c/ **8**:1169e–h/ **15**:622a–b	**1**:972d–e/**6**:980a–c/**7**:462a–d/ **10**:1040e–g/ **13**:1095f–1096h *passim*
2. The nature and scope of psychology	PSYCHOLOGY **15**:149–151		
a. The scope of the modern study of psychology; *e.g.*, sensation-perception, motivation, emotion, innate patterns of behaviour, learning, thinking, intelligence, personality		**15**:149b–150d/ **10**:748h–749c/ **13**:1002a–c/ **19**:544b–f	**10**:335g–336b/**15**:596f–g/ **17**:378f–h
b. Methods of psychological research; *e.g.*, laboratory testing, quantitative data, statistical analysis		**15**:150d–g/ **10**:749c–f/ **14**:108f–113c/ **16**:545e–f	**8**:1150d–1151e *passim*/ **11**:735b–739f *passim*/ **14**:117d–118e *passim*/ **18**:355b–d

	articles	article sections	other references
c. Psychology as a profession: educational requirements, certification, and professional organizations		**15**:150g–151f	
3. Special branches and cognate disciplines of psychology *with special attention to*			
a. The study of the physiological basis of behaviour: physiological psychology	PSYCHOLOGY, PHYSIOLOGICAL **15**:158–159	**14**:115c–118e	
b. The study of the behaviour of individuals in their social and cultural setting: social psychology	PSYCHOLOGY, SOCIAL **15**:163–166	**16**:986b–d	

Section 10/37. The technological sciences

[for Part Ten headnote see page 694
for Division III headnote see page 725]

The articles and parts of articles referred to in Section 10/37 deal with four main subjects: A, the history of the technological sciences; B, the academic and professional aspects of engineering; C, the nature and scope of agricultural sciences; and D, the nature and scope of recently developed interscience disciplines.

The outline of subject A deals first with the emergence of the technological sciences. It treats engineering practice from ancient times to the 20th century; the development of scientific agriculture; and the development during the 20th century of such interdisciplinary fields as systems engineering, operations research, cybernetics, bionics, and information science. The outline then deals with the development of the history of technology as a separate discipline.

The outline of subject B deals first with the functions of the engineer; with the education and training of the engineer; with the organization of the engineering profession; and with the responsibilities of the engineer. Articles are then referred to that separately treat civil engineering, aeronautical engineering, chemical engineering, electrical and electronics engineering, mechanical engineering, and optical engineering.

The outline of subject C treats the subdivisions of the agricultural sciences. It deals first with soil science, involving soil physics and chemistry and other factors relevant to soil fertility. It goes on to treat plant production, which involves applied plant physiology, plant nutrition, plant breeding, plant diseases, and weed and pest control. It next deals with animal production, which involves animal breeding and genetics, animal nutrition, and animal husbandry. It further treats agricultural economics and management, which involves behavioral science, market research, and rural sociology. Finally, it treats agricultural engineering, which involves the application of mechanical and civil engineering, of hydraulics, and of soil mechanics to problems in agriculture.

The outline of subject D begins with the recently named science of bionics, an offspring of biology and electronics, which studies living organisms as prototypes for man-made devices and synthetic systems, such as information system circuitry. It then refers to other sections in which there are treatments of systems engineering and operations research, and of cybernetics, control theory, and information science.

	articles	article sections	other references
A. History of the technological sciences	TECHNOLOGICAL SCIENCES **18**:19–21		
		18:19g–20e	
1. Emergence of the technological sciences		**18**:19c–20c/ **1**:129e–130b/ **4**:124b–125b/ **4**:654a–g/ **5**:441a–442b/ **6**:535h–536b/ **6**:861a–f/ **8**:633a–f/ **16**:1011d–f	**18**:248b–249a/**19**:37h–38h
a. The engineering disciplines: engineering practice from ancient times through the Renaissance; emergence of the different branches of engineering in the 18th and 19th centuries; developments in the classical engineering sciences in the 20th century			
b. Agricultural sciences: early agricultural lore; development of scientific agriculture		**18**:20c–e/ **1**:322h–323a	**1**:324e–345h *passim*
c. Interscience disciplines: the development during the 20th century of systems engineering, operations research, cybernetics, bionics, information science, and other specialized fields		**2**:1032f–1033a/ **8**:1168a–c/ **13**:594c–595c/ **13**:632f–h/ **15**:158b/ **16**:140e–h/ **17**:970f–971g	**9**:574f–h/**16**:137c–e/ **19**:823b–824a *passim*
2. The study of the history of technology: development of the history of technology as a separate discipline		**18**:20e–21a	
B. Academic and professional aspects of engineering	ENGINEERING **6**:860–862	**9**:509h–510d	

	articles	article sections	other references
1. Functions of the engineer; *e.g.*, research and development, design and construction		**6**:861f–h/ **1**:131b–f/ **4**:654g–655d/ **6**:536c–e/ **11**:755h–756b/ **13**:603d–g	
2. Education and training of the engineer: undergraduate and graduate curricula; the trend toward more vigorous science and mathematics education for engineers		**6**:861h–862c/ **1**:130g–131b/ **4**:125d–e/ **4**:656b–e/ **6**:537a–c/ **6**:866c–e	**11**:756b–c/**16**:145a–b
3. Organization of the engineering profession: technical societies and standards of professional competence		**6**:862c–e/ **4**:125f–g/ **4**:656e–h/ **6**:537d–e/ **8**:1169f–h	**11**:756d–f
4. Responsibilities of the engineer: problem solution and decision making to achieve maximum benefits for mankind		**6**:862e–g/ **8**:1169e–f	
5. Branches of engineering *with special attention to*			
a. Civil engineering, which deals primarily with the design, construction, and maintenance of public works such as highways, bridges, and waterways	CIVIL ENGINEERING **4**:654–656	**8**:632d–h	
b. Aeronautical engineering, which deals with the development, design, construction, testing, and operation of flight vehicles in the Earth's atmosphere and in space	AERONAUTICAL ENGINEERING **1**:129–131	**1**:136a–139b	
c. Chemical engineering, which deals with the development of manufacturing processes and with the design and operation of plants	CHEMICAL ENGINEERING **4**:124–125		
d. Electrical and electronics engineering, which deals with the practical application of electricity especially as related to communications, automatic control of machines and systems, and generation and distribution of electric power	ELECTRICAL AND ELECTRONICS ENGINEERING **6**:535–537		**17**:668a–669c
e. Mechanical engineering, which deals with the development, design, and operation of machines and with the generation, transmission, and utilization of heat and mechanical power	MECHANICAL ENGINEERING **11**:755–756		
f. Optical engineering, which deals with the design, construction, and testing of optical equipment	OPTICAL ENGINEERING **13**:603–608		**12**:130d–132f *passim*
C. The nature and scope of agricultural sciences	AGRICULTURAL SCIENCES **1**:322–324	**1**:362g–365b	
1. History of the agricultural sciences [see A.1.b., above]			
2. Subdivisions of the agricultural sciences		**1**:323b–324d	
a. Soil science, which is concerned with the agricultural aspects of soil generation, with soil physics and chemistry, and with all other factors relevant to soil fertility		**1**:323c	
b. Plant production, comprising applied plant physiology, plant nutrition, plant breeding, plant diseases, and weed and pest control		**1**:323c–e/ **1**:362h–364d/ **7**:532a–e/ **7**:901h–902a	
c. Animal production, comprising animal breeding and genetics, animal nutrition, and animal husbandry		**1**:323e–f/ **1**:364d–365a	
d. Agricultural economics and management, including behavioral science, agricultural policy, market research, and rural sociology		**1**:323f–324a/ **7**:177d–179e	
e. Agricultural engineering, including appropriate areas in mechanical engineering, construction, hydraulics, and soil mechanics		**1**:324a/ **9**:900g–901d/ **9**:902f–g	
D. The nature and scope of recently developed interscience disciplines			
1. Bionics	BIONICS **2**:1032–1034		

	articles	article sections	other references
a. Mimicry of nature as the basis for bionics; *e.g.*, design of torpedoes with surface layers similar to a dolphin's skin, construction of vehicles with articulated legs		2:1032g–1033a	
b. The use of natural models to understand and solve engineering problems; *e.g.*, natural neural networks as models for electronic circuits, the human brain as a model for computers and information processing devices		2:1033b–1034d/ 2:497d–498c	
2. Systems engineering and operations research [see 712.B.]			
3. Cybernetics, control theory, and information science [see 10/23]			

For biographical articles pertinent to Division III, see the lists after Sections 112, 128, 133, 243, 355, 425, 438, 512, 525, 537, 544, 554, 563, and 738.

Division IV. History and the humanities

[for Part Ten headnote see page 694]

The outlines, and the articles and parts of articles referred to, in the two sections of Division IV deal with historiography and the study of history, and with the humanities and humanistic scholarship.

Section 10/41 first treats the history of historical writing in the major cultures of both East and West, and the disciplines and methods involved in modern historical investigation and research. It then treats the speculative philosophies of history that have appeared in the West and the East, and philosophical analyses of the specific character of historical knowledge.

Section 10/42 first sets forth a historical review of changing conceptions of the humanities and of humanistic scholarship, covering all the major periods and mutations, from the Greek ideal of *paideia* to contemporary developments. It then treats issues about the nature and scope of the humanities; about the relation of the component disciplines to one another; and about their distinction from the sciences, their validity as ways of knowing, and their role in education.

Section 10/41. Historiography and the study of history 753
10/42. The humanities and humanistic scholarship 756

Section 10/41. Historiography and the study of history

[for Part Ten headnote see page 694]

The articles and parts of articles referred to in Section 10/41 deal with three main subjects: A, historiography; B, modern historical investigation and research; and C, the philosophy of history.

The outline of subject A begins with a broad survey of the history of historical writing, covering the characteristics of historical writing in the major cultures of both East and West, and in various epochs. It goes on to diverse ways of distinguishing kinds of historical writing and to factors involved in the writing of history.

The outline of subject B first deals with the different kinds of sources used in historical writing. Going on to the methodology of historical research and writing, it treats auxiliary disciplines for ascertaining and interpreting sources, such as epigraphy, paleography, and sigillography. It then treats methods by which evidence and testimony are evaluated for authenticity and credibility.

The outline of subject C begins with the distinction between philosophical speculations about the historical process and philosophical analysis of the writing of histories. Dealing with speculative philosophy of history, the outline first treats diverse views about the possibility of discerning an order or design, a plan, pattern, or meaning in the course of history as a whole. It then treats the speculative philosophies of history that have appeared in the West from antiquity to the 20th century, and Chinese, Japanese, and Indian philosophies of history. The outline deals finally with critical or analytical philosophy of history—history as a discipline. It treats the distinction between history and other forms of knowledge; the problem of historical explanation and interpretation; and the problem of historical objectivity and accuracy.

	articles	article sections	other references
A. Historiography: the types of historical writing	HISTORIOGRAPHY AND HISTORICAL METHODOLOGY	8:945–960	

	articles	article sections	other references
1. Development of historiography: the history of historical writing		**8**:946a–960f	
a. In the ancient world		**8**:946a–948h	
i. Near Eastern historiography		**6**:916f–918a/ **10**:284d–285b	**6**:461g–462b/**6**:916a–c
ii. Classical historiography: Greek and Roman		**8**:946a–947h/ **6**:918f–919g	**8**:325b–f/**8**:360g–361c/ **8**:820h–822a/**10**:278d–g/ **10**:1092f–h/**10**:1098d–f/ **11**:3f–4h/**14**:763a–764a/ **16**:184e–185e *passim*/ **17**:983f–985a/ **18**:359a–361a *passim*/ **19**:1056e–h
iii. Early Christian historiography		**8**:947h–948h	**6**:1130b–1131b
b. In the Middle Ages		**8**:948h–951e	
i. Western Christian historiography		**8**:948h–950f	**8**:422g–423a
ii. Byzantine historiography		**8**:950g–951e	
c. From the Renaissance to the present		**8**:951f–959c	
i. Renaissance historiography		**8**:951f–953b/ **15**:660e–661b	**8**:465d–466d *passim*
ii. Early modern historiography		**8**:953b–956d	
iii. Enlightenment historiography: the 18th century		**8**:956d–957e	**8**:154c–h/**8**:1194a–b
iv. 19th- and 20th-century historiography		**8**:957f–959c/ **15**:661b–662f	**11**:223a–d/ **12**:102g–103e *passim*/ **14**:993b–h/ **15**:506g–508c *passim*
d. Non-Western historiographical traditions			
i. Islāmic historiography		**8**:959c–960b	**9**:962a–b/**11**:610d–g/ **17**:980g–981c
ii. East Asian historiography		**8**:960c–f/ **4**:1106d–1107a/ **6**:918b–f	**13**:947h–948g/ **17**:525d–526d *passim*
2. Types of historical writing: diverse ways of distinguishing or classifying kinds of historical writing by method or function		**8**:947h–948h/ **2**:1006f–1007b/ **10**:1079e–1080a	**14**:249c–f
3. Factors involved in the writing of history: the background of the author; his vantage point, method of work, and purpose		**8**:964d–965e	**14**:249f–250a
B. Modern historical investigation and research: sources and methods			
1. Sources for historical writing			
a. Material remains; *e.g.*, sites, burials, architecture, sculpture, seals, coins		**1**:1079h–1081e/ **5**:500a–501a/ **6**:915h–916a/ **14**:984b–e/ **16**:741f–743f	
b. Written materials		**1**:837h–839a/ **19**:1040f–1044d	**3**:645h–669g *passim*
i. Literary sources; *e.g.*, poetry, letters, journals		**2**:980b–981a/ **2**:1009f–1010g/ **4**:301e–g	
ii. Official documents; *e.g.*, government documents		**5**:808a–809h	
c. Traditional remains; *e.g.*, folklore, place-names		**7**:463c–466e/ **12**:819a–g	
2. The methodology of historical research and writing			
a. Auxiliary disciplines for ascertaining and interpreting the sources			
i. Anthropology	ANTHROPOLOGY **1**:968–975		**15**:618f–619a
ii. Archaeology	ARCHAEOLOGY **1**:1078–1082	**5**:500a–501f/ **6**:462f–463d/ **14**:984e–985c/ **15**:618c–f	

	articles	article sections	other references
iii. Bibliography	BIBLIOGRAPHY **2**:978–981		
iv. Chronology	CHRONOLOGY **4**:572–582	**5**:501a–502c	
v. Diplomatics	DIPLOMATICS **5**:807–813		
vi. Epigraphy	EPIGRAPHY **6**:915–924	**19**:1042b–f	
vii. Genealogy	GENEALOGY **7**:991–993		**10**:477h–478b
viii. Geography	GEOGRAPHY **7**:1035–1052	**6**:793c–f	
ix. Heraldry		**8**:782h–793e/ **8**:798d–e	
x. Iconography and iconology		**12**:795g–796e/ **17**:900f–904b	
xi. Linguistics	LINGUISTICS **10**:992–1012		**5**:699c–701c *passim*
xii. Paleography	PALEOGRAPHY **13**:911–914	**8**:856d–857b/ **19**:1042b–f	**3**:645h–660e *passim*
xiii. Psychoanalysis			**14**:116a–117a
xiv. Sigillography	SIGILLOGRAPHY **16**:741–743		
xv. Textual criticism	TEXTUAL CRITICISM **18**:189–195	**2**:941a–942g/ **15**:617d–618c	**8**:952a–f/ **13**:912e–913g *passim*
b. The determination of authenticity and the extraction of credible testimony: external and internal criticism		**8**:958b–d/ **1**:1081e–1082e/ **6**:923e–924b	**13**:913d–g/**13**:914b–d
C. Philosophy of history: speculations about the historical process; philosophical analysis of the writing of histories	HISTORY, PHILOSOPHY OF **8**:961–965		
1. Conceptions of the philosophy of history: the distinction between speculative philosophy of history and critical or analytical philosophy of history		**8**:961f–g	**1**:981f–h
2. Speculative philosophy of history: explanations of the pattern of historical events		**8**:961g–964b/ **18**:411f–413b	
a. Diverse views of the possibility of discerning an order or design, a plan, pattern, or meaning in the course of history		**8**:961g–962a/ **4**:556g–558b/ **5**:365d–368d/ **6**:958g–960c/ **11**:1017d–1018a/ **11**:1021a–1022a/ **15**:135d–136d	**5**:239a–243d *passim*/ **5**:1066c–e/**7**:198f–h/ **15**:594g–h/**16**:201f–202f/ **18**:275c–e
b. Speculative philosophies of history in the West		**8**:962a–964b/ **6**:961c–962f/ **7**:7e–8f/ **7**:21h–22g/ **16**:202h–203b	**11**:230e–f
i. Greek and Roman views		**8**:750d–751b	**12**:783e–f/ **14**:250e–256h *passim*/ **14**:685g–687d *passim*/ **15**:787c–f
ii. Christian philosophies of history		**8**:962a–c/ **4**:507a–508e/ **6**:959b–960c/ **11**:1018h–1019g/ **12**:201d–203b/ **16**:203g–204a	**2**:367d–368a/ **4**:486g–490g *passim*/ **4**:551f–552e/**4**:561h–562a/ **14**:687d–690a *passim*/ **15**:787f–788a
iii. Islāmic philosophies of history		**16**:204a–b	**9**:148e–149a/ **9**:1013e–1025a *passim*/ **11**:1020e–f/**15**:600g–601a
iv. Jewish philosophies of history		**10**:284d–285b/ **11**:1018a–h/ **16**:203e–g	**2**:929c–d/ **10**:191e–193h *passim*/ **10**:208b–216h *passim*/ **10**:292b–f

	articles	article sections	other references
v. Philosophy of history in the Enlightenment: secular approaches		**8**:962c–963b/ **1**:976h–977a/ **4**:657c–f/ **6**:893h–894e	**4**:1081d–g/**8**:800a–f/ **11**:1019g–1020a/ **14**:690a–691e *passim*/ **15**:788a–d/ **19**:104g–105c
vi. Philosophy of history in the 19th century		**8**:963c–h/ **4**:657f–659e/ **11**:554a–557h/ **15**:661b–662a/ **15**:788d–789a	**1**:970h–971d/**3**:484c–g/ **14**:691e–693e *passim*
vii. Philosophy of history in the 20th century		**8**:963h–964b/ **1**:971f–972f/ **4**:659e–660e/ **11**:557h–560e/ **15**:662b–f	**7**:78d–g/ **14**:693f–695h *passim*
c. Oriental philosophies of history		**6**:960g–961b/ **16**:203b–e	**3**:425g–h/**11**:445c–446e/ **15**:599e–600f
i. Chinese philosophies of history		**17**:1035b–1036e/ **17**:1051e–1052e	**4**:410e–414h *passim*
ii. Japanese philosophies of history			**10**:104h–105a
iii. Indian philosophies of history		**8**:889f–h	**9**:333f
3. Critical or analytical philosophy of history: the analysis of history as a discipline		**8**:964b–965g	
a. The concept of history: the distinction between history and other forms of knowledge		**8**:964b–d	
b. The problems of historical explanation and interpretation		**8**:964d–965b	**14**:729a–c
c. Truth and fact in history: the problem of historical objectivity and accuracy		**8**:965b–e	

Section 10/42. The humanities and humanistic scholarship

[for Part Ten headnote see page 694
for Division IV headnote see page 753]

The articles and parts of articles referred to in Section 10/42 deal with two main subjects: A, the history of humanistic scholarship; and B, the nature and scope of the humanities.

The outline of subject A begins with the Greek ideal of *paideia,* treating its development from the Homeric tradition, through the teachings of the Sophists and of Socrates, to the Platonic Academy, with its emphasis on mathematics, and to Aristotle and the Lyceum, with its invention of logic and its emphasis on the organization of the sciences. It goes on to treat Hellenistic scholarship and the Roman ideal of *humanitas,* focussed by a conception of the training of the orator.

Dealing with Christian learning in antiquity and in the Middle Ages, the outline goes on to treat the ways in which pagan culture was Christianized. It covers the codification of the seven liberal arts; the founding of the universities; the Scholastic methods used in various kinds of theological exposition; and the distinction of philosophy from sacred theology.

Dealing with the development of humane letters from the Renaissance to the present, the outline begins with the changes in scholarship and in education brought about by the ideals of the Renaissance, by the idea of Humanism, and by the search for a universal method for the pursuit of all truth. It goes on to deal with such developments as the consequences, for the organization of learning, of the separation of the empirical sciences from philosophy; the rise and development of the liberal arts college and the graduate school; the proliferation of special disciplines; the conflict between the humanities and the sciences; and the organization of the contemporary university.

Finally, the outline of subject A treats the Jewish tradition of humanistic scholarship; the Islāmic tradition; and the humanities and humanistic scholarship in India, China, and Japan.

The outline of subject B, the humanities, first deals with diverse views about the criteria, in regard to content, method, and purpose, that are used to identify language and literature, the fine arts, history, philosophy, and religion as components of the group called the humanities. It goes on to questions about the humanities as an educational program, issues about whether they lend themselves to unified presentation and study. It next deals with theories that assert and theories that deny a radical difference between the humanities and the sciences. Finally, it treats diverse methods of and approaches to humanistic education, and the humanities in the context of a conflict of cultural ideals—for example, the ancient conflict between philosophy and poetry, or the modern one between science and the humanities.

	articles	article sections	other references
A. History of humanistic scholarship	HUMANISTIC SCHOLARSHIP, HISTORY OF	**8**:1170–1179	

	articles	article sections	other references
1. The beginnings of learning: the ideal of *paideia*		**8**:1170g–1173c/ **8**:372e–373e/ **10**:856g–857e/ **10**:1038b–e/ **14**:250e–256h	**6**:317h–318c/**6**:793f–h/ **8**:1180a/ **14**:384d–385e *passim*
a. Homeric education: the ideal of the hero		**8**:1170h–1171f/ **6**:322f–323h/ **8**:822c–f	**8**:1017g–1018c
b. The Sophists and Socrates: the turn to *logos;* the beginnings of rhetoric		**8**:1171f–h/ **14**:252f–253e/ **17**:11b–13h	**6**:323h–324b/**12**:863e–f/ **15**:800c–d/**16**:1003h–1005a
c. Plato and the Academy: the relation of theology to mythology; mathematics in the service of philosophy		**8**:1172a/ **6**:409g–410a/ **12**:23d–h/ **14**:253f–254d/ **14**:685g–686d	**6**:324b–f/**6**:931e–h/ **6**:937g–938c/**10**:716a–c/ **12**:10h–11b/**12**:863g–h/ **14**:532a–538d *passim*/ **14**:539e–540c/**16**:377d–f/ **18**:274b–c
d. Aristotle and the Lyceum: the invention of logic; the division and organization of the sciences		**8**:1172b/ **1**:1155f–1156g/ **10**:23h–24c/ **14**:254d–255d/ **14**:686d–687b	**1**:1163h–1164a/**6**:324f–h/ **6**:932a–e/**6**:938c–g/ **11**:57g–59c *passim*/**12**:10f–h/ **12**:863h–864a/**14**:538d–f/ **15**:800d–f/**16**:366h–367b/ **16**:377f–h
e. Hellenistic scholarship: the development of literary and textual criticism; Alexandria and Pergamum as cultural centres		**8**:1172b–g/ **14**:255d–256h/ **14**:540d–542e	**1**:1156g–1157b/**3**:1084e–f/ **6**:324h–325a/**8**:388f–h/ **10**:1094a–g/**16**:367b–e/ **18**:192g–h
f. The Roman ideal of *humanitas:* the training of the orator		**8**:1172g–1173c/ **6**:326h–328h/ **14**:687b–d	**10**:1098b–c/**10**:1098h–1099a/ **11**:174a–g/**15**:800g–801b/ **17**:13h–14b
g. The conflict of cultural ideals: the battle among rhetoric, philosophy, and science		**16**:366d–367e	**3**:1084c–e/**16**:377h–378a
2. Christian learning in antiquity and the Middle Ages		**8**:1173c–1175f/ **3**:1085g–1086b/ **6**:333f–339d/ **10**:857e–858a/ **10**:1100a–1101e/ **14**:256h–261d/ **14**:385f–386a/ **16**:367f–h	**1**:486d–f/**4**:45g–46c/ **4**:514b–516d *passim*/ **6**:793h–794g/**11**:933h–934b/ **12**:161f–164a *passim*/ **15**:645a–d/**16**:980g–981d
a. The Christianization of pagan culture: the reconciliation of classical humanism with Christian revelation		**8**:1173e–1174a/ **2**:947c–948a/ **4**:467h–469h/ **6**:328h–329e/ **8**:947h–948h/ **10**:1038f–g/ **14**:542g–544d/ **14**:687d–h/ **15**:801b–c	**1**:657c–658a/ **2**:364f–368b *passim*/ **2**:1180c–1181e *passim*/ **3**:554f–555g *passim*/ **4**:558b–f/**4**:710e–711g/ **6**:887d–e/**14**:257b–258a/ **15**:615e–f/ **15**:1130h–1131e *passim*
b. The codification of the liberal arts: the trivium and the quadrivium		**8**:1175d–e	**6**:336c–g
c. The founding of the universities		**8**:1175b–d/ **6**:336g–338h	**4**:515e–g
d. The Scholastic method: logic and the genres of theological exposition		**8**:1175d–e/ **6**:410a–c/ **6**:932f–933e/ **12**:864b–f/ **14**:688b–d/ **16**:352g–357a	**1**:10c–11c *passim*/**1**:937f–h/ **5**:1083c–1084e/ **10**:716h–717a/ **11**:60f–62e *passim*/ **13**:504h–505g *passim*/ **14**:258d–260d/ **15**:1004g–1005a/**15**:1006d–f/ **18**:346b–348b
e. Faith and reason: the distinction of philosophy from sacred theology		**6**:939a–e/ **12**:24d–g/ **15**:615b–h/ **15**:786c–e	**4**:558g–h/**14**:260b–261a

	articles	article sections	other references
3. The development of humane letters from the Renaissance to the present		**8**:1175f–1178h/ **3**:1086b–f/ **6**:794h–797f/ **6**:887f–888e/ **10**:858a–860e/ **10**:1038g–1041d/ **12**:24h–26c/ **12**:864g–865g/ **14**:261d–274c/ **15**:615h–617b/ **15**:623a–f/ **15**:801c–802g	**1**:1159h–1161b *passim*/ **5**:714d–717f *passim*/ **6**:343c–356a *passim*/ **6**:371g–376e *passim*/ **6**:933e–937e *passim*/ **6**:939e–943h *passim*/ **6**:1066d–1081c *passim*/ **8**:1180b–c/**13**:77f–78g/ **14**:688f–695h *passim*/ **15**:598g–599e/**15**:645d–f/ **16**:256f–257e *passim*
a. The idea of Renaissance: the ideal of the classical; the rise of the vernacular; the concept of the dignity of the free individual		**8**:1175f–1176f/ **10**:1038g–1039a/ **14**:261f–262d/ **15**:660e–662f/ **15**:666d–667a/ **15**:669e–h/ **19**:379b–380b	**1**:427e–429d *passim*/ **5**:482b–485f *passim*/ **10**:1130g–1131b/**14**:544f–h/ **19**:397c–g
b. Humanism and the new learning		**8**:1176d–h/ **3**:656g–657g/ **6**:343c–345h/ **10**:1131d–h/ **15**:663h–665c/ **15**:668e–669a	**6**:952a–954a/**10**:858a–d/ **11**:141d–f/ **12**:437h–440c *passim*/ **13**:66e–67d *passim*/ **14**:161c–163d *passim*/ **14**:262d–263a/**18**:193a–b/ **19**:19c–20c *passim*
c. The search for a universal method		**8**:962c–f	**14**:263a–g/ **15**:1171d–1173d *passim*/ **17**:509c–511c
d. The separation of science from philosophy: the rise and development of empirical science		**8**:1176h–1177d/ **6**:348g–h/ **6**:888a–e/ **6**:939e–942a/ **14**:263h–265h/ **15**:669h–670h/ **16**:368h–374h/ **16**:378c–380f	**2**:563h–566a/ **10**:786c–788c *passim*/ **14**:386b–391b *passim*/ **16**:983h–984a/**18**:35d–g
e. The quarrel between ancients and moderns: the problem of progress in learning		**10**:1170c–1171h/ **14**:266d–269c	**6**:888f–894g *passim*
f. The growth of modern humanistic scholarship: the transition from the ideal of belles lettres to the scientific investigation of antiquity through archaeology and philology		**8**:1177c–1178h	
g. The rise and development of the liberal arts college and the graduate school [see 562.B.]			
h. The growth and proliferation of special disciplines: the knowledge explosion			**14**:271h–272a/**16**:988a–b
i. The development of the conflict between the humanities and the sciences		**1**:975e–g/ **4**:558h–560a/ **8**:962g–963b/ **8**:1182g–1183a	**5**:804d–g/**6**:363g–364a/ **16**:378c–380f *passim*
j. The organization of the contemporary university: questions of its social responsibility; the profession of learning [see 563.A.3.]			
4. The Jewish tradition of humanistic scholarship: its nature, methods, and development; its relation to classical and Christian learning		**6**:322b–f/ **14**:542f–g/ **17**:1006a–1008b	**1**:1158c–e/**8**:873c–e/ **9**:146f–h/ **10**:208b–216h *passim*/ **14**:246a–247c/**15**:644b–g/ **16**:111f–h
5. The Islāmic tradition of humanistic scholarship: its nature, methods, and development; its relation to classical and Christian learning		**3**:644b–g/ **6**:332a–333e/ **6**:798e–h/ **14**:544d–e/ **16**:368a–c	**1**:1158a–c/ **2**:143c–144c *passim*/ **2**:540d–541d *passim*/ **8**:145f–146c *passim*/ **9**:961c–g/ **9**:1012a–1025g *passim*/ **11**:992c–e/**15**:600g–601a/ **15**:645g–646b
6. The humanities and humanistic scholarship in the East		**6**:339d–343c/ **16**:368c–g	**15**:599e–600f

	articles	article sections	other references
a. In India		**6**:319b–320d/ **6**:339d–340c/ **9**:313h–316d	**15**:599e–f/**15**:600b–f/ **15**:642d–643b
b. In China		**4**:1091g–1099c/ **6**:320d–322b/ **6**:340c–342b/ **6**:797g–798c	**4**:1099f–1103g *passim*/ **4**:1104a–1107h *passim*/ **4**:1108c–1109g *passim*/ **6**:318c–e/**8**:1127g–1128d/ **15**:223f–g/**15**:599h–600a/ **15**:643b–g/ **17**:1044g–1050f *passim*
c. In Japan		**6**:342c–343c	**10**:75h–76f/ **10**:101a–109b *passim*/ **15**:600a–b/**15**:643g–644a
B. The humanities	HUMANITIES **8**:1179–1183	**8**:1170a–g	
1. Diverse views of the definition and scope of the humanities		**8**:1179f–h	**8**:1170c–g/**15**:664d–g/ **16**:980d–e
a. The study of language and literature as humanities		**8**:1182d–e/ **7**:461d–f	**10**:1037b–1041d *passim*/ **15**:664c–d/ **15**:800b–802d *passim*
b. The role and place of the study of the fine arts among the humanities		**2**:93e–95b	
c. The role of history in the humanities		**6**:893h–894e	**8**:957b–e/ **8**:961f–965g *passim*
d. Philosophy as a humanistic discipline		**4**:555b–556g/ **6**:925b–926g/ **6**:979f–980c	**14**:248a–249b/**14**:261d–g/ **14**:262d–263a
e. The study of religion as a humanistic discipline		**14**:1040d–1041f/ **15**:629h–631d	**15**:603c–e/ **15**:613b–627g *passim*/ **18**:274a–276b *passim*
2. The humanities as an educational program: the question of the humanities as a unified field of study		**8**:1180a–d/ **4**:560b–h/ **8**:1178h–1179b	**6**:411g–412c/**14**:249a–b
3. Theories of the humanities as a fundamental division of knowledge: the question of the distinction of the humanities from the sciences		**8**:1180d–1182b/ **1**:977a–b/ **14**:391c–e/ **16**:374h–375e/ **16**:380g–382b/ **16**:391f–393a/ **18**:274d–h	**2**:843f–844d/ **8**:964b–965g *passim*/ **10**:1010b–1012h *passim*/ **14**:248g–249b/ **14**:879a–882h *passim*/ **16**:988c–d
a. Theories denying a radical difference between the humanities and the sciences; *e.g.*, the general methods theory, the language analysis theory		**8**:1181a–e	
b. Theories asserting a radical difference between the humanities and the sciences; *e.g.*, the imaginative arts theory, the substantive logic theory		**8**:1181e–1182b	
4. Problems about the humanities		**8**:1182b–1183a	
a. Questions of the role and function of the humanities in education: diverse methods of and approaches to humanistic education		**8**:1182b–g	**6**:343c–345h *passim*/ **6**:373c–e/ **8**:957e–960g *passim*/ **10**:107e–f/ **10**:856e–860e *passim*/ **15**:664d–g/ **15**:800b–802d *passim*
b. The humanities and the conflict of cultural ideals: the struggle between conflicting opinions about the proper approach to knowledge; *e.g.*, the ancient conflict between philosophy and poetry, the modern conflict between the humanities and the sciences		**8**:1182g–1183a/ **1**:975e–g/ **2**:99f–g/ **16**:375e–f/ **16**:391f–393a	**10**:1040e–1041d/ **14**:248g–249b/**16**:988a–d/ **18**:21e–23a *passim*

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ALBERTI, LEON BATTISTA **1**:427
ARISTOTLE **1**:1162
BRUNO, GIORDANO **3**:345
BURCKHARDT, JACOB **3**:484
CARLYLE, THOMAS **3**:923
CONDORCET, MARQUIS DE **4**:1080
CROCE, BENEDETTO **5**:285
ERASMUS, DESIDERIUS **6**:951
FA-HSIEN **7**:142
GIBBON, EDWARD **8**:153
GREGORY OF TOURS, SAINT **8**:422
GUICCIARDINI, FRANCESCO **8**:465
HAKLUYT, RICHARD **8**:553
HERDER, JOHANN GOTTFRIED VON **8**:799
HERODOTUS **8**:820
IBN KHALDŪN **9**:147
IDRĪSĪ, AL **9**:198
JOSEPHUS, FLAVIUS **10**:277
LEONARDO DA VINCI **10**:809

LIVY 11:3
LOMONOSOV, MIKHAIL VASILYEVICH 11:88
MACAULAY, THOMAS BABINGTON 11:223
MACKINDER, SIR HALFORD JOHN 11:267
MAS'ŪDĪ, AL- 11:610
MERCATOR, GERARDUS 11:914
MICHELET, JULES 12:102
MOMMSEN, THEODOR 12:333
OU-YANG HSIU 13:796
PAN KU 13:947
PARKMAN, FRANCIS 13:1019
PETRARCH 14:161
PETRIE, SIR FLINDERS 14:164
PLATO 14:531
POLYBIUS 14:762
PRESCOTT, WILLIAM HICKLING 14:992
RANKE, LEOPOLD VON 15:506
SALLUST 16:184
SCHLIEMANN, HEINRICH 16:348
SSU-MA CH'IEN 17:525
STRABO 17:713
TACITUS, CORNELIUS 17:982
TAINE, HIPPOLYTE 17:992
THUCYDIDES 18:359
VALLA, LORENZO 19:19
VESPUCCI, AMERIGO 19:97
VICO, GIAMBATTISTA 19:103
WANG AN-SHIH 19:536
WEBSTER, NOAH 19:720
WINCKELMANN, JOHANN 19:840
XENOPHON 19:1056

Division V. Philosophy

[for Part Ten headnote see page 694]

The outlines, and the articles and parts of articles referred to, in the three sections of Division V treat the nature and the divisions of philosophy; the history of philosophy; and philosophical schools and doctrines.

Section 10/51 first deals with theories about philosophy as a whole—theories about its nature, scope, methods, forms of exposition, and about the criteria of meaning and truth in philosophical thought. It then treats the traditional component disciplines of philosophy—metaphysics, the philosophy of nature, epistemology, the philosophy of mind, the philosophy of man, ethics, political philosophy, and aesthetics. In the case of each of these eight disciplines, the outline and the articles referred to treat its historical development; its nature and scope; its relations to other branches of philosophy and other intellectual disciplines; and its principal problems. At the end, the outline of this section indicates other sections that treat disciplines involving philosophical studies of other subjects—language, logic, mathematics, art, science, religion, law, education, and history.

The articles referred to in Section 10/51 treat the historical development of each of the eight component disciplines. The articles referred to in Section 10/53 treat historical matters from a different perspective—the perspective of philosophical schools, movements, and major doctrines. The outline and the articles referred to in Section 10/52 present a synoptic history of philosophy, taken generally. The outline treats problems involved in the writing of the history of philosophy, the history of Western philosophy, the history of non-Western philosophies, and philosophies associated with religions.

The articles first referred to in Section 10/53 separately treat twenty-five major philosophical schools in the West. The section then deals with doctrinal differences between these schools on major philosophical issues, treating differences in theories about Being and existence; about thought, knowledge, and the faculties of the mind; and about human conduct.

Section 10/51. The nature and the divisions of philosophy 760
10/52. History of philosophy 767
10/53. Philosophical schools and doctrines 772

Section 10/51. The nature and the divisions of philosophy

[for Part Ten headnote see page 694]

The articles and parts of articles referred to in Section 10/51 deal with two main subjects: A, the nature, scope, and methods of philosophy; and B, the divisions of philosophy.

The outline of subject A begins with diverse conceptions of philosophy—as a way of life; as speculative knowledge, an autonomous discipline with its own distinctive subject matter and methods; as identical with logical and linguistic analysis; and as a humanistic discipline. It goes on to diverse views of the methods of philosophy, arising from different judgments about the roles in relation to philosophy of experience and common sense, of first principles and rational argumentation, of intuition, insight, and special experience; and arising from different judgments about the possibility of constructing unified, comprehensive philosophical systems. The outline next treats the several different forms of exposition that have appeared in the history of philosophy. Finally, it deals with controversies about the criteria of

meaning and truth in philosophical thought. Here, it first treats judgments about the empirical verifiability of philosophical theories; about rational criteria of validity, requiring certain intrinsic qualities in the structure of philosophical thought and exposition; and about Phenomenological and Existential criteria. At the end it treats different ways in which philosophical doctrines and methods have been subject to dismissal or radical criticism.

Subject B is the divisions of philosophy. The articles referred to deal separately with metaphysics; the philosophy of nature; epistemology, or the theory of knowledge; the philosophy of mind, or philosophical psychology; the philosophy of man, or philosophical anthropology; ethics, or moral philosophy; political philosophy; and aesthetics.

In the case of each of these eight divisions of philosophy, the outline first deals with the history of the particular discipline, thereby supplementing the synoptic treatment of the history of philosophy in Section 10/52; the historical dimension of articles on philosophical schools and doctrines is referred to in Section 10/53. In the case of each of the eight disciplines, the outline treats its nature and scope, and its relations to other parts of philosophy and, in some cases, to disciplines outside of philosophy. In each case, the outline then goes on to the problems and issues special to the particular division of philosophy.

Thus, the outline of metaphysics deals with such traditional problems in the province of metaphysics as the problem of the one and the many; being and becoming; appearance and reality; the nature and kinds of causality; and the nature of metaphysical arguments and assertions. The outline of the philosophy of nature begins with the basic aspects of the natural order, going on to the philosophy of physics, and finally treating the philosophy of biology. The outline of epistemology covers such topics as the nature and kinds of knowledge, the nature of the concept, and the problem of the universal. Dealing with the philosophy of mind, or philosophical psychology, the outline treats such matters as the nature of the mind and of mental acts, the problem of personal identity through time, and the problem of the status of our knowledge of other minds.

Dealing next with the philosophy of man, or philosophical anthropology, the outline of subject B treats the physical and biological basis of man's existence in the universe, man in relation to culture, the concept of the individual person, and the question of the relation of man to God. Turning next to ethics, or moral philosophy, the outline treats moral precepts and judgments, obligations, happiness, virtue, and the natural moral law and natural rights. The outline of political philosophy treats such topics as the classification of different types of government; the source of political authority; the idea of natural law, and analyses of the structures of political power. The last division of philosophy treated on subject B is aesthetics. Here the outline deals with different approaches to the study of the aesthetic experience, and the nature of aesthetic statements and judgments.

At the end, the outline indicates other sections that treat disciplines involving philosophical studies of language, logic, mathematics, art, science, religion, law, education, and history.

articles	article sections	other references
A. The nature, scope, and methods of philosophy [for the major philosophical schools in the West, see 10/53; for the development of non-Western philosophy, see 10/52.C.]	**14**:248a–249b	
1. Diverse conceptions of philosophy		
a. The conception of philosophy as a way of life	**14**:255e–256c/ **15**:323c–e/ **17**:698c–g	**3**:425c–g/**6**:326c–e/**6**:912a–e/ **14**:533h–534c/**14**:541f–g
b. The conception of philosophy as speculative knowledge: an autonomous discipline with its own distinctive subject matter and methods	**8**:732h–733b/ **12**:11b–14b/ **14**:210f–211c	**5**:804d–g/**9**:190d–e/ **14**:250e–g/**16**:355b–e
c. The conception of philosophy as identical with logical and linguistic analysis, having the therapeutic function of eliminating pseudo-problems, category mistakes, and confusions	**12**:14f–15d	**1**:800g–801e/**9**:323h–324c/ **14**:272g–273a/**14**:879e–h/ **14**:882b–d
d. The conception of philosophy as a humanistic discipline: its relation to, and distinction from, poetry and other forms of literature or humanistic discourse	**7**:73a–h/ **10**:1080g–1082d	**8**:1170a–1179b *passim*/ **9**:1023h–1024b/**10**:1040g–h
2. Diverse views of the methods of philosophy		**1**:800d–f/**12**:224c–e
a. The relation of philosophy to experience and common sense	**6**:769g–770e/ **11**:611a–612a/ **12**:27d–h/ **16**:383g–387h	**1**:802h–803c/**6**:911e–h/ **14**:877a–b/**14**:940d–e/ **17**:12h–13c/**19**:1d–f
b. Conceptions of the role of reason in philosophical thought	**15**:527g–h	**2**:350g–351a
i. Positions about first principles, axioms, and a priori truths	**6**:930g–931c/ **11**:658f–659c/ **12**:26d–27c	**14**:881e–882a/**16**:382g–h/ **16**:384f–385f
ii. Demonstration in philosophy; the types of argument in philosophy	**6**:526b–527c/ **8**:732h–733b/ **12**:29a–30a/ **15**:803c–e/ **17**:895a–896b/ **17**:898b–d	**15**:799b–c
c. The role in philosophy of intuition, insight, and special experience	**1**:156h–157h/ **6**:936h–937e/ **7**:75b–e/ **9**:1022f–h/ **12**:27h–28b/ **15**:786c–e	**4**:556c–f/ **6**:980d–983a *passim*/ **9**:191a–c/**12**:23d–g/ **12**:787a–g/ **14**:256h–261d *passim*
d. The construction of philosophical systems		**9**:190d–e/**9**:313h–314a/ **14**:259g–260b/**17**:509e–f

	articles	article sections	other references
3. The forms of philosophical exposition; *e.g.*, dialogues, commentaries, histories, systematically ordered treatises		**9**:314d–e/ **14**:249c–250a/ **14**:269b–c	**7**:136f–h/**10**:1080g–1081h/ **10**:1093d–f/**14**:265h–266a/ **14**:532g–533g
4. Criteria of meaning and truth in philosophical thought		**6**:928e–929h/ **16**:387h–388f/ **16**:507f–510c	
a. The empirical verifiability or falsifiability of philosophical theories or hypotheses		**1**:800d–802d	**6**:767d–g/**14**:879h–880f/ **14**:940e–941a/**16**:387h–388c
b. Rational criteria of validity in philosophical thought; *e.g.*, coherence, consistency, comprehensiveness		**12**:28b–g/ **15**:527h–528g	**9**:189h–190a/**17**:509e–f
c. Phenomenological and Existential criteria		**12**:28h–29a/ **14**:210f–211c	**7**:73b–c
d. Dismissals or criticisms of philosophical doctrines or methods		**12**:30a–33b	**9**:193c–e/**17**:12h–13c
i. As consisting of meaningless and untestable opinions or worthless abstractions		**12**:30b–31f/ **14**:252f–253a/ **16**:830b–f	**1**:802d–f/**1**:804f–g
ii. As a primitive state of knowledge, now replaced by science			**14**:248g–h/**14**:877d–f
iii. As concerned with pseudo-problems or puzzles of linguistic origin		**12**:31f–32h/ **17**:11g–12f	**1**:800a–c/**6**:767h–768d/ **14**:879c–f
iv. As distorting our apprehension: as irrelevant to life or ignoring its deeper resources		**10**:398c–f/ **12**:32h–33b	**4**:557h–558a/**4**:561b–e/ **9**:1025b–g/**11**:554a–b/ **17**:1037g–h
B. The divisions of philosophy			
1. Metaphysics, or speculative philosophy in general	METAPHYSICS **12**:10–35		
a. The history, nature, and scope of metaphysics		**12**:10f–14b/ **14**:250e–252a	**14**:254a–d/**14**:272b–d
i. The view of metaphysics as an inquiry into what exists		**12**:11c–g	
ii. The view of metaphysics as the science of ultimate reality		**12**:11g–12f	
iii. The view of metaphysics as the science of the world as a whole		**12**:12g–13d/ **12**:875b–c	**10**:392b–g
iv. The view of metaphysics as the science of first principles [for schools of thought in metaphysics, see 10/53.B.1.]		**12**:13d–14b	**1**:1169a–h/**10**:391b–e
b. The relation of metaphysics to other parts of philosophy; *e.g.*, ethics, logic, natural theology		**12**:14c–f/ **11**:75b–g	**4**:560b–e/**6**:979a–c/ **18**:267b–c/**18**:274g–h
c. Problems in metaphysics		**12**:15e–23c	
i. One and many: monism and pluralism; doctrines of forms, categories, and particulars; the status and naming of particulars		**12**:15e–17f/ **5**:1066a–e/ **5**:1069d–e/ **6**:525h–527c/ **9**:1023b–h/ **14**:250e–252a/ **14**:540d–g/ **15**:323e–h/ **17**:1038c–e	**2**:346h–347g/**2**:565a–e/ **6**:931c–932e/**9**:326h–327b/ **9**:1020d–e
ii. The existence and nature of God		**12**:17g–18f/ **1**:312c–313d/ **1**:976a–d/ **4**:560b–h/ **5**:242b–243d/ **5**:928e–h/ **9**:328g–333a/ **15**:601b–602b/ **15**:649e–h/ **18**:265g–267f	**2**:260g–261c/**4**:1095b–c/ **4**:1096c–e/**9**:328b–d/ **9**:1017g–h/**10**:105g–h/ **10**:208b–216h *passim*/ **13**:949b–d/**14**:257g–258a/ **14**:541g–542a/ **16**:353h–354e/**17**:510a–d
iii. Being and becoming: appearance and reality		**12**:20d–21a/ **4**:416f–417b/ **4**:418h–420e/ **15**:323e–h	**3**:382a–c/**7**:75f–76c/ **9**:1024b–1025a/**10**:102d–h/ **12**:225g–226b/ **17**:1036h–1037b

	articles	article sections	other references
iv. The organizing principles of nature; *e.g.*, the nature and kinds of causality; the concepts of time and space		**12**:21a–22d/ **9**:322f–323a	**3**:425g–h/**9**:322b–c/ **14**:878c–879a/**14**:880f–881a/ **15**:531d–f/**16**:390c–e/ **18**:410d–420g *passim*
v. Matter and spirit		**12**:18f–20c/ **12**:22d–23c/ **11**:300e–h/ **11**:613h–614c	**3**:382d–f/**3**:426c–430f/ **3**:968g–969c/**14**:541a–b/ **18**:347f–348a
vi. The nature of metaphysical arguments and assertions: the nature of metaphysical claims; their method of validation; criticisms of metaphysics		**12**:14f–15d/ **12**:26d–33b/ **10**:395f–396c	**1**:804f–g
2. The philosophy of nature: the philosophical problems concerning the phenomena, laws, and theories of the natural sciences	NATURE, PHILOSOPHY OF **12**:865–876		
a. The history, status, and scope of the philosophy of nature		**12**:865h–867b/ **12**:872d–873c/ **14**:250e–252a	**1**:1167g–1168g/**2**:564h–565f/ **14**:259b–c/**14**:262d–263a/ **14**:384c–391f *passim*/ **14**:537f–g/ **16**:366a–375f *passim*/ **16**:377c–382b *passim*/ **17**:855c–e
b. The relation of the philosophy of nature to science, the philosophy of science, and metaphysics		**16**:376b–377b/ **16**:386g–389f	**14**:880f–881a
c. The basic aspects of the natural order		**12**:867c–869e/ **12**:21a–22d	**14**:878g–h
i. Theories of time: diverse approaches to the experience, observation, and measurement of time	TIME **18**:410–420	**18**:421d–g	
ii. Theories of space: the contribution of Cartesian analytic geometry; the possible curvature of space		**12**:867c–868b/ **11**:660e–661e/ **15**:585c–g	**3**:969d–f
iii. Theories concerning the constituents of the physical world: symmetries, fields, matter, and action		**12**:868b–869a/ **5**:33a–h	
iv. Theories concerning the modalities of the natural order: the effect of diverse theories of matter on the understanding of causal interaction		**12**:869b–c	
d. The philosophy of physics		**12**:869e–872d/ **2**:351a–g/ **18**:417f–420a	
i. Formal theories concerning the mathematical nature of reality; *e.g.*, topological properties of space, the four-dimensional space–time manifold		**12**:869e–h/ **5**:33h–34c/ **15**:586e–587a/ **16**:389g–390e	**15**:584d–e
ii. Theories of quantum physics: elementary particles; the uncertainty principle; charge–parity–time symmetry		**12**:869h–870g/ **5**:37a–d/ **13**:1023b–g/ **14**:427c–f	**14**:426f–g/**15**:531f–g/ **16**:390f–h
iii. Theories of macrophysical substance aggregates: motion, inertia, and statistical mechanics; entropy		**12**:870h–871g/ **6**:854a–b	**14**:425a–c
iv. Theories of the universe as a whole: models, principles, and limits		**12**:871g–872d/ **2**:253e–g/ **4**:121h–122d/ **11**:705c–f/ **14**:250e–252a/ **15**:588b–h/ **18**:1007a–1008d/ **18**:1015f–1018a	**4**:1105c–f/**9**:320d–f/ **19**:817e–f
e. The philosophy of biology		**12**:872d–876g	
i. Theories concerning the origin and nature of life: vitalism, mechanism, and organicism		**12**:873c–874a/ **2**:1026c–1027a/ **3**:968f–969g/ **10**:894g–895b	**11**:612e–g/**16**:381f–h
ii. Theories concerning the understanding of organisms: holistic concepts; general systems theory		**12**:874a–d	

	articles	article sections	other references
iii. Problems related to theories of evolution: determinism and unpredictability; the definition of species; viewpoints concerning the nature of evolutionary change; evolution as a world view		**12**:874d–875c/ **5**:643a–d/ **5**:650d–f/ **7**:7e–8f/ **10**:900a–f	**6**:1072a–d/**7**:14b–g
iv. The implications of various biological theories for man's understanding of himself; problems related to man's self-consciousness, freedom, and values; moral issues connected with man's relationship to the biosphere		**12**:875c–876g/ **1**:977c–980c/ **2**:1027a–c/ **6**:1026d–g/ **8**:818f–819e/ **12**:232d–233a/ **18**:420a–g	**7**:21d–f/**14**:878e–f/**16**:375a–c
3. Epistemology, or theory of knowledge	EPISTEMOLOGY **6**:925–947		
a. The history, nature, and scope of epistemology [for schools of thought in epistemology, see 10/53.C.]		**6**:925g–h/ **14**:252a–c/ **14**:263h–265h/ **14**:266f–267e/ **14**:268f–269b/ **14**:272g–274b/ **16**:830f–833f	**14**:536h–537b
b. The relation of epistemology to metaphysics, philosophy of mind, logic, and other disciplines		**6**:925h–926g	**6**:979d–f/**14**:38g–h
c. Problems in epistemology		**6**:926g–947g	
i. The nature of knowledge; the kinds of knowledge and the degrees of certitude		**6**:926g–927a/ **6**:928e–929h/ **10**:395f–396g/ **15**:531g–532c/ **15**:785g–786b/ **16**:833f–834b	**2**:564h–565h/**4**:561b–e/ **9**:320f–h/**9**:325b–d/ **9**:328d–e/**12**:231f–g/ **14**:878a–f
ii. The validity and reliability of sense perception		**6**:927b–928e/ **12**:20d–21a/ **15**:541e–542c	**1**:802h–803c/**9**:324c–e/ **12**:226g–227a/**14**:266g–267e/ **14**:879h–880f/**16**:391a–b/ **17**:12h–13c
iii. Problems in the study of mental activity: the relation of thinking to language; the nature of the concept		**6**:929h–931c/ **6**:943h–945e/ **9**:325d–328a/ **16**:507f–510c	**1**:800a–c/**1**:803c–805f *passim*/ **3**:382a–c/**6**:767d–768d/ **10**:643h–644d/**14**:879e–h/ **14**:941e–h/**15**:528b–c/ **17**:378g–h
iv. The problem of the universal: the diverse positions concerning the referents of common nouns and general concepts		**6**:945e–946b/ **4**:693g–694b/ **6**:769g–770e/ **12**:15e–17f/ **15**:541b–c	**9**:325a–b/**15**:528d–e
4. The philosophy of mind, or philosophical psychology	MIND, PHILOSOPHY OF **12**:224–233		
a. The history, nature, and scope of the philosophy of mind		**12**:224a–c/ **15**:152b–154c	**1**:1168g–h/ **2**:564a–565h *passim*/ **14**:266g–267e/ **16**:381h–382b/**17**:510d–h
b. The relation of the philosophy of mind to the empirical and mathematical sciences and to other philosophical disciplines		**12**:224c–e/ **6**:926a–d	
c. Problems in the philosophy of mind		**12**:224e–233c	
i. The nature of mental acts: the role of purposeful behaviour, intentionality, and subjective experience in the analysis of mental phenomena		**12**:224e–229c/ **6**:929h–930d/ **6**:943h–944g	**3**:382d–g/**12**:20a–c/ **18**:352b–354e *passim*
ii. The existence and nature of the mind: Materialist and immaterialist views; the mind–body problem		**12**:229d–231e/ **3**:430d–431a/ **10**:9g–10b/ **11**:611g–614d/ **12**:19a–20a	**2**:348b–c/**2**:843f–h/ **3**:376h–377g/**3**:968g–969d/ **6**:911f–h/**9**:318f–h/ **14**:541b–f/**15**:153d–154c/ **15**:158h–159b
iii. The problem of cognition: the nature of knowledge, belief, attention, sense perception, understanding, memory, inferring, and doubting		**12**:231f–g/ **6**:926g–930g/ **6**:946c–947g/ **13**:1004b–g/ **15**:648a–d/ **18**:421d–g	**6**:911f–912a/**9**:320f–h/ **9**:322a–b/**9**:328d–e/ **10**:396e–g/**14**:878a–f/ **15**:528a/**16**:391a–b/ **17**:378g–h

	articles	article sections	other references
iv. The problem of affectivity: the emotional response to what is known		**12**:231h–232a	**1**:150h–157h *passim*/**7**:77b–d
v. The problem of volition: the question of freedom of the will		**12**:232a–d/ **1**:983b–c/ **12**:556h–557g	**7**:76c–f
vi. The problem of personal identity through time: the role of self-knowledge in its analysis		**12**:232d–f/ **18**:410d–411a/ **18**:420a–g	**9**:320c–d/ **9**:328g–332e *passim*/ **3**:375h–376b
vii. The problem of the intelligibility of views of personal immortality [for various religious views concerning immortality, see 811.B.3.b.iv.]		**12**:232g–233a/ **5**:533g–534a/ **12**:18f–h/ **17**:1039b–c	**9**:1020f–g/**14**:535b–d/ **15**:602c–d
viii. The problem of the status of knowledge of other minds		**12**:233a–c	**1**:805f–806b/**14**:881a–d
5. The philosophy of man, or philosophical anthropology	ANTHROPOLOGY, PHILOSOPHICAL **1**:975–985		
a. The history, nature, and scope of philosophical anthropology [for schools of thought in philosophical anthropology, see 10/53.B.3.]		**1**:975h–977b/ **6**:892a–d/ **8**:734f–736c/ **15**:665a–c	**5**:804d–g/**14**:257b–d/ **14**:262d–263a/ **19**:104g–105b
b. The relation of philosophical anthropology to physical and cultural anthropology and to other disciplines in philosophy and the social sciences		**1**:975e–g/ **1**:981d–h	**16**:986h–987c
c. Problems in philosophical anthropology		**1**:977c–985f	
i. Man's status as a natural being: the physical and biological basis of man's existence in the universe; his nature and difference from other entities [for the influence of antecedent conditions and the current environment upon behaviour and consciousness, see 432 and 433; for man's place in the biosphere, see 355]		**1**:977c–980c/ **1**:911h–912c/ **3**:381a–c/ **4**:458f–h/ **9**:875c–876b/ **17**:1039d–1040e	**7**:21d–f/**10**:643h–644d/ **12**:224g–232d *passim*/ **14**:254g–255c/**17**:1035c–d/ **18**:347f–348a
ii. Man as the product of culture and as the creator of culture		**1**:980g–981h/ **1**:574c–575g/ **6**:409f–411f/ **9**:195b–h/ **16**:920b–921d	**2**:135b–f/ **4**:657a–660e *passim*/ **8**:739b–740c/ **8**:1151g–1158h *passim*/ **10**:107b–e/**11**:554d–555a/ **14**:686e–h/ **14**:688f–696b *passim*/ **15**:789a–c/**17**:1037c–e
iii. Man's status as an individual person: the person as a concrete reality, as a subject of values, and as a mystery		**1**:981h–984c/ **3**:426b–427f/ **7**:76g–77h/ **12**:232d–233c/ **14**:116a–117d	**6**:912a–e/ **6**:994d–996h *passim*/ **9**:192b–193a/**11**:554b–d
iv. The question of the relation of man to God: theistic and atheistic philosophical anthropology [for views on the part of the particular religions of the significance of religious beliefs and practices for man, see 811.B.3.]		**1**:984c–985f/ **4**:557d–558b/ **15**:593a–b/ **15**:648e–g	**4**:561e–g/**7**:77h–78c/ **14**:694g–h/**15**:602b–f
6. Ethics, or moral philosophy	ETHICS **6**:976–997		
a. The history, nature, and types of ethics: the distinction between meta-ethics and normative ethics		**6**:977a–978e/ **15**:530a–c	**1**:1169h–1170d/**6**:881c–892a/ **14**:254g–255g *passim*/ **14**:534c–535a/ **16**:1004e–h
b. The relation of ethics to other philosophical disciplines or to other branches of knowledge or experience		**6**:978f–980c	**16**:391f–392b
i. The relation of moral philosophy to metaphysics, logic, and epistemology		**6**:978f–979f	
ii. The relation of moral philosophy to religion and history		**6**:979f–980a	
iii. The relation of moral philosophy to psychology, the social sciences, and law		**6**:980a–c	
c. Problems in ethics		**6**:980d–997e	
i. The logical status of moral precepts and judgments: meta-ethics		**6**:980d–990b/ **6**:997a–e/ **15**:531c–d	**9**:319a–e

	articles	article sections	other references
ii. The nature and sources of obligation and duty		**6**:990h–994d	**10**:396h–397b
iii. The concept of happiness or the good life for man: the order and kinds of goods; the locus and distribution of the goods		**6**:994d–996h/ **19**:1a–2a	**2**:135b–f/**6**:912a–e/**6**:913f–g/ **14**:254g–255c/**14**:255e–g/ **14**:535g–536d/**17**:1036c–e/ **17**:1037h–1038c
iv. The nature and kinds of virtue		**6**:978d–e/ **3**:390d–391c/ **3**:428h–430d/ **4**:416a–f	**1**:1170b–c/ **4**:1092c–1094d *passim*/ **14**:534f–g/**17**:13g–h/ **17**:1037c–d
v. The natural moral law and natural rights		**10**:715d–h/ **12**:876b–g/ **14**:688b–d	**10**:214b–c/**10**:717g–718a/ **10**:719f–721a/ **12**:863e–865g *passim*/ **17**:13c–e
7. Political philosophy	POLITICAL PHILOSOPHY **14**:684–696		
a. The nature and scope of political philosophy: its relation to political science		**14**:684h–685b/ **14**:698h–699e/ **14**:728d–e/ **16**:985b–c	**14**:702d–f/**14**:729e–f
b. The form of political statements and arguments			**10**:1082d–1083c/**14**:705b–e/ **15**:38c–39a/**15**:39h–40e
c. The history of political philosophy		**14**:685e–696b/ **9**:194d–195b/ **10**:846e–h	
i. Developments in antiquity: early analyses of political behaviour; attitudes toward different types of government; views concerning the role of law as a safeguard against tyranny		**14**:685e–687g/ **4**:511b–h/ **9**:352h–353b/ **12**:863e–864b/ **14**:253f–254a/ **16**:856d–h	**1**:1169h–1170d/**9**:318a–b/ **9**:323a–c/**13**:847d–848a/ **15**:787c–f/**17**:1037d–e
ii. Developments in the Middle Ages: views concerning the source of political authority; the idea of natural law		**14**:687g–688f/ **12**:864b–f/ **13**:848a–h	**9**:1019d–f/**15**:787f–h
iii. Developments from the Renaissance through the Enlightenment: attempts to create a scientific and secular political theory; constitutionalism and romanticism in political writings		**14**:688f–691e/ **5**:93h–94h/ **9**:1146d–1147c/ **12**:864g–865d/ **15**:787h–788d/ **17**:309h–311c/ **17**:610c–612b	**6**:892d–893a/**7**:631e–g/ **12**:851g–852c/**13**:849a–c/ **14**:261h–262d/ **14**:267h–268c/ **15**:655c–666d
iv. Developments during the 19th century: the influence of Utilitarianism and liberalism; the effect of new economic and social institutions on political thought; Positivism, Hegelianism, and Marxism		**14**:691e–693e/ **15**:788d–789a/ **17**:612b–613a	**6**:991h–992a/ **11**:553e–557a *passim*/ **19**:2g–h
v. 20th-century analyses of society and its power structures: developments in religious, Existentialist, and Marxist political thought		**14**:693f–695h/ **7**:183h–184c/ **9**:196d–197a/ **9**:781f–782a	**11**:557a–560e *passim*
8. Aesthetics	AESTHETICS **1**:149–162		
a. The nature and scope of aesthetics as a discipline		**1**:149g–150h	
b. The development of aesthetics: approaches to the study of the aesthetic experience		**1**:150h–162b	
i. Naturalistic or scientific approaches		**1**:150h–153e	
ii. Nonscientific approaches: contextualistic, organicistic, formistic, expressionistic, and mystic views		**1**:153e–157h	
iii. Linguistic approaches		**1**:157h–159c	
c. Problems in aesthetics		**1**:162b–g	
i. The nature of the aesthetic experience		**1**:150h–151b/ **1**:153h–154b	
ii. The nature of aesthetic statements and judgments: their meaning, justification, and verification		**1**:157h–159c/ **2**:41e–42g/ **2**:85g–88c/ **10**:1037d–1038b	

	articles	article sections	other references
iii. The psychology of aesthetic creativity		**1**:161d–e/ **2**:47f–49a	
d. The relation of aesthetics to other disciplines			
i. Aesthetics and the general theory of values		**1**:150b–e/ **2**:84e–85a	
ii. The relation of aesthetics to theories of criticism		**1**:154d–g/ **2**:85c–88c/ **10**:1038g–1040c	
iii. The relation of aesthetics and psychology		**1**:152f–153b	
iv. The relation of aesthetics and moral and political philosophy		**1**:153f–154b	
9. The philosophy of language [see 442.A.]			
10. The philosophy of logic [see 10/11.B.]			
11. The philosophy of mathematics [see 10/21.B.]			
12. The philosophy of art [see 611.A.]			
13. The philosophy of science [see 10/31.B.]			
14. The philosophy of religion [see 811]			
15. The philosophy of law [see 551.A.]			
16. The philosophy of education [see 561.A.]			
17. The philosophy of history [see 10/41.C.]			

Section 10/52. History of philosophy

[for Part Ten headnote see page 694
for Division V headnote see page 760]

The articles and parts of articles referred to in Section 10/52 deal with four main subjects: A, problems involved in the writing of the history of philosophy; B, the history of Western philosophy; C, non-Western philosophy; and D, philosophies associated with religion.

Subject A involves considerations concerning the division of the history of philosophy into time periods; conceptions of it as primarily the history of ideas or as the history of the intellectual products of men; and the influence on it of changing social and cultural contexts, and of shifts in the focus and concerns of philosophy.

The outline of subject B, the history of Western philosophy, begins with the philosophy of the ancients, treating the founding achievements of the Pre-Socratics and of Socrates, Plato, and Aristotle, and developments in Hellenistic and Roman philosophy from the time of Alexander the Great to the closing of the philosophical schools in Athens. The treatment of philosophy in the Middle Ages covers the work of philosophers such as Augustine, Boethius, Anselm, and Abelard in the period extending to the 12th century; that of the great Scholastics such as Bonaventure, Albertus Magnus, and Thomas Aquinas; and that of such late medieval philosophers as Duns Scotus, William of Ockham, and Nicholas of Cusa. The outline of subject B turns next to the history of modern philosophy. Beginning with philosophy in the Renaissance, it treats new views of political power, Humanism, and the influence on philosophy of scientific discoveries. Dealing with developments in the early modern period, the outline treats the work of such philosophers as Descartes, Spinoza, and Leibniz. Dealing with philosophy during the Enlightenment, it treats the views of the British Empiricists and the subsequent critical examination of reason by Kant. Going on to the 19th century, the outline covers the resurgence of the metaphysical spirit in the German idealists; the Positivism of Comte, the logic of J.S. Mill, and the dialectical Materialism of Marx and Engels; and the reactions against rationalism of Kierkegaard, Schopenhauer, and Nietzsche. The treatment of philosophy in the 20th century begins with the philosophies of Bergson, Whitehead, and Dewey, and goes on to developments in Marxist thought. It next treats developments in analytical philosophy, the Logical Positivism of the Vienna Circle, the work of such philosophers as Russell, Moore, and Wittgenstein. Finally, the outline of subject B treats the Phenomenology of Husserl and his followers, and the philosophy of human experience presented by Jaspers, Sartre, and other Existentialists.

Subject C is non-Western philosophy. Beginning with Indian philosophy, the outline covers early Indian philosophical thought; the beginning of system building in Indian philosophy; the further developments of systematic thought in India; the schools of Vedānta; the Vaiṣṇava and Śaiva schools; the influence of Islāmic thought and of European philosophy; and recent trends in Indian philosophy. Turning next to Chinese philosophy, the outline covers the classical philosophical schools, such as Confucianism, Taoism, and Yin–Yang; Neo-Taoist and Buddhist thought; Neo-Confucianism and the development of the concept of principle; and 20-century Chinese philosophy, including the influences of Western thought and of Maoism. Finally, the outline of subject C deals with Japanese philosophy. Beginning with early Japanese philosophical thought, it goes on to developments during the Kamakura and Muromachi periods, covering the origins and concerns of the Zen, Jōdo, and Nichiren sects, and the tendencies during these periods in Shintō and Confucian thought; to developments in the Edo (Tokugawa) period, covering Neo-Confucianism, the revival of Shintō, Buddhist thought, and the writings of independent philosophers; and to modern philosophical thought, covering the influence of Western philosophy and the concerns of Nishida Kitarō and other recent philosophers.

Subject D is philosophies associated with religion. The articles referred to separately treat the philosophies associated with the Hindu, Buddhist, Confucian, Taoist, Jewish, Islāmic, and Christian religions.

	articles	article sections	other references
A. The writing of the history of philosophy: decisions about periodization; the history of philosophy conceived of as primarily a history of ideas or as a history of the intellectual products of men; conceived of as expressing the influence of social and cultural contexts; as reflecting shifts in the focus and concerns of philosophy		**4**:415c–h/ **4**:555a–556g/ **9**:313e–g/ **9**:1012a–g/ **14**:249c–250a	**1**:1170f–1171a/**4**:1092a–c/ **10**:100h–101a/**17**:1034f–h
B. History of Western philosophy	PHILOSOPHY, HISTORY OF WESTERN **14**:250–274		
1. Ancient Greek and Roman philosophy		**14**:250e–256h/ **3**:1084c–h/ **5**:93c–f/ **6**:768d–f/ **6**:931c–932f/ **6**:937e–939a/ **10**:715h–716f/ **11**:57c–60e/ **11**:612b–c/ **12**:15e–16d/ **13**:951f–952d/ **15**:152d–g/ **15**:614h–615f/ **15**:800b–801b/ **16**:366d–367e/ **16**:856d–f	**2**:349d–f/**5**:1066g–1067f/ **12**:779g–780b/ **15**:528g–529c
a. The beginnings of philosophy in Greece: the Pre-Socratic philosophers		**14**:250e–253a/ **6**:525d–g	**6**:937e–g/**15**:614h–615b/ **16**:377c–d
i. Cosmology and the metaphysics of matter: theories of the origin and nature of the physical world; monistic and pluralistic cosmologies		**14**:250e–252a/ **6**:525h–526g/ **8**:333e–f	**2**:347e–g/**5**:1066g–1067a/ **8**:353e–f/**13**:951f–h
ii. The rise of problems in the theory of knowledge: problems about the real and phenomenal worlds		**14**:252a–c/ **6**:526g–527c	**15**:528g–h
iii. The metaphysics of number: Pythagorean speculations about number and the nature of reality; advances toward the foundation of quantitative science		**14**:252d–f/ **15**:324h–325e	
iv. Anthropology and relativism: the Sophists' criticism of cosmological and metaphysical speculations; man as the measure of all things; the positions of the Sophists about the conventionality of law and justice		**14**:252f–253a/ **17**:11b–f	**8**:1171f–h/**16**:830f–g
b. The maturity of Greek philosophy		**14**:253a–255d/ **8**:372e–373e	**6**:769g–h/**6**:983f–h/ **8**:1172a–b/**10**:1093d–f/ **12**:863e–864a/**15**:152e–f/ **15**:528h–529c/**16**:366f–367b/ **16**:377d–378a/**18**:265g–h
i. The ethical concerns and positions of Socrates: the Socratic method of teaching; the influence of Socrates		**14**:253a–e	**14**:533e–g/**16**:1003h–1005a
ii. The philosophy of Plato: his dialogues on issues in politics, ethics, metaphysics, epistemology, and cosmology; his emphasis on the relations of mathematics to philosophy		**14**:253f–254d/ **14**:685g–686d	**5**:1067b–c/**6**:931e–h/ **6**:937h–938c/**8**:372g–373b/ **12**:10h–11b/**13**:951h–952a/ **14**:532f–538f
iii. The philosophy of Aristotle: his criticisms of Platonic metaphysics and theory of knowledge; the corpus of his works on logic; his teleological positions in biology, ethics, and politics; his empirical researches in the natural sciences and on laws and political institutions		**14**:254d–255d/ **11**:57g–59c/ **14**:686d–687b	**1**:1164d–1170e/**6**:932a–e/ **6**:938c–g/**8**:373c–e/ **12**:10f–h/**14**:539e–g/ **16**:366h–367b
c. Hellenistic and Roman philosophy: developments from the time of Alexander III the Great to the closing of the philosophical schools in Athens		**14**:255d–256h/ **15**:615d–f/ **16**:367c–e	**1**:1156c–1157b/**8**:266g–267b/ **8**:1172b–1173c *passim*/ **15**:152g
i. The philosophy of the Stoics: the teaching of Zeno of Citium concerning the basis of human happiness; the further elaboration of Stoic thought by Cleanthes and Chrysippus; the role of Stoicism during the late Roman Republic and the empire		**14**:255e–256a/ **14**:687b–d/ **17**:698g–699h	**4**:609f–610b/**11**:60a–d/ **12**:864a–b/**13**:952b–c
ii. The philosophy of the Epicureans: the teaching of Epicurus concerning the universe, the role of pleasure, and man's relationship to the gods		**14**:256a–c/ **6**:911d–912g	**6**:914g–915a/**11**:174a–e

	articles	article sections	other references
iii. The philosophy of the Skeptics: the teaching of Pyrrhon of Elis concerning man's lack of certainty in knowing; the role of the Skeptics in preserving the doctrines of ancient philosophers		**14**:256c-d	**14**:539h-540a/**16**:830h-831b
iv. The philosophy of the Neo-Pythagoreans and of the Neoplatonists: the teaching of Plotinus concerning the various levels of being; Neo-Pythagorean schools in Asia Minor		**14**:256d-h/ **14**:540b-542e/ **15**:325f-h	**1**:1156g-1157a/**5**:1067c-f/ **6**:936h-937a/**13**:952c-d
v. Jewish and Christian philosophy during the Hellenistic Age: diverse attempts to relate the teachings of the Hellenistic and Roman schools to Jewish and Christian theology		**10**:208d-f/ **17**:699h-700c	**4**:536f-g/**14**:246a-c
2. Philosophy in the Middle Ages		**14**:256h-261d/ **1**:1157b-1159h/ **11**:60f-62e/ **15**:801b-c/ **16**:367f-h/ **17**:700c-g	**13**:952d-f
a. Early medieval philosophy		**14**:257b-258c/ **15**:152h-153c	**14**:542g-544b
i. The patristic period: Augustine's use of Neoplatonist thought in his theology and his doctrine of man; the role of Boethius' translations and commentaries; Anselm's proofs of the existence of God; the methodology of Abelard		**14**:257b-257e/ **1**:1157e-g/ **14**:687d-g	**2**:1180d-1181c *passim*/ **4**:558c-e/**10**:716f-g/ **14**:542g-543h/ **16**:353d-354d/**17**:700c-f
ii. Philosophy and the liberal arts in the schools of the Christian West from the 9th to the 11th century		**14**:257f-258c/ **8**:267b-g/ **16**:354e-355e	**1**:10c-11c *passim*/ **8**:1174g-1175b/ **14**:543h-544b
b. The contribution of Arabic and Jewish philosophy: the role of the Islāmic philosophers in increasing the influence of Aristotle in the West; the teaching of Solomon ibn Gabirol and Maimonides		**14**:258d-259a/ **1**:1157g-1158e/ **9**:1022f-1023a/ **10**:208g-214c/ **14**:544d-e	**2**:349g-h/**9**:146f-h/ **9**:1019f-g/**9**:1020b-e/ **11**:60h-61b/**16**:355g-h
c. The age of the Schoolmen: the attempt to reconcile philosophy and theology; the teaching of Bonaventure and Albertus Magnus; Thomas Aquinas' synthesis of Aristotelianism and Christian theology		**14**:259b-260d/ **12**:864b-f/ **14**:687h-688d/ **15**:1006d-f/ **16**:355e-357a	**1**:430a-c/**1**:1158e-1159e/ **4**:558f-h/**6**:932f-933d/ **6**:939a-c/**8**:1175b-e/ **10**:716h-717a/**15**:787f-h/ **18**:266a-c/ **18**:346b-348b
d. Philosophy in the late Middle Ages: new styles of philosophy and theology that vied with Thomism; the criticism of Aristotelian thought by Duns Scotus and Ockham; the speculative mysticism of Eckehart; Nicholas of Cusa's doctrine of the "coincidence of opposites"		**14**:260d-261d/ **6**:768f-g/ **11**:61b-62e/ **14**:688d-f	**1**:1159d-h/**5**:1084a-e/ **6**:933d-e/**6**:939c-e/ **12**:864e-f/**13**:505b-c/ **16**:356f-357a
3. Modern philosophy		**14**:261d-274c/ **1**:976c-977b/ **6**:768h-769g/ **6**:912h-913c/ **14**:544f-545c/ **15**:153d-154c/ **16**:831d-833c	**2**:259d-260b/**15**:598g-599e/ **19**:2b-f
a. Philosophy in the Renaissance		**14**:261d-263g/ **13**:952f-953a/ **16**:831d-g	
i. Political theory: the views of Machiavelli, Bodin, Hobbes, Grotius, and others on the nature and moral status of political power		**14**:261h-262d/ **9**:1146d-1147c/ **14**:688f-690a/ **15**:665c-666d/ **17**:610c-611b	**10**:717a-d/**12**:438c-f/ **12**:864g-865b
ii. Humanism: the influence of the writings of Plato on moral theory and literary endeavour; renewed interest in Atomistic Materialism, ancient Skepticism, and Stoicism [for humanistic scholarship in the Renaissance, see also 10/42.A.3.]		**14**:262d-263a/ **8**:1175f-1176f/ **11**:64a-d/ **15**:665a-c	**1**:1159h-1160f/**3**:346d-h/ **14**:544f-h/**15**:801c-f/ **17**:700g-701c
iii. Philosophy of nature: the pluralistic, machinelike, and mathematically ordered character ascribed to the natural world; the influence of discoveries in anatomy, physics, and astronomy on philosophy		**14**:263a-g/ **16**:368h-369g	**15**:669h-670c

	articles	article sections	other references
b. The early modern period: the rise of Empiricism and Rationalism		**14**:263h–266d/ **4**:558h–559e/ **6**:939e–940a/ **16**:369h–371d	**11**:612d–e/**12**:21a–c/ **16**:378c–379a
i. Developments in the Empiricist tradition: Bacon's attempt to formulate a new scientific method; Hobbes's theory of knowledge		**14**:263h–264e	**2**:564a–565h/**6**:768h–769a/ **6**:770a–c/**8**:970g–972d
ii. Developments in the Rationalist tradition: the anti-empirical character of Descartes's metaphysics and the dualism of his doctrine of man and the world; the speculative systems philosophy provided by the writings of Spinoza and Leibniz		**14**:264f–265h/ **3**:968f–970a/ **6**:933e–934f/ **10**:214d–215e	**2**:347g–348a/**2**:349h–350c/ **5**:599h–601f/**10**:787b–e/ **12**:19a–e/**15**:529d–f/ **16**:831h–832a/ **17**:509c–510h/ **17**:855c–e
c. Philosophy in the period of the Enlightenment, or the Age of Reason		**14**:266d–269c/ **6**:888f–894e/ **10**:1170c–1171h	
i. Epistemological issues: the attempt of Locke and Berkeley to inquire into the origin and nature of reason; Hume's science of man; Kant's critical examination of reason		**14**:266f–267e/ **14**:268g–269b/ **6**:934g–935h/ **6**:940b–942g/ **10**:395f–396c/ **12**:30e–31f/ **15**:541c–e	**6**:769a–d/**6**:891a–b/ **8**:1192c–1193d/ **10**:390f–393h/**12**:18b–e/ **12**:20f–21a/**15**:529f–g/ **16**:832a–h
ii. Developments in the philosophy of science: Materialist views; the effect of scientific discoveries on philosophical thought		**14**:267f–h/ **16**:372d–e	**12**:21c–e/**16**:379b–e
iii. Social and political philosophy: the concern of Locke and Rousseau with the freedom and equality of citizens; developments in religious philosophy		**14**:267h–268c/ **4**:657c–f/ **5**:562b–563e/ **6**:892d–894e/ **8**:962c–963b/ **14**:690a–691e/ **15**:616c–h/ **16**:981g–982c/ **17**:611c–612b	**8**:799f–800f/**10**:215e–g/ **12**:865c–d/**15**:788c–d/ **15**:1171d–1173d *passim*
d. Philosophy in the 19th century		**14**:269d–271g/ **15**:616h–617b	**6**:1072h–1073e/**9**:195b–c/ **10**:215g–216e
i. The resurgence of the metaphysical spirit: the Idealism of Fichte, Schelling, and Hegel		**14**:269f–270d/ **8**:733e–736h/ **8**:1180e–g/ **10**:396c–397d/ **13**:953c–954b	**6**:935h–936c/**8**:728h–732a/ **8**:963c–e/**9**:191e–h/ **15**:529g–530a/**15**:788d–g/ **17**:612b–e
ii. Developments in the empirical and scientific tradition: Comte's Positivism and its subsequent influence on the philosophy of science; J.S. Mill's theory of knowledge and ethics; the dialectical Materialism of Marx and Engels		**14**:270d–271b/ **11**:553f–557d/ **14**:691e–693e/ **14**:877d–879a/ **16**:379e–380f/ **16**:983f–984d	**1**:574c–f/**4**:657f–h/**6**:769d–e/ **6**:942g–943b/**8**:963e–h/ **11**:612e–g/**14**:941c–942e/ **15**:788g–h/**17**:612f–613a/ **19**:2c–e
iii. The reaction against Rationalism: Kierkegaard's preoccupation with the states of consciousness; Schopenhauer's doctrine of cosmic will; the writings of Nietzsche		**14**:271c–g/ **7**:74c–e/ **12**:664d–f/ **18**:591g–592f	
e. Philosophy in the 20th century		**14**:271h–274c/ **8**:736h–738e/ **8**:963h–965e/ **9**:196d–197a/ **12**:31f–32h/ **15**:602g–603e	**10**:216e–h/**10**:397f–g/ **10**:719f–721a
i. Independent speculative and social philosophies: Bergson's intuitionism; Whitehead's speculative philosophy; William James's and Dewey's Pragmatism		**14**:272a–e/ **12**:33c–34b/ **12**:35a–d/ **13**:954b–d/ **14**:693h–694e/ **14**:942e–943h/ **15**:541e–542c	**2**:843f–844g/**6**:985g–986c/ **9**:192b–d/**13**:1109d–f/ **19**:817e–f
ii. Developments in Marxist thought: Lenin's metaphysical Materialism and his theory of knowledge; the continuing attempt to make theory serve practice		**14**:272e–f/ **11**:557d–560e/ **14**:694h–695h	**17**:613b–c

	articles	article sections	other references
iii. Developments in Analytical philosophy: the Logical Positivism of the Vienna Circle; the concern of Russell and other Logical Empiricists with logic, language, and perception; the influence of Moore and Wittgenstein on language analysis at British and American universities [for formal logic in the 20th century, see also 10/11.A.4.]		**14**:272g–273d/ **1**:802d–807g/ **6**:769f–g/ **8**:964d–965b/ **14**:879a–882f/ **15**:623a–b	**16**:35e–g/**16**:380g–381h/ **16**:386g–389f *passim*
iv. Developments in continental philosophy: the Phenomenology of Husserl and his disciples; the philosophy of human experience presented by Jaspers, Sartre, and other Existentialists		**14**:273d–274b/ **7**:74e–75a/ **12**:34b–35a/ **14**:211c–215b/ **15**:623c–f	**8**:739b–740c/**16**:256f–257d
C. Non-Western philosophy			
1. Indian philosophy	INDIAN PHILOSOPHY **9**:313–334	**11**:62e–63f/ **16**:833c–f	
a. Early Indian philosophical thought: the role of Hindu and Buddhist sacred literature in presystematic philosophy; the concepts of Brahman and *ātman* in Hindu thought and of selflessness and Nirvāṇa in early Buddhist writings		**9**:316d–318h/ **3**:375e–376e/ **10**:9e–10e	**8**:910h–911d
b. The beginning of system building in Indian philosophy: the role of the *sūtra;* metaphysical and epistemological concerns; ethical and political thought; the teaching of the Ājīvikas and Cārvākas		**9**:318h–323h	**5**:1068a–b/**11**:62g–63b
c. The further developments of systematic thought in India: Realism and Idealism in metaphysical and epistemological thought; the relation of pluralistic and monistic views to various linguistic philosophies		**9**:323h–328g/ **3**:381f–382f	**11**:63c–e/**12**:808e–809b
d. The schools of Vedānta: the contribution of Śaṅkara and Rāmānuja and their followers; the schools of Nimbārka, Vallabha, and Caitanya		**9**:328g–332c/ **8**:916a–e	**8**:892a–893d *passim*/ **8**:924c–925b/**13**:950f–h/ **15**:499e–500a/**16**:222f–223b
e. The Vaiṣṇava and Śaiva schools: philosophical systems based on the literature of Vaiṣṇavism and Śaivism		**9**:332d–333a	**8**:895a–f
f. Later Indian philosophical thought: the influence of Islāmic thought and European philosophy; recent trends		**9**:333a–334b	**9**:192e–g/**15**:536g–537c
2. Chinese philosophy	CHINESE PHILOSOPHY **4**:415–421		**4**:423h–424e
a. The classical Chinese philosophical schools; *e.g.,* Confucianism, Taoism, Yin-Yang, Moism, Dialecticians, the Legalist school		**4**:415h–417g/ **3**:1083e–f/ **4**:422g–423a/ **4**:1092c–1095h/ **4**:1100b–1101d/ **11**:63f–64a/ **17**:1036g–1038g	**4**:1105c–f/**4**:1109b–f/ **8**:625b–f/**8**:1127g–1128d/ **11**:898a–d/**15**:599h–600a/ **17**:1051e–1052e
b. Neo-Taoist and Buddhist thought		**4**:417h–418g/ **4**:352g–353a/ **4**:423a–c/ **17**:1038g–1039a	**3**:382f–386h *passim*
c. Neo-Confucianism: the development of the concept of principle		**4**:418h–420e/ **4**:1095h–1097b/ **4**:1101g–1102h	**4**:586c–e/**6**:341a–c/ **9**:192h–193a/**17**:1043d–e
d. 20th-century Chinese philosophy: the effects of Western thought and of Maoism		**4**:420e–421g/ **4**:380c–h/ **4**:1097b–e/ **4**:1102h–1103g	**4**:423f–g
3. Japanese philosophy	JAPANESE PHILOSOPHY **10**:100–109		**15**:600a–b
a. Early Japanese philosophical thought: the introduction of Buddhism and Confucianism; the Six Schools of Nara; Tendai and Shingon philosophy		**10**:101a–103a/ **3**:383a–384e/ **3**:389e–390c	
b. Developments during the Kamakura and Muromachi periods: the origins and concerns of the Zen, Jōdo (Pure Land), and Nichiren sects; tendencies in Shintō and Confucian thought		**10**:103a–105c/ **3**:384e–386h	**8**:1060c–g

	articles	article sections	other references
c. Developments in the Edo (Tokugawa) period: Neo-Confucianism; the revival of Shintō; Buddhist thought; the writings of independent philosophers		**10**:105c–107e	**10**:75h–76f
d. Modern Japanese philosophical thought: influence of Western philosophy; the concerns of Nishida Kitarō and other recent philosophers		**10**:107e–109b	**13**:119g–120f
D. Philosophies associated with religion			
1. Hindu philosophy	INDIAN PHILOSOPHY **9**:313–317	**9**:317g–318c/ **9**:318h–322f/ **9**:324g–333a/ **8**:910h–911d/ **8**:916a–e	**15**:499e–500a/**15**:600b–f/ **16**:222h–223b
2. Buddhist philosophy	BUDDHIST PHILOSOPHY **3**:425–431	**3**:375e–376e/ **3**:380d–386h/ **3**:389e–391c/ **3**:436b–g/ **4**:418b–g/ **9**:317a–g/ **9**:318e–h/ **9**:322f–323a/ **9**:323h–324g/ **10**:101a–g/ **10**:102a–105a/ **10**:106f–h	**3**:376g–377g/**3**:434g–h/ **8**:1060c–g/**12**:808e–809b/ **15**:599e–h
3. Confucian philosophy	CONFUCIANISM **4**:1091–1099	**4**:416a–f/ **4**:418h–420e/ **10**:101h–102a/ **10**:105c–106d	**4**:1099f–1103g *passim*/ **4**:1105c–f/**4**:1108d–1109f/ **8**:1127g–1128d/ **9**:192h–193a
4. Taoist philosophy	TAOISM **17**:1036–1039	**4**:417h–418b	**4**:416f–417a
5. Jewish philosophy	JEWISH PHILOSOPHY **10**:208–216	**10**:325b–e/ **14**:542f–g	**1**:1158c–e/**3**:359h–360f/ **9**:146f–h/**10**:322f–323a/ **11**:353c–e/**14**:246a–c/ **14**:258g–h/**16**:111f–h
6. Islāmic philosophy	ISLĀMIC THEOLOGY AND PHILOSOPHY **9**:1018–1025	**9**:333a–b/ **9**:915e–916g	**9**:961c–g/**9**:1012e–f/ **15**:600g–601a
7. Christian philosophy	CHRISTIAN PHILOSOPHY **4**:555–562	**12**:24d–g/ **14**:256h–261d/ **14**:542g–544d/ **14**:687d–688f/ **14**:689g–690a/ **16**:352g–353d/ **16**:357a–f	**1**:10c–11c/**1**:984d–e/ **18**:265e–268e/**18**:346f–347b

Section 10/53. Philosophical schools and doctrines
[for Part Ten headnote see page 694
for Division V headnote see page 760]

Section 10/51 deals with the nature, scope, and methods of philosophy, taken generally, and with the history, nature, scope, and special problems of the eight divisions of philosophy. Section 10/52 presents a synoptic view of the history of Western and non-Western philosophy. The articles and parts of articles referred to in Section 10/53 present the history and the substance of the Western philosophical tradition in a different way. They treat four main subjects: A, the major philosophical schools in the West; B, different theories of Being and existence in various philosophical schools and movements; C, different theories of thought, knowledge, and the faculties of mind in various philosophical schools and movements; and D, different theories of human conduct in various philosophical schools and movements.

The outline of subject A first deals with the major Western philosophical schools or movements in antiquity. Articles referred to separately treat Pythagoreanism, the Sophists, Eleaticism, Atomism, Platonism and Neoplatonism, Aristotelianism, Stoicism, Epicureanism, and Greek and Roman Skepticism. The outline goes on to the origins and early developments of the movements in the Middle Ages grouped together as Scholasticism, and to the maturation of and later developments in Scholasticism. The outline then treats philosophical developments in the modern period. Articles are referred to that separately treat Cartesianism, Empiricism, Rationalism, Materialism, Kantianism, Idealism, Hegelianism, Utilitarianism, Positivism and Logical Empiricism, Marxism, Realism, Pragmatism, Phenomenology, Existentialism, and Analytic and Linguistic philosophy.

The outline of subject B deals with different theories of Being and existence in the various schools and movements of Western philosophy. It treats different types of metaphysical theories in the major philosophical schools, different views in the several philosophical positions about the existence, attributes, and

knowledge of God; different conceptions, in different philosophical schools, of man as knower, doer, and maker; and different views concerning the existence of the mind and its relation to the body.

The outline of subject C treats different views in the several schools and movements of Western philosophy concerning the object of knowledge, the validity of philosophic knowledge, the sources of knowledge, the status of universal concepts, and the epistemic status of scientific theories.

The outline of subject D, theories of conduct, treats different views, in different philosophical schools, of the logical status of moral concepts and judgments, and different views of the criteria for justifying rules and judgments of what is morally right and wrong, good and bad.

articles	article sections	other references
A. Major philosophical schools in the West		
1. Philosophical schools in antiquity and the Middle Ages		
a. Pythagoreanism		
PYTHAGOREANISM **15**:322–326		**14**:252d–f
i. Pythagoreanism as a religious brotherhood: the belief in the transmigration of souls; ritual and philosophical approaches to purification; doctrines associated with the metaphysics of number	**15**:323a–324g/ **18**:741f–742b	
ii. History of Pythagoreanism: developments from the 6th century BC to the early Hellenistic Age; Neo-Pythagoreanism	**15**:324h–326b	**2**:221f–h
b. The Sophists		
SOPHISTS **17**:11–14		
i. The role of the Sophistic movement in the 5th-century BC Athenian democracy: its attack upon traditional values; the education offered by Sophists	**17**:11b–f	**6**:323h–324b/**8**:360g–h
ii. Methods and doctrines associated with the Sophistic movement: its use of eristic and antilogic; skeptical attitudes concerning traditional views of nature, the gods, and history	**17**:11g–13h/ **14**:252f–253a	**8**:1171f–h/**12**:864e–f/ **15**:800c–d
iii. The second Sophistic movement: the revival of the Greek spirit under the philhellenic emperors	**17**:13h–14b	
c. Eleaticism		
ELEATICISM **6**:525–527		**14**:536e–g
i. The methodology and doctrines of the Eleatic school: its reaction against the Empiricism of rival movements; the radical monism of the Eleatics' "way of truth"	**6**:525h–526g	**2**:346h–347b/**14**:251c–e
ii. Development of Eleatic rationalism: Parmenides' logical and linguistic approach to nature; Melissus' theory of Being; the paradoxes of Zeno	**6**:526g–527c	**14**:252b–c
d. Atomism		
ATOMISM **2**:346–351		
i. Types of ancient philosophical Atomism: atoms viewed as endowed with intrinsic qualities or as inherently qualityless	**2**:346c–349d	**6**:911f–912a/**6**:913c–e
ii. Historical development of ancient and medieval Atomism: the strict Atomism of Leucippus and Democritus; the qualitative Atomism of Empedocles and Anaxagoras	**2**:349d–g/ **14**:251e–252b	**6**:937f–g/**11**:174a–e/**11**:612b
e. Platonism		
PLATONISM AND NEOPLATONISM **14**:539–545	**12**:23d–h	**5**:1067b–d/**15**:787c–e
i. The doctrines of the *Dialogues* of Plato and the subsequent development of Greek Platonism from Aristotle through Middle Platonism	**14**:539d–540c/ **6**:409g–410a/ **14**:253f–254d/ **14**:685g–686d	**1**:156b–d/**2**:53f–h/**6**:324b–h/ **6**:931e–h/**6**:937g–938c/ **8**:215b–c/**8**:372g–373c/ **10**:716a–c/**12**:10h–11b/ **12**:15f–16c/**12**:18f–h/ **12**:663b–e/**12**:779h–780b/ **13**:951h–952a/**14**:532f–538f/ **15**:528h–529c/ **16**:377d–377h
ii. The nature and development of Neoplatonism: the emanationism of Plotinus and his view of the worlds of intellect and sense; the spiritualism of Porphyry; the extreme Realism of Iamblichus; the different schools of late Neoplatonism	**14**:540d–542e/ **14**:256d–h	**1**:1156d–1157b/**6**:936h–937a/ **12**:289h–290b/**13**:952c–d

	articles	article sections	other references
iii. The role of Platonism in Jewish, Christian, and Islāmic philosophy and theology		**14**:542f–544e/ **4**:485e–g/ **9**:1017g–1018e/ **9**:1022f–h/ **9**:1023b–f/ **10**:210a–211d/ **14**:687d–g/ **15**:540h–541a	**2**:539g–540c/**4**:558c–e/ **9**:145g–146h *passim*/ **9**:1020b–e/**13**:952d–f/ **14**:257b–258a/**14**:261b–d/ **15**:153a–b
f. Aristotelianism	ARISTOTELIANISM **1**:1155–1161	**12**:23h–24c	**6**:983g–984d
i. The nature of Aristotelianism: the methods, inquiries, and theories of Aristotle; diverse features that characterize his thought and that of his successors		**1**:1155f–h/ **4**:959e–f/ **11**:57g–59c/ **14**:686d–687b	**1**:1164b–1170e/**2**:349f–h/ **6**:932a–e/**6**:938c–g/ **8**:373c–e/**12**:10f–h/ **12**:16c–d/**14**:254d–255c/ **14**:538d–f/**15**:153b–c/ **15**:800d–f/**16**:366h–367b/ **17**:890f–898d *passim*/ **18**:588d–g
ii. Developments in the Greek tradition and in the Latin tradition through the time of Boethius: critical research into the doctrinal writings of Aristotle; elaborations of his thought in metaphysics, psychology, logic, and other areas		**1**:1155h–1157g/ **11**:59c–h	**1**:1165b–f/**14**:255c–d
iii. Later developments: the Syriac, Arabic, and Jewish traditions; Aristotelian thought in the later Latin tradition		**1**:1157g–1159h/ **9**:1022h–1023a/ **10**:211d–214c/ **14**:259b–261a/ **14**:688b–d/ **16**:355e–356f	**2**:539c–540c/**4**:558f–g/ **14**:258d–f/**18**:346f–348a
g. Stoicism	STOICISM **17**:698–701	**14**:255e–256a	**10**:716d–e/**13**:952b–c
i. Early Greek Stoicism: the concept of logic, physics, and ethics in the teachings of Zeno of Citium, Cleanthes, and Chrysippus		**17**:698g–699e	**11**:60a–e
ii. Later Roman Stoicism: the teachings of Panaetius and Poseidonius concerning moral philosophy and science; the practical themes found in the writings of Seneca, Epictetus, and Marcus Aurelius		**17**:699e–h/ **14**:687b–d	**11**:492f–493a/ **15**:1061h–1062a
iii. Stoicism in biblical, patristic, and medieval Christian philosophy: the assimilation of Stoic themes of brotherhood and providence by Christian writers		**17**:699h–700g	
h. Epicureanism	EPICUREANISM **6**:911–913	**14**:256a–c	
i. The doctrine of Epicurus: his Atomistic physics and its application in his psychology; the attempt in his ethics to banish fear and to establish equilibrium and security		**6**:911d–912e	**6**:914g–915a
ii. The Epicurean school: Epicurus' successors in Athens; the popularity of his doctrines in Rome		**6**:912e–g	**11**:174a–e
i. Skepticism	SKEPTICISM **16**:830–834		
i. Ancient and medieval Skepticism: the Skepticism of Pyrrhon of Elis; Academic Skepticism among certain Platonists; the antidogmatic methodology of Sextus Empiricus and other Pyrrhonists; antirational religious Skepticism		**16**:830d–833f/ **14**:256c–d	**1**:976d–f/**17**:12h–13b
ii. The role of Skeptical attitudes in the treatment of issues in epistemology and the philosophy of religion: the attempt to establish criteria in the search for certain and indubitable foundations of human knowledge		**16**:833f–834b	**1**:311e–314c *passim*
j. Scholasticism	SCHOLASTICISM **16**:352–357	**6**:932f–933e/ **15**:542a–c	**1**:1157e–1159h *passim*/ **6**:939a–e/**8**:1175d–e
i. The origins and early development of Scholasticism: Boethius' program for joining faith and reason; the patristic heritage, especially the negative theology of Pseudo-Dionysius; the confidence in reason reflected in Anselm's arguments and the logic of Abelard		**16**:352e–355e	**2**:1180d–1181c *passim*/ **14**:257d–259a

	articles	article sections	other references
ii. The maturation of and later developments in Scholasticism: the Arabic commentators; the Aristotelianism of Albertus Magnus and Thomas Aquinas; the reaction of Duns Scotus and Ockham against the conjunction of faith and reason		**16**:355e–357a/ **6**:410a–c/ **6**:939a–e/ **11**:61b–62e/ **12**:24d–g/ **12**:864b–f/ **14**:259b–261a/ **14**:688b–d	**1**:430a–c/**5**:1084a–e/ **10**:212f–g/**10**:716h–717a/ **18**:346b–348a
2. Philosophical schools in the modern period			
a. Cartesianism	CARTESIANISM **3**:968–970	**12**:24h–25d	**2**:347g–348a
i. The nature of Cartesianism: its origin in Descartes's methodic doubt and in his division of reality into mind and matter		**3**:968c–e	**5**:599h–601f/**6**:933e–934b/ **12**:19a–c/**12**:230d–g/ **14**:264f–265d/**16**:378c–379a/ **16**:831h–832a/**17**:509c–e
ii. The development of Cartesianism after Descartes: diverse approaches to resolving the problem of the relationship of mind and body; mechanistic doctrines in physics; determinism in ethics; contemporary importance of Cartesianism		**3**:968f–970e/ **1**:977e–g	**15**:598g–h
b. Empiricism	EMPIRICISM **6**:766–770		
i. The Empiricist theory of concepts of meaning and theory of knowledge: the contrast of the empirical with the a priori and with the innate; absolute, substantive, and partial Empiricisms		**6**:766g–768d/ **6**:927f–928e	**1**:800d–f/**15**:531g–532a/ **16**:383a–h
ii. The place of the Empiricist tradition in modern philosophy: the classical Empiricists—Locke, Berkeley, and Hume [for Empiricist tendencies in earlier philosophy, see A.1.b. and A.1.i., above; for contemporary Logical Empiricism, see A.2.i., below]		**6**:768d–769f/ **6**:410c–e/ **6**:937e–943h/ **12**:30e–h	**1**:312c–h/**8**:1192c–1193d/ **11**:14c–e/ **12**:863e–865g *passim*/ **14**:263h–264f/**14**:266g–267e/ **14**:270e–271a/**15**:153f–h/ **15**:598h–599b/**16**:832c–e
c. Rationalism	RATIONALISM **15**:527–532		
i. The Rationalist belief that the world is a rationally ordered whole, having an intelligible structure: the effect of this confidence on Rationalist positions in metaphysics, epistemology, ethics, and religious philosophy		**15**:527h–528g/ **6**:928e–929b/ **6**:946c–947g	**6**:930g–931b/**16**:383b–e
ii. The Rationalist elements in the thought and method of various major modern philosophers: recent approaches to ethical and religious Rationalism [for Rationalist tendencies in ancient and medieval philosophy, see A.1.a., A.1.c., A.1.e., and A.1.j., above]		**15**:528g–531g/ **3**:262g–263a/ **6**:931c–936h	**6**:768d–e/**12**:15c–d/ **13**:953a–b/**14**:265d–h/ **15**:153d–f/**16**:353d–h/ **16**:354e–355a/**17**:509c–510h
d. Materialism	MATERIALISM **11**:611–614		
i. The concept of mechanical Materialism: the denial of the existence of immaterial or apparently immaterial things; variations of Materialist metaphysics [for dialectical Materialism, see A.2.j., below]		**11**:611a–612a/ **12**:25g–26c	**16**:380a–b
ii. The development of modern Materialist philosophy: its revival by Gassendi and Hobbes; 18th-century French and 19th-century German Materialists; theories and issues in contemporary Materialism		**11**:612b–613h	**4**:558h–559a
e. Kantianism	KANTIANISM **10**:395–398		**9**:191d–g/**10**:718a–c/ **16**:832f–g
i. The critical philosophy of Kant; the influence of the romantic tendencies of German Idealism; attempts to clarify his thought by early Kantian thinkers		**10**:395a–396c/ **1**:153e–154d/ **6**:934g–935h/ **12**:30h–31f/ **14**:268g–269b	**6**:993f–994d/**7**:289h–291a/ **10**:391g–393h/**12**:21c–e/ **12**:25b–d/**13**:953c–f/ **15**:529f–g/**16**:379d–h
ii. Neo-Kantianism: epistemological, metaphysical, axiological, and psychological approaches; diverse assessments of Kantian thought		**10**:396c–397g	**10**:216c–e/**16**:381d–e
f. Idealism	IDEALISM **9**:189–193		

	articles	article sections	other references
i. The nature of Idealism: its typical concerns, doctrines, questions, and arguments		**9**:189f–191c/ **1**:802d–f/ **12**:22d–23c/ **12**:25d–f	
ii. Types of philosophical Idealism: cultural and historical variations of Idealism		**9**:191d–193c/ **6**:935h–936e/ **14**:269f–270c	**2**:847b–f/**4**:559e–g/ **6**:940g–941b/**8**:99h–100d/ **10**:215g–216b/ **13**:953c–954a/**16**:339h–341c
g. Hegelianism	HEGELIANISM **8**:732–738		**15**:599c–d
i. The origins of the Hegelian system in Hegel's writings and his response to polemics during his lifetime		**8**:733f–h/ **15**:629h–631d/ **15**:788d–g	**6**:935h–936c/**8**:728h–732a/ **8**:963c–e/**11**:60a–e/ **13**:953f–954a/**14**:270a–c/ **15**:529g–530a/**15**:622f–g/ **17**:612b–e/**18**:591c–f
ii. Religious and political controversies during the period 1831–44; developments in the late 19th and 20th centuries		**8**:733h–738e	**5**:804d–g/**11**:549e–g/ **15**:530h–531a/**15**:622g–h/ **15**:788g–789c
h. Utilitarianism	UTILITARIANISM **19**:1–3		
i. The nature of Utilitarianism: its evaluation of acts through an assessment of its consequences; modifications of Utilitarian theory in response to criticism		**19**:1b–2a/ **6**:995g–996h	
ii. Historical development of Utilitarianism: the classical Utilitarian philosophy of Bentham and his disciples; "act" and "rule" Utilitarian philosophies in the late 19th and early 20th centuries		**19**:2a–f/ **14**:691e–692a	**14**:270e–271a
i. Positivism and Logical Empiricism	POSITIVISM AND LOGICAL EMPIRICISM **14**:877–882	**1**:804e–805a/ **8**:964d–965b/ **12**:31f–32c	**15**:532a–c/**16**:507a–e
i. Early developments: the social Positivism of Comte and J.S. Mill; the critical Positivism of Mach and Avenarius in the philosophy of science		**14**:877b–879a	**6**:942g–943b/**10**:717g–718a/ **10**:718d–h/**14**:270d–e/ **16**:380d–f
ii. Logical Positivism: the attempt by the Vienna Circle to clarify the meanings of basic concepts and assertions; the formulation of the verifiability criterion of meaning		**14**:879a–881d	**3**:925e–h/**6**:943b–c/ **14**:272g–273b/ **16**:380g–381e/ **16**:384f–389b *passim*
iii. Logical Empiricism: studies in logic and the philosophy of mathematics; developments in linguistic analysis [for metalogical studies, see 10/12.B.; for studies in the foundations of mathematics, see 10/21.B.]		**14**:881d–882f/ **15**:602g–603e	**3**:925h–926f/**11**:73g–74a
j. Marxism	MARXISM **11**:553–560	**14**:272e–f	**6**:375f–h/**15**:598a–d/ **15**:788g–789a/**19**:545a–e
i. The philosophical dimension of the writings of Marx, Engels, and their early followers		**11**:553e–557h/ **6**:410g–411a/ **14**:693c–e	**4**:658d–f/**8**:735h–736c/ **8**:963e–h/ **11**:549e–553a *passim*/ **14**:271a–b/**15**:620c–d/ **17**:612h–613a
ii. Soviet dialectical Materialism: Marxism–Leninism; the elaborations of Lenin's thought by Stalin and Trotsky		**11**:557h–559e/ **14**:695a–c	**10**:719b–d/**11**:611e–f/ **17**:613b–c
iii. Recent developments: Marxist thought in China, Yugoslavia, Cuba		**11**:559e–560d/ **4**:421b–g/ **14**:695d–h	**4**:291g–292b/**7**:78e–g/ **8**:738b–e/**16**:257b–d
k. Realism	REALISM **15**:539–542		
i. The nature and scope of philosophical Realism: the varied uses of "Realism" in epistemology and the philosophy of science		**15**:539g–540h	
ii. Realism in modern philosophy: diverse attempts to respond to the problems raised by Descartes, Berkeley, and other philosophers; representative and direct Realism in 20th-century philosophy		**15**:540h–542c	
l. Pragmatism	PRAGMATISM **14**:940–944		

	articles	article sections	other references
i. Major theses of philosophical Pragmatism: views about the nature of reality, the priority of experience, the understanding of meaning and truth, and the role of ideas and language		**14**:940e–941a/ **6**:985d–986c	**13**:1109d–f/**15**:648b–c
ii. History of Pragmatism: its antecedents; its expression by Peirce, James, and Dewey; its heritage		**14**:941a–944c/ **6**:411a–c/ **12**:33c–34b	**6**:943d–h/**10**:28h–29d
m. Phenomenology	PHENOMENOLOGY **14**:210–215	**15**:632h–633e	**14**:273e–g/**15**:603b–c
i. The phenomenological method in philosophy: the principles and concerns of Husserl		**14**:210f–213c/ **12**:34b–e	**9**:68b–69h
ii. Later developments of the movement: the contributions of Heidegger, Sartre, Merleau-Ponty, and other Phenomenologists		**14**:213c–215e/ **12**:34e–35a/ **15**:623c–f	**8**:739b–740c/**16**:256f–257b
n. Existentialism	EXISTENTIALISM **7**:73–78	**9**:196h–197a	**9**:196d–e
i. The nature of Existentialism: its concern with the concreteness and problematic character of human existence in the world; methodological and substantive issues in Existentialism		**7**:73h–75a/ **12**:34e–35a	**8**:734h–735a/**8**:739b–740c/ **10**:465h–467g/**11**:489a–c/ **14**:271d–g/**14**:273h–274b/ **16**:256f–257d
ii. Historical development of Existentialist philosophies: themes of Existentialists found in the writings of earlier philosophers; the emergence of an Existentialist movement during and after World War II		**7**:75b–78h/ **6**:411e–f/ **14**:213e–214g	**4**:559g–560a/**14**:694g–h/ **15**:597e–h
o. Analytic and Linguistic philosophy	ANALYTIC AND LINGUISTIC PHILOSOPHY **1**:799–807		**14**:273b–d
i. The nature and methodology of Analytic philosophy: its relationship to the empirical tradition; its use and understanding of language		**1**:800d–802c/ **1**:157h–159c/ **12**:16h–17f	**12**:14f–15d/**16**:507a–e
ii. Characteristics of early Analytic philosophy: the role of the work of Moore and Russell, and the early work of Wittgenstein; use of the principle of verification		**1**:802d–805a/ **6**:980e–983c/ **12**:32c–h	**12**:16d–e/**14**:881h–882f/ **16**:35e–g/**19**:902a–c
iii. Characteristics of later Analytic philosophy: the influence of the later work of Wittgenstein; recent trends		**1**:805a–807g/ **6**:986c–990b	**6**:945a–c/**12**:224e–f/ **19**:903b–e
B. Theories of Being and existence			
1. Different types of metaphysical theory: positions concerning the world as a whole *with special attention to*	METAPHYSICS **12**:23–26	**12**:12f–13d	
a. Platonism		**12**:23d–h/ **9**:1023b–f	**12**:15f–16c/**14**:254a–d/ **14**:533d–f/**14**:539e–g/ **14**:540e–g
b. Aristotelianism		**12**:23h–24c/ **1**:1155e–h	**1**:1169a–h
c. Thomism		**12**:24d–g	**18**:347f–348a
d. Cartesianism		**12**:24h–25d	**2**:347g–348a/**3**:969d–f
e. Idealism		**12**:25d–g/ **8**:732h–733b	**9**:190c–d
f. Materialism		**12**:25g–26c/ **11**:611a–e	
i. Atomism	ATOMISM **2**:346–351		**6**:911f–912a/**6**:937f–g/ **9**:1014h–1015a/**11**:174a–e/ **14**:251e–252b/**14**:878c–e
ii. Naturalism		**12**:33c–34b	**12**:26a–c/**16**:380a–b
iii. Dialectical Materialism			**8**:736a–c/**11**:555a–e/ **11**:556f–557a/**11**:558h–559b/ **11**:611e–f
g. Pythagoreanism		**14**:252d–f/ **15**:323e–h	
h. Organismic dynamism		**12**:35a–d	**13**:954b–c/**19**:818a–c

	articles	article sections	other references
2. Different views concerning the existence, attributes, and knowledge of God *with special attention to*	RELIGION, PHILOSOPHY OF **15**:592–603	**5**:242b–243d/ **15**:649e–h	
a. Agnosticism	AGNOSTICISM **1**:311–314		
b. Atheism	ATHEISM **2**:258–262	**1**:985b–e	**6**:889h–890c/**8**:735b–d
c. Deism	DEISM **5**:561–563		**6**:888g–889h/**15**:530e–h
d. Fideism		**1**:313d–314c/ **16**:831c–d	
e. Humanism			**2**:259h–260b/**15**:596d–f/ **15**:597h–598a
f. Pantheism	PANTHEISM AND PANENTHEISM **13**:948–954		**17**:510a–d/**17**:1037g–h
g. Theism	THEISM **18**:265–269	**1**:984c–985b/ **4**:556g–557c/ **12**:24d–g/ **15**:592b–595d/ **15**:597d–e/ **15**:598d–603e/ **15**:648g–649c	**9**:191h–192b/ **9**:328g–333a *passim*/ **14**:256h–261d *passim*
3. Different conceptions of man as knower, doer, and maker *with special attention to*	ANTHROPOLOGY, PHILOSOPHICAL **1**:979–984		
a. Existentialism	EXISTENTIALISM **7**:73–78		
b. Humanism		**1**:976c–d/ **15**:665a–c	
c. Phenomenology	PHENOMENOLOGY **14**:210–215		
d. Pragmatism	PRAGMATISM **14**:940–944		**6**:943d–h
e. Rationalism	RATIONALISM **15**:527–532	**1**:982g	
f. Irrationalism		**6**:936h–937e	**14**:271d–g
4. Different views concerning the existence of the mind and its relation to the body *with special attention to*	MIND, PHILOSOPHY OF **12**:229–231	**5**:533g–534a/ **12**:19a–20c	
a. Materialism	MATERIALISM **11**:611–614	**12**:229d–230c	
b. Dualism		**12**:230d–g	**1**:977e–g/**3**:968g–969d/ **12**:19a–c
c. Immaterialism		**12**:230g–231b	
C. Theories of thought, knowledge, and faculties of mind	EPISTEMOLOGY **6**:925–947		
1. Different conceptions of the object of knowledge *with special attention to*		**6**:927b–928e/ **12**:20d–21a	**16**:380d–381a
a. Sense-datum theory		**6**:927b–f	**1**:803b–c
b. Phenomenalism		**6**:927f–928b	**14**:878a–879a
c. Idealism	IDEALISM **9**:189–193		**2**:847b–f/**9**:324c–g
d. Realism	REALISM **15**:539–542		**9**:325a–b/**9**:330g–331b
2. Different conceptions of the validity of knowledge *with special attention to*		**6**:928e–929h/ **15**:648a–d	
a. Kantianism	KANTIANISM **10**:395–398	**12**:30h–31f/ **14**:268g–269b	**10**:390f–393h *passim*/ **16**:379d–h/**16**:381d–e
b. Positivism	POSITIVISM AND LOGICAL EMPIRICISM **14**:877–882	**1**:804e–805a/ **12**:31f–32h	**16**:381a–d

	articles	article sections	other references
c. Pragmatism	PRAGMATISM **14**:940–944		**13**:1109d–f
d. Skepticism	SKEPTICISM **16**:830–834	**12**:30e–h/ **14**:252f–253a	**6**:890c–f
3. Different views of the sources or foundations of knowledge *with special attention to*		**6**:929h–943h/ **6**:946c–947g/ **16**:381h–383f/ **16**:387h–388f	
a. Rationalism	RATIONALISM **15**:527–532	**6**:931c–936h	**12**:15c–d/**14**:254a–d
b. Empiricism	EMPIRICISM **6**:766–770	**6**:937e–943h	**1**:800d–f/**8**:1192b–1193b/ **12**:14f–15b/**14**:266h–267e/ **14**:693h–694c/ **14**:878a–882f *passim*/ **15**:531g–532a
4. Different views of the status of the universal: Realism, Conceptualism, and Nominalism		**6**:411c–e/ **6**:945e–946b/ **15**:539d–541c	**9**:325a–b/**12**:16e–h/ **14**:685h–686a
5. Different views of the epistemic status of scientific theories; *e.g.*, Realism, conventionalism, and operationalism; the Unity of Science principle; reductionism	SCIENCE, PHILOSOPHY OF **16**:375–393	**14**:878a–879a	**8**:964f–h/ **12**:872d–876g *passim*/ **14**:880f–881a
D. Theories of conduct *with special attention to*	ETHICS **6**:980–997		
1. Different views of the logical status of moral concepts and judgments: meta-ethical theories		**6**:980d–990b	
a. Intuitionism		**6**:980d–983c	
b. Naturalism		**6**:983c–986c/ **14**:941h–943e	
c. Noncognitivism		**6**:986c–990b	
d. Good reasons theories		**6**:997a–e	
2. Different views of the criteria for justifying rules and judgments of what is morally right and wrong, good and bad: normative ethical theories		**6**:990h–996h	**14**:254g–255c
a. Deontological theories *with special attention to*		**6**:990h–994d	
i. Rationalism		**6**:992b–994d/ **15**:530a–c	**10**:392g–393a/**10**:396h–397b
ii. Intuitionism		**6**:991a–e	
iii. Existentialism	EXISTENTIALISM **7**:76–77	**6**:411e–f	**15**:597e–h
b. Teleological theories *with special attention to*		**6**:994d–996h	
i. Eudaimonism			**1**:1170b–c/**6**:994h–995b/ **16**:1004g–h/**17**:698c–e
ii. Utilitarianism	UTILITARIANISM **19**:1–3	**6**:995g–996h	

Biographical articles in the *Macropædia*
(Additional biographical entries may also be found in the *Micropædia*)

ABELARD, PETER **1**:10
ALBERTUS MAGNUS, SAINT **1**:429
ANSELM OF CANTERBURY, SAINT **1**:937
ARISTOTLE **1**:1162
AUGUSTINE OF HIPPO, SAINT **2**:364
AVERROËS **2**:538
AVICENNA **2**:540
BACON, FRANCIS **2**:561
BACON, ROGER **2**:567
BENTHAM, JEREMY **2**:837
BERGSON, HENRI **2**:843
BERKELEY, GEORGE **2**:846
BOETHIUS **2**:1180
BONAVENTURE, SAINT **3**:17
BUBER, MARTIN **3**:358
CAMUS, ALBERT **3**:711
CARNAP, RUDOLF **3**:925
CHUANG-TZU **4**:584
CHU HSI **4**:585
COMTE, AUGUSTE **4**:1058
CROCE, BENEDETTO **5**:285
DESCARTES, RENÉ **5**:597
DEWEY, JOHN **5**:680
DILTHEY, WILHELM **5**:804
DUNS SCOTUS, JOHN **5**:1083
ENGELS, FRIEDRICH **6**:858
EPICURUS **6**:914
FICHTE, JOHANN GOTTLIEB **7**:289
HAN-FEI-TZU **8**:625
HEGEL, GEORG WILHELM FRIEDRICH **8**:728
HEIDEGGER, MARTIN **8**:738
HOBBES, THOMAS **8**:970
HŌNEN **8**:1060
HSÜAN-TSANG **8**:1126
HSÜN-TZU **8**:1127
HUME, DAVID **8**:1191
HUSSERL, EDMUND **9**:67
IBN AL-ʿARABĪ **9**:143
IBN GABIROL **9**:145
IQBĀL, MUḤAMMAD **9**:820
JAMES, WILLIAM **10**:27
JASPERS, KARL **10**:115
KANT, IMMANUEL **10**:390
KIERKEGAARD, SØREN **10**:465
LAO-TZU **10**:679
LEIBNIZ, GOTTFRIED WILHELM **10**:785
LOCKE, JOHN **11**:12
LUCRETIUS **11**:173
MACHIAVELLI, NICCOLO **11**:227
MAIMONIDES, MOSES **11**:352
MARCEL, GABRIEL **11**:487
MARX, KARL **11**:549
MENCIUS **11**:897
MILL, JOHN STUART **12**:197
MONTESQUIEU **12**:400
MO-TZU **12**:577
NĀGĀRJUNA **12**:808
NICHIREN **13**:65
NIETZSCHE, FRIEDRICH **13**:76
NISHIDA KITARŌ **13**:118
OCKHAM, WILLIAM OF **13**:504
PEIRCE, CHARLES SANDERS **13**:1108
PHILO OF ALEXANDRIA **14**:245
PLATO **14**:531
PLOTINUS **14**:573

RĀMĀNUJA **15**:499
ROUSSEAU, JEAN-JACQUES **15**:1170
RUSSELL, BERTRAND **16**:34
SAʿADIA BEN JOSEPH **16**:111
ŚAṄKARA **16**:222
SANTAYANA, GEORGE **16**:230
SARTRE, JEAN-PAUL **16**:256
SCHELLING, FRIEDRICH **16**:339
SCHOPENHAUER, ARTHUR **16**:357
SENECA **16**:530
SHINRAN **16**:670
SOCRATES **16**:1001
SPENCER, HERBERT **17**:492
SPINOZA, BENEDICT DE **17**:508
SWEDENBORG, EMANUEL **17**:854
THOMAS AQUINAS, SAINT **18**:345
WANG YANG-MING **19**:537
WHITEHEAD, ALFRED NORTH **19**:816
WITTGENSTEIN, LUDWIG **19**:901

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• FREDERICK B. ARTZ. *Emeritus Professor of History, Oberlin College, Ohio.*

• JACQUES BARZUN. *University Professor Emeritus, Columbia University; Dean of the Faculties and Provost, 1958–67.*

JOHN A. BRINKMAN. *Director and Professor of Mesopotamian History, Oriental Institute, University of Chicago.*

JOHN F. CADY. *Distinguished Professor Emeritus of History, Ohio University, Athens.*

AINSLIE T. EMBREE. *Professor of History, Columbia University.*

JOSEPH FLETCHER. *Professor of Chinese and Central Asian History, Harvard University.*

WALTER EMIL KAEGI, JR. *Professor of Byzantine and Roman History, University of Chicago.*

HERBERT S. KLEIN. *Professor of History, Columbia University.*

• LEONARD KRIEGER. *University Professor of History, University of Chicago.*

PHILIP A. KUHN. *Professor, Departments of Far Eastern Languages and Civilizations and History, University of Chicago.*

DONALD P. LITTLE. *Professor and Assistant Director, Institute of Islāmic Studies, McGill University, Montreal.*

DONALD M. LOWE. *Professor of History, San Francisco State University.*

JAMES G. LYDON. *Professor of History, Duquesne University, Pittsburgh.*

PAUL T. MASON. *Professor of History, Duquesne University, Pittsburgh.*

KARL F. MORRISON. *Professor of Medieval History and Chairman, Department of History, University of Chicago.*

HERBERT GEORGE NICHOLAS. *Rhodes Professor of American History and Institutions, University of Oxford; Fellow of New College, Oxford.*

STEWART IRVIN OOST. *Professor of Ancient History, University of Chicago.*

RICHARD E. PIPES. *Frank B. Baird, Jr., Professor of History, Harvard University.*

JAN M. VANSINA. *Professor, Catholic University of Louvain, Belgium.*

GORDON RANDOLPH WILLEY. *Bowditch Professor of Mexican and Central American Archaeology, Harvard University.*

GEORGE MACKLIN WILSON. *Associate Professor of Japanese History, Indiana University, Bloomington.*

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RODERICK M. CHISHOLM. *Andrew Mellon Professor of the Humanities and Professor of Philosophy, Brown University, Providence, Rhode Island.*

JAMES DANIEL COLLINS. *Professor of Philosophy, St. Louis University, Missouri.*

ALAN DONAGAN. *Professor of Philosophy, University of Chicago.*

• WILLIAM H. DRAY. *Professor of Philosophy, Trent University, Peterborough, Ontario.*

ELDON DYER. *Distinguished Professor of Mathematics, Graduate School, City University of New York.*

• NORWOOD HANSON (d. 1967). *Professor of Philosophy, Yale University, 1963–67.*

• J.H. HEXTER. *Charles L. Stillé Professor of History, Yale University.*

EDWARD HERMAN LEZAK. *Actuary, Continental Assurance Company, Chicago.*

• RICHARD P. McKEON. *Charles F. Grey Distinguished Service Professor Emeritus of Philosophy and of Greek, University of Chicago.*

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• NICHOLAS RESCHER. *University Professor of Philosophy, University of Pittsburgh. Editor,* American Philosophical Quarterly.

PAUL ARTHUR SCHILPP. *Distinguished Visiting Professor, Southern Illinois University, Carbondale. Emeritus Professor of Philosophy, Northwestern University, Evanston, Illinois.*

• SEYMOUR SCHUSTER. *Professor of Mathematics, Carleton College, Northfield, Minnesota.*

HENRY BABCOCK VEATCH. *Professor of Philosophy, Northwestern University, Evanston, Illinois.*

JULIUS R. WEINBERG (d. 1971). *Vilas Professor of Philosophy, University of Wisconsin, Madison.*

IZAAK WIRSZUP. *Professor of Mathematics, University of Chicago.*

Geography

NATHANIEL O. ABELSON. *Map Librarian, Dag Hammarskjöld Library, United Nations, New York City.*

IBRAHIM A. ABU-LUGHOD. *Professor of Political Science, Northwestern University, Evanston, Illinois.*

GEORGE I. BLANKSTEN. *Professor of Political Science, Northwestern University, Evanston, Illinois.*

NORTON S. GINSBURG. *Professor of Geography, University of Chicago.*

HELVI A. KALMAN. *Writer-Editor, United Nations, New York City.*

HANS E. PANOFSKY. *Curator of Africana, Northwestern University Library, Evanston, Illinois.*

G. ETZEL PEARCY. *Professor of Geography, California State University, Los Angeles, 1969–73.*

IVOR G. WILKS. *Professor of History, Northwestern University, Evanston, Illinois.*

Authors of Propædia Essays

Part One

NIGEL CALDER. *Physicist and Science Writer. Science Correspondent,* New Statesman *(1966–71). Editor,* New Scientist *(1962–66). Author of* Robots; Technopolis: Social Control of the Uses of Science; *and others.*

Part Two

PETER J. WYLLIE. *Petrologist, Educator, and Author. Homer J. Livingston Professor of Petrology and Geochemistry, University of Chicago; Master of College and Associate Dean of Physical Sciences, 1972–73. Author of* Ultramafic and Related Rocks; The Dynamic Earth; *and others.*

Part Three

RENÉ DUBOS. *Microbiologist, Pathologist, and Author. Emeritus Professor of Pathology, Rockefeller University. Author of* So Human an Animal; Mirage of Health; A God Within; *and others.*

Part Four

LOREN EISELEY (d. 1977). *Anthropologist, Poet, and Essayist. Benjamin Franklin Professor of Anthropology and the History of Science, University of Pennsylvania, 1961–77; Curator of Early Man, University of Pennsylvania Museum, 1948–77. Author of* The Immense Journey; The Invisible Pyramid; *and others.*

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Part Six

MARK VAN DOREN (d. 1972). *Poet, Critic, and Teacher. Professor of English, Columbia University, 1920–59. Author of lyric and narrative poems, novels, stories, plays, and works of criticism and biography.*

Part Seven

PETER RITCHIE RITCHIE-CALDER, BARON RITCHIE-CALDER. *Author, Journalist, and Educator. Senior Fellow, Center for the Study of Democratic Institutions. Montague Professor of International Relations, University of Edinburgh, 1961–67. Author of* Birth of the Future; Medicine and Man; The Evolution of the Machine; *and others.*

Part Eight

WILFRED CANTWELL SMITH. *Educator and Author. McCulloch Professor of Religion, Dalhousie University. Professor of World Religions and Director of the Center for the Study of World Religions, Harvard University, 1964–73. Author of* Islam in Modern History; The Meaning and End of Religion; Questions of Religious Truth; *and others.*

Part Nine

JACQUES BARZUN. *Historian, Educator, and Author. University Professor Emeritus, Columbia University; Dean of Faculties and Provost, 1958–67. Author of* Berlioz and the Romantic Century; Darwin, Marx, and Wagner; The House of Intellect; On Writing, Publishing, and Editing; *and others.*

Part Ten

MORTIMER J. ADLER. *Philosopher and Editor. Director of the Institute for Philosophical Research. Author of* The Idea of Freedom; The Conditions of Philosophy; The Common Sense of Politics; *and others. Editor of the Syntopicon of* Great Books of the Western World *and Director of Planning,* Encyclopædia Britannica, *Fifteenth Edition.*

Initials of
Contributors and Consultants to the Macropædia

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Listed are the initials signed to articles in the *Macropædia* volumes, the names of the persons identified by the initials, a brief description of the persons so identified, and the titles of the articles with which they were involved.

A. Morys George Lyndhurst Bruce, 4th Baron Aberdare. *Minister of State, Department of Health and Social Security, U.K., 1970–74. Author of* The Story of Tennis.
TENNIS AND ALLIED COURT GAMES

A.A. Anatole Abragam. *Professor of Nuclear Magnetism, Collège de France, Paris. Aurthor of* Les principes du magnétisme nucléaire; Cours sur les phénomènes liés à la résonance magnétique; and others.
MAGNETIC RESONANCE (*in part*)

A.A.A. Alfred Alvin Angrist, M.D. *Professor of Pathology, Albert Einstein College of Medicine, Yeshiva University, Bronx, New York. Editor,* New York State Journal of Medicine. *Author of several articles on the autopsy.*
AUTOPSY

A.Ad. Anthony Adamovich. *Vice President, Byelorussian Institute of Arts and Sciences, Inc., Bronx, New York. Senior Editor,* Radio Liberty. *Author of* Opposition to Sovietization in Belorussian Literature.
BELORUSSIAN SOVIET SOCIALIST REPUBLIC (*in part*)

A.A.F. Arnold A. Friedmann. *Professor of Design, University of Massachusetts, Amherst. Co-author of Interior Design.*
INTERIOR DESIGN (*in part*)

A.Ai. Ayinipalli Aiyappan. *Special Officer, Tribal Research and Training Centre, Chevayur, Calicut, India. Editor of* Social Revolution in a Kerala Village.
MADRAS
TAMIL NADU

A.A.K. Anna Alekseyevna Klyukanova. *Junior Scientist, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow.*
AMU DARYA (RIVER)

A.A.Ke. Arno Artur Keerna. *Director, Institute of Economics, Estonian S.S.R. Academy of Sciences, Tallin. Author of papers on the Estonian S.S.R.*
ESTONIAN SOVIET SOCIALIST REPUBLIC (*in part*)

A.Al. Angeles Alvariño. *Fishery Research Biologist, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, La Jolla, California. Author of numerous papers on chaetognaths.*
CHAETOGNATHA

A.Al-Sh. Ahmed S. Al-Shahi. *Lecturer in Social Anthropology, University of Newcastle upon Tyne, England.*
EASTERN SUDAN, CULTURES OF THE

A.A.M. Aleksey Aleksandrovich Mints. *Chief, Department of Economic Geography, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow. Author of books on Transcaucasia.*
ARMENIAN SOVIET SOCIALIST REPUBLIC (*in part*)

A.A.Ma. Rev. Armand Maurer, C.S.B. *Professor of Philosophy, Pontifical Institute of Mediaeval Studies, University of Toronto. Author of* Medieval Philosophy.
PHILOSOPHY, HISTORY OF WESTERN (*in part*)

A.A.N.M. Amélia A. Nogueira Moreira. *Professor of Geography, Federal University of Ceará, Fortaleza, Brazil. Author of* Nordeste Brasileiro e Tentativas de Desenvolvimento.
CEARÁ

A.A.P. Alexander A. Parker. *Emeritus Professor of Spanish Literature, University of Texas at Austin. Author of* The Allegorical Drama of Calderón *and others.*
CALDERÓN DE LA BARCA, PEDRO

A.As. Arthur C.V.D. Aspinall (d. 1972). *Professor of Modern History, University of Reading, England, 1947–65. Author of* The Cabinet Council, 1783–1835 *and others.*
CANNING, GEORGE
FOX, CHARLES JAMES
PITT, WILLIAM, THE YOUNGER

A.A.S. Arthur A. Siebens, M.D. *Darnall Professor of Rehabilitation Medicine and Surgery; Chief, Division of Rehabilitation Medicine, Johns Hopkins University, Baltimore. Author of "The Mechanics of Breathing" in* The Physiological Basis of Medical Practice.
RESPIRATION, HUMAN

A.A.Si. Andrew Annandale Sinclair. *Historian and film maker. Author of* Guevara *and others.*
GUEVARA, "CHE"

A.A.So. Aleksey Aleksandrovich Sokolov. *Director, Leningrad Hydrological Institute. Author of* Hydrography of the U.S.S.R.
HSI CHIANG (RIVER)

A.B. Alan Bullock, Baron Bullock. *Master of St. Catherine's College, Oxford; Vice Chancellor, University of Oxford, 1969–73. Author of* Hilter: A Study in Tyranny *and others.*
HITLER, ADOLF (*in part*)

Ab.A.S. Abdou Aly Shata. *Professor of Hydrogeology and Director, Desert Institute, Cairo.*
SINAI DESERT

A.B.-B. Albert Bush-Brown. *Chancellor, Long Island University, Greenvale, New York. Author of* Louis Sullivan; *co-author of* The Architecture of America.
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A.B.C. Andrew Barnett Christie, M.D. *Honorary Physician, Fazakerly Hospital, Liverpool. Former Head, Department of Infectious Diseases, University of Liverpool. Author of* Infectious Diseases: Epidemiology and Clinical Practice.
INFECTIOUS DISEASES

A.Be. André Beaufre (d. 1975). *General, French Army. Director, French Institute of Strategic Studies, Paris. Author of* Introduction à la stratégie *and others.*
WARFARE, CONDUCT OF (*in part*)

A.B.F. Albert B. Friedman. *William Starke Rosecrans Professor of English Literature, Claremont Graduate School, Claremont, California. Author of* The Ballad Revival; *Editor of* Ywain and Gawain.
BALLAD

A.B.Fo. Arthur B. Ford. *Geologist, Geological Survey, U.S. Department of the Interior, Menlo Park, California. Author of "Review of Antarctic Geology" in* American Geophysical Union Transactions.
ANTARCTICA
ROSS ICE SHELF
ROSS SEA
SCOTIA SEA
WEDDELL SEA

A.B.G. Ashley B. Gurney. *Research Entomologist, Systematic Entomology Laboratory, U.S. Department of Agriculture, Washington, D.C. Author of numerous articles on classification and distribution of insects.*
ORTHOPTERAN

A.B.Ga. Alfred B. Garrett. *Emeritus Professor of Chemistry, Ohio State University, Columbus.*
DALTON, JOHN

A.B.Gr. Alfred Byrd Graf. *President, Roehrs Company (horticultural publishers); Vice President, Roehrs Exotic Nurseries, East Rutherford, New Jersey. Author of* Exotica *and other books dealing with houseplants.*
HOUSEPLANT

A.Bh. Agehananda Bharati. *Professor and Chairman, Department of Anthropology, Syracuse University, New York. Author of* The Tantric Tradition.
MONASTICISM

A.B.J. Abeodu Bowen Jones. *Research Director, Department of Education, Monrovia, Liberia. Author of* Grand Cape Mount County; *co-editor of* The Official Papers of William V.S. Tubman, President of the Republic of Liberia.
LIBERIA

A.B.K. Alexander B. Klots. *Research Associate, Department of Entomology, American Museum of Natural History, New York City. Emeritus Professor of Biology, City University of New York. Author of* Field Guide to the Butterflies of North America *and others.*
LEPIDOPTERA

A.Bl. Anton Blok. *Professor of Cultural Anthropology, Catholic University of Nijmegen, The Netherlands. Author of* The Mafia of a Sicilian Village.
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A.Bo. Alfonso Bosellini. *Professor of Sedimentology, University of Ferrara, Italy.*
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A.Br. Adam Bromke. *Professor of Political Science, McMaster University, Hamilton, Ontario. Author of* Poland's Politics: Idealism vs. Realism.
GOMUŁKA, WŁADYSŁAW

A.B.R. Andreas B. Rechnitzer. *Special Deputy for International and Interagency Affairs, Office of the Oceanographer of the Navy, Alexandria, Virginia.*
UNDERSEA EXPLORATION

A.Bu. Allison Butts (d. 1977). *Professor of Metallurgy and Materials Science, Lehigh University, Bethlehem, Pennsylvania. Editor of* Copper: The Science and Technology of the Metal, Its Alloys and Compounds.
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A.B.W. Rev. Allan Bernard Wolter, O.F.M. *Professor of Philosophy, Catholic University of America, Washington, D.C. Author of* The Transcendentals and Their Function in the Metaphysics of Duns Scotus.
DUNS SCOTUS, JOHN

A.By. André Berry. *Author of* Florilège des troubadours; Anthologie de la poésie occitane; *and others.*
LITERATURE, WESTERN: *Provençal*

A.C.B. A. Craig Baird. *Emeritus Professor of Speech, University of Iowa, Iowa City. Author and editor of* American Public Addresses; *co-author of* Speech Criticism; General Speech; Communication.
ORATORY

A.C.Bi. Alan Curtis Birnholz. *Associate Professor of Art History, State University of New York at Buffalo.*
TOULOUSE-LAUTREC, HENRI DE

A.C.Bk. Alfred C. Beck, M.D. *Emeritus Professor of Obstetrics and Gynecology, State University of New York Downstate Medical Center at Brooklyn. Author of* Obstetrical Practice.
PARTURITION, HUMAN (*in part*)

A.C.Br. Armin C. Braun. *Professor and Head, Laboratory of Plant Biology, The Rockefeller University, New York City. Editor of* Plant Tumor Research.
MALFORMATION, BIOLOGICAL (*in part*)

A.C.C. Rev. Arthur C. Cochrane. *Emeritus Professor of Systematic Theology, Dubuque Theological Seminary, Iowa. Author of* The Existentialists and God *and others.*
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A.C.Cl. Andrew Christopher Clark. *Rural development fieldwork consultant to OXFAM (Oxford Committee for Famine Relief), Oxford, England.*
BANGLADESH (*in part*)

A.C.H. Alan Crawford Howie. *Lecturer in Music, Victoria University of Manchester.*
BRUCKNER, ANTON

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ELTON, CHARLES

A.C.M. Adolfo C. Mascarenhas. *Director of Research, Bureau of Resource Assessment and Land Use Planning, University of Dar es Salaam, Tanzania.*
TANZANIA

A.Co. Alexander Cowie. *Emeritus Professor of Mechanical and Aerospace Engineering, Illinois Institute of Technology, Chicago. Associate Editor, Technology,* Encyclopædia Britannica, *Chicago, 1967–72. Author of* Kinematics and Design of Mechanisms.
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A.D. Allison Danzig. *Sportswriter,* The New York Times, *1923–68. Author of* The History of American Football; The Racquet Game; *and others.*
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A.Da. Adrien Dansette. *Member of the Academy of Moral and Political Sciences, Paris. Author of* Les Affaires de Panama.
LESSEPS, FERDINAND DE

A.D.B. Alexander D. Baxter. *Engineering Consultant. Professor of Aircraft Propulsion, College of Aeronautics, Cranfield, England, 1950–57. Author of* Design of Liquid Propellant Rocket Motors.
JET ENGINE

A.D.Bu. Alexander Dean Burt. *Former Manager of Engineering, Victrola Division, Radio Corporation of America.*
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A.De. Alesksandar R. Despić. *Professor of Physical Chemistry, University of Belgrade. Author of chapter 4 in* Modern Aspects of Electrochemistry, vol. 7.
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A.D.E. Antonia Déa Erdens. *Assistant Professor and Assistant Director, Department of Geography, Federal University of Bahia, Salvador, Brazil.*
BAHIA

A.De C. Alexander De Conde. *Professor of History, University of California, Santa Barbara. Author of* The Quasi-War: The Politics and Diplomacy of the Undeclared War with France, 1797–1801 *and others.*
HAMILTON, ALEXANDER

A.Dem. Abraham Demoz. *Professor of Linguistics; Director, Program of African Studies, Northwestern University, Evanston, Illinois.*
ADDIS ABABA
ETHIOPIA (*in part*)

A.D.H. Athan(assios) D. Hatzikakidis. *General Director, Institute of Oceanographic and Fisheries Research, Athens. Author of numerous articles on oceanography.*
ADRIATIC SEA
AEGEAN SEA

A.D.H.B. Adrian David Hugh Bivar. *Lecturer in Iranian and Central Asian Art and Archaeology, School of Oriental and African Studies, University of London.*
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A.D.H.C. Antony Dacres Hippisley Coxe. *Author of* A Seat at the Circus.
CIRCUS (*in part*)

A.D.M. Arthur D. Murphy. *Motion-Picture Editor,* Daily Variety, *Hollywood.*
MOTION-PICTURE INDUSTRY

A.D.Mo. Arnaldo Dante Momigliano. *Professor of Ancient History, University of London. Author of* Claudius, The Emperor and His Achievement *and others.*
CLAUDIUS I

A.D.N. Arne D. Naess. *Professor of Philosophy, University of Oslo. Editor of* Inquiry. *Author of* Four Modern Philosophers.
HEIDEGGER, MARTIN

A.Do. Andreas Dorpalen. *Professor of History, Ohio State University, Columbus. Author of* Hindenburg and the Weimar Republic *and others.*
HINDENBURG, PAUL VON

A.Du. Rev. Avery Dulles, S.J. *Professor of Systematic Theology, Catholic University of America; Washington, D.C. Author of* Revelation and the Quest for Unity *and others.*
REVELATION

A.E. Angna Enters. *Dancer, mime, and artist. Originator of phase dance mime. Author of* On Mime.
MIME AND PANTOMIME

A.E.A. Alfred E. Alford. *Communication Officer, CARE, Inc., Belize.*
BRITISH HONDURAS (BELIZE)

A.E.Ar. Annette Elizabeth Armstrong. *Fellow and Tutor in Modern Languages, Somerville College, Oxford; Lecturer in French Literature, University of Oxford. Author of* Ronsard and the Age of Gold.
RONSARD, PIERRE DE

A.Eb. Arimichi Ebisawa. *Professor of History, International Christian University, Tokyo. President, Society of Historical Studies of Christianity, Japan. Author of* Sen-roppyaku-kyūnen Kirishitan junkyōki *and others.*
ODA NOBUNAGA

A.E.D. Augustus E. DeMaggio. *Professor of Biology, Dartmouth College, Hanover, New Hampshire.*
TISSUES AND FLUIDS, PLANT (*in part*)

A.Ei. Albert Einstein (d. 1955). *Theoretical physicist. Nobel Prize for Physics, 1921, for his services to physics and for the discovery of the law of the photoelectric effect. Originator of special and general theories of relativity. Author of* The Meaning of Relativity *and others.*
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

A. el A.T.S. Abd el Aziz Torayah Sharaf. *Professor of Geography, University of Khartoum, The Sudan. Author of* A Short History of Geographical Discovery.
CASABLANCA

A.E.M. Adolphe Erich Meyer. *Emeritus Professor of Educational History, New York University, New York City. Author of* An Educational History of the American People; An Educational History of the Western World.
EDUCATION, HISTORY OF (*in part*)

A.E.R. Alfred Edward Ringwood. *Professor of Geochemistry, Australian National University, Canberra. Designer of models of development of the Earth's interior through geochemical research. Co-editor of* Phase Transformation and the Earth's Interior.
EARTH, STRUCTURE AND COMPOSITION OF

A.E.S. Alan Edouard Samuel. *Professor of Greek and Roman History, University College, University of Toronto. Author of* Ptolemaic Chronology *and others.*
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A.E.Sc. Alfred Eric Scott. *Former Editor in Chief, Editorial and Publications Section, Commonwealth Scientific and Industrial Research Organization, Melbourne.*
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A.E.Si. Akiba Ernst Simon. *Emeritus Professor of Education, Hebrew University of Jerusalem. Author of* Aufbau im Untergang *and others.*
BUBER, MARTIN

A.E.Sm. Arthur Eltringham Smailes. *Emeritus Professor of Geography, Queen Mary College, University of London.*
LOIRE RIVER
SEINE RIVER

A.E.T. Aristide Émile Théodoridès. *Professor of Ancient Egyptian Language, Institutions, and Law; Director, Institute of Eastern and Slavonic Philology and History, Free University of Brussels.*
EGYPTIAN LAW

A.E.Ta. Alfred Edward Taylor (d. 1954). *Professor of Moral Philosophy, University of Edinburgh, 1924–41. Author of* Plato; Socrates; *and others.*
SOCRATES

A.E.W. Albert E. Wood. *Emeritus Professor of Biology, Amherst College, Massachusetts.*
RODENTIA

A.F. Anne Foner. *Associate Professor of Sociology, Rutgers University, New Brunswick, New Jersey. Co-author of* Aging and Society, *vol. 1,* An Inventory of Research Findings, *and vol. 3,* A Sociology of Age Stratification.
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A.F.A.H. Andreas F.A. Heldrich. *Professor of Civil Law, University of Munich, West Germany. Author of* Internationale Zuständigkeit und anwendbares Recht.
TORTS, LAW OF

A.F.A.M. Alice F.A. Mutton. *Former Reader in Geography, Queen Mary College, University of London. Author of* Central Europe; Western Europe.
BALTIC SEA
RHINE RIVER

A.F.B. The Hon. Alastair Francis Buchan (d. 1976). *Montague Burton Professor of International Relations, University of Oxford, 1972–76. Founder and Director, International Institute for Strategic Studies, London, 1958–69. Author of* The Spare Chancellor: The Life of Walter Bagehot.
BAGEHOT, WALTER

A.F.H. Alfred F. Havighurst. *Emeritus Professor of History, Amherst College, Massachusetts. Author of* Twentieth-Century Britain *and others.*
BRITAIN AND IRELAND, HISTORY OF (*in part*)

A.F.Ho. Arthur F. Holmes. *Professor of Philosophy, Wheaton College, Illinois. Author of* Christian Philosophy in the Twentieth Century *and others.*
CHRISTIAN PHILOSOPHY

A.Fi. Andrew Field. *Professor of Comparative Literature, Griffith University, Brisbane, Australia. Author of* Nabokov: His Life in Art.
NABOKOV, VLADIMIR

A.Fr. Lady Antonia Fraser. *Writer. Author of* Mary, Queen of Scots *and others.*
MARY, QUEEN OF SCOTS

A.F.R. Anne F. Rockwell. *Free-lance writer and illustrator. Author of* Glass, Stones and Crown: The Abbé Suger and the Building of St. Denis *and others.*
SUGER OF SAINT-DENIS

A.F.Sh. Arthur Frank Shore. *Brunner Professor of Egyptology, University of Liverpool; England. Author of* Portrait Painting from Roman Egypt.
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A.F.St. Adolf F. Sturmthal. *Professor of Labor and Industrial Relations, University of Illinois, Urbana. Author of* Workers' Councils: A Study of Workplace Organization on Both Sides of the Iron Curtain *and others.*
TRADE UNIONISM

A.Fu. André Fu-Kiau kia Bunseki-L. *Director, Centre of Development and Scientific Research in African Languages, Kumba, Zaire.*
CONGO (BRAZZAVILLE)

A.F.W. Arthur F. Wright (d. 1976). *Charles Seymour Professor of History, Yale University, 1961–76. Author of "The Formation of Sui Ideology" in* Chinese Thought and Institutions.
SUI WEN TI

A.F.We. Arthur Frederick Wells (d. 1966). *Praelector in Classics, University College, University of Oxford.*
LUCRETIUS

A.G. Ashton Graybiel, M.D. *Special Assistant for Scientific Programs; Head, Biological Sciences Department, Naval Aerospace Medical Research Laboratory, Pensacola, Florida; Director of Research, 1945–70.*
MOTION SICKNESS

A.G.B.H. Åke Gunnar Birger Hultkrantz. *Professor and Chairman, Department of Comparative Religion, University of Stockholm. Author of* The North American Indian Orpheus Tradition *and others.*
NORTH AMERICAN PLATEAU INDIANS

A.G.C. André George Corbet. *Lecturer in Maritime Studies, University of Wales Institute of Science and Technology, Cardiff. Co-author of* Marine Gyro Compasses and Automatic Pilots.
GYROSCOPE (*in part*)

A.Ge. Arthur Gelb. *Deputy Managing Editor,* The New York Times. *Co-author of* O'Neill.
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A.G.H. A. Gordon Hammer. *Professor of Psychology, Macquarie University, North Ryde, Australia. Author of* Elementary Matrix Algebra for Psychologists and Social Scientists.
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A.G.Ha. Rev. Adalbert G. Hamman. *Professor at Patristic Institute, Rome. Editor,* Patrologiae Latinae Supplementum. *Author of* La Prière *and others.*
PRAYER

A.Gi. Alexander Gillies (d. 1977). *Professor of German Language and Literature, University of Leeds, England, 1945–72. Author of* Goethe's Faust: An Interpretation *and many other books on German writers and literature.*
LITERATURE, WESTERN: *German; 18th century*

A.G.J. Adriaan G. Jongkees. *Professor of Medieval History, State University of Groningen, The Netherlands. Author of* Het koninkrijk Friesland in de vijftiende eeuw *and others.*
WILLIAM I THE SILENT, PRINCE OF ORANGE

A.G.L. Andrew George Lehmann. *Director, Institute of European Studies, University of Hull, England. Author of* Sainte-Beuve: A Portrait of the Critic *and others.*
SAINTE-BEUVE, CHARLES-AUGUSTIN

A.G.Ly. A. Gordon Lyne. *Senior Principal Research Scientist, Division of Wildlife Research, Commonwealth Scientific and Industrial Research Organization, Blacktown, Australia. Researcher on the anatomy and physiology of Australian mammals. Author of* Marsupials and Monotremes of Australia.
MONOTREMATA

Ag.M. Agnes Mongan. *Emeritus Curator of Drawings, Fogg Art Museum, Harvard University. Co-author of* Ingres Centennial Exhibition, 1867–1967; Drawings in the Fogg Museum; *and others.*
INGRES, JEAN-AUGUSTE-DOMINIQUE

A.G.M. Alan Gibbs Massey. *Reader in Inorganic Chemistry, Loughborough University of Technology, England. Co-author of* Inorganic Chemistry in Non-aqueous Solvents.
BORON GROUP ELEMENTS AND THEIR COMPOUNDS

A.G.Ma. Alla Genrikhovna Massevitch. *Vice President, Astronomical Council, Academy of Sciences of the U.S.S.R., Moscow. Author of* Life of the Sun.
AMBARTSUMIAN, VIKTOR A.

A.G.M.v.M. Andrew G.M. van Melsen. *Professor of Philosophy, Catholic University of Nijmegen, The Netherlands. Author of* From Atomos to Atom *and others.*
ATOMISM

A.Gn. Alfonz Gspan (d. 1977). *Scientific Adviser, Slovene Academy of Sciences and Arts, Ljubljana; Editor,* Slovenski biografski leksikon. *Co-author of* Incunabule v Sloveniji *and others.*
LITERATURE, WESTERN: *Slovene* (*in part*)

A.G.N.F. Antony Garrard Newton Flew. *Professor of Philosophy, University of Reading, England. Author of* God and Philosophy; *co-editor and contributor to* New Essays in Philosophical Theology.
AGNOSTICISM

A.Go. Andres Goth, M.D. *Professor and Chairman, Department of Pharmacology, University of Texas Southwestern Medical School at Dallas. Author of* Medical Pharmacology.
CHEMOTHERAPEUTIC DRUGS

A.G.P. Alexis G. Pincus. *Visiting Professor of Ceramics, Rutgers University, New Brunswick, New Jersey. Co-author of* Utilization of Ceramics in Microelectronics.
CERAMICS, INDUSTRIAL

A.G.W. A. Geoffrey Woodhead. *Fellow of Corpus Christi College, Cambridge; Lecturer in Classics, University of Cambridge. Adjunct Professor of Classics; Ohio State University, Columbus. Author of* The Greeks in the West *and others.*
CHRONOLOGY (*in part*)
SYRACUSE

A.G. y B. Antonio García y Bellido (d. 1972). *Professor of Archaeology, University of Madrid, Spain. Director, Spanish Institute of Archaeology. Member, Royal Academy of History. Author of* Las Colonizaciones Púnica y Griega en la península ibérica *and others.*
SPAIN, HISTORY OF (*in part*)

A.H. Anthony Hallam. *Professor of Geology, University of Birmingham, England. Co-author of* Cyclic Sedimentation.
MESOZOIC ERA

A.Ha. Andrew Hacker. *Professor of Political Science, Queens College, City University of New York. Author of* Politics and the Corporation.
CORPORATION, BUSINESS (*in part*)

A.H.A. A. Hilary Armstrong. *Gladstone Professor Emeritus of Greek, University of Liverpool. Editor of* The Cambridge History of Later Greek and Early Mediaeval Philosophy; *translator of* Plotinus.
PLATONISM AND NEOPLATONISM
PLOTINUS

A.H.Ao. Anselm H. Amadio. *Chaplain; Instructor in Philosophy, Illinois Institute of Technology, Chicago. Staff Writer, Philosophy and Religion,* Encyclopædia Britannica, *Chicago, 1970–73.*
ARISTOTLE
PALAMAS, SAINT GREGORY

A.H.B. Addeke Hendrik Boerma. *Director General, Food and Agriculture Organization of the United Nations, Rome, 1968–76.*
FOOD SUPPLY OF THE WORLD

A.H.C. Arthur Herbert Cook. *Director, Brewing Industry Research Foundation, Nutfield, England, 1958–71. Editor of* Barley and Malt: Biology, Biochemistry, Technology.
BREWING

A.H.Ca. Arthur H. Cash. *Professor of English, State University of New York, College at New Paltz. Author of* Laurence Sterne: The Early and Middle Years *and others.*
STERNE, LAURENCE

A.H.D. Andrew Hutchinson Dawson. *Lecturer in Geography and Modern Russian Studies, University of St. Andrews, Scotland. Author of many papers on the geography of Poland.*
POLAND (*in part*)
WARSAW (*in part*)

A.He. Antony Hewish. *Professor of Radioastronomy, University of Cambridge; Fellow of Churchill College, Cambridge. Co-discoverer of pulsars. Co-winner, Nobel Prize for Physics, 1974. Co-author and editor of* Seeing Beyond the Visible.
PULSAR

A.H.E. Archie H. Easton. *Professor of Civil and Mechanical Engineering; Director, Motor Vehicle Research Laboratory, University of Wisconsin, Madison. President, A.H. Easton and Associates, Inc. (Consulting Engineers), Madison.*
TRUCKS AND BUSES

A.H.F. Rabbi Albert H. Friedlander. *Director of Rabbinic Studies, Leo Baeck College, London. Minister, Westminster Synagogue, London. Author of* Leo Baeck: Teacher of Theresienstadt *and others.*
BAECK, LEO

A.H.G. Alan H. Gayfer. *Editor,* Super Marketing, *London. Editor,* Cycling, *1964–69.*
BICYCLE

A.H.Gt. Ann Hutchinson Guest. *Honorary President, Dance Notation Bureau, New York. Director, Language of Dance Centre, London. Notation Teacher, Royal Academy of Dancing, London. Author of* Labanotation: The System for Recording Movement.
CHOREOGRAPHY AND DANCE NOTATION

A.H.H. A.H. Hanson (d. 1971). *Professor of Politics, University of Leeds, England. Author of* Public Enterprise and Economic Development.
PUBLIC ENTERPRISES

A.H.Ho. Albert Habib Hourani. *Reader in the Modern History of the Near East, University of Oxford; Fellow of St. Antony's College, Oxford. Author of* Arabic Thought in the Liberal Age, 1798–1939.
SYRIA AND PALESTINE, HISTORY OF (*in part*)

A.H.M. Allan H. Morrish. *Professor and Head, Department of Physics, University of Manitoba, Winnipeg. Author of* The Physical Principles of Magnetism.
FERROMAGNETISM

A.H.McD. Alexander Hugh McDonald. *Lecturer in Ancient History, University of Cambridge, 1952–73. Author of* Republican Rome; *editor of* Oxford Text of Livy, *vol. 5.*
TACITUS, CORNELIUS

A.Ho. Abram Hoffer, M.D. *Psychiatrist. Co-author of* The Hallucinogens; How to Live with Schizophrenia.
HALLUCINOGEN

A.H.P. Arnold H. Price. *Area Specialist for Central Europe, Slavic and Central European Division, Library of Congress, Washington, D.C.*
CLAUSEWITZ, CARL VON

A.H.Ro. Arthur H. Rosenfeld. *Professor of Physics, University of California, Berkeley. Co-author of* Nuclear Physics.
PARTICLES, SUBATOMIC (*in part*)

A.H.S. Anna Hester Smith. *Former Head Librarian, Johannesburg Public Library. Former Director, Africana Museum, Johannesburg. Author of* Pictorial History of Johannesburg.
JOHANNESBURG

A.H.St. Alan Howard Stratford. *Chairman, Alan Stratford and Associates (air transport consultants), Lymington, England. Author of* Air Transport Economics in the Supersonic Era *and others.*
TRANSPORTATION, AIR

A.I.I. Aleksandr Ilyich Imshenetsky. *Senior Research Associate, Scientific Council on the Location of U.S.S.R. Productive Forces, Academy of Sciences of the U.S.S.R., Moscow; Candidate of Sciences (Geology and Mineralogy). Co-author of* Complex Study on Arid Zones of the U.S.S.R.
TADZHIK SOVIET SOCIALIST REPUBLIC (*in part*)

A.I.M. Albert I. Mendeloff, M.D. *Physician in Chief, Sinai Hospital, Baltimore. Professor of Medicine, Johns Hopkins University, Baltimore. Co-author of* Digestive Diseases.
DIGESTION, DISORDERS OF
DIGESTIVE SYSTEM DISEASES

Ai.S. Aidan William Southall. *Professor of Anthropology, University of Wisconsin, Madison. Editor of* Social Change in Modern Africa.
MADAGASCAR (*in part*)

A.J.B. Arthur Joseph Brown. *Professor of Economics, University of Leeds, England. Author of* The Great Inflation, 1939–51.
INFLATION AND DEFLATION

A.J.Bo. Arthur James Boucot. *Professor of Geology, Oregon State University, Corvallis. Authority on Silurian paleontology and stratigraphy.*
SILURIAN PERIOD

A.J.Ca. A.J. Cain. *Derby Professor of Zoology, University of Liverpool. Editor of* Function and Taxonomic Importance.
CLASSIFICATION, BIOLOGICAL

A.J.E. Armand J. Eardley (d. 1972). *Professor of Geology, University of Utah, Salt Lake City, 1965–70; Dean, College of Mines and Mineral Industries, 1954–65. Author of* Structural Geology of North America.
BASIN AND RANGE PROVINCE
PACIFIC COAST RANGES
ROCKY MOUNTAINS
SIERRA NEVADA RANGE

A.J.El. Alexander J. Elwyn. *Physicist, Argonne National Laboratory, Argonne, Illinois.*
NEUTRON

A.J.H. Arlen J. Hansen. *Professor of English, University of the Pacific, Stockton, California.*
SHORT STORY

A.J.Ha. Anna J. Harrison. *Professor of Chemistry, Mount Holyoke College, South Hadley, Massachusetts.*
CHEMISTRY

A.J.I. Aaron J. Ihde. *Professor of Chemistry and History of Science, University of Wisconsin, Madison. Author of* The Development of Modern Chemistry.
PAULING, LINUS

A.J.K. Anthony John Kirby. *University Lecturer in Chemistry, University of Cambridge. Co-author of* Organic Chemistry of Phosphorus.
ORGANIC PHOSPHORUS COMPOUNDS

A.Jn. Albert Jourcin. *Professeur agrégé honoraire. Author of* Les Médicis *and others.*
MEDICI FAMILY

A.J.P. Anthony J. Podlecki. *Professor and Head, Department of Classics, University of British Columbia, Vancouver. Author of* The Political Background of Aeschylean Tragedy *and others.*
AESCHYLUS

A.J.P.T. A.J.P. Taylor. *Lecturer in International History, University of Oxford, 1953–63; Fellow of Magdalen College, Oxford, 1938–76. Author of* Bismarck; The Struggle for Mastery in Europe, 1848–1918; *and others.*
BISMARCK, OTTO VON

A.J.Sc. Alvin J. Schumacher. *Author of* Thunder on Capitol Hill: The Life of Chief Justice Roger B. Taney.
TANEY, ROGER BROOKE

A.J.Sh. Aaron J. Sharp. *Alumni Distinguished Service Professor Emeritus of Botany, University of Tennessee, Knoxville. Associate editor,* Journal of the Hattori Botanical Laboratory, *devoted to bryology.*
BRYOPSIDA
HEPATOPSIDA

A.J.So. Alan James Southward. *Zoologist and Senior Principal Scientific Officer, Marine Biological Association of the United Kingdom, Plymouth. Author of* Life on the Sea-Shore.
COASTAL FEATURES (*in part*)

A.J.T. Arnold Joseph Toynbee (d. 1975). *Director of Studies, Royal Institute of International Affairs, London, 1925–55. Research Professor of International History, University of London, 1925–55. Author of* A Study of History *and many others.*
CAESAR, JULIUS
TIME (*in part*)

A.J.V. Alan John Villiers. *Free-lance writer. Vice President, Society for Nautical Research, London. Author of* Captain James Cook; The Way of a Ship; *and many others.*
COOK, JAMES

A.Ka. Adrienne L. Kaeppler. *Anthropologist, Bernice P. Bishop Museum, Honolulu. Lecturer in Music, University of Hawaii, Honolulu. Author of several articles on Polynesian dance.*
OCEANIAN PEOPLES, ARTS OF (*in part*)

A.K.C. Rt. Rev. Albert Kenneth Cragg. *Assistant Bishop, Diocese of Chichester, England. Reader in Religious Studies, University of Sussex, Brighton, England. Author of* Counsels in Contemporary Islam *and others.*
ḤADĪTH

A.K.Ca. Alan K. Campbell. *Chairman, U.S. Civil Service Commission, Washington, D.C. Author of* The States and the Urban Crisis.
NEW YORK (STATE)

A.K.Ch. Abdel Kader Chanderli. *Senior Adviser, the Arab Fund, Kuwait. Former President and General Manager, C.A.M.E.L. Petroleum Company, Algiers.*
ALGERIA (*in part*)
ALGIERS

A.K.Co. Ananda K. Coomaraswamy (d. 1947). *Fellow for Research in Indian, Persian and Mohammedan Art, Museum of Fine Arts, Boston, 1917–47. Author of* History of Indian and Indonesian Art *and many others.*
METALWORK (*in part*)

A.K.H. A. Kent Hieatt. *Professor of English, University of Western Ontario, London. Author of* Chaucer, Spenser, Milton: Mythopoeic Continuities and Transformations; *co-editor of Spenser's* Selected Poetry.
SPENSER, EDMUND

A.Kn. Arthur Knight. *Professor of Cinema, University of Southern California, Los Angeles. Film Critic,* The Hollywood Reporter *and* Westways. *Author of* The Liveliest Art; The Hollywood Style.
CHAPLIN, CHARLIE

A.K.N. A.K. Narain. *Professor of History and South Asian Studies, University of Wisconsin, Madison. Author of* The Indo-Greeks *and others.*
VĀRĀNASI

A.Ko. Arthur Koestler. *Author of* The Act of Creation; Darkness at Noon; *and many others.*
HUMOUR AND WIT

A.K.P. A. Keith Pierce. *Astronomer, Solar Division, Kitt Peak National Observatory, Tucson, Arizona.*
SUN (*in part*)

A.K.Pa. Andrew K. Pawley. *Professor of Linguistics, University of Hawaii, Honolulu. Author of "Samoan Phrase Structure: The Morphology-Syntax of a Western Polynesian Language" in* Anthropological Linguistics *and other articles on the languages of Oceania.*
AUSTRONESIAN LANGUAGES

A.K.R. A.K. Ramanujan. *Professor of Dravidian Studies and of Linguistics; Professor, Committee on Social Thought, University of Chicago. Author of* Speaking of Śiva *and others.*
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

A.K.S. Arthur K. Solomon. *Professor of Biophysics, Medical School, Harvard University. Author of numerous scientific papers. Author of* Why Smash Atoms?
BIOPHYSICS

A.K.Se. Anna K. Seidel. *Member, French School of the Far East. Author of* La divinisation de Lao tseu dans le taoisme des Han.
TAOISM

Ak.W. Akira Watanabe. *President, Japan Cartographers Association. Former Chairman,*

Department of Geography, Ochanomizu Women's University, Tokyo. Editor of Gazetteer of Japan.
JAPAN (*in part*)

A.Ky. Ado Kyrou. *Writer, motion-picture and television director. Author of* Le Surréalisme au cinéma; Luis Buñuel; *and others.*
BUÑUEL, LUIS

A.L. Alberto Lecco. *Novelist, poet, essayist, and reviewer. Author of* Anteguerra *and others.*
MILAN

A.La. Abdallah Laroui. *Professor of History, Mohammed V University, Rabat, Morocco. Author of* History of the Maghrib *and others.*
MOROCCO

A.L. al-S.M. Afaf Lutfi al-Sayyid Marsot. *Professor of History, University of California, Los Angeles. Author of* Egypt and Cromer.
BARING, EVELYN, 1ST EARL CROMER

Al.B. Alfredo Bosisio. *Professor of Medieval History, University of Pavia, Italy. Author of* Storia di Milano *and others.*
SFORZA, LUDOVICO

A.L.B. Arthur Llewellyn Basham. *Professor of Asian Civilizations, Australian National University, Canberra. Author of* History and Doctrines of the Ajīrikas *and others.*
HINDUISM, HISTORY OF

Al.Be. Alfons Becker. *Professor of Medieval History, Johannes Gutenberg University of Mainz, West Germany. Author of* Papst Urban II (1088–1099) *and others.*
URBAN II, POPE

Al.Bo. Alan Bowness. *Reader in the History of Art, Courtauld Institute of Art, University of London. Author of* Modern European Art; Recent British Painting.
COROT, JEAN-BAPTISTE-CAMILLE
MOORE, HENRY

Al.C. Alphonse Chapanis. *Professor of Psychology, Johns Hopkins University, Baltimore. Author of* Research Techniques in Human Engineering.
HUMAN-FACTORS ENGINEERING

A.L.C. Arthur L. Cohen. *Director, Electron Microscope Center; Professor of Botany and of Biological Sciences, Washington State University, Pullman.*
SLIME MOLD

A.Le. Aureliano Leite. *President of the São Paulo Historical and Geographical Institute; Member of the São Paulo Academy of Letters; Member of the Brazilian Historical and Geographical Institute. Author of* História da Civilização Paulista.
SÃO PAULO (CITY)
SÃO PAULO (STATE)

Al.G. Albert Goodwin. *Emeritus Professor of Modern History, Victoria University of Manchester. Author of* The French Revolution *and others.*
LOUIS XVI OF FRANCE
NECKER, JACQUES

A.L.G. Arnold L. Gordon. *Professor of Oceanography, Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York. Editor of* Studies in Physical Oceanography.
DRAKE PASSAGE

Al.Ge. Alan Gewirth. *Edward Carson Waller Distinguished Service Professor of Philosophy, University of Chicago. President, American Philosophical Association, 1973–74. Author of* Reason and Morality *and others.*
ETHICS

Al.Go. Alan Gowans. *Professor and Chairman, Department of History in Art, University of Victoria, British Columbia. Author of* Building Canada, An Architectural History of Canadian Life; The Unchanging Arts; Images of American Living; *and others.*
ARCHITECTURE, ART OF (*in part*)

Al.Gr. Alan Gregg, M.D. (d. 1957). *Vice President, Rockefeller Foundation, 1951–56; Director of Medical Sciences, 1930–51.*
MEDICAL EDUCATION (*in part*)

A.L.H. Arnold Lionel Haskell. *Governor, Royal Ballet; Governor, Royal Ballet School; Vice President, Royal Academy of Dancing, London. Author of* Ballet: A Complete Guide to Appreciation *and others.*
BALLET (*in part*)

A.L.-Ho. Alexander Marie Norbert Lernet-Holenia. *President, Austrian P.E.N. Club. Author of* Prinz Eugen *and others.*
EUGENE OF SAVOY

A.Li. Assar Lindbeck. *Professor of International Economics; Director, Institute for International Economics Studies, University of Stockholm. Author of* Monetary-Fiscal Analysis and General Equilibrium.
FISCAL AND MONETARY POLICY

A.Lip. Adolf Lippold. *Professor of History, University of Regensburg, West Germany. Author of* Theodosius der Grosse und seine Zeit *and others.*
THEODOSIUS I THE GREAT

A.L.L. Arthur L. Lange. *Geophysicist, Amax Exploration, Inc., Denver, Colorado. Former Editor of* Cave Studies. *Investigator of cavern development through experimental and theoretical studies.*
CAVES AND CAVE SYSTEMS

A.L.La. Arthur Lon Labanauskas. *Research Editor, Science,* Encyclopædia Britannica, *Chicago, 1969–73.*
EARTH, HEAT FLOW IN

A.L.Ll. Albert Lancaster Lloyd. *Member, Editorial Board, English Folk Dance and Song Society, London. Member, European Permanent Commission for the Study of Industrial Folklore. Member, International Folk Music Council. Author of* Folk Song in England *and others.*
POPULAR MUSIC

A.L.M. Akinlawon Ladipo Mabogunje. *Professor and Head, Department of Geography, University of Ibadan, Nigeria. Vice President, International Geographical Union. Author of* Urbanization in Nigeria.
NIGER RIVER

Al.N. Allan Nevins (d. 1971). *Historian. Senior Research Associate, Henry E. Huntington Library and Art Gallery, San Marino, California, 1958–69. Dewitt Clinton Professor of History, Columbia University, 1931–58. Author of* The American States During and After the Revolution; The Emergence of Modern America; *and many biographies.*
WASHINGTON, GEORGE

A.Lo. Alan Lomax. *Director, Cantometrics and Choreometrics Projects (systems for classifying world song and dance styles), Department of Anthropology, Columbia University. Author of* Folk Song Style and Culture; The Folk Songs of North America; *and others.*
SINGING (*in part*)

Al.R. Alfredo Riva. *Assistant Professor of Industrial Chemistry, University of Bologna, Italy.*
MALPIGHI, MARCELLO (*in part*)

A.L.R. Alexander L. Ringer. *Professor of Musicology, University of Illinois, Urbana. Author of* The Hunt as a Musical Topic: A Brief History of the Chasse.
MUSICAL COMPOSITION

Al.Re. Albert Resis. *Associate Professor of History, Northern Illinois University, DeKalb. Author of articles on Russian and Soviet history.*
LENIN

Al.S. Albert M. Soboul. *Professor of the History of the French Revolution, University of Paris I. Author of* Précis d'histoire de la révolution française *and others.*
CARNOT, LAZARE
DANTON, GEORGES
FRANCE, HISTORY OF (*in part*)

A.L.S. A.L. Srivastava. *Emeritus Professor of History, Āgra College, Āgra University, India. Author of* The Mughal Empire *and others.*
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

A.L.T. Sir A. Landsborough Thomson (d. 1977). *President, British Ornithologists' Union, 1948–55. President, Zoological Society of London, 1954–60. Chairman of Trustees, British Museum (Natural History), London, 1967–69. Author of* Problems of Bird Migration.
CICONIIFORMES

A.L.Tu. Anthony Leonid Turkevich. *James Franck Distinguished Service Professor of Chemistry, Enrico Fermi Institute and Department of Chemistry, University of Chicago. Author of papers on reactions of energetic particles with atomic nuclei.*
ISOTOPES

A.L.W. A.L. Waddams. *Manager, Market Research and Information Division, BP Chemicals (UK) Ltd., London. Author of* Chemicals from Petroleum *and others.*
PETROLEUM REFINING (*in part*)

A.M. Abdou Moumouni. *Director, Office of Solar Energy, Niamey, Niger. Author of* L'Education en Afrique.
EDUCATION, HISTORY OF (*in part*)

A.Ma. Andrew Henry Robert Martindale. *Professor of Visual Arts, University of East Anglia, Norwich, England. Author of* Gothic Art.
VISUAL ARTS, WESTERN (*in part*)

A.M.B. Alfred M. Beeton. *Professor of Natural Resources and Atmospheric and Oceanic Science; Director, Great Lakes and Marine Waters Center, University of Michigan, Ann Arbor. Author of numerous scientific articles on the Great Lakes.*
GREAT LAKES
GREAT SALT LAKE

A.M.-C. Arturo Morales-Carrión. *Executive Director, Puerto Rican Endowment for the Humanities, San Juan. Author of* Puerto Rico and the Non-Hispanic Caribbean.
PUERTO RICO

A.M.C.L. Agnes M.C. Latham. *Former Reader in English, Bedford College, University of London. Editor of* The Poems of Sir Walter Ralegh *and others.*
RALEIGH, SIR WALTER

A.M.D. A.M. Dauer. *Chairman, Department of Afro-American Studies, College of Music and Dramatic Arts, Graz, Austria. Author of* Studien zur Ethnogenese bei den Mangbetu.
AFRICAN PEOPLES, ARTS OF (*in part*)

A.M.G. Alan M. Gaines. *Associate Program Director for Geochemistry, National Science Foundation, Washington, D.C.*
CARBONATE MINERALS

A.M.Ga. Aleksandr Mikhaylovich Gavrilov. *Senior Scientist, Leningrad Hydrological Institute.*
DON RIVER
DVINA RIVER, NORTHERN

A.Mi. Arthur Mizener. *Mellon Foundation Professor Emeritus of Humanities, Cornell University, Ithaca, New York. Author of* The Far Side of Paradise: A Biography of F. Scott Fitzgerald *and others.*
FITZGERALD, F. SCOTT

A.M.J. Rev. A.M. Jones. *Lecurer in African Music, School of Oriental and African Studies, University of London. 1952–66. Author of* Studies in African Music *and others.*
AFRICAN PEOPLES, ARTS OF (*in part*)

A.M.M. Aleksandr Mefodyevich Marinich. *Head, Physical Geography, T.G. Shevchenko State University, Kiev. Author of* Geomorfologiya yuzhnogo Polesya.
PRIPET MARSHES

A.M.Ma. Abraham M. Max. *Emeritus Professor of Mechanical Engineering, Indiana University-Purdue University at Indianapolis.*
SOUND RECORDING AND REPRODUCING (*in part*)

A.M.Mu. Aleksey Mikhaylovich Muromtsev. *Assistant Director, State Institute of Oceanography, Moscow. Author of* Mirovoy okean.
AZOV, SEA OF

A.M.N. Alois M. Nagler. *Henry McCormick Professor of Dramatic History and Criticism; Director of Graduate Studies in the History of the Theatre, Yale University. Author of* Sources of Theatrical History *and others.*
BERNHARDT, SARAH
DUSE, ELEONORA

A.Mo. Alberto Monroy, M.D. *Director, Zoological Station, Naples. Author of* Chemistry and Physiology of Fertilization.
FERTILIZATION

A.Moz. Asokendu Mozumder. *Associate Faculty Fellow, Radiation Laboratory, University of Notre Dame, Indiana. Co-author of* Advances in Radiation Chemistry.
RADIATION EFFECTS ON MATTER (*in part*)

A.M.Q. Anthony M. Quinton. *President, Trinity College, Oxford; Former Lecturer in Philosophy, University of Oxford. Author of* Utilitarian Ethics *and others; editor of* Political Philosophy.
EMPIRICISM

A.M.Sl. Axel Mose Sløk. *Head of Section, Department of Economics and Statistics, Danish Employers' Confederation, Copenhagen. Instructor, Copenhagen School of Economics and Business Administration. Co-author and editor of* The Danish Legislation 1968–71.
DENMARK

A.M.W. A.M. Winchester. *Professor of Biology, University of Northern Colorado, Greeley. Author of* Genetics *and others.*
GENETICS

A.N. Alvin Novick. *Associate Professor of Biology, Yale University. Researcher on the biology of bats, with emphasis on echolocation. Co-author of* The World of Bats.
CHIROPTERA

A.Na. Arata Naka. *Former Professor of Japanese History of Education, University of Tokyo. Author of* The Formation of the Modern Textbook System.
EDUCATION, HISTORY OF (*in part*)

An.A.A. Anwar Abdel Aleem. *Professor of Biological Oceanography; Chairman, Department of Oceanography, University of Alexandria, Egypt.*
ARABIAN SEA

An.B. Anthony Burgess. *Novelist and critic. Author of* A Clockwork Orange; The Novel Now; Urgent Copy's; *and many others.*
NOVEL

An.Br. André Brincourt. *Director of Cultural Services,* Le Figaro, *Paris. Author of* André Malraux ou le temps du silence.
MALRAUX, ANDRÉ

A.Ne. Andries Nel. *Professor of Geography, University of Stellenbosch, South Africa. Author of* Stad en dorp; Die warm Reënstreke.
SOUTH AFRICA (*in part*)

A.Ni. Arnold Niederer. *Professor of European Ethnology, University of Zürich, Switzerland. Co-author of* Atlas der schweizerischen Volkskunde.
ALPINE FOLK CULTURES

A.N.J. Alexander Norman Jeffares. *Professor of English, University of Stirling, Scotland. Editor,* Ariel. *Author of* W.B. Yeats: Man and Poet; A Commentary on the Collected Poems of W.B. Yeats; *editor of* Selected Poems and Prose: Whitman.
WHITMAN, WALT

A.N.K. Aleksey Nilovich Kosarev. *Senior Scientist in Oceanography, Department of Geography, Moscow M.V. Lomonosov State University.*
CASPIAN SEA (*in part*)

An.L. Antonino Lombardo. *Inspector General of National Archives, Rome. Professor of the Study of Archives, University of Rome. Co-author of* Documenti del commercio veneziano nei secoli XI-XIII.
DANDOLO, ENRICO

A.N.L.W. Arthur N.L. Wina. *Member of Parliament, 1962–68 and 1973– ; Minister of Finance, 1963–67; Minister of Education, 1967–68, Government of Northern Rhodesia, renamed Zambia in 1964.*
VICTORIA FALLS
ZAMBEZI RIVER

A.No. Alexander Nove. *Professor of Economics; Head, Institute of Soviet and East European Studies, University of Glasgow, Scotland. Author of* An Economic History of the U.S.S.R. *and others.*
ECONOMIC PLANNING (*in part*)

A.N.R.R. Arthur Napoleon Raymond Robinson. *Barrister at Law. Author of* The Mechanics of Independence: Patterns of Political and Economic Transformation in Trinidad and Tobago.
TRINIDAD AND TOBAGO (*in part*)

An.S. Ailon Shiloh. *Professor and Director of Graduate Studies, Department ofAnthropology, University of South Florida, Tampa. Editor of* Peoples and Cultures of the Middle East.
MASHRIQ, CULTURES OF THE

An.Sc. Annemarie Schimmel. *Professor of Indo-Muslim Culture, Harvard University. Author of* Gabriel's Wing; Islamic Calligraphy; Spiritual Dimensions of Islam; *and others.*
ISLĀMIC MYSTICISM
ISLĀMIC MYTH AND LEGEND
ISLĀMIC PEOPLES, ARTS OF (*in part*)
JALĀL AD-DĪN AR-RŪMĪ

A.N.Y. A.N. Yiannopoulos. *Professor of Law, Louisiana State University, Baton Rouge. Reporter, Civil Code Revision, Louisiana State Law Institute. Author of* Civil Law Property.
CARRIAGE OF GOODS, LAW OF
PROPERTY, LAW OF

A.O.J.C. A.O.J. Cockshut. *G.M. Young Lecturer in 19th-Century English Literature, University of Oxford; Fellow of Hertford College, Oxford. Author of* The Achievement of Walter Scott; Anglican Attitudes: A Study of Victorian Religious Controversies; *and others.*
CARLYLE, THOMAS
SCOTT, SIR WALTER

A.O.S. Alfred Osipovich Shpaykher. *Senior Scientist, Arctic and Antarctic Scientific Research Institute, Leningrad.*
KARA SEA (*in part*)
LAPTEV SEA (*in part*)

A.P. A. Papp. *Professor of Micropaleontology, University of Vienna.*
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A.Pa. André Parrot. *Director of the Louvre. Member of the Institute of France. Author of* Abraham and His Times *and others.*
ABRAHAM

A.P.D. Anatoly Petrovich Domanitsky. *Senior Scientist, Leningrad Hydrological Institute.*
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DNESTR RIVER
DVINA RIVER, WESTERN

A.P.G. Alberto Passos Guimarães. *Geography Editor,* Enciclopedia Mirador Internacional, *Rio de Janeiro.*
RIO DE JANEIRO (CITY)
RIO DE JANEIRO (STATE)

A.P.L. Aleksandr Petrovich Lisitsin. *Head, Laboratory of Physical Methods of Research, Institute of Oceanology, Academy of Sciences of the U.S.S.R., Moscow. Author of* Processes of Recent Sedimentation in the Bering Sea; Sedimentation in the World Ocean; *and others.*
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BERING SEA AND STRAIT

A.P.M. Aleksandr Pavlovich Muranov. *Senior Scientist, Leningrad Hydrological Institute. Author of* Velichayshiye reki mira.
AMUR RIVER
YANGTZE RIVER

A.P.Ma. Arthur Paul Mattuck. *Professor of Mathematics, Massachusetts Institute of Technology, Cambridge.*
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A.P.S. Antonio Padoa Schioppa. *Professor of the History of Law, University of Pavia, Italy. Author of* Ricerche sull' appello nel diritto intermedio.
EUROPEAN LAW, MEDIEVAL

A.Q.Y. Angel Quintana Yoingco. *Executive Director, National Tax Research Center, Manila, Philippines. Consultant on Academic Affairs, Lyceum of the Philippines, Manila. Co-author of* Fiscal Systems and Practices in Selected Asian Countries.
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A.R. Alan Ryalls. *Former Editor,* Camping and Caravanning *magazine, Camping Club of Great Britain and Ireland. Author of* Modern Camping *and others.*
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Ar.B. Arnaldo Bruschi. *Professor of the History of Architecture, University of Rome. Author of* Bramante architetto.
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A.R.B. A. Richard Baldwin. *Vice President and Executive Director of Research, Cargill, Inc., Minneapolis, Minnesota. Editor,* Journal of the American Oil Chemists' Society.
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PEPYS, SAMUEL

A.R.Bu. Andrew Robert Burn. *Visiting Professor, A College Year in Athens, Inc., 1969–72. Reader in Ancient History, University of Glasgow, 1965–69. Author of* Persia and the Greeks *and others.*
THEMISTOCLES

A.R.C. A. Robert Caponigri. *Professor of Philosophy, University of Notre Dame, Indiana. Author of* History and Liberty: The Historical Writings of Benedetto Croce.
CROCE, BENEDETTO

Ar.D. Arthur J.M. Doucy. *Professor of Social Economics; Director, Institute of Sociology, Free University of Brussels. Author of* Traité d'économie sociale.
BELGIUM

A.Re. Alan Reed (deceased). *Head, Department of Architecture, Faculty of*

Construction Technology and Design, Polytechnic of the South Bank, London. Fellow of the Royal Institute of British Architects.
CARPENTRY

Ar.H. Rabbi Arthur Hertzberg. *Adjunct Professor of History, Columbia University. Author of* The French Enlightenment and the Jews; *editor of* The Zionist Idea; Judaism; *and others.*
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A.-R.H. Abdul-Rahman Hamidé. *Head, Department of Geography, Damascus University. Author of* La Région d'Alep.
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SYRIA (*in part*)

Ar.Hü. Arthur Hübscher. *Director, Schopenhauer Archives, Frankfurt. President, International Schopenhauer Society, Frankfurt. Author of many books on Schopenhauer; editor of* Schopenhauer's Works.
SCHOPENHAUER, ARTHUR

A.Ri. Alan Rich. *Music Critic and Arts Editor,* New York Magazine. *Author of* Music: Mirror of the Arts *and others.*
HARMONY

A.R.J. Alan R. Jefferson. *Light Orchestral Manager, British Broadcasting Corporation, London. Visiting Professor, Guildhall School of Music and Drama, London. Author of* The Lieder of Strauss *and others.*
STRAUSS, RICHARD

A.R.K. Alan Roy Katritzky. *Professor of Chemistry, University of East Anglia, Norwich, England. Co-author of* Principles of Heterocyclic Chemistry.
HETEROCYCLIC COMPOUNDS

A.R.Ki. Albert Roland Kiralfy. *Professor of Law, King's College, University of London. Author of* The English Legal System.
COMMON LAW

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A.R.L. Alan R. Longhurst. *Director, Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, Nova Scotia.*
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Ar.L.S. Arthur L. Schawlow. *Professor of Physics, Stanford University, California.*
LASER AND MASER

Ar.M. Arthur Mitzman. *Professor of History, University of Amsterdam. Author of* The Iron Cage: An Historical Interpretation of Max Weber.
WEBER, MAX

A.R.M. Alexander Reginald Myers. *Professor of Medieval History, University of Liverpool. Author of* England in the Late Middle Ages; The Household of Edward IV; *and others.*
EDWARD IV OF ENGLAND
HENRY VII OF ENGLAND

A.R.McB. Alexander R. McBirney. *Professor of Geology, Center for Volcanology, University of Oregon, Eugene. Co-author of* Geology and Petrology of the Galapagos Islands.
IGNEOUS ROCKS, EXTRUSIVE

A.R.Mi. Andrew Ronald Mitchell. *Professor of Numerical Analysis, University of Dundee, Scotland. Author of* Computational Methods in Partial Differential Equations.
NUMERICAL ANALYSIS (*in part*)

A.Ro. Arnold Rood. *Professor of Dramatic Art, Dowling College, Oakdale, New York. Author of* Edward Gordon Craig, Artist of the Theatre, 1872–1966; *co-author of* Edward Gordon Craig: A Bibliography.
CRAIG, EDWARD GORDON

A.R.P. Allison R. Palmer. *Professor of Paleontology, State University of New York at Stony Brook. Co-author of* Cambrian of the New World
CAMBRIAN PERIOD

A.R.R. Allen R. Russon. *Emeritus Professor of Management, College of Business, University of Utah, Salt Lake City. Author of* Methods of Teaching Shorthand.
SHORTHAND

Ar.S. Arthur Selzer, M.D. *Chief of Cardiology; Director, Cardiopulmonary Laboratories, Presbyterian Hospital of Pacific Medical Center, San Francisco. Clinical Professor of Medicine; Stanford University and University of California. Author of* The Heart: Its Function in Health and Disease.
BLOOD CIRCULATION, HUMAN

A.Rs. Angus Ross. *Reader in English, University of Sussex, Brighton, England. Author of* Gulliver's Travels: A Study *and others.*
Reviewer: LITERATURE, WESTERN (*in part*)

A.R.S. Alarich R. Schultz. *Professor of Botany, Federal University of Rio Grande do Sul, Pôrto Alegre, Brazil. Author of* Estudo Prático da Botânica Geral.
AMAZON RAIN FOREST

A.R.W. Almon Robert Wright. *Senior Historian, U.S. Department of State, Washington, D.C., 1958–66. Compiler and editor of South America, Panama, and part of the Inter-American sections of U.S. Department of State,* Foreign Relations: The American Republics, 1941–48.
CENTRAL AMERICAN STATES, HISTORY OF (*in part*)

A.S.A. Ass'ad Sulaiman Abdo. *Lecturer in Geography; President of the Saudi Geographical Society, University of Riyadh, Saudi Arabia. Author of* Land and Air Transport in Saudi Arabia.
MECCA

As.B. Asa Briggs, Baron Briggs. *Provost of Worcester College, University of Oxford. Author of* The Age of Improvement, 1783–1867 *and others.*
BRITAIN AND IRELAND, HISTORY OF (*in part*)
COBDEN, RICHARD

A.Sc. Aaron Scharf. *Professor of Art History, Open University, Milton Keynes, England. Author of* Art and Photography; Pioneers of Photography.
CARTIER-BRESSON, HENRI

A.S.C. Alden S. Crafts. *Emeritus Professor of Botany, University of California, Davis. Author of* Weed Control *and others.*
WEED CONTROL

A.S.Cu. Alan S. Curtis. *Professor of Music, University of California, Berkeley. Author of* Sweelinck's Keyboard Music.
RAMEAU, JEAN-PHILIPPE

A.S.D. A.S. Davidsohn. *Consulting Chemist. Co-author of* Soap Manufacture; Synthetic Detergents.
SOAPS AND DETERGENTS

A.Se. Amulya Chandra Sen. *Former Editor,* The Indo-Asian Culture. *Author of* Asoka's Edicts *and others.*
AŚOKA

A.S.F. Angus Stewart Fletcher. *Professor of English, State University of New York at Buffalo. Author of* Allegory: The Theory of a Symbolic Mode *and others.*
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A.Sg. Alfred Steinberg. *Free-lance writer. Author of* Man from Missouri: The Life and Times of Harry S. Truman *and others.*
TRUMAN, HARRY S.

A.Sh. Amnon Shiloah. *Professor of Musicology, Hebrew University of Jerusalem. Author of* Caracteristiques de l'art vocal arabe au Moyen-Âge; La Perfection des connaissances musicales; *and others.*
ISLĀMIC PEOPLES, ARTS OF (*in part*)

A.Sh.-W. Adrian N. Sherwin-White. *Reader in Ancient History, University of Oxford. Author of* The Roman Citizenship; Roman Society and Roman Law in the New Testament.
GRACCHI, THE

A.Si. Alfredo Siragusa. *Director, School of Geographical Sciences, University of Salvador, Buenos Aires. Author of* Geomorfología de la provincia de Buneos Aires *and others.*
ARGENTINA (*in part*)

A.S.K. Arvid S. Kapelrud. *Professor of Old Testament, University of Oslo. Author of* Israel.
AARON

A.S.K.-F. Alexander Sydney Kanya-Forstner. *Associate Professor of History, York University, Downsview, Ontario. Author of* The Conquest of the Western Sudan: A Study in French Military Imperialism.
FAIDHERBE, LOUIS

A.S.L. Arthur Stanley Link. *George H. Davis '86 Professor of American History; Director of the Woodrow Wilson Papers, Princeton University. Author of* Wilson; *editor of* The Papers of Woodrow Wilson.
UNITED STATES, HISTORY OF THE (*in part*)

A.S.M. Arve Sverre Moen (d. 1976). *Cultural Editor,* Arbeiderbladet *newspaper, Oslo. Member of the Board, Edvard Munch Museum, Oslo. Author of* Edvard Munch *and others.*
MUNCH, EDVARD

A.So. Angelo Solmi. *Film critic,* Oggi *(weekly literary periodical). Managing Editor, Rizzoli Editore, Milan. Author of* Storia di Federico Fellini *and others.*
FELLINI, FEDERICO

A.Sp. Athelstan Spilhaus. *Fellow, Woodrow Wilson International Center for Scholars, Smithsonian Institution, Washington, D.C. Author of* Waste Management and Control.
POLLUTION CONTROL (*in part*)

A.S.Pa. Ante S. Pavelić. *Writer. Author of* Dr. Ante Trumbić: Problemi hrvatsko-srpskih odnosa *and others.*
PAŠIĆ, NIKOLA

A.S.R. Alfred S. Romer (d. 1973). *Alexander Agassiz Professor of Zoology, Harvard University, 1947–65.*
SIMPSON, GEORGE GAYLORD

A.St. Anthony Standen. *Executive Editor,* Kirk-Othmer Encyclopedia of Chemical Technology, *New York City, 1963–70. Author of* Science Is a Sacred Cow.
CHEMICAL INDUSTRY (*in part*)

A.S.Wi. Arthur Strong Wightman. *Thomas D. Jones Professor of Mathematical Physics, Princeton University.*
PARTICLES, SUBATOMIC (*in part*)

A.T. Armen Takhtajan. *Director; Chief, Department of Higher Plants, Komarov Botanical Institute, Academy of Sciences of the U.S.S.R., Leningrad. Author of* Flowering Plants: Origin and Dispersal.
ANGIOSPERM

A.Ta. Allen Tate. *Poet and critic. Regents' Professor Emeritus of English, University of Minnesota, Minneapolis. Editor of* T.S. Eliot: The Man and His Work, A Critical Evaluation by Twenty-six Distinguished Writers *and others.*
ELIOT, T.S.

A.Te. Ahmet Temir. *Professor of Turcology and Mongolian Language, University of*

Ankara. Director, Turkish Cultural Research Institute, Ankara.
TURKEY (*in part*)

A.T.L. Anthony Thornton Luttrell. *Former Assistant Director, British School at Rome.*
GENOA
PISA
SIENA

A.To. Augusto Torre (d. 1977). *Professor and Chairman, Department of Modern and Contemporary History, University of Bologna, Italy, 1956–60. President, Scientific Lyceum and Teaching Institute of Ravenna, Italy, 1937–60. Author of* Ravenna: Storia di 3000 anni *and others.*
RAVENNA

A.Tt. Albert Thibaudet (d. 1936). *Literary critic. Author of* La Poésie de Stéphane Mallarmé.
BERGSON, HENRI (*in part*)

A.T.v.M. Arthur Taylor von Mehren. *Story Professor of Law, Harvard University. Author of* The Civil Law System.
CONTRACTS, LAW OF

A.Ty. Andrew Tracey. *Musicologist, International Library of African Music; Roodepoort, South Africa, Editor,* African Music *(journal of the African Music Society).*
AFRICAN PEOPLES, ARTS OF (*in part*)

A.U. Arne Unhjem. *Professor of Philosophy, Wagner College, Staten Island, New York. Author of* Dynamics of Doubt: A Preface to Tillich.
TILLICH, PAUL

Au.G. Aubrey Gorbman. *Professor of Zoology, University of Washington, Seattle. Co-author of* Textbook of Comparative Endocrinology; *editor of* General and Comparative Endocrinology.
ENDOCRINE SYSTEMS

Au.L.R. Austin L. Rand. *Research Associate, Archbold Biological Station, Lake Placid, Florida. Chief Curator of Zoology, Field Museum of Natural History, Chicago, 1955–70. Author of* Ornithology: An Introduction; *co-author of* Birds of New Guinea.
CORACIIFORMES

Au.T. Auguste Toussaint. *Director of Mauritius Archives, Port Louis, 1945–70. Author of* History of the Indian Ocean *and others.*
MAURITIUS

A.V. Arthur Vööbus. *Professor of Primitive Christianity and Ancient Church History, Lutheran School of Theology at Chicago. Visiting Professor, Department of Near Eastern Languages and Civilizations, University of Chicago. Author of* History of Asceticism in the Syrian Orient; Early Versions of the New Testament; *and others.*
ASCETICISM
EASTERN CHRISTIANITY, INDEPENDENT CHURCHES OF

A.Va. Amry Vandenbosch. *Emeritus Professor of Political Science, University of Kentucky, Lexington. Co-author of* The United Nations.
UNITED NATIONS (*in part*)

A.v.B. Andres R.F.T. von Brandt. *Emeritus Professor of Fish Catching Techniques, University of Hamburg. Director, Institute for Fish Catching Techniques, Ministry for Food and Agriculture, Hamburg, 1936–71. Author of* Fish Catching Methods of the World *and others.*
FISHING, COMMERCIAL

A.V.B.N. A.V.B. Norman. *Master of the Armouries, Tower of London. Author of* Arms and Armour *and others.*
ARMOUR

A.V.D. A. Vibert Douglas. *Emeritus Professor of Astronomy, Queen's University at Kingston, Ontario. Author of* Arthur Stanley Eddington.
EDDINGTON, SIR ARTHUR STANLEY

A.V.I. Artemy V. Ivanov. *Head, Laboratory of Evolutionary Morphology, Zoological Institute, Academy of Sciences of the U.S.S.R., Leningrad. Professor of Zoology, Leningrad A.A. Zhdanov State University. Author of* Pogonophora.
POGONOPHORA

A.Vo. (William) Arthur Voyce. *Historian of Russian Art and Architecture. Author of* The Art and Architecture of Medieval Russia *and others.*
VISUAL ARTS, WESTERN (*in part*)

A.V.S. Arseny Vladimirovich Shnitnikov. *Senior Scientist, Limnology Laboratory, Academy of Sciences of the U.S.S.R., Leningrad.*
BALKHASH, LAKE

A.v.T. Arved, Baron von Taube. *Chairman of the Carl Schirren Society. Member of the Board, Baltic Historical Commission. Teacher of History, Latin, and Russian, Gerhard Rohlfs Gymnasium, Bremen, West Germany, 1951–71. Co-author of* Von den baltischen Provinzen zu den baltischen Staaten.
BALTIC STATES, HISTORY OF THE (*in part*)

A.W. Alan Walker. *Professor and Chairman, Department of Music, McMaster University, Hamilton, Ontario. Author of* An Anatomy of Musical Criticism; A Study in Musical Analysis; *and others.*
MUSICAL CRITICISM

A.Wa. Andrew Warren. *Senior Lecturer in Geography, University College, University of London.*
SAND SHEETS AND SAND DUNES

A.W.G. Alan William Gentry. *Prinicpal Scientific Officer, Department of Palaeontology, British Museum (Natural History), London. Author of numerous research papers on Old World hoofed mammals.*
ARTIODACTYLA

A.W.Ge. Arnold Wycombe Gomme (d. 1959). *Professor of Greek, University of Glasgow, 1946–57. Author of* Historical Commentary on Thucydides; Greece; *and others.*
THUCYDIDES

A.W.Gr. Alic William Gray. *Head, Agricultural Advisory and Development Section, Electricity Council, London, 1966–70; Principal Assistant, 1948–65.*
AGRICULTURE, HISTORY OF (*in part*)

A.Wh. Alwyne Wheeler. *Staff member, Fish Section, Zoology Department, British Museum (Natural History), London. Author of* Fishes of the British Isles and North West Europe.
SCORPAENIFORMES

A.W.J. A. Walter James. *Principal, St. Catharine's, Windsor, England. Editor,* The Times (*London*) Educational Supplement, *1952–69. Author of* The Christian in Politics *and others.*
ACTON, LORD

A.W.Ke. A.W. Keuffel (deceased). *Director, Vice President, and Secretary, Keuffel and Esser Company (manufacturers of slide rules and other equipment), Morristown, New Jersey.*
MATHEMATICS, HISTORY OF (*in part*)

A.W.L. Albert William Levi. *David May Distinguished University Professor of Humanities, Washington University, St. Louis, Missouri. Author of* Philosophy and the Modern World.
PHILOSOPHY, HISTORY OF WESTERN (*in part*)

A.W.M. Anne Wood Murray. *Emeritus Curator of American Costume, Division of Costume and Furnishings, Department of Cultural History, United States National Museum of History and Technology, Smithsonian Institution, Washington, D.C.*
DRESS (*in part*)

A.Wo. Albert Wolfson. *Professor of Biological Sciences, Northwestern University, Evanston, Illinois.*
PHOTOPERIODISM.

A.W.P. Alois Wilhelm Podhajsky (d. 1973). *Director, Spanish Riding School of Vienna, 1939–64. Winner, Olympic Bronze Medal for Dressage (equestrian event), 1936. Author of* The Complete Training of Horse and Rider *and others.*
HORSE

A.W.R. Alan Westcott Richards. *Development Manager, Imperial Smelting Ltd., Bristol, England. Author of articles on zinc smelting and zinc metallurgy.*
ZINC PRODUCTS AND PRODUCTION

A.W.Re. Allen Walker Read. *Professor of English, Columbia University. Author of "Approaches to Lexicography and Semantics" in* Current Trends in Linguistics.
DICTIONARY

A.W.S. Albert Wilbur Schlechten. *Director, Institute for Extractive Metallurgy, Colorado School of Mines, Golden; Alcoa Foundation Professor of Metallurgy, 1971–75.*
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OPTIMIZATION, MATHEMATICAL THEORY OF (*in part*)

A.Y. Atsuchiko Yoshida. *Professor of Comparative Religion, Seikei University, Tokyo. Author of* Origins of Japanese Myths *and others.*
EPIC

A.Zy. Antoni Zygmund. *Gustavus F. and Anne M. Swift Distinguished Service Professor of Mathematics, University of Chicago. World authority on Fourier analysis. Author of* Trigonometric Series; *co-author of* Analytic Functions.
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B. Robert Norman William Blake, Baron Blake. *Provost, Queen's College, University of Oxford. Author of* The Conservative Party from Peel to Churchill *and others.*
ASQUITH, H.H.
DISRAELI, BENJAMIN
LLOYD GEORGE, DAVID

B.A. Bruno Accordi. *Former Director, Geology and Paleontology Institute, University of Rome. Author of numerous publications on geology.*
APENNINE RANGE

B.A.A. Barbara Anne Alpert. *Assistant Editor, Geography,* Encyclopædia Britannica, *Chicago.*
MANIPUR

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B.A.D. Boyce A. Drummond, Jr. *Professor of History; Dean, School of Liberal Arts, Henderson State University, Arkadelphia, Arkansas. Author of* Arkansas, Politics and Government.
ARKANSAS

B.A.F. Boris Aleksandrovich Fedorovich. *Senior Scientist, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow.*
KARA-KUM DESERT

B.A.J. Benjamin A. Jones, Jr. *Professor of Agricultural Engineering, University of Illinois, Urbana. Co-author of* Engineering Applications in Agriculture.
IRRIGATION AND DRAINAGE

B.Am. Barthélemy Amengual. *Editor,* Études Cinématographiques. *Author of* René Clair; Clés pour le cinéma.
CLAIR, RENÉ

B.A.M. Boyd A. Martin. *Distinguished Borah Professor of Political Science; Director, Institute of Human Behavior; Director, Bureau of Public Affairs Research, University of Idaho, Moscow. Author of* Idaho Voting Trends *and others.*
IDAHO

B.A.R. Barbara A. Ringer. *Register of Copyrights, Copyright Office, Library of Congress, Washington, D.C. Co-author of* Copyrights.
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B.A.-S. Brian Abel-Smith. *Professor of Social Administration, London School of Economics and Political Science, University of London. Author of* An International Study of Health Expenditure *and others.*
HEALTH AND DISEASE, ECONOMICS OF

B.B. Bela Balassa. *Professor of Political Economy, Johns Hopkins University, Baltimore, Maryland. Consultant, International Bank for Reconstruction and Development. Author of* Trade Liberalization Among Industrial Countries: Objectives and Alternatives *and others.*
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B.B.Bo. Boris Borisovich Bogoslovsky. *Professor of Physical Geography of the U.S.S.R., Belorussian V.I. Lenin State University, Minsk, U.S.S.R.*
LADOGA, LAKE
ONEGA, LAKE

B.Be. Bernard Beckerman. *Brander Matthews Professor of Dramatic Literature; Chairman, Theatre Arts Division, Columbia University. President, American Society for Theatre Research. Author of* Shakespeare at the Globe; Dynamics of Drama; *and others.*
THEATRICAL PRODUCTION

B.B.H. Bruce B. Hanshaw. *Research Geochemist, Water Resources Division, Geological Survey, U.S. Department of the Interior, Reston, Virginia. An authority on the geochemistry of groundwater.*
GEOCHEMICAL EQUILIBRIA AT LOW TEMPERATURES AND PRESSURES (*in part*)

B.B.J. Benjamin Burwell Johnston, Jr. *Composer. Professor of Music, University of Illinois, Urbana.*
MUSIC THEORY

B.Bl. Brand Blanshard. *Sterling Professor Emeritus of Philosophy, Yale University. Author of* The Nature of Thought; Reason and Analysis.
RATIONALISM

B.Ble. Brebis Bleaney. *Former Dr. Lee's Professor of Experimental Philosophy, University of Oxford. Co-author of* Electricity and Magnetism.
MAGNETISM

B.Bo. Baruch Boxer. *Professor of Human Ecology and Social Science, Cook College, Rutgers University, New Brunswick, New Jersey. Author of* Ocean Shipping in the Evolution of Hong Kong.
SHANGHAI
SHANSI
SHANTUNG
TIENTSIN
WU-HAN

B.B.R. B.B. Roy. *Professor of Agricultural Chemistry; Head, Department of Agriculture, University of Calcutta.*
THAR DESERT (*in part*)

B.B.S. Brian Betham Schofield. *Vice-Admiral, Royal Navy (retired). Author of* British Seapower *and others.*
GUNNERY (*in part*)

B.C. Barnaby Conrad. *Free-lance writer. Student of bullfighting with Juan Belmonte, 1943–46; bullfighter, 1946. Author of* Matador; La Fiesta Brava; Encyclopedia of Bullfighting; *and others.*
BULLFIGHTING

B.Ch. Brian Chapman. *Professor of Government, Victoria University of Manchester, England. Author of* The Profession of Government *and others.*
CIVIL SERVICE (*in part*)

B.C.H. Bruce C. Heezen (d. 1977). *Associate Professor of Geology, Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York, 1964–77. Co-author of* The Floors of the Oceans.
ATLANTIC OCEAN (*in part*)

B.Cr. Bosley Crowther. *Creative consultant, Columbia Pictures, New York City, 1968–73. Screen critic and editor,* The New York Times, *1940–68. Author of* The Great Films: Fifty Golden Years of Motion Pictures.
DISNEY, WALT

B.C.R. Bruce Carlisle Robertson. *Specialist in Oriental Studies. Former Instructor in Philosophy and Religion, Towson State College, Maryland.*
RAY, RAMMOHAN

B.C.S. B. Charlotte Schreiber. *Instructor in Geology, Barnard College, Columbia University. Co-editor of* Sedimentology, *"Earth Science Series."*
RED SEA (*in part*)

B.C.So. Brian C. Southam. *Publisher, Concord Books, London. Author of* Jane Austen's Literary Manuscripts; Tennyson; *and others.*
AUSTEN, JANE

B.D.B. B. Devereux Barker III. *Associate Editor,* Yachting *magazine. Chairman, New York Yacht Club Race Committee. Co-author of* 1001 Questions Answered About Boats and Boating.
BOATING AND YACHTING (*in part*)

B.Di. Bern Dibner. *Director, Burndy Library, Norwalk, Connecticut. Author of* Heralds of Science.
GALVANI, LUIGI

B.D.N. B. Davie Napier. *Dean of the Chapel; Professor of Religion, Stanford University, California. Author of* Prophets in Perspective *and others.*
EZEKIEL

B.E. Blake Ehrlich (d. 1974). *Free-lance writer. Author of* Paris on the Seine; London on the Thames; *and many others.*
ATHENS (*in part*)
DUBLIN
EDINBURGH
FLORENCE
ISTANBUL
LISBON
LONDON
MADRID
MARSEILLE
NAPLES
PARIS
ROME (*in part*)
THAMES RIVER
VENICE
VIENNA

B.E.C. Bernard Earl Conor. *Vice President, International Marketing AMF, Incorporated, Stamford, Connecticut.*
BILLIARD GAMES

Be.J. Bernard Jaffe. *Free-lance science writer. Chairman, Science Department, James Madison High School, Brooklyn, New York, 1944–58. Author of* Men of Science in America.
FERMI, ENRICO

B.E.J.P. Bernard E.J. Pagel. *Deputy Chief Scientific Officer, Royal Greenwich Observatory, Herstmonceux, England. Visiting Professor of Astronomy, University of Sussex, Brighton, England.*
ASTRONOMY AND ASTROPHYSICS

B.E.M. Bernard E. Meland. *Emeritus Professor of Constructive Theology, University of Chicago. Author of* The Realities of Faith *and others.*
OTTO, RUDOLF

Be.N. Beaumont Newhall. *Professor of Art, University of New Mexico, Albuquerque. Director, George Eastman House, Rochester, New York, 1958–71. Author of* The History of Photography; Latent Image; *and others.*
PHOTOGRAPHY, ART OF

B.E.N. Brian E. Newton. *Professor of Linguistics, Simon Fraser University, Burnaby, British Columbia. Author of* The Generative Interpretation of Dialect: A Study of Modern Greek Phonology.
GREEK LANGUAGE (*in part*)

B.E.W. Bengt E. Westerlund. *Professor, Astronomical Observatory, Uppsala, Sweden. Co-editor of* Symposium on Radio and Optical Studies of the Galaxy *and others.*
GALAXY, THE

B.F. Basil Alais Fletcher. *Emeritus Professor of Education, University of Leeds, England. Author of* A Philosophy for the Teacher *and others.*
HIGHER EDUCATION

B.F.S. Bradford Fuller Swan (d. 1976). *Theatre and Art Critic,* The Providence Journal and Evening Bulletin, *Rhode Island.*
RHODE ISLAND

B.G. Branko Grünbaum. *Professor of Mathematics, University of Washington, Seattle. Author of* Convex Polytopes.
COMBINATORICS AND COMBINATORIAL GEOMETRY (*in part*)

B.Ga. Balwant Gargi. *Playwright. Former Professor and Head, Department of Indian Theatre, Panjab University, Chandīgarh, India. Author of* Folk Theater of India *and others.*
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

B.Ge. Barbara Gelb. *Writer. Co-author of* O'Neill.
O'NEILL, EUGENE (*in part*)

B.G.M. Barbara G. Mertz. *Historian and writer. Author of* Temples, Tombs and Hieroglyphs *and others.*
MEMPHIS (EGYPT)

B.Gr. Benny Green. *Jazz Critic,* The Observer, *London. Record reviewer, British Broadcasting Corporation. Author of* The Reluctant Art; Drums in My Tears; *and others.*
JAZZ

B.G.S. Bernice Giduz Schubert. *Curator, Arnold Arboretum, Harvard University. Co-author of* The Begoniaceae of Colombia.
BEGONIALES (*in part*)

B.G.Sa. Bernard G. Saunders. *Associate Editor, Physics,* Encyclopædia Britannica, *Chicago, 1970–73. Physicist, Lawrence Radiation Laboratory, University of California, Livermore, 1959–70.*
MAGNETIC RESONANCE (*in part*)

B.Gu. B. Gungaadash. *Head of section, Institute of Geography and Geocryology, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

B.G.V. Burke G. Vanderhill. *Professor of Geography, Florida State University, Tallahassee.*
EVERGLADES

B.H.C. Ben H. Caudle. *Professor of Petroleum Engineering, University of Texas at Austin. Author of* Reservoir Engineering Fundamentals.
PETROLEUM AND GAS EXTRACTION

B.-h.H. Bae-ho Hahn. *Professor of Political Science, Korea University, Seoul. Author of* Theoretical Political Science.
KOREA, HISTORY OF (*in part*)

B.H.J. Burgess H. Jennings. *Emeritus Professor of Mechanical Engineering, Northwestern University, Evanston, Illinois. Author of* Air Conditioning and Refrigeration.
REFRIGERATION EQUIPMENT

B.H.M. Brian H. Mason. *Chairman, Department of Mineral Sciences, Smithsonian Institution, Washington, D.C. An authority on the distribution of elements in the Earth's crust. Author of* Principles of Geochemistry.
ELEMENTS, GEOCHEMICAL DISTRIBUTION OF

B.H.McC. Bayard H. McConnaughey. *Professor of Biology, University of Oregon, Eugene. Author of* Laboratory Methods in Microbiology.
MESOZOA

B.H.W. Brian H. Warmington. *Reader in Ancient History, University of Bristol, England. Author of* The Roman North African Provinces *and others.*
NORTH AFRICA, HISTORY OF (*in part*)

B.H.We. Byron H. Webb. *Consultant in dairy technology. Former Chief, Dairy Products Laboratory, Eastern Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. Co-editor of* Fundamentals of Dairy Chemistry.
DAIRYING AND DAIRY PRODUCTS

B.I.B. Boris Ivan Balinsky. *Emeritus Professor of Zoology, University of the Witwatersrand, Johannesburg, South Africa. Author of* An Introduction to Embryology.
DEVELOPMENT, ANIMAL

Bi.C. Bin Cheng. *Professor of Air and Space Law; Dean, Faculty of Laws, University of London. Author of* The Law of International Air Transport.
AIR LAW

B.I.O. Boniface Ihewunwa Obichere. *Professor of History, University of California, Los Angeles. Author of* West African States and European Expansion.
LAGOS

B.Ja. Bernard Jacobson. *Writer and music critic. Music Critic,* Chicago Daily News, *1967–73. Author of* The Music of Johannes Brahms.
SONATA

B.J.C. Bryant J. Cratty. *Professor of Kinesiology; Director, Perceptual-Motor Learning Laboratory, University of California, Los Angeles. Author of* Movement Behavior and Motor Learning; Perceptual and Motor Development in Infants and Children.
SENSORIMOTOR SKILLS

B.J.D.M. Bastiaan J.D. Meeuse. *Professor of Botany, University of Washington, Seattle. Author of* The Story of Pollination.
POLLINATION
SEED AND FRUIT

B.Je. Barbara Jelavich. *Professor of History, Indiana University, Bloomington. Co-author of* The Balkans *and others.*
BALKANS, HISTORY OF THE (*in part*)

B.J.M. Basil John Mason. *Director General, Meteorological Office, Bracknell, England. Author of* The Physics of Clouds; Clouds, Rain and Rainmaking.
CLOUDS
PRECIPITATION

B.Jo. Bernard Joy. *Football correspondent,* Evening Standard, *London. Author of* Soccer Tactics.
ASSOCIATION FOOTBALL (SOCCER)

B.J.T. Brian J. Thompson. *Professor of Optics; Dean, College of Engineering and Applied Science, University of Rochester, New York. Author of* Physical Optics Notebook.
OPTICS, PRINCIPLES OF (*in part*)

B.J.U. Benton J. Underwood. *Stanley G. Harris Professor of Social Science, Northwestern University, Evanston, Illinois. Author of* Experimental Psychology; *co-author of* Meaningfulness and Verbal Learning.
MEMORY: RETENTION AND FORGETTING

B.J.W. Bernard J. Wall (d. 1974). *Free-lance writer. Author of* Report on the Vatican; A City and a World; *and many others.*
VATICAN CITY

B.K. Benjamin Keen. *Professor of History, Northern Illinois University, De Kalb. Editor of* Readings in Latin American Civilization, 1492 to the Present *and others.*
BALBOA, VASCO NÚÑEZ DE
LATIN AMERICA AND THE CARIBBEAN, COLONIAL

B.Ke. Betty Kemp. *Fellow and Tutor in Modern History, St. Hugh's College, University of Oxford. Author of* King and Commons, 1660–1832 *and others.*
BLACKSTONE, SIR WILLIAM

B.K.N. Basheer K. Nijim. *Professor and Head, Department of Geography, University of Northern Iowa, Cedar Falls.*
SAUDI ARABIA

B.Ku. Bernhard Kummel. *Professor of Geology, Harvard University. Investigator of Mesozoic stratigraphy in the Himalayas and Peru. Author of* History of the Earth.
TRIASSIC PERIOD

B.L.C. Barbara Lovett Cline. *Biology teacher. Author of* The Questioners: Physicists and the Quantum Theory.
BROGLIE, LOUIS-VICTOR, DUC DE
DIRAC, P.A.M.

B.Le. Bernard Lewis. *Cleveland E. Dodge Professor of Near Eastern Studies, Princeton University. Author of* The Assassins *and others.*
FĀṬIMIDS

B.L.K. Barry L. Karger. *Professor of Chemistry, Northeastern University, Boston, Massachusetts. Co-author of* Introduction to Separation Science.
CHEMICAL SEPARATIONS AND PURIFICATIONS

B.L.S. Bruce Lannes Smith. *Professor of Political Science, Michigan State University, East Lansing. Co-author of* Propaganda, Communication and Public Opinion.
PROPAGANDA

B.L.T. B.L. Turner. *Professor of Botany; Director, Research in Botany-Herbarium, University of Texas at Austin. Author of* Legumes of Texas; *co-editor* Chemotaxonomy of the Leguminosae.
FABALES

B.L.v.d.W. Bartel Leendert van der Waerden. *Emeritus Professor of Mathematics, University of Zürich. Author of* Science Awakening *and others.*
ARCHIMEDES (*in part*)
EUCLID

B.M. Björn Matthíasson. *Economist; European Free Trade Association, Geneva. Former Economist, Central Bank of Iceland, Reykjavík.*
ICELAND (*in part*)

B.Ma. Benjamin March (d. 1940). *Curator of Asiatic Art, Detroit Institute of Arts. Author of* The History of Chinese Painting in Outline.
METALWORK (*in part*)

B.M.H. Bernice Margaret Hamilton. *Emeritus Leverhulme Research Fellow and Associate of Clare Hall, University of Cambridge. Former Senior Lecturer in Politics, University of York, Heslington, England. Author of* Political Thought in 16th–Century Spain.
VITORIA, FRANCISCO DE

B.M.J. Brian Michael Jenkins. *Senior Staff Member, The RAND Corporation, Santa Monica, California.*
P'YŎNGYANG
VIETNAM, NORTH

B.M.M. Barbara Mary Middlehurst. *Staff member, Lunar Science Institute, Houston, Texas. Associate Editor, Astronomy,* Encyclopædia Britannica, *Chicago, 1968–72. Co-editor of* Moon, Meteorites and Comets.
TIDES (*in part*)

B.Mo. Brita Maud Ellen Mortensen (d. 1958). *Lecturer in Swedish, University of Cambridge, 1950–58. Co-author of* An Introduction to Scandinavian Literature.
LITERATURE, WESTERN: *Swedish* (*in part*)
STRINDBERG, AUGUST

B.M.P. Benigno Mantilla Pineda. *Professor of the Sociology and Philosophy of Law, University of Antioquia, Medellín, Colombia. Author of* General Sociology.
CIVILIZATION AND CULTURAL EVOLUTION

B.N. Burno Nettl. *Professor of Music and of Anthropology, University of Illinois, Urbana. Author of* Theory and Method in Ethnomusicology; Folk and Traditional Music of the Western Continents; *and others.*
FOLK MUSIC

B.Ne. Bert Nelson. *Editor and Publisher,* Track & Field News.
TRACK-AND-FIELD SPORTS

B.N.P. Baij Nath Puri. *Research Professor, University of Lucknow, India. Author of* Cities of Ancient India *and others.*
PATNA AND PĀṬALIPUTRA
TAXILA

B.Ns. Bezalel Narkiss. *Professor of Art History, Hebrew University of Jerusalem. Author of* Hebrew Illuminated Manuscripts; *editor of* Jewish Art.
JEWISH PEOPLES, ARTS OF (*in part*)

B.N.T. B.N. Taylor. *Chief, Electricity Division, Institute for Basic Standards, National Bureau of Standards. Co-author of* The Fundamental Constants and Quantum Electrodynamics.
CONSTANTS, PHYSICAL

B.O'G. Brendan Anthony O'Grady. *Professor of English, University of Prince Edward Island, Charlottetown.*
NOVA SCOTIA
PRINCE EDWARD ISLAND

B.O'K. Bernard O'Kelly. *Dean, College of Arts and Sciences; Professor of English, University of North Dakota, Grand Forks.*
NORTH DAKOTA (*in part*)

B.R. Bayard Rankin. *Associate Editor, Mathematics,* Encyclopædia Britannica, *Chicago, 1971–73. Associate Professor of Mathematics, Case Western Reserve University, Cleveland, 1960–71. Co-author and editor of* Differential Space, Quantum Systems, and Prediction.
AUTOMATA THEORY (*in part*)

B.R.N. B.R. Nanda. *Director, Nehru Memorial Museum and Library, New Delhi. Author of* Mahatma Gandhi: A Biography *and others.*
GANDHI, MAHATMA

B.R.S. B. Raphael Sealey. *Professor of History, University of California, Berkeley. Author of* A History of the Greek City States, ca. 700–338 B.C.
GREEK CIVILIZATION, ANCIENT (*in part*)

B.R.W. Bryan R. Wilson. *Reader in Sociology, University of Oxford; Fellow of All Souls College, Oxford. Author of* Sects and Society; Religion in Secular Society; *and others.*
CHRISTIAN SCIENCE
MORMONISM

B.S.B. Benedikt Sigurdur Benedikz. *Head of Special Collections, Library, University of Birmingham, England. Author of* Iceland: The Spread of Printing.
LITERATURE, WESTERN: *Icelandic* (*in part*)

B.Sc. Bobb Schaeffer. *Curator of Vertebrate Paleontology, American Museum of Natural History, New York City. Author of numerous articles on fossil fishes.*
CHONDROSTEI (*in part*)

B.S.-E. Bickham A.C. Sweet-Escott. *Group Finance Coordinator, The British Petroleum Company Ltd., 1957–72. Manager, Ionian Bank Ltd., 1950–57. Author of* Greece: A Political and Economic Survey, 1939–1953 *and others.*
CYPRUS, HISTORY OF (*in part*)

B.S.F. Bernard S. Finn. *Curator, Division of Electricity and Modern Physics, Smithsonian Institution, Washington, D.C.*
TELEPHONE AND TELECOMMUNICATIONS SYSTEMS (*in part*)

B.S.L. Bruce Sween Liley. *Professor of Physics, University of Waikato, Hamilton, New Zealand.*
PLASMA STATE

B.Sv. B. Shirendev. *Historian. President, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

B.T. B. Tissot. *Head of Department, French Institute of Petroleum, Rueil-Malmaison.*
NATURAL GAS (*in part*)

B.T.D. Bernard Thomas Donovan. *Professor of Neuroendocrinology, Institute of Psychiatry, University of London. Author of* Mammalian Neuroendocrinology.
LACTATION, HUMAN

B.T.S. Bradley Titus Scheer. *Emeritus Professor of Biology, University of Oregon, Eugene. Author of* Animal Physiology *and others.*
PHYSIOLOGY

Bu. Richard Austen Butler, Baron Butler of Saffron Walden. *Master of Trinity College, University of Cambridge, 1965–78. Member of Parliament, 1929–65; Leader of the House of Commons, 1955–61. Author of* The Art of the Possible.
UNITED KINGDOM (*in part*)

B.V. Birgit Vennesland. *Head, Vennesland Research Laboratory, Max Planck Society; Director, Max Planck Institute for Cell Physiology, Berlin, 1968–70.*
BIOCHEMISTRY (*in part*)

B.V.G. Boris Vladimirovich Gnedenko. *Professor of Physics and Mathematics; Head, Faculty of Mathematics, Moscow M.V. Lomonosov State University. Member, Academy of Sciences of the Ukrainian S.S.R. Co-author with A.N. Kolmogorov of* Limited Distribution for Sums of Independent Random Values.
KOLMOGOROV, A.N.

B.V.Gy. Bo Vilhelm Gyllensvärd. *Director, Museum of Far Eastern Antiquities, Stockholm. Assistant Professor, Far Eastern Section, Institute of History of Art, University of Stockholm. Author of* T'ang Gold and Silver *and others.*
METALWORK (*in part*)

B.V.S. Brian Vincent Street. *Lecturer in Social Anthropology, University of Sussex, Brighton, England. Author of* The Savage in Literature.
TYLOR, SIR EDWARD BURNETT

B.W. Basil Willey (d. 1978). *King Edward VII Professor Emeritus of English Literature, University of Cambridge, 1946–64. Author of* Darwin and Butler: Two Versions of Evolution; Nineteenth Century Studies; *and others.*
ARNOLD, MATTHEW
BUTLER, SAMUEL
LITERATURE, WESTERN: *English; 19th century*
WORDSWORTH, WILLIAM

B.W.A. Bruce W. Atkinson. *Lecturer in Geography, Queen Mary College, University of London. Author of* The Weather Business.
METEOROLOGICAL MEASUREMENT

B.W.B. Bernard Winslow Beckingsale. *Senior Lecturer in Modern History, University of Newcastle upon Tyne, England. Author of* Burghley: Tudor Statesman *and others.*
CECIL, WILLIAM, LORD BURGHLEY

B.-W.C. Byong-Wuk Chong. *Professor of Korean Literature, Seoul National University. Author of* Essays on Korean Literature; Complete Anthology of Sijo.
LITERATURE, EAST ASIAN (*in part*)

B.We. Bruce Webster. *Senior Lecturer in History, University of Kent, Canterbury, England.*
ROBERT I THE BRUCE, OF SCOTLAND

B.W.H. Bruce W. Halstead, M.D. *Director, World Life Research Institute, Colton, California. Author of* Poisonous and Venomous Marine Animals of the World.
POISONOUS ANIMALS AND PLANTS

B.W.M. Bernard W. Minifie. *Consultant, Knechtel Laboratories, Inc. (consultants to the candy industry), Skokie, Illinois. Author of* Science and Technology of Chocolate, Cocoa and Confectionery.
CONFECTIONERY AND CANDY PRODUCTION (*in part*)

B.W.W. Bruce Withington Wilshire. *Professor and Chairman, Department of Philosophy, University College, Rutgers University, New Brunswick, New Jersey. Author of* Metaphysics: An Introduction to Philosophy.
METAPHYSICS (*in part*)

B.Z.B. Rabbi Ben Zion Bokser. *Rabbi, Forest Hills Jewish Center, Forest Hills, New York. Adjunct Professor of Slavic and East European Languages and Literatures, Queens College, City University of New York. Author of* The Legacy of Maimonides.
MAIMONIDES, MOSES

C.A. Claude Arpigny. *Associate Professor, Institute of Astrophysics, State University of Liège, Belgium.*
COMET

Ca.B. Carl Bode. *Professor of English, University of Maryland, College Park. Editor of* Collected Poems of Henry Thoreau; The Portable Thoreau.
THOREAU, HENRY DAVID

C.A.B. Clifford A. Barnes. *Emeritus Professor of Oceanography, University of Washington, Seattle. Author of numerous articles on oceanography.*
ATLANTIC OCEAN (*in part*)

Ca.C. Camille Camara. *Expert in Curriculum Development, United Nations Development Program, Abidjan, Ivory Coast. Author of* Saint-Louis du Senegal.
SENEGAL

C.A.E. Clive Arthur Edwards. *Principal Scientific Officer, Rothamsted Experimental Station, Harpenden, England. Author of* Principles of Agricultural Entomology.
SOIL ORGANISM

C.A.G.W. C.A.G. Wiersma. *Emeritus Professor of Biology, California Institute of Technology, Pasadena. Editor of* Invertebrate Nervous Systems: Their Significance for Mammalian Neurophysiology.
SENSORY RECEPTION

C.A.L. Carl Adam Lawrence (d. 1972). *Director, Bureau of Laboratories, Los Angeles County Health Department, California, 1953–70. Author of* Surface-Active Quaternary Ammonium Germicides; *co-editor of* Disinfection, Sterilization, and Preservation.
ANTISEPTIC AND GERMICIDE

C.-A.La. Charles-André Laffargue. *General, French Army (retired). Author of* Foch et la Bataille de 1918 *and others.*
FOCH, FERDINAND

C.A.M. Carlile Aylmer Macartney (d. 1978). *Research Fellow, All Souls College, University of Oxford, 1936–65. Montagu Burton Professor of International Relations, University of Edinburgh, 1951–57. Author of* Hungary: A Short History *and others.*
DEÁK, FERENC
HUNGARY, HISTORY OF
KOSSUTH, LAJOS

C.A.McC. Charles A. McClelland. *Professor of International Relations; Director, Research Institute, School of International Relations, University of Southern California, Los Angeles. Author of* Theory and the International System.
INTERNATIONAL RELATIONS, THEORIES OF

C.A.M.K. Cuchlaine Audrey Muriel King. *Professor of Physical Geography, University of Nottingham, England. An authority on coastal geomorphology. Author of* Beaches and Coasts; An Introduction to Oceanography.
LAGOONS

C.A.R. Colin Alistair Ronan. *Science writer and lecturer. Editor,* Journal of the British Astronomical Association. *Author of* Discovering the Universe *and many others.*
CALENDAR (*in part*)
COPERNICUS
HIPPARCHUS
PTOLEMY
RUSSELL, HENRY NORRIS

C.A.Rn. Charles Alan Robson. *Reader in French Philology and Old French Literature, University of Oxford; Fellow of Merton College, Oxford. Author of* Maurice of Sully and the Medieval French Vernacular Homily.
LITERATURE, WESTERN: *French; Medieval* (*in part*)

C.A.Ro. C. Ambrose Rogers. *Astor Professor of Mathematics, University College, University of London. Author of* Packing and Covering; Hausdorff Measures.
NUMBER THEORY (*in part*)

C.A.T. Cornelius A. Tobias. *Professor of Medical Physics, University of California, Berkeley. Author of papers in radiation biology.*
RADIATION, BIOLOGICAL EFFECTS OF

C.A.Tr. Constantine Athanasius Trypanis. *Minister of Culture and Science, Government of Greece. Professor of Classical Languages and Literatures, University of Chicago, 1968–74. Emeritus Fellow, Exeter College, Oxford; Sotheby Professor of Byzantine and Modern Greek Language and Literature, University of Oxford, 1947–68. Author of* Medieval and Modern Greek Poetry.
LITERATURE, WESTERN: *Greek*

C.Au. Charlotte Auerbach. *Emeritus Professor of Animal Genetics, University of Edinburgh.*

Author of The Science of Genetics; Mutation Research: Problems, Results, and Perspectives.
MUTATION

C.A.V. Claude A. Villee. *Andelot Professor of Biological Chemistry, Medical School, Harvard University, Boston, Massachusetts. Author of* Biological Principles and Processes *and others.*
MORPHOLOGY

C.A.W. Charles A. Wert. *Professor of Metallurgy; Head, Department of Metallurgy and Mining Engineering, University of Illinois, Urbana. Co-author of* Physics of Solids.
SOLID STATE OF MATTER (*in part*)

C.B. Colin Boocock (d. 1973). *Director of Geological Survey, Republic of Botswana, Lobatse. Co-author of* Notes on the Geology and Hydrogeology of the Central Kalahari Region.
KALAHARI (DESERT) (*in part*)

C.B.B. Carl B. Boyer (d. 1976). *Professor of Mathematics, Brooklyn College, City University of New York, 1952–76. Author of* The History of the Calculus and Its Conceptual Development; History of Analytic Geometry; A History of Mathematics; *and others.*
EULER, LEONHARD
FERMAT, PIERRE DE

C.B.C. Carl B. Crawford. *Director, Division of Building Research, National Research Council of Canada, Ottawa.*
EXPLORATION, SURFACE AND UNDERGROUND

C.B.Co. Carl B. Cone. *Professor of History, University of Kentucky, Lexington. Author of* Burke and the Nature of Politics; The English Jacobins.
BRITAIN AND IRELAND, HISTORY OF (*in part*)

C.B.D. Caio Benjamin Dias. *Former Rector, University of Brasília.*
BRASÍLIA

C.B.H. Charles B(utler) Hunt. *Professor of Geology, Johns Hopkins University, Baltimore, Maryland, 1961–73. A principal investigator of the geology of the western United States. Author of* Physiography of the United States *and others.*
EARTH, GEOLOGICAL HISTORY OF

C.B.He. Charles B. Heiser, Jr. *Professor of Botany, Indiana University, Bloomington. Author of* Seed to Civilization: The Story of Man's Food.
PIPERALES

C.Bi. Cyril Bibby. *Principal, Kingston upon Hull College of Education, University of Hull Institute of Education, England. Author of* Scientist Extraordinary: The Life and Scientific Work of T.H. Huxley *and others.*
HUXLEY FAMILY

C.B.-J. C. Burdon-Jones. *Professor of Marine Biology; Head, School of Biological Sciences, James Cook University of North Queensland, Townsville, Australia.*
HEMICHORDATA

C.Bl. Claude Blair. *Keeper of Metalwork, Victoria and Albert Museum, London. Author of* European Armour; European and American Arms; *and others.*
METALWORK (*in part*)

C.B.M. C. Beat Meyer. *Professor of Chemistry, University of Washington, Seattle. Author of* Sulfur, Energy, and Environment.
SULFUR PRODUCTS AND PRODUCTION

C.B.MacD. Charles B. MacDonald. *Deputy Chief Historian for Southeast Asia, U.S. Army Center of Military History, Washington, D.C. Author of* The Mighty Endeavor: American Armed Forces in the European Theater in World War II.
FORTIFICATIONS (*in part*)

C.B.Mo. C.B. Monk, Jr. *Senior Consultant, Wiss, Janney, Elstner, and Associates (consulting engineers), Northbrook, Illinois.*
MASONRY CONSTRUCTION

C.B.My. Charles B. Morrey, Jr. *Professor of Mathematics, University of California, Berkeley, 1945–73. Author of* Multiple Integrals in the Calculus of Variations.
ANALYSIS, FUNCTIONAL (*in part*)

C.Bo. Clara Boscaglia. *Executive Officer, Secretariat of State for Foreign Affairs, San Marino.*
SAN MARINO (*in part*)

C.C. Claude Cahen. *Professor of Islāmic History, University of Paris. Author of* La Syrie du nord à l'époque des croisades *and others.*
ALP-ARSLAN
SYRIA AND PALESTINE, HISTORY OF (*in part*)

C.C.A. Claude C. Albritton. *Hamilton Professor of Geology; Senior Scientist, Institute for the Study of Earth and Man, Southern Methodist University, Dallas, Texas. Co-author and editor of* The Fabric of Geology; Uniformity and Simplicity.
EARTH SCIENCES
UNIFORMITARIANISM

C.C.B. Charles Calvert Bayley. *Kingsford Professor of History, McGill University, Montreal. Author of* The Formation of the German College of Electors in the Mid-Thirteenth Century *and others.*
GERMANY, HISTORY OF (*in part*)

C.C.D. Charles C. Davis. *Professor of Biology, Memorial University of Newfoundland, St. John's. Author of* The Marine and Fresh-Water Plankton.
CTENOPHORA

C.Ce. Charles Cestre (d. 1959). *Professor of American Literature and Civilization, University of Paris, 1917–42. Author of* Histoire de la littérature américaine *and others.*
POE, EDGAR ALLAN (*in part*)

C.Ch. Charles Chadwick. *Carnegie Professor of French, University of Aberdeen, Scotland. Author of* Mallarmé, sa pensée dans sa poésie; Symbolism; *and others.*
MALLARMÉ; STÉPHANE

C.Ck. Cecily Clark. *Editor of* The Peterborough Chronicle 1070–1154.
LITERATURE, WESTERN: *English; Medieval (in part)*

C.Cl. Cecil Clutton. *Secretary, Organs Advisory Committee, Council for Places of Worship, England. Consultant for the rebuilding of the organ, St. Paul's Cathedral, London. Fellow, Society of Antiquaries, London. Author of* The Organ: Its Tonal Structure and Registration; The British Organ; *and others.*
ORGAN

C.C.M. Claudius Cornelius Müller. *Doctoral Candidate, Seminar for East Asian Culture and Linguistics, Ludwig Maximilian University of Munich. Co-editor of* Konkordanz zum Lao-tzu.
CH'IN SHIH HUANG TI

C.C.MacD. C.C. MacDuffee (d. 1961). *Professor of Mathematics, University of Wisconsin, 1943–61. President, Mathematical Association of America, 1945–46. Author of* The Theory of Matrices *and others.*
ARITHMETIC (*in part*)

C.C.O'B. Conor Cruise O'Brien. *Member of Seanad Eireann, Dublin. Pro-Chancellor, University of Dublin. Editor in Chief,* The Observer, *London. Author of* Parnell and His Party.
PARNELL, CHARLES STEWART

C.C.P. Cuthbert Coulson Pounder. *Marine engineering consultant. Director and Chief Technical Engineer, Harland and Wolff Ltd., Belfast, Northern Ireland, 1930–65. Co-author of* Marine Diesel Engines.
SHIP DESIGN AND CONSTRUCTION (*in part*)

C.C.T. Clifford Charles Townsend. *Principal Scientific Officer, Royal Botanic Gardens, Kew, England. Editor and co-author of* Flora of Iraq.
CORNALES
GERANIALES

C.D. Carlo Diano (d. 1974). *Professor of Greek Literature, University of Padua, Italy. Author of* Lettre di Epicuro e dei suoi; *editor of* Epicuri Ethica.
EPICUREANISM
EPICURUS

C.D.C. Charles D. Calnan. *Director, Department of Occupational Dermatoses, St. John's Hospital for Diseases of the Skin, London. Editor,* Contact Dermatitis.
SKIN DISEASES

C.D.Cu. Charles D. Cuttler. *Professor of Art History, University of Iowa, Iowa City. Author of* Northern Painting from Pucelle to Bruegel . . . .
SLUTER, CLAUS

C.De. Charles Dédéyan. *Professor and Head, Department of Comparative Literature, University of Paris IV. Author of* Montaigne chez ses amis Anglo-Saxons *and others.*
FRANCE (*in part*)

C. de P.L. Celso de Paiva Leite. *Director, Institute of Economic and Social Research, Federal University of Paraíba, João Pessoa, Brazil.*
PARAÍBA

C.D.G. C. David Gutsche. *Professor of Chemistry, Washington University, St. Louis, Missouri. Author of* Chemistry of Carbonyl Compounds.
ALDEHYDES AND KETONES

C.Do. Clifford Dowdey. *Free-lance writer. Lecturer in Creative Writing, University of Richmond, Virginia, 1958–69. Author of* Lee *and others; editor of* The Wartime Papers of Robert E. Lee.
LEE, ROBERT E.

C.D.O. Clifford David Ollier. *Senior Research Fellow, Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University, Canberra.*
JUNGLES AND RAIN FORESTS (*in part*)

C.D.R. C.D. Ross. *Reader in Medieval History, University of Bristol, England. Author of* The Wars of the Roses *and others.*
HENRY V OF ENGLAND

C.D.S. Carol D. Kiesinger. *Arts consultant. Hiker and mountain climber. Co-editor of* The Armchair Mountaineer.
MOUNTAINEERING (*in part*)

C.D.T. Conrad D. Totman. *Professor of History, Northwestern University, Evanston, Illinois. Author of* Politics in the Tokugawa Bakufu, 1600–1843.
TOKUGAWA IEYASU

C.E.B. Clifford Edmund Bosworth. *Professor of Arabic Studies, Victoria University of Manchester, England. Author of* The Islamic Dynasties *and others.*
CALIPHATE, EMPIRE OF THE

C.E.B.B. Charles Edmond Bradlaugh Bonner (d. 1976). *Principal Curator, Conservatory and Botanical Garden, Geneva. Author of* Index Hepaticarum.
EBENALES (*in part*)

C.E.B.C. Charles E.B. Conybeare. *Reader in Geology, Australian National University, Canberra.*
ORE DEPOSITS

C.E.C. Charles Edward Casolani. *Lieutenant Colonel, British Army (retired). Amateur rider, show jumper, and trainer, 1919–56.*
RIDING AND HORSEMANSHIP

C.E.Ca. Concepción E. Castañeda. *Associate Professor of Spanish, Millikin University, Decatur, Illinois. Professor of Geography, University of Havana, 1960–62.*
SÃO FRANCISCO RIVER

C.E.Co. Charles E. Cornelius. *Dean, College of Veterinary Medicine, University of Florida, Gainesville. Editor of* Advances in Veterinary Science and Comparative Medicine; Clinical Biochemistry of Domestic Animals.
DISEASES OF ANIMALS

C.E.E. Cyril Ernest Everard. *Senior Lecturer in Geography, Queen Mary College, University of London. Editor, Physical Geography,* Encyclopedia of Geography.
ENGLISH CHANNEL

C.E.H. Charles E. Hamm. *Composer. Arthur Virgin Professor of Music, Dartmouth College, Hanover, New Hampshire. Author of* Opera.
VARIATIONS, MUSICAL

C.E.He. Charles E. Hecht. *Professor of Chemistry, Hunter College, City University of New York. Author of papers on statistical and quantum mechanics and on physical and chemical processes occurring at very low temperatures.*
LOW-TEMPERATURE PHENOMENA

C.E.N. Clyde Everett Noble. *Professor of Experimental Psychology, University of Georgia, Athens. Author of* Outline of Psychological Measurement *and others.*
LEARNING, PSYCHOMOTOR

C.E.No. Charles E. Nowell. *Emeritus Professor of History, University of Illinois, Urbana. Author of* The Great Discoveries and the First Colonial Empires *and others.*
COLONIALISM (*in part*)
HENRY THE NAVIGATOR

C.E.R. Charles Edward Reynolds (d. 1971). *Managing Editor, Concrete Publications Ltd., London, 1960–69. Author of* Reinforced Concrete Designer's Handbook *and others.*
CONCRETE

C.E.T. Cecil Edgar Tilley (d. 1973). *Professor of Mineralogy and Petrology, University of Cambridge, 1931–61. World authority on igneous petrology.*
BOWEN, NORMAN LEVI
OLIVINES

C.F. Cornelio Fabro. *Professor of Theoretical Philosophy, University of Perugia, Italy. Author of* God in Exile: Modern Atheism.
ATHEISM

C.Fa. Clifton Fadiman. *Member, Board of Editors,* Encyclopædia Britannica; *Consultant in Humanities and Language Arts, Encyclopædia Britannica Educational Corporation. Consultant, Center for the Study of Democratic Institutions. Member, Board of Judges, Book-of-the Month Club. Senior Editor,* Cricket: The Children's Magazine. *Author of* The Lifetime Reading Plan *and others.*
CHILDREN'S LITERATURE

C.F.A.S. Claude Frédéric Armand Schaeffer. *Honorary Professor of the Archaeology of Western Asia, College of France, Paris. Director of the French Archaeological Expeditions to Ras Shamra-Ugarit, Syria, and Enkomi-Alasia, Cyprus. Editor of* Ugaritica I to VII.
UGARIT

C.Fe. Cyrille Felteau. *Editorial and News Writer of* La Presse, *Montreal.*
MONTREAL

C.F.F. Charles F. Fuechsel (d. 1977). *Atlantic Region Engineer, Topographic Division, Geological Survey, U.S. Department of the Interior, Washington, D.C., 1959–65. Author of numerous articles on mapping and surveys.*
MAPS AND MAPPING

C.Fi. Constantine FitzGibbon. *Writer. Author of* The Life of Dylan Thomas *and many others; editor of* Selected Letters of Dylan Thomas.
THOMAS, DYLAN

C.F.O. Christian F. Otto. *Associate Professor of Architecture, Cornell University, Ithaca, New York.*
BORROMINI, FRANCESCO

C.F.P. Charles Franklin Phillips, Jr. *Professor of Economics, Washington and Lee University, Lexington, Virginia. Author of* The Economics of Regulation.
PUBLIC UTILITIES, U.S.

C.F.R. Charles F. Richter. *Emeritus Professor of Seismology, California Institute of Technology, Pasadena. World authority on earthquakes, for whom the Richter scale of earthquake magnitude is named. Author of* Elementary Seismology.
EARTHQUAKES

C.F.S. Carl Fredrik Sandelin. *Novelist. General Manager and Editor in Chief, Finnish News Agency, Helsinki.*
FINLAND (*in part*)
HELSINKI

C.F.Sc. Carl Frederic Schmidt, M.D. *Emeritus Professor of Pharmacology, University of Pennsylvania, Philadelphia. Clinical Professor of Pharmacology, University of South Florida, Tampa.*
NERVOUS SYSTEM, HUMAN (*in part*)

C.F.V. Charles F. Voegelin. *Distinguished Professor Emeritus of Anthropology and of Linguistics, Indiana University, Bloomington. Editor,* International Journal of American Linguistics. *Co-author of* Classification and Index of the World's Languages *and others.*
LANGUAGES OF THE WORLD (*in part*)

C.G. Christiaan Glasz. *Professor of Public Finance, State University of Leyden, The Netherlands. Royal Commissioner, De Nederlandsche Bank. Co-author of* Geld en maatschappig.
MONEY MARKET (*in part*)

C.Ga. Clemente Garavito. *Vice President, Colombian Geographical Society, Bogotá. Author of numerous articles on geography.*
COLOMBIA

C.G.B. Carl G. Baker, M.D. *Medical Director; Ludwig Institute for Cancer Research, Zurich. Director, National Cancer Institute, U.S. Department of Health, Education, and Welfare, Bethesda, Maryland, 1969–72.*
CANCER

C.G. de C. Charles Gustave de Comarmond. *Editor,* Le Seychellois; *Member, Board of Directors, Le Seychellois Press Ltd.*
SEYCHELLES (*in part*)

C.G.F. Claudio Gilberto Froehlich. *Associate Professor of Zoology, Institute of Biosciences, University of São Paulo, Brazil. Author of several papers on tropical arthropods.*
ONCOPOD

C.G.G. Charles Goode Gomillion. *Emeritus Professor of Sociology, Tuskegee Institute, Alabama.*
ALABAMA

C.G.H. Carl G. Hempel. *Stuart Professor Emeritus of Philosophy, Princeton University. University Professor of Philosophy, University of Pittsburgh, Pennsylvania. Author of* Philosophy of Natural Science.
CARNAP, RUDOLF

C.G.P. Charles G. Pearson. *Chairman, Department of Journalism, Wichita State University, Kansas.*
KANSAS

C.G.S. Charles Gordon Smith. *Fellow of Keble College, Oxford; Lecturer in Geography, University of Oxford. Editor of* Oxford Regional Economic Atlas: The Middle East and North Africa.
BAHRAIN
SYRIA (*in part*)

C.G.St. Chester G. Starr. *Bentley Professor of Ancient History, University of Michigan, Ann Arbor. Author of* Rise and Fall of the Ancient World *and others.*
PEISISTRATUS

C.G.T. Constantine Gennadiyevich Tikhotskiy. *Professor, Moscow M.V. Lomonosov State University. Author of numerous articles on hydrology.*
YENISEY RIVER

C.H. Claude Harmel. *Editor,* Est et Ouest *and* Les Études Sociales et Syndicales, *Paris. Secretary, Institute for Social History, Paris. Author of* Lettre à Léon Blum sur le socialisme et la paix *and others.*
JAURÈS, JEAN

C.Ha. Carl Hanson. *Professor of Chemical Engineering, University of Bradford, England. Editor of* Recent Advances in Liquid-Liquid Extraction.
CHEMICAL ENGINEERING

C.H.B.P. Charles Henry Brian Priestley. *Professor of Meteorology, Monash University, Clayton, Australia. Author of* Turbulent Transfer in the Lower Atmosphere.
MICROCLIMATES

C.H.C. Charles Henry Cotter. *Senior Lecturer in Maritime Studies, University of Wales Institute of Science and Technology, Cardiff. Author of* The Physical Geography of the Oceans.
PACIFIC OCEAN

C.H.D. Calaway H. Dodson. *Director, Marie Selby Botanical Gardens, Sarasota, Florida. Co-author of* Orchid Flowers: Their Pollination and Evolution; The Biology of the Orchids.
ORCHIDALES

Ch.Do. Charles Dollfus. *Aeronautical historian. Honorary Director, Museum of the Air, Paris. Co-author of* Histoire de l'aéronautique.
MONTGOLFIER, JACQUES-ÉTIENNE AND JOSEPH-MICHEL

C.H.G. Cyrus H. Gordon. *Emeritus Professor of Mediterranean Studies, Brandeis University, Waltham, Massachusetts. Gottesman Professor of Hebraic Studies, New York University, New York City. Author of* The Ancient Near East; The World of the Old Testament; *and others.*
NEAR EASTERN RELIGIONS, ANCIENT
SOLOMON

C.H.Gi. Charles Hugh Giles. *Former Reader in Surface Chemistry and Dyeing, University of Strathclyde, Glasgow, Scotland. Author of* A Laboratory Course in Dyeing.
DYESTUFFS AND PIGMENTS

C.H.Go. Charles H. Goren. *Author and lecturer. Bridge Editor, Chicago Tribune-New York News Syndicate. Author of* Contract Bridge Complete; Point Count Bidding; *and others.*
BRIDGE
CARDS AND CARD GAMES

C.H.G.-S. Charles Harvard Gibbs-Smith. *Lindbergh Professor of Aerospace History,*

National Air and Space Museum, Smithsonian Institution, Washington, D.C. Research Fellow, Science Museum, London. Author of Aviation: An Historical Survey; The Wright Brothers; *and others.*
WRIGHT, ORVILLE AND WILBUR

C.H.H. Charles Harold Hayward. *Free-lance writer and artist. Editor,* Woodworker, *1939–65. Author of* English Period Furniture *and others.*
FURNITURE INDUSTRY

C.H.Ha. Cadet H. Hand, Jr. *Professor of Zoology, University of California, Berkeley; Director, Bodega Marine Laboratory, Bodega Bay, California.*
CNIDARIA

C.H.Ho. Cyrus Henry Hoy. *John B. Trevor Professor of English, University of Rochester, New York. Author of* The Hyacinth Room: An Investigation into the Nature of Comedy, Tragedy, and Tragicomedy.
COMEDY

C.Hi. Christopher Hibbert. *Historian and biographer. Author of* Benito Mussolini; The Rise and Fall of Il Duce; *and others.*
MUSSOLINI, BENITO

Ch.L. Chao Lin. *Visiting Associate Professor of History, National Chung hsing University, Tai-chung, Taiwan. Author of* Marriage, Inheritance and Lineage Organization in Shang–Chou China.
CALENDAR (*in part*)

C.H.L. Clarence H. Lorig (d. 1975). *Assistant Director, Battelle Memorial Institute, Columbus, Ohio, 1947–65. Author of* Copper as an Alloying Element in Steel and Cast Iron.
METALLURGY

C.H.Lo. Charles H. Long. *Willaim Rand Kenan, Jr., Professor of the History of Religion, University of North Carolina, Chapel Hill. Professor of the History of Religions, Duke University, Durham, North Carolina. Author of* Alpha: Myths of Creation.
CREATION, MYTHS AND DOCTRINES OF

C.H.P. Clifford Hillhouse Pope (d. 1974). *Science writer. Curator, Division of Reptiles and Amphibians, Field Musuem of Natural History, Chicago, 1941–53. Author of* The Reptile World; Turtles of the United States and Canada; *and others.*
CHELONIA

Ch.R. Chaim Rabin. *Professor of Hebrew Language, Hebrew University of Jerusalem. Author of* Qumran Studies: A Short History of the Hebrew Language.
LITERATURE, WESTERN: *Hebrew*

Ch.S. Charles Süsskind. *Professor of Engineering Science, University of California, Berkeley. Editor of* The Encyclopedia of Electronics.
CAVENDISH, HENRY

C.H.T. Charles Henri Toupet. *Professor and Director, Department of Geography, University of Dakar, Senegal. Author of* Étude du milieu physique du massif de l'Assaba, Mauritanie.
MAURITANIA

C.Hu. Charles Y. Hu. *Professor of Geography, University of Maryland, College Park. Author of monographs on the military geography of China.*
SZECHWAN (*in part*)

C.H.W. Conrad H. Waddington (d. 1975). *Buchanan Professor of Genetics, University of Edinburgh, Scotland, 1947–75. Author of* Principles of Embryology.
DEVELOPMENT, BIOLOGICAL

C.H.Wi. Charles Henry Wilson. *Professor of Modern History, University of Cambridge; Fellow of Jesus College, Cambridge. Author of* Anglo-Dutch Commerce and Finance in the Eighteenth Century *and others; co-editor of* Cambridge Economic History of Europe.
ECONOMIC HISTORY SINCE 1500 (in part)
MAURICE OF NASSAU, PRINCE OF ORANGE

C.I. Charles Issawi. *Bayard Dodge Professor of Near Eastern Studies, Princeton University. Author of* An Arab Philosophy of History *and others.*
IBN KHALDŪN

C.J. Charles Jelavich. *Professor of History, Indiana University, Bloomington. Co-author of* The Balkans *and others.*
BALKANS, HISTORY OF THE (*in part*)

C.J.A. Charles Joseph Adams. *Professor and Director, Institute of Islamic Studies, McGill University, Montreal. Editor of* A Reader's Guide to the Great Religions.
RELIGIONS, CLASSIFICATION OF

C.J.Al. Constantine John Alexopoulos. *Emeritus Professor of Botany, University of Texas at Austin. Author of* Introductory Mycology.
MYCOTA

C.J.D. Cornelius J. Dyck. *Professor of Historical Theology, Mennonite Biblical Seminary; Director, Institute of Mennonite Studies, Elkhart, Indiana. Editor of* A Legacy of Faith; An Introduction to Mennonite History; *and others.*
MENNONITES
MENNO SIMONS

C.J.F. Carl J. Friedrich. *Eaton Professor Emeritus of Science of Government, Harvard University. Author of* Tradition and Authority; Europe—An Emergent Nation.
REVOLUTION, POLITICAL

C.J.F.D. Charles James Frank Dowsett. *Calouste Gulbenkian Professor of Armenian Studies, University of Oxford; Fellow of Pembroke College, Oxford. Translator (with commentary) of Movsēs Dasxurançi's* The History of the Caucasian Albanians *and others.*
URARTU AND ARMENIA, HISTORY OF (*in part*)

C.J.G. Coleman Jett Goin. *Emeritus Professor of Biological Sciences, University of Florida, Gainesville. Member of the staff, Museum of Northern Arizona, Flagstaff. Co-author of* Introduction to Herpetology; *author of numerous articles on reptiles and amphibians.*
AMPHIBIA

C.J.Go. Clarence James Goodnight. *Professor of Biology, Western Michigan University, Kalamazoo. Co-author of* Biology: An Introduction to the Science of Life *and others.*
ARACHNDIA (*in part*)

C.J.L.P. Cecil John Layton Price. *Professor of English Language and Literature, University College of Swansea, University of Wales.*
SHERIDAN, RICHARD BRINSLEY

C.J.M. Charles John Merdinger. *Captain, U.S. Navy (retired). Deputy Director, Scripps Institution of Oceanography, University of California, San Diego, at La Jolla. Author of* Civil Engineering Through the Ages.
AQUEDUCT

C.J.Mo. Cyril John Morley. *Former Honorary Secretary, British Falconers' Club and International Association of Falconry and Conservation of Birds of Prey.*
FALCONRY (*in part*)

C.J.S. Charles J. Sippl. *Consultant in the computer, communications, and calculator fields. Co-author of* Computer Dictionary and Handbook; Computers at Large; *and others.*
COMPUTERS

C.J.T. Rt. Rev. Cyril James Tucker. *Former Anglican Bishop of the Falkland Islands.*
FALKLAND ISLANDS AND DEPENDENCIES

C.J.U. Caroline Jean Upton. *Research Associate, Department of Social Studies. University of Newcastle upon Tyne, England.*
MELANESIAN CULTURES

C.K.B. C.K. Bertram. *President, Lucy Cavendish College, University of Cambridge.*
SIRENIA (*in part*)

C.-K.L. Chi-Keung Leung. *Lecturer in Geography and Geology, University of Hong Kong.*
KWEICHOW

C.K.W. Charles Kipp Weichert (d. 1970). *Dean, College of Arts and Sciences, University of Cincinnati, Ohio, 1958–70; Professor of Zoology, 1943–70. Author of* Anatomy of the Chordates.
ORGANS AND ORGAN SYSTEMS, ANIMAL (*in part*)

C.L.C. C. Lockard Conley, M.D. *Professor of Medicine; Head, Hematology Division, Johns Hopkins University and Hospital, Baltimore, Maryland. Contributor to* Medical Physiology.
BLOOD, HUMAN

C.L.Cl. C.L. Cline. *Ashbel H. Smith Professor Emeritus of English, University of Texas at Austin. Author of* Byron, Shelley, and Their Pisan Circle; *Editor of* The Letters of George Meredith.
MEREDITH, GEORGE

C.-L. de B. Charles-Louis de Beaumont (d. 1972). *President, Amateur Fencing Association of Great Britain. President, British Commonwealth Fencing Federation. Deputy chairman, British Olympic Association. Author of* Fencing: Ancient Art and Modern Sport *and others.*
FENCING

C.Le. Chan Lee. *Professor of Geography, Seoul National University, Korea.*
KOREA, NORTH
KOREA, SOUTH
SEOUL

C.L.F. Charles L. Fefferman. *Professor of Mathematics, University of Chicago.*
ANALYSIS, FOURIER (*in part*)

C.L.Ha. C. Lowell Harriss. *Professor of Economics, Columbia University. Co-author of* American Public Finance *and others.*
PROPERTY TAX (*in part*)

C.Li. Chan Lien. *Professor of Political Science, National Taiwan University, Taipei. Co-author of* Taiwan: From Pre-history to Modern Times.
HU SHIH

C.L.K. Charlotte L. Kellner. *Former Lecturer in Physics, Imperial College of Science and Technology, University of London. Author of* Alexander von Humboldt.
HUMBOLDT, ALEXANDER VON

Cl.L. Clifford Leech (d. 1977). *Professor of English, University of Toronto, 1963–74. Author of* The Dramatist's Experience with Other Essays in Critical Theory *and others; editor of* Marlowe: A Collection of Critical Essays.
JONSON, BEN
MARLOWE, CHRISTOPHER

C.L.M. Charles L. Mantell. *Consulting engineer. Emeritus Professor of Chemical Engineering, Newark College of Engineering, Newark, New Jersey. Co-author of* Calcium Metallurgy and Technology.
CALCIUM PRODUCTS AND PRODUCTION

C.L.Ma. Clyde L. Manschreck. *Professor of the History of Christianity; Director, Center for Reformation and Free Church Studies, Chicago Theological Seminary. Editor of* Melanchthon on Christian Doctrine *and others.*
MELANCHTON, PHILIPP

C.Lo. Constance Lowenthal. *Faculty member, Sarah Lawrence College, Bronxville, New York.*

Adjunct Assistant Professor of Art History, Cooper Union for the Advancement of Science and Art, New York City.
GHIBERTI, LORENZO

C.L.P.P. Charles L.P. Pellat. *Professor of Arabic Language and Civilization, University of Paris IV. Author of* L'Arabe vivant *and others.*
MESOPOTAMIA AND IRAQ, HISTORY OF (*in part*)

C.L.Q. Charles Loreaux Quittmeyer. *Dean, School of Business Administration, College of William and Mary, Williamsburg, Virginia. Author of* The Virginia Travel Trade.
VIRGINIA

C.L.R.J. C.L.R. James. *Star Professor of History, University of the District of Columbia, Washington, D.C. Secretary, West Indian Federal Labor Party, 1958–62. Author of* Beyond a Boundary; The Black Jacobins; *and others.*
HAITI, HISTORY OF
TRINIDAD AND TOBAGO (*in part*)

C.L.T. Carol Lewis Thompson. *Editor,* Current History, *Philadelphia.*
PENNSYLVANIA

C.L.W. Carl Louis Wilson. *Emeritus Professor of Botany, Dartmouth College, Hanover, New Hampshire. Co-author of* Botany.
TISSUES AND FLUIDS, PLANT (*in part*)

C.M. Christopher Marriage Marsh. *Special Engineering Adviser, British Waterways Board, 1964–66; North Western Divisional Manager, 1948–64. Author of many papers on waterways.*
CANALS AND INLAND WATERWAYS (*in part*)

C.Ma. Carleton Mabee. *Professor of History, State University of New York College at New Paltz. Author of* The American Leonardo: A Life of Samuel F.B. Morse.
MORSE, SAMUEL F.B.

C.M.A. Sister Consuelo Maria Aherne. *Assistant Superior General, Sisters of St. Joseph, Philadelphia; Chairman, Department of History, Chestnut Hill College, Philadelphia, 1947–69. Assistant Staff Editor for* Mediaeval Church History; *contributor to the* New Catholic Encyclopedia.
BONIFACE, SAINT

C.M.C. Carlos M. Chavez, M.D. *Associate Professor of Surgery, University of Mississippi Medical Center, Jackson. Chief of Cardiac Surgery, Veteran's Administration Hospital, Jackson. Co-author of* Human Organ Support and Replacement.
BODY CAVITIES AND MEMBRANES, HUMAN (*in part*)

C.McH. Christine McHugh. *Instructor in American History, Roosevelt University, Chicago.*
ADAMS, HENRY

C.M.E. Chester Monroe Edelmann, Jr., M.D. *Professor and Chairman, Department of Pediatrics, Albert Einstein College of Medicine, Yeshiva University, Bronx, New York. Editor of* Pediatric Nephrology.
CHILDHOOD DISEASES (*in part*)

C.-M.H. Chiao-Min Hsieh. *Professor of Geography, University of Pittsburgh, Pennsylvania. Author of* China: A Geography in Perspective *and others.*
NINGSIA HUI
SINKIANG UIGHUR
TSINGHAI

C.M.K. Cecelia M. Kenyon. *Clarke Professor of Government, Smith College, Northampton, Massachusetts. Editor of* The Antifederalists.
JEFFERSON, THOMAS

C.M.N. C.M. Naim. *Associate Professor of Urdu, University of Chicago. Editor of* Readings in Urdu: Prose and Poetry.
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

C.M.S. Conrad M. Schirokauer. *Professor of History, City College, City University of New York. Author of "Chu Hsi's Political Career: A Study in Ambivalence" in* Confucian Personalities.
CHU HSI

C.M.W. Charles Morrow Wilson. *Free-lance writer. Author of* Diesel: His Engine Changed the World *and others; co-author of* Rudolf Diesel.
DIESEL, RUDOLF

C.M.Wi. C. Martin Wilbur. *George Sansom Professor Emeritus of Chinese History, Columbia University. Co-author of* Documents on Communism, Nationalism and Soviet Advisers in China, 1918–1927.
CHINA, HISTORY OF (*in part*)

C.M.Wo. Christopher Montague Woodhouse. *Member of Parliament for Oxford. Fellow of the Royal Society of London. Fellow of Trinity Hall, University of Cambridge. Co-author of* Rhodes.
RHODES, CECIL

C.M.Y. C. Maurice Yonge (d. 1975). *Regius Professor of Zoology, University of Glasgow, Scotland, 1944–64; Research Fellow in Zoology, 1965–70. Author of* Oysters; *co-editor of* Physiology of Mollusca.
BIVALVIA

C.N. Curtis L. Newcombe. *Emeritus Professor of Marine Biology, San Francisco State University. Director, Marine Research Center, Richmond, California. Author of* An Experimental Study of Shock Effects on Surface and Subsurface Organisms.
OCEANS AND SEAS (*in part*)

C.N.B. Cyril Nelson Barclay. *Brigadier, The Cameronians (Scottish Rifles), retired. Free-lance writer on military subjects. Editor,* The Army Quarterly and Defence Journal, *1950–66; co-editor,* Brassey's Annual: The Armed Forces Year Book, *1950–69.*
GUNNERY (*in part*)
MOLTKE, HELMUTH VON
WARFARE, CONDUCT OF (*in part*)

C.N.C. Charles N. Cofer. *Professor of Psychology, University of Houston, Texas. Co-author of* Motivation: Theory and Research.
MOTIVATION

C.O. Carola (Lady Lenanton) Oman (d. 1978). *Biographer. Author of* David Garrick *and others.*
GARRICK, DAVID

C.O.H. Colin O. Hines. *Professor of Physics (Aeronomy), University of Toronto. Co-author and editor of* Physics of the Earth's Upper Atmosphere.
IONOSPHERE

C.O.Hu. Charles O(scar) Hucker. *Professor of Chinese and History, University of Michigan, Ann Arbor. Author of* The Traditional Chinese State in Ming Times *and others.*
CHINA, HISTORY OF (*in part*)
YUNG-LO

Co.L. Colin Legum. *Associate Editor,* The Observer, *London; Editor,* Africa Contemporary Record, *1968–78. Author of* Attitude to Africa; Pan-Africanism; *and others.*
BOTSWANA
LESOTHO
SWAZILAND

Co.S.B. Cole S. Brembeck. *Director, Institute for International Studies in Education; Associate Dean, College of Education, Michigan State University, East Lansing. Author of* Social Foundations of Education: Environmental Influences in Teaching and Learning.
EDUCATION, SOCIAL ASPECTS OF

C.P. Colin Patterson. *Curator of Fossil Fishes, British Museum (Natural History), London. Co-editor of* Fossil Vertebrates.
ATHERINIFORMES
ELOPIFORMES

C.P.D. Carlos Pablo Dubois. *Economic Research Officer, Bank of London and South America Ltd., London.*
URUGUAY (*in part*)

C.Pe. Chaim Perelman. *Professor of Logic and Ethics, Free University of Brussels. Author of* The New Rhetoric *and others.*
RHETORIC (*in part*)

C.Pf. Carl Pfaffmann. *Vice President; Professor of Physiological Psychology, Rockefeller University, New York City. Editor of* Olfaction and Taste, *proceedings of the Third International Symposium on Olfaction and Taste.*
SENSORY RECEPTION, HUMAN

C.P.F. Charles Patrick FitzGerald. *Emeritus Professor of Far Eastern History, Australian National University, Canberra. Author of* Son of Heaven (T'ang T'ai Tsung); The Empress Wu; *and others.*
T'ANG T'AI TSUNG
WU HOU

C.P.L. Charles P. Loomis. *M.D. Anderson Professor of Sociology, University of Houston, Texas. Co-author of* Rural Sociology, The Strategy of Change.
RURAL SOCIETY, CONTEMPORARY

C.R. Claude Robineau. *Director of Research, Overseas Office of Scientific and Technological Research (ORSTOM), Papeete, French Polynesia, and Paris.*
FRENCH POLYNESIA (*in part*)

C.Ra. Chakravarthi Raghavan. *Correspondent, IPS Third World News Agency, Geneva.*
BOMBAY
HARYANA
HIMACHAL PRADESH
MEGHALAYA

C.R.B. Charles R. Bawden. *Professor of Mongolian, University of London. Author of* The Modern History of Mongolia.
GENGHIS KHAN
KUBLAI KHAN

C.R.H. Campbell Ronald Harler. *Adviser on tea to the Central Treaty Organization. Author of* The Culture and Marketing of Tea *and others.*
TEA PRODUCTION

C.R.N. Charles R. Noback. *Professor of Anatomy, College of Physicians and Surgeons, Columbia University. Author of* The Human Nervous System.
NERVOUS SYSTEM, HUMAN (*in part*)

C.R.No. Carl R. Noller. *Emeritus Professor of Chemistry, Stanford University, California. Author of* Chemistry of Organic Compounds *and others.*
CHEMICAL COMPOUNDS, ORGANIC

C.R.R. Charles R. Russell. *Associate Dean, School of Engineering and Technology, California Polytechnic State University, San Luis Obispo. Author of* Elements of Energy Conversion.
ENERGY SOURCES

C.R.T. Charles Rowland Twidale. *Reader in Geography, University of Adelaide, Australia. Author of* Geomorphology with Special Reference to Australia *and others.*
AUSTRALIA (*in part*)
WEATHERING

C.S. Calambur Sivaramamurti. *Director, National Museum of India, New Delhi; Hony Adviser on Museums, Government of India.*

Author of Indian Sculpture *and others.*
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

C.Sa. Claudio Sartori. *Chief, Office of Research and Indexing of the Italian Musical Funds, Braidense National Library, Milan. Author of* Puccini *and others.*
PUCCINI, GIACOMO

C.S.B. Cyril S. Belshaw. *Professor of Anthropology, University of British Columbia, Vancouver. Editor,* Current Anthropology. *Internationally known scholar in areas of social change and economics. Author of* Traditional Exchange and Modern Markets *and others.*
ECONOMIC SYSTEMS, PRIMITIVE

C.S.C. Carleton Stevens Coon. *Research Associate in Ethnology, Peabody Museum, Harvard University. Emeritus Curator of Ethnology, University Museum, University of Pennsylvania, Philadelphia. Author of* The Origin of Races *and others.*
POPULATIONS, HUMAN

C.S.Ca. Rev. Carnegie Samuel Calian. *Professor of Theology, University of Dubuque Theological Seminary, Iowa. Author of* Icon and Pulpit *and others.*
EASTERN RITE CHURCHES

C.-S.Ch. Cheng-Siang Chen. *Professor of Geography; Director, Geographical Research Centre, Chinese University of Hong Kong. Author of* Taiwan: An Economic and Social Geography *and several reports on Hong Kong.*
CHINA (*in part*)
HONG KONG

C.Se. Charles Seymour (d. 1963). *President, Yale University, 1937–50; Professor of History, 1918–37. Author of* The Diplomatic Background of the War; Woodrow Wilson and the World War; *and others.*
WILSON, WOODROW

C.S.F. Catherine S. Fowler. *Associate Professor of Anthropology, University of Nevada, Reno. Author of* Great Basin Anthropology: A Bibliography.
NORTH AMERICAN GREAT BASIN INDIANS (*in part*)

C.S.G.P. Courtenay Stanley Goss Phillips. *University Lecturer in Inorganic Chemistry, University of Oxford; Fellow of Merton College, Oxford. Co-author of* Inorganic Chemistry.
ALKALINE-EARTH METALS AND THEIR COMPOUNDS

C.S.H. Cornelius Searle Hurlbut. *Professor of Mineralogy, Harvard University. Author of* Dana's Manual of Mineralogy; Minerals and Man.
NATIVE ELEMENTS

C.S.Ha. Craig S. Harbison. *Assistant Professor of Art, University of Massachusetts, Amherst. Author of* Symbols in Transformation: Iconographic Themes at the Time of the Reformation.
GRÜNEWALD, MATTHIAS
HOLBEIN, HANS, THE YOUNGER

C.S.J. Christopher Stewart Jackson. *Former Senior Lecturer in English, University of the West Indies, Cave Hill, Barbados.*
BARBADOS

C.Sn. Carl (Edward) Sagan. *Director, Laboratory for Planetary Studies; David Duncan Professor of Astronomy, Cornell University, Ithaca, New York. Co-author of* Planets; Intelligent Life in the Universe.
LIFE
MERCURY
VENUS

C.S.S. Sir Charles Scott Sherrington, M.D. (d. 1952). *Waynflete Professor of Physiology, University of Oxford, 1913–35. Co-winner, Nobel Prize for Physiology or Medicine, 1932, for discoveries regarding the function of neurons. Author of* The Integrative Action of the Nervous System.
NERVOUS SYSTEM, HUMAN (*in part*)

C.Su. Chusei Suzuki. *Professor of Asian History, Aichi University, Toyohashi, Japan. Author of* A Study of Mid-Ch'ing History *and others.*
CHINA, HISTORY OF (*in part*)

C.S.W. C. Stuart Welch, M.D. *Professor of Surgery, Albany Medical College, Union University, New York. Co-author of* The Essence of Surgery.
SURGERY

C.S.Wh. Charles S. Whewell. *Emeritus Professor of Textile Industries, University of Leeds, England. Associate Editor of* Review of Textile Progress.
TEXTILE INDUSTRY

C.S.-y. Chuang Shang-yen. *Deputy Director, National Palace Museum, Taipei, Taiwan.*
MI FEI

C.T. Curt Teichert. *Adjunct Professor of Geological Sciences, University of Rochester, New York. Regents Distinguished Professor of Geology, University of Kansas, Lawrence, 1964–75. An authority on the Permian stratigraphy of the world.*
PERMIAN PERIOD

C.-t.C. Chen-tung Chang. *Lecturer in Sociology, University of Singapore. Author of* Fertility Transition in Singapore.
KWANGTUNG (*in part*)

C.-t.H. Chun-tu Hsueh. *Professor of Government and Politics, University of Maryland, College Park. Co-author and editor of* Revolutionary Leaders of Modern China.
CHOU EN-LAI

C.T.J. Carl T. Jackson. *Professor of History, University of Texas at El Paso. Contributor to* Journal of the History of Ideas *and* American Quarterly.
THEOSOPHY

C.T.M., Jr. Charles T. Mason, Jr. *Professor of Plant Sciences; Curator of the Herbarium, University of Arizona, Tucson.*
GENTIANALES

C.T.Mo. Charles Thomas Morrissey. *Chairman, Vermont Council on Humanities and Public Issues. Adjunct Professor of History, University of Vermont, Burlington, 1969–71.*
VERMONT

C.T.R. C.T. Ritchie. *Writer and consulting geologist. Author of* The First Canadian: The Story of Champlain *and others.*
CHAMPLAIN, SAMUEL DE

C.T.W. Cheves T. Walling. *Distinguished Professor of Chemistry, University of Utah, Salt Lake City. Author of* Free Radicals in Solution.
RADICALS, FREE

C.V.B. Clinton V. Black. *Archivist, Jamaica Archives, Spanish Town. Author of* The Story of Jamaica *and others.*
JAMAICA

C.v.d.K. C. van de Kieft. *Professor of Medieval History, University of Amsterdam. Co-author of* 500 Jaren Staten-Generaal in de Nederlanden.
LOW COUNTRIES, HISTORY OF (*in part*)

C.V.-F. Claudio Vita-Finzi. *Reader in Geography, University College, University of London. Author of* The Mediterranean Valleys; Recent Earth History.
PHYSIOGRAPHIC EFFECTS OF MAN

C.V.N. Chakravarthi V. Narasimhan. *Undersecretary-General of the United Nations. Author of* The Mahābhārata: An English Version Based on Selected Verses.
ASIA (*in part*)

C.V.W. Dame C.V. Wedgwood. *Free-lance writer and historian. Fellow, University College, University of London. Fellow, Lady Margaret Hall, University of Oxford. Author of* Thomas Wentworth, First Earl of Strafford, 1593–1641: A Revaluation *and others.*
STRAFFORD, THOMAS WENTWORTH, 1ST EARL OF

C.W. Claus Westermann. *Professor of Old Testament Exegesis, University of Heidelberg. Author of* Handbook to The Old Testament.
SACRED KINGSHIP

C.W.B. Curt W. Beck. *Matthew Vassar, Jr., Professor of Chemistry, Vassar College, Poughkeepsie, New York.*
STAHL, GEORG ERNST

C.Wh. Charity Waymouth. *Senior Staff Scientist and Associate Director for Scientific Affairs, the Jackson Laboratory, Bar Harbor, Maine. Editor of* Advances in Tissue Culture.
TISSUE CULTURE

C.W.H. Charles W. Hayford. *Yale–China Representative, New Asia College, Chinese University of Hong Kong.*
LIN TSE-HSÜ

C.W.H.H. C(yril) William H(olmes) Havard, M.D. *Consultant Physician, Royal Free Hospital and Royal Northern Hospital, London. Author of* Lectures in Medicine.
THERAPEUTICS (*in part*)

C.W.Ho. C. Warren Hollister. *Professor of History, University of California, Santa Barbara. Author of* The Impact of the Norman Conquest *and others.*
HENRY I OF ENGLAND

C.W.J. C. Wilfred Jenks (d. 1973). *Director General of the International Labour Office, Geneva, Switzerland, 1970–73. Author of* Human Rights and International Labour Standards *and others.*
LABOUR LAW

C.W.Pa. Charles William Parkin. *Fellow and Lecturer of Clare College, University of Cambridge. Author of* The Moral Basis of Burke's Political Thought.
BURKE, EDMUND

C.W.Pu. Carroll W. Pursell. *Professor of History, University of California, Santa Barbara. Co-editor of* Technology in Western Civilization.
TECHNOLOGICAL SCIENCES

C.W.S. Clyde William Sanger. *Director of Information, Commonwealth Secretariat, London. Author of* Central African Emergency.
RHODESIA

C.W.T. Charlton W. Tebeau. *Emeritus Professor of History, University of Miami, Coral Gables, Florida. Author of* A History of Florida.
JACKSON, "STONEWALL"

C.W.W. Charles W. Wagley. *Graduate Research Professor of Anthropology and Latin American Studies, University of Florida, Gainesville. Author of* Introduction to Brazil *and others.*
BRAZIL (*in part*)

C.Y. Chiang Yee (d. 1977). *Painter. Professor of Chinese, Columbia University, 1968–71. Author of* Chinese Calligraphy *and others.*
CALLIGRAPHY (*in part*)

C.-y.C. Chu-yuan Cheng. *Professor of Economics, Ball State University, Muncie, Indiana. Consultant, National Science Foundation, Washington, D.C. Author of* The Machine-Building Industry in Communist China *and others.*
INNER MONGOLIA
KANSU

C.-y.H. Cho-yun Hsu. *Professor of History and Sociology, University of Pittsburgh. Author of* Ancient China in Transition.
CHINA, HISTORY OF (*in part*)

C.Z. Conway Zirkle (d. 1972). *Professor of Biology, University of Pennsylvania, Philadelphia, 1937–66. Author of* Death of a Science in Russia *and others.*
LYSENKO, TROFIM DENISOVICH

Cz.L. Czeslaw Lejewski. *Professor of Philosophy, Victoria University of Manchester. Author of "Logic and Existence,"* British Journal for the Philosophy of Science, *and numerous other journal articles.*
LOGIC, HISTORY OF

D.A. Don Adams. *Professor of International Development Education, University of Pittsburgh, Pennsylvania. Co-author of* Patterns of Education in Contemporary Societies.
ELEMENTARY AND SECONDARY EDUCATION

D.A.E.S. David A.E. Spalding. *Head Curator of Natural History, Provincial Museum of Alberta, Edmonton. Author of* Natural History of the Sheffield District.
ALBERTA (*in part*)

Da.H. David Harris (d. 1975). *Professor of History, Stanford University, California, 1941–66. Author of* A Diplomatic History of the Balkan Crisis of 1875–1878; The First Year *and others.*
ENLIGHTENMENT

D.A.H. Donald August Holm. *Senior Geologist, Arabian American Oil Company, Dhahran, Saudi Arabia, 1946–61. Author of "Desert Geomorphology of the Arabian Peninsula" in* Science.
ARABIAN DESERT

D.A.He. D. Alan Heslop. *Dean of the Faculty; Claremont Men's College, California. Editor of* Californians in Congress.
POLITICAL SYSTEMS

D.A.K. David A. Kronick. *Library Director, University of Texas Health Science Center at San Antonio. Author of* A History of Scientific and Technical Periodicals.
INFORMATION PROCESSING (*in part*)

D.A.K.B. Sir Douglas A.K. Black, M.D. *Emeritus Professor of Medicine, Victoria University of Manchester; Physician, Manchester Royal Infirmary. Editor of* Renal Disease.
EXCRETORY SYSTEM DISEASES

D.A.L. Daniel A. Livingstone. *Professor of Zoology, Duke University, Durham, North Carolina. Limnologist, Geological Survey, U.S. Department of the Interior, 1956–63.*
AQUATIC ECOSYSTEM
LAKES AND LAKE SYSTEMS (*in part*)

D.A.Lo. D. Anthony Low. *Vice Chancellor, Australian National University, Canberra. Author of* Buganda in Modern History *and others.*
EAST AFRICA, HISTORY OF

Da.Ma. David Magarshack (d. 1977). *Author of* Chekhov the Dramatist; Dostoevsky; Pushkin: A Biography; *and others.*
LITERATURE, WESTERN: *Russian; 18th, 19th century, 20th* (*in part*)

D.A.M.L. David A.M. Lea. *Professor of Geography, University of New England, Armidale, Australia. Co-author of* New Guinea: The Territory and Its People.
NEW GUINEA, TRUST TERRITORY OF

D.An. Donald M. Anderson. *Professor of Art, University of Wisconsin, Madison. Author of* The Art of Written Forms.
CALLIGRAPHY (*in part*)

D.Ar. Daniel Argov. *Former Lecturer in Modern Indian History, Institute of Asian and African Studies, Hebrew University of Jerusalem. Author of* Moderates and Extremists in the Indian Nationalist Movement, 1883–1920.
PATEL, VALLABHBHAI JHAVERBHAI

D.A.S. Donald Arnold Smith. *General Manager, Antietam Cable Television, Inc., Hagerstown, Maryland. Author of* ABC's of Vacuum Tubes *and others.*
ELECTRON TUBE

D.A.Sa. Dawlat Ahmed Sadek. *Chairman of the Geography Department, Faculty of Arts, Ain Shams University, Cairo.*
KUWAIT

D.At. Donald Attwater (d. 1977). *Author of* Penguin Dictionary of Saints; St. John Chrysostom, Pastor and Preacher.
CHRYSOSTOM, SAINT JOHN

D.B. Douglas Bush. *Gurney Professor Emeritus of English Literature, Harvard University. Author of* Paradise Lost in Our Time *and others.*
MILTON, JOHN

D.Ba. D. Banzragch. *Scientific Secretary, Institute of Biology, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

D.B.C. David B. Chan. *Professor of History, California State University, Hayward. Author of* The Yung Lo Usurpation.
HUNG-WU

D.B.D. Daniel B. Dallas. *Editorial Director, Society of Manufacturing Engineers, Dearborn, Michigan; Editor,* Manufacturing Engineering. *Author of* Progressive Dies.
TOOL AND DIE MAKING

D.B.E. David Barnard Ericson. *Senior Research Scientist, Lamont-Doherty Geological Observatory, Columbia University, New York City. Co-author of* The Ever Changing Sea.
ATLANTIC OCEAN (*in part*)

D.B.-G. David Ben-Gurion (d. 1973). *Prime Minister and Minister of Defense, Government of Israel, 1948–53, 1955–63. Author of* The Struggle *and many others.*
HERZL, THEODOR

D.B.H. Dwight B. Heath. *Professor of Anthropology, Brown University, Providence, Rhode Island. Editor of* Contemporary Cultures and Societies of Latin America.
CENTRAL AMERICAN AND NORTHERN ANDEAN CULTURES

D.B.J.F. David B.J. Frost. *Rugby Union correspondent,* The Guardian (*London*). *Author of* The All-Blacks, 1967.
RUGBY

D.B.O.S. Douglas B.O. Savile. *Emeritus Research Associate, Biosystematics Research Institute, Canada Department of Agriculture, Ottawa; Principal Mycologist, 1957–75. Author of* Arctic Adaptations in Plants.
ARCTIC ISLANDS (*in part*)

D.Br. Doris Bry. *Writer on photography, art history, and natural science. Representative for the paintings of Georgia O'Keeffe. Author of* Alfred Stieglitz: Photographer; *co-author of* Georgia O'Keeffe.
STIEGLITZ, ALFRED

D.B.S. David B. Stewart. *Research Geologist, Geological Survey, U.S. Department of the Interior, Washington, D.C.*
SILICA MINERALS

D.B.W. David B. Wake. *Director, Museum of Vertebrate Zoology; Professor of Zoology, University of California, Berkeley.*
URODELA

D.C. Douglas Cooper. *Art historian and critic. Author of* Toulouse Lautrec *and many other works on French artists of the late 19th and 20th century.*
GAUGUIN, PAUL

D.Ca. David Carson. *Professor of Business Administration, Boston University. Author of* International Marketing: A Comparative Systems Approach.
MARKETING AND MERCHANDISING

D.C.A. Dorothy C. Adkins (deceased). *Psychologist. Professor of Education, University of Hawaii, Honolulu, 1965–74. Author of* Test Construction.
MEASUREMENT, PSYCHOLOGICAL

D.C.B. Douglas C. Baxter. *Associate Professor of History, Ohio University, Athens.*
LOUVOIS, FRANÇOIS-MICHEL LE TELLIER, MARQUIS DE

D.C.Br. David C. Brown. *Reader in Music, University of Southampton, England. Author of* Mikhail Glinka *and* Tchaikovsky.
SHOSTAKOVICH, DMITRY

D.C.G.S. David C.G. Sibley. *Free-lance writer and artist. Lecturer, Commonwealth Institute, Scotland, and Department of Adult Education and Extra-Mural Studies, University of Edinburgh. Author of* With La Salle down the Mississippi *and others.*
LA SALLE, ROBERT CAVELIER, SIEUR DE

D.C.H. David C. Hoaglin. *Senior Analyst, Abt Associates, Inc., Cambridge, Massachusetts. Research Associate in Statistics, Harvard University.*
STATISTICS (*in part*)

D.C.H.L. Dorothy C.H. Ley, M.D. *Consultant and former Director, Laboratory Certification and Proficiency Testing Program, Ontario Medical Association. Former Director of Clinical Hematology, Toronto Western Hospital. Co-editor of* Physiological Basis of Medical Practice.
DEHYDRATION

D.C.Hu. David C. Hughes. *Architect.*
BUILDING CONSTRUCTION (*in part*)

D.C.J. D. Clayton James. *Professor of History, Mississippi State University, Mississippi State. Author of* The Years of MacArthur *and others.*
MACARTHUR, DOUGLAS

D.C.S. Domingo C. Salita. *Dean, College of Arts and Sciences; Professor of Geology and Geography, University of the Philippines, Quezon City.*
MANILA

D.C.T. Denis C. Twitchett. *Professor of Chinese, University of Cambridge. Author of* The Financial Administration Under the T'ang Dynasty.
CHINA, HISTORY OF (*in part*)
SHENSI
SSU-MA CH'IEN
T'ANG HSÜAN TSUNG

D.C.Th. David Christopher Traherne Thomas. *Former Assistant Director of Art, Arts Council of Great Britain, London. Joint compiler of* The First Hundred Years of the Royal Academy, 1769–1868 (*catalog of the Royal Academy Winter Exhibition, London, 1951–52).*
DEGAS, EDGAR

D.D. David Diringer (d. 1975). *Reader in Semitic Epigraphy, University of Cambridge, 1966–68. Founder and Director, Alphabet Museum, Tel Aviv, Israel. Author of* The Alphabet *and many other works.*
ALPHABETS

D.Da. David Daiches. *Emeritus Professor of English, University of Sussex, Brighton, England. Author of* Robert Burns; Robert Burns and His World; R.L. Stevenson and His World; *and others.*
BURNS, ROBERT
STEVENSON, ROBERT LOUIS

D.D.B. Dimitry Dimitriyevich Blagoy. *Correspondent Member, Academy of Sciences of the U.S.S.R., Moscow. Member, Academy of Pedagogical Sciences of the U.S.S.R., Moscow. Author of* Tvorchesky put Pushkina.
PUSHKIN, ALEKSANDR

D.D.Br. Donald Dilworth Brand. *Emeritus Professor of Geography, University of Texas at Austin. Author of* Mexico: Land of Sunshine and Shadow.
RIO GRANDE

D. de C. Donald de Carle. *Author of* Horology; Practical Watch Repairing; *and others.*
CLOCKS, WATCHES, AND SUNDIALS

D.D.F. Don D. Fowler. *Research Professor of Anthropology; Executive Director, Social Sciences Center, Desert Research Institute, University of Nevada System, Reno. Co-editor of* Anthropology of the Numu, Smithsonian Contributions to Anthropology, *vol. 14.*
NORTH AMERICAN GREAT BASIN INDIANS (*in part*)

D.D.J. Donald D. Johnson. *Professor of History, University of Hawaii, Honolulu. Author of* The United States in the Pacific: Private Interests and Public Policy.
PACIFIC ISLANDS, TRUST TERRITORY OF THE

D.Dn. D. Dashtseren. *Journalist and publicist.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

D.Do. Denis Donoghue. *Professor of Modern English and American Literature, University College, Dublin, National University of Ireland. Co-editor of* An Honoured Guest: New Essays on W.B. Yeats *and other works on British and American literature.*
YEATS, WILLIAM BUTLER

D.D.R. D.D. Raphael. *Professor of Philosophy, Imperial College of Science and Technology, University of London. Author of* Problems of Political Philosophy *and others.*
STATE, THE

D.Ds. D. Dashjamts. *Director, Institute of Philosophy and Law, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

D.E. David A. Ede. *Assistant Professor of Islamic Studies, Western Michigan University, Kalamazoo.*
ḤASAN AL-BAṢRĪ, AL-

D.E.B. D.E. Berlyne (d. 1976). *Professor of Psychology, University of Toronto. Author of* Structure and Direction in Thinking.
THOUGHT PROCESSES, THEORIES OF

D.E.Bl. Donald Eustace Blackwell. *Savilian Professor of Astronomy, University of Oxford.*
LIGHT, ABERRATION OF

D.E.Bu. Douglas E. Busby, M.D. *Deputy Federal Air Surgeon, Federal Aviation Administration, U.S. Department of Transportation, Washington, D.C. Author of* Space Medicine.
AEROSPACE MEDICINE

D.E.C.Y. David Eryl Corbet Yale. *Reader in English Legal History, University of Cambridge; Fellow of Christ's College, Cambridge.*
HALE, SIR MATTHEW

D.E.K. Daniel E. Koshland, Jr. *Professor of Biochemistry, University of California, Berkeley. Editor of* Protein Structure and Function.
ENZYME

D.E.L. David Edward Luscombe. *Professor of Medieval History, University of Sheffield, England. Author of* The School of Peter Abelard; *editor of* Peter Abelard's Ethics.
ABELARD, PETER

De.M.S. Denis Mack Smith. *Senior Research Fellow and Dean of Visiting Fellows, All Souls College, University of Oxford. Author of* Garibaldi; *editor of* Garibaldi.
GARIBALDI, GIUSEPPE

D.E.P. David E. Pingree. *Professor of the History of Mathematics, Brown University, Providence, Rhode Island. Author of* Gregory Chioniades and Palaeologan Astronomy *and others.*
ASTROLOGY

D.Er. Donald James Erb. *Composer in Residence, Cleveland Institute of Music, Ohio. Composer of "The Seventh Trumpet" and many others.*
ORCHESTRATION AND INSTRUMENTATION

D.E.S. David Eugene Smith (d. 1944). *Professor of Mathematics, Teachers College, Columbia University, 1901–26. Author of* History of Modern Mathematics *and others.*
ARITHMETIC (*in part*)
MATHEMATICS, HISTORY OF (*in part*)

D.E.S.M. D.E.S. Maxwell. *Professor of English; Master of Winters College, York University, Toronto. Author of* Herman Melville; American Fiction; *and others.*
MELVILLE, HERMAN

DeW.C.R. DeWitt C. Reddick. *Jesse H. Jones Professor Emeritus of Journalism and Education, University of Texas, Austin; Dean, School of Communication, 1967–69.*
TEXAS

D.E.W.W. Donald Ernest Wilson Wormell. *Senior Fellow of Trinity College, Dublin; Professor of Latin, University of Dublin. Co-author of* The Delphic Oracle.
PINDAR

D.F. David Foulkes. *Research Scientist, Georgia Mental Health Institute, Atlanta. Author of* The Psychology of Sleep.
SLEEP

D.F.B. Donald F. Bond. *Emeritus Professor of English, University of Chicago. Author of* A Reference Guide to English Studies; *editor of* The Spectator.
ADDISON, JOSEPH

D.F.D. Donald F. Durnbaugh. *Professor of Church History, Bethany Theological Seminary, Oak Brook, Illinois. Author of* The Brethren in Colonial America *and others.*
BRETHREN

D.F.Do. Douglas F. Dowd. *Professor of Economics, San Jose State University, California.*
OWEN, ROBERT

D.Fe. David Fellman. *Vilas Professor of Political Science, University of Wisconsin, Madison. Author of* The Defendant's Rights Today.
CONSTITUTIONAL LAW

D.Fl. David Flusser. *Professor of the History of Religions, Hebrew University of Jerusalem. Author of* Jesus *and others.*
BIBLICAL LITERATURE (*in part*)

D.F.N.H. Donald F.N. Harrison, M.D. *Professor of Laryngology and Otology, University of London.*
SINUS

D.Fu. David Fuller. *Associate Professor of Music, State University of New York at Buffalo. Author of* Music of Armand-Louis Couperin.
COUPERIN FAMILY

D.G.C. David Gawen Champernowne. *Professor of Economics and Statistics, University of Cambridge, 1969–78; Fellow of Trinity College, Cambridge. Author of* The Distribution of Income Between Persons *and others.*
WEALTH AND INCOME, DISTRIBUTION OF

D.G.Ch. Donald Geoffrey Charlton. *Professor of French; Chairman, Department of French Studies, University of Warwick, Coventry, England. Author of* Positivist Thought in France, 1852–1870 *and others.*
TAINE, HIPPOLYTE

D.G.D. Denys G. Dyer. *University Lecturer in German, University of Oxford; Fellow of Exeter College, Oxford.*
LITERATURE, WESTERN: *German; 17th century*

D.Ge. Deno John Geanakoplos. *Professor of History and Religious Studies, Yale University. Author of* Emperor Michael Palaeologus and the West *and others.*
MICHAEL VIII PALAEOLOGUS

D.G.F. Donald G. Fink. *General Manager and Executive Director, Institute of Electrical and Electronics Engineers, New York City. Author of* Television Engineering.
TELEVISION (*in part*)

D.Gi. Douglas Stuart Gilbert. *Sports reporter,* Montreal Gazette.
FOOTBALL, AMERICAN AND CANADIAN (*in part*)

D.G.J. D. Gale Johnson. *Eliakim Hastings Moore Distinguished Service Professor of Economics; Provost, University of Chicago. Author of* World Agriculture in Disarray *and others.*
AGRICULTURAL ECONOMICS

D.G.MacR. Donald Gunn MacRae. *Professor of Sociology, University of London.*
MALTHUS, THOMAS ROBERT

D.Go. D. Gongor. *Scientific Secretary, Institute of History, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

D.Gr. David Greene. *Senior Professor, School of Celtic Studies, Dublin Institute for Advanced Studies. Author of* The Irish Language; Writing in Irish Today; *and others.*
CELTIC LANGUAGES
LITERATURE, WESTERN: *Irish Gaelic*

D.G.R. Donald G. Rea. *Assistant Laboratory Director for Science, Jet Propulsion Laboratory, California Institute of Technology, Pasadena.*
SOLAR SYSTEM

D.G.S. David G. Scanlon. *Professor of International Education, Columbia University. Director, Center for Education in Africa. Co-editor of* Problems and Prospects in International Education.
INTERNATIONAL EDUCATIONAL RELATIONS

D.G.T. David Gordon Tucker. *Professor and Head, Department of Electronic and Electrical Engineering, University of Birmingham, England, 1955–73. Co-author of* Applied Underwater Acoustics *and others.*
SONAR

D.H. David Himmelfarb. *Former Superintendent, U.S. Navy Ropewalk, Boston Naval Shipyard, Charlestown, Massachusetts. Consultant to the cordage industry. Author of* The Technology of Cordage Fibres and Rope.
ROPES AND CABLES

D.Ha. Donald Hawes. *Professor of English, Polytechnic of Central London. Co-editor of* Thackeray: The Critical Heritage.
THACKERAY, WILLIAM MAKEPEACE

D.H.B. Daryle H. Busch. *Professor of Chemistry, Ohio State University, Columbus. Co-author of* Introduction to Qualitative Analysis; Chemistry.
CHEMICAL COMPOUNDS, INORGANIC

D.H.D. David Herbert Donald. *Charles Warren Professor of American History, Harvard University. Author of* Lincoln Reconsidered *and others.*
UNITED STATES, HISTORY OF THE (*in part*)

D.Hi. Dorothy Hill. *Research Professor Emeritus of Geology, University of Queensland, St. Lucia, Brisbane, Australia. Author of* Paleozoic Corals; *co-author of* Elements of the Stratigraphy of Queensland.
CARPENTARIA, GULF OF
CORAL ISLANDS, CORAL REEFS, AND ATOLLS
EYRE, LAKE
GREAT BARRIER REEF

D.H.P. D.H. Pennington. *Fellow and Tutor in History, Balliol College, Oxford; Lecturer in Modern History, University of Oxford. Author of* Seventeenth Century Europe *and others.*
LAUD, WILLIAM

D.H.R.B. Sir Derek Harold Richard Barton. *Hofmann Professor of Organic Chemistry, Imperial College of Science and Technology, University of London. Co-winner, Nobel Prize for Chemistry, 1969, for the development of conformational analysis.*
CONFORMATIONAL ANALYSIS, PRINCIPLES OF (*in part*)

D.Hus. Dyneley Hussey (d. 1972). *Music Critic,* The Times, *London, 1923–46;* The Listener, *1946–60. Author of* Verdi; Some Composers of Opera.
DONIZETTI, GAETANO
VERDI, GIUSEPPE

D.I. David Irwin. *Chairman, Department of History of Art, University of Aberdeen, Scotland. Author of* English Neoclassical Art *and others.*
CANOVA, ANTONIO
VISUAL ARTS, WESTERN (*in part*)

Di.B. Dieter Brunnschweiler. *Professor of Geography, Michigan State University, East Lansing. Co-author of* Geography in Latin America: Prospect for the Seventies.
LLANOS

Di.C. Dieter Christensen. *Professor of Music; Director, Center for Studies in Ethnomusicology, Columbia University. Author of* Die Musik der Kate und Sialum; *co-author of* Die Musik der Ellice-Inseln.
OCEANIAN PEOPLES, ARTS OF (*in part*)

D.I.D. Denis Ian Duveen. *Consultant to the cosmetics industry in Brazil. President, Duveen Soap Corporation, Brooklyn, New York, 1949–69. Co-author of* A Bibliography of the Works of Antoine Laurent Lavoisier.
LAVOISIER, ANTOINE-LAURENT

D.I.F. David I. Fand. *Professor of Economics, Wayne State University, Detroit. Author of* Savings Intermediaries and Consumer Credit Market.
CONSUMER CREDIT

Di.L. Diuldé Laya. *Director of the Centre for Linguistic and Historical Studies by Oral Tradition, Organization of African Unity, Niamey, Niger. Author of "Tradition orale et recherche historique en Afrique,"* Journal of World History (UNESCO).
NIGER

D.J.B. D. Joseph Bodin. *Vice President, Standard Manufacturing Division, Technicolor, Inc., West Springfield, Massachusetts. Editor,* Grits & Grinds *magazine, 1967–70.*
ABRASIVES

D.J.C. Daniel J. Crowley. *Professor of Anthropology and Art, University of California, Davis. Author of* I Could Talk Old-Story Good: Creativity in Bahamian Folklore.
CARIBBEAN CULTURES

D.J.D. Denis John Dwyer. *Professor of Geography, University of Keele, England. Editor of* Asian Urbanization: A Hong Kong Casebook.
MACAU

D.J.E. Daniel Judah Elazar. *Director, Center for the Study of Federalism; Professor of Political Science, Temple University, Philadelphia. Professor of Political Science, Bar-Ilan University, Ramat Gan, Israel. Author of* American Federalism: A View from the States *and others.*
FEDERALISM

D.J.G. Douglas James Guthrie, M.D. (d. 1975). *Medical historian. Lecturer on the History of Medicine, University of Edinburgh, 1945–56. Author of* A History of Medicine *and others.*
MEDICINE, HISTORY OF (*in part*)

D.J.H. Donald J. Hanahan. *Professor of Biochemistry, University of Texas Health Science Center at San Antonio. Author of* Lipide Chemistry.
LIPID (*in part*)

D.J.M.H. David J.M. Higgins (d. 1975). *Associate Professor of English, Monmouth College, West Long Branch, New Jersey, 1973–75. Author of* Portrait of Emily Dickinson.
DICKINSON, EMILY

D.J.R. Donald J. Reish. *Professor of Biology, California State University, Long Beach. Author of* Biology of the Oceans.
ANNELIDA

D.J.S. Dirk Jan Struik. *Emeritus Professor of Mathematics, Massachusetts Institute of Technology, Cambridge. Author of* Concise History of Mathematics *and others.*
FOURIER, JEAN-BAPTISTE-JOSEPH, BARON
LAGRANGE, JOSEPH-LOUIS, COMTE DE
LOBACHEVSKY, NIKOLAY IVANOVICH

D.J.W. Donald John Wiseman. *Professor of Assyriology, School of Oriental and African Studies, University of London. Author of* Chronicles of Chaldaean Kings *and others.*
ASHURBANIPAL
TIGLATH-PILESER III

D.K. Delmar Karlen. *Tazewell Taylor Professor of Law, College of William and Mary, Williamsburg, Virginia. Emeritus Professor of Law, New York University, New York City. Author of* Judicial Administration: The American Experience *and others.*
COURTS AND THE JUDICIARY (*in part*)

D.K.B. Dmitri Konstantinovich Belyaev. *Director, Institute of Cytology and Genetics; Chief of the Laboratory of Evolution Genetics, Siberian Department, Academy of Sciences of the U.S.S.R., Novosibirsk. Author of many papers on the genetic basis of animal domestication; co-author and editor of* General Biology.
DOMESTICATION, PLANT AND ANIMAL (*in part*)

D.Ke. Donald Keene. *Professor of Japanese, Columbia University. Translator into English of many of the great literary works in Japanese; and author of* World Within Walls: Japanese Literature of the Pre-Modern Era.
LITERATURE, EAST ASIAN (*in part*)

D.Ko. Dimiter Konstantinov Kossev. *Vice President, Bulgarian Academy of Sciences, Sofia. Former rector, University of Sofia. Author of* Concise History of Bulgaria.
SOFIA (*in part*)

D.Le. (Mary) Dominica Legge. *Emeritus Professor of Anglo-Norman Studies, University of Edinburgh. Author of* Anglo-Norman Literature and Its Background *and others.*
LITERATURE, WESTERN: *Anglo-Norman*

D.L.E. Don L. Eicher. *Professor of Geology, University of Colorado, Boulder. Author of* Geologic Time.
GEOLOGICAL TIME SCALE

D. Le V. David Le Vay. *Consultant Surgeon, National Health Service, U.K. Author of* Human Anatomy and Physiology.
EXCRETION, HUMAN

D.L.F. Denis Llewellyn Fox. *Emeritus Professor of Marine Biochemistry, Scripps Institution of Oceanography, University of California, La Jolla. Author of* Animal Biochromes and Structural Colours.
COLORATION, BIOLOGICAL (*in part*)

D.L.L. David L. Lack (d. 1973). *Director, Edward Grey Institute of Field Ornithology, University of Oxford, 1945–73. Author of* Natural Regulation of Animal Numbers *and others.*
POPULATION, BIOLOGICAL

D.L.Le. David L. Lewis. *Professor of History, University of the District of Columbia, Washington, D.C. Author of* King: A Critical Biography.
KING, MARTIN LUTHER, JR.

D.L.M. David Livingstone Mueller. *Professor of Christian Theology, Southern Baptist Theological Seminary, Louisville, Kentucky. Author of* An Introduction to the Theology of Albrecht Ritschl *and others.*
RITSCHL, ALBRECHT

D.L.P. David Leo Pawson. *Curator of Echinoderms, Smithsonian Institution, Washington, D.C. Contributor to* Physiology of Echinodermata.
ECHINODERMATA

D.L.S. David Llewelyn Snellgrove. *Professor of Tibetan, University of London. Fellow of the British Academy. Author of* Buddhist Himālaya *and others; co-author of* Cultural History of Tibet.
BUDDHIST MYTHOLOGY
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

D.L.Se. D.L. Serventy. *Principal Research Scientist, Division of Wildlife Research, Commonwealth Scientific and Industrial Research Organization, Nedlands, Australia; Officer in Charge, 1951–69. Researcher on the distribution and ecology of Australian birds. Author of* Birds of Western Australia; Handbook of Australian Sea-Birds.
CASUARIIFORMES

D.M. Dieter Meischner. *Professor of Geology, Georg August University of Göttingen, West Germany.*
CARBONIFEROUS PERIOD, UPPER

D.Ma. Most Rev. David Mathew. *Archbishop of Apamea; Assistant at the Pontifical Throne. Author of* James I *and others.*
JAMES I OF GREAT BRITAIN

D.M.A. David M. Armstrong. *Associate Professor of Biological Sciences; Associate Curator, University Museum, University of Colorado, Boulder.*
MAMMALIA (*in part*)

D.M.Ar. Denis Midgley Arnold. *Heather Professor of Music, University of Oxford. Author of* Monteverdi *and the complete edition of Giovanni Gabrieli.*
MONTEVERDI, CLAUDIO

D.M.B. D. Mary Benson. *Writer. Author of* Chief Albert Lutuli of South Africa *and others.*
LUTULI, ALBERT

D.M.Be. Dewey M. Beegle. *Professor of Old Testament, Wesley Theological Seminary, Washington, D.C. Author of* Moses, the Servant of Yahweh.
MOSES

D.McI. Donald McIntyre. *Professor of Chemistry and of Polymer Science, University of Akron, Ohio. Editor of* Characterization of Macromolecular Structure.
MOLECULAR WEIGHT

D.M.DeL. Dwight Moore DeLong. *Emeritus Professor of Entomology, Ohio State University, Columbus. Co-author of* An Introduction to the Study of Insects.
HOMOPTERA

D.M.E. Dorothy M. Ellicott. *Justice of the Peace. Member, City Council of Gibraltar, 1947–55; House of Assembly, 1959–64. Author of* From Rooke to Nelson: 101 Eventful Years in Gibraltar *and others.*
GIBRALTAR

D.M.Ea. David Magarey Earl. *Former Professor of History, Eastern Michigan University, Ypsilanti. Author of* Emperor and Nation in Japan: Political Thinkers of the Tokugawa Period.
SAIGŌ TAKAMORI

D.M.F. Donald M. Frame. *Professor of French, Columbia University. Author of* Montaigne: A Biography; *translator of* Montaigne: The Complete Works.
MONTAIGNE, MICHEL DE

D.M.G. David M. Gates. *Professor of Botany; Director, Biological Station, University of Michigan, Ann Arbor. Author of* Energy Exchange in the Biosphere *and others.*
BIOSPHERE

D.M.Gi. Donald M. Ginsberg. *Professor of Physics, University of Illinois, Urbana. Author of papers on electrical and magnetic properties of metals at very low temperatures.*
SUPERCONDUCTIVITY

D.M.H. Donald M. Hunten. *Professor of Planetary Sciences, University of Arizona, Tucson.*
ASTRONOMICAL SPECTROSCOPY, PRINCIPLES OF

D.Mi. Dorothy Middleton. *Assistant Editor,* Geographical Journal, *1953–71. Author of* Baker of the Nile *and others.*
STANLEY, SIR HENRY MORTON

D.M.J. Dorothy M. Johnson. *Free-lance writer. Author of* The Hanging Tree; A Man Called Horse; Montana.
MONTANA

D.M.K. David Marcus Knight. *Senior Lecturer in History of Science, University of Durham, England. Author of* Atoms and Elements *and others.*
ARRHENIUS, SVANTE AUGUST

D.M.Ke. David M. Kunzie. *Assistant Professor of Art, University of California, Santa Barbara. Author of* The Early Comic Strip.
CARICATURE, CARTOON, AND COMIC STRIP (*in part*)

D.M.L. David Malcolm Lewis. *Student and Tutor in Ancient History, Christ Church, Oxford; Lecturer in Greek Epigraphy, University of Oxford. Co-author of* A Selection of Greek Historical Inscriptions to the End of the Fifth Century B.C.
PERICLES

D.M.L.-J. David Mathias Lloyd-Jones. *Musicologist and conductor; specialist in Slavic music.*
DVOŘÁK, ANTONÍN

D.M.Lo. David Morrice Low (d. 1972). *Classical Lecturer and Sub-dean, Arts Faculty, King's College, University of London, 1945–57. Author of* Edward Gibbon, 1737–94 *and others.*
GIBBON, EDWARD

D.M.N. Donald MacGillivray Nicol. *Koraës Professor of Byzantine and Modern Greek History, Language, and Literature, King's College, University of London. Author of* The Despotate of Epiros *and others.*
BYZANTINE EMPIRE (*in part*)

D.M.P. Dorothy M. Pickles. *Writer, lecturer, and broadcaster. Author of* The Fifth French Republic, The Government and Politics of France; *and others.*
GAULLE, CHARLES DE

D.M.S. D.M. Sen. *Vice Chancellor, University of Burdwan, West Bengal, India. 1965–69.*
WEST BENGAL

D.M.Sm. Dale M. Smith. *Professor of Botany, University of California, Santa Barbara. Co-author of* The North American Sunflowers.
POLEMONIALES

D.M.W.A. Douglas M.W. Anderson. *Senior Lecturer in Chemistry, University of Edinburgh. Co-editor of series of monographs on organic functional group analysis.*
CHEMICAL ANALYSIS

D.M.Wh. D. Maxwell White. *Professor and Head, Department of Italian Language and Literature, University of Leeds, England. Author of* Zaccaria Seriman *and others.*
LITERATURE, WESTERN: *Italian; 17th, 18th century*

D.N. Dika Newlin (deceased). *Professor of Music, North Texas State University, Denton, 1965–73. Author of* Bruckner-Mahler-Schoenberg; *editor of* Arnold Schoenberg: Style and Idea.
SCHOENBERG, ARNOLD

D.N. da C. Décio Neves da Cunha. *Professor, Centre for General Education, Federal University of Espírito Santo, Vitória, Brazil.*
ESPÍRITO SANTO

D.N.P. Devavrat Nanubhai Pathak. *Professor of Political Science; Director, University School of Social Sciences, Gujarāt University, Ahmadābād, India. Co-author of* Fourth Elections in Gujarat and India.
GUJARĀT

D.N.W. Donald N. Wilber. *Free-lance writer and consultant on the Middle East and Southeast Asia. Author of* Iran Past and Present *and others.*
SHĀPŪR II OF PERSIA

D.O. David Oteiza. *Professor of Geography of the Western Hemisphere, National University of La Plata, Argentina. Author of* Geografía regional de Eurasia y Africa.
PARANÁ RIVER
PLATA, RÍO DE LA

D.O.B. Donald O. Bushman (d. 1973). *Associate Professor of Geography, University of South Carolina, Columbia, 1960–73.*
SOUTH CAROLINA

D.O.D.W David O.D. Wurfel. *Professor of Political Science, University of Windsor, Ontario. Co-author of* The United States and the Philippines.
PHILIPPINES, HISTORY OF THE

D.O.E. Dietz O. Edzard. *Professor of Assyriology, Ludwig Maximilian University of Munich. Author of* Die zweite Zwischenzeit Babyloniens *and others.*
MESOPOTAMIA AND IRAQ, HISTORY OF (*in part*)

D.Ol. Daria Olivier. *Writer and historian. Book reviewer,* Reforme. *Author of* Alexandre Ier *and others.*
ALEXANDER I OF RUSSIA

D.O'N. Denis O'Neill. *Under Secretary, Ministry of Transport, London, 1951–68.*
TRANSPORTATION, HISTORY OF (*in part*)

Do.S. Donald Southgate. *Reader in Political and Constitutional History, University of Dundee, Scotland. Author of* The Most English Minister—The Policies and Politics of Palmerston *and others.*
PALMERSTON, LORD

D.P. Dimitris Pournaras. *Former Publisher and Editor of* Eleutheros (*newspaper*), *Athens. Former Chairman, Greek Broadcasting Corporation. Author of* Eleuthérois Venizélos *and others.*
VENIZÉLOS, ELEUTHÉRIOS

D.P.C. Douglas Parodé Capper. *Commander, Royal Navy and Royal Navy Volunteer Reserve. Naval Historian. Author of* Famous Sailing Ships of the World *and others.*
SAILS AND SAILING SHIPS

D.P.Cl. Derek Plint Clifford. *Free-lance writer. Author of* A History of Garden Design *and others.*
GARDEN AND LANDSCAPE DESIGN (*in part*)

D.P.G. Derek Peter Gregory. *Assistant Vice President, Engineering Research, Institute of Gas Technology, Illinois Institute of Technology, Chicago. Author of* Fuel Cells; Metal-Air Batteries (*monographs*).
BATTERIES AND FUEL CELLS

D.P.Ga. David P. Gamble. *Professor of Anthropology, San Francisco State University. Author of* The Wolof of Senegambia.
WESTERN SUDAN, CULTURES OF THE

D.P.K. Daniel P. Kunene. *Professor of African Languages and Literature, University of Wisconsin, Madison. Author of* The Heroic Poetry of the Basotho.
AFRICAN PEOPLES, ARTS OF (*in part*)

D.P.L. Donald P. Little. *Professor and Assistant Director, Institute of Islāmic Studies, McGill University, Montreal. Author of* An Introduction to Mamlūk Historiography.
EGYPT, HISTORY OF (*in part*)
MAMLŪKS
MU'ĀWIYAH I

D.P.O'C. Daniel Patrick O'Connell. *Chichele Professor of International Law, University of Oxford. Author of* Richelieu *and others.*
RICHELIEU, CARDINAL DE

D.P.T. David P. Thelen. *Professor of History, University of Missouri, Columbia. Author of* Robert M. La Follette and the Insurgent Spirit.
LA FOLLETTE, ROBERT M.

D.R. Don Russell. *Free-lance writer. Author of* The Wild West: A History of the Wild West Shows; The Lives and Legends of Buffalo Bill; *and others.*
RODEO

D.R.C. David R. Coffin. *Howard Crosby Butler Memorial Professor of the History of Architecture, Princeton University. Author of* Villa d'Este at Tivoli.
VISUAL ARTS, WESTERN (*in part*)

D.R.D. Donald Reynolds Dudley (d. 1972). *Professor of Latin, University of Birmingham, England, 1955–72. Author of* The Romans *and others.*
SENECA

D.Re. Donald Read. *Professor of Modern English History, University of Kent at Canterbury, England. Author of* Cobden and Bright *and others.*
BRIGHT, JOHN

D.R.G. Denis Rolleston Gwynn (d. 1971). *Research Professor of Modern Irish History, University College, Cork, National University of Ireland, 1946–63. Author of* The History of Partition *and others.*
DE VALERA, EAMON

D.R.H. Delbert R. Hillers. *W.W. Spence Professor of Semitic Languages, Johns Hopkins University, Baltimore, Maryland. Author of* Treaty-Curses and Old Testament Prophets; The Covenant.
SYRIAN AND PALESTINIAN RELIGIONS

D.R.I. David Rittenhouse Inglis. *Emeritus Professor of Physics, University of Massachusetts, Amherst. Author of* Testing and Taming of Nuclear Weapons *and others.*
NUCLEUS, ATOMIC

D.R.M. Donald R. Morris. *News analyst,* The Houston (*Texas*) Post. *Author of* The Washing

of the Spears: A History of the Rise of the Zulu Nation Under Shaka and Its Fall in the Zulu War of 1879.
SHAKA

D.R.S. Dale R. Simpson. *Professor of Geology, Lehigh University, Bethlehem, Pennsylvania.*
PHOSPHATE MINERALS

D.R.Sw. Don R. Swanson. *Professor of Library Science; Dean, Graduate Library School, University of Chicago. Co-editor of* Operations Research: Implications for Libraries *and others.*
INFORMATION PROCESSING (*in part*)

D.S. Donald Sayenga. *Author of "The Oldest Sport," a series of articles on the history and development of wrestling, in* Amateur Wrestling News.
WRESTLING AND ALLIED SPORTS (*in part*)

D.S.B. Daniel Stephen Barker. *Professor of Geology, University of Texas at Austin.*
IGNEOUS ROCKS, INTRUSIVE

D.S.-C. David Stafford-Clark, M.D. *Director, York Clinic and Department of Psychiatry, Guy's Hospital, London, 1954–73. Consultant Physician, Bethlem Royal Hospital and Maudsley Hospital, and Institute of Psychiatry of the University of London, 1954–73. Author of* Psychiatry Today; *and numerous others.*
PSYCHIATRIC TREATMENT, CONCEPTS OF

D.S.D. Donald Stephen Dugdale. *Professor of Mechanical Engineering, University of Sheffield, England. Author of* Elements of Elasticity.
ELASTICITY

D.Še. Drago Šega. *Scientific adviser, Institute for the Slovene Literature and Literary Sciences, Slovene Academy of Sciences and Arts, Ljubljana, Yugoslavia. Author of* Eseji in kritike; *editor of* Anthologie de la poésie slovène.
LITERATURE, WESTERN: *Slovene* (*in part*)

D.S.H.W.N. Davidson S.H.W. Nicol. *Under Secretary General, United Nations; Executive Director, United Nations Institute for Training and Research, New York City. Permanent Representative and Ambassador for Sierra Leone to the United Nations, 1969–71. Author of* Africa: A Subjective View; *Editor of* Black Nationalism: The Writings of Africanus Horton.
AFRICA (*in part*)
SIERRA LEONE (*in part*)

D.Si. Denis Sinor. *Distinguished Professor and Chairman, Department of Uralic and Altaic Studies, Indiana University, Bloomington. Author of* Inner Asia; History of Hungary; *and others.*
INNER ASIA, HISTORY OF
LITERATURE, WESTERN: *Hungarian* (*in part*)

D.S.J. David Starr Jordan, M.D. (d. 1931). *Chancellor, Stanford University, California, 1913–16; President, 1891–1913. President, Indiana University, Bloomington, 1885–91; Professor of Zoology, 1879–85. Author of* A Guide to the Study of Fishes *and many others.*
AGASSIZ, LOUIS

D.S.L. David S. Lifson. *Playwright and drama critic. Professor of English, Monmouth College, West Long Branch, New Jersey. Author of* The Yiddish Theatre in America; *contributor to* A History of the Theatre.
JEWISH PEOPLES, ARTS OF (*in part*)

D.S.La. David S. Landes. *Robert Walton Goelet Professor of French History, Harvard University. Editor of* The Rise of Capitalism; *contributor to* The Cambridge Economic History of Europe, *vol. 6.*
ECONOMIC HISTORY SINCE 1500 (*in part*)

D.So. Dominique Sourdel. *Professor of Muslim Civilization, University of Bordeaux III, France. Author of* Le Vizirat 'abbāside de 749 à 936 *and others.*
MA'MŪN, AL-

D.Sp. David Spring. *Professor of History, Johns Hopkins University, Baltimore. Author of* The English Landed Estate in the Nineteenth Century.
RUSSELL, JOHN RUSSELL, 1ST EARL

D.S.R. Daniel Sommer Robinson. *Emeritus Director of the School of Philosophy, University of Southern California, Los Angeles. Author of* Royce and Hocking: American Idealists *and others.*
IDEALISM

D.S.T. Derick S. Thomson. *Professor of Celtic, University of Glasgow. Author of* An Introduction to Gaelic Poetry *and others.*
LITERATURE, WESTERN: *Scottish Gaelic*

D.Su. Denys Sutton. *Editor,* Apollo *magazine. Art Critic,* Financial Times. *Author of* Bonnard; Nocturne: The Art of James McNeill Whistler; *and others.*
BONNARD, PIERRE
WHISTLER, JAMES MCNEILL

D.T. David Turnock. *Reader in Geography, University of Leicester, England. Author of* An Economic Geography of Romania.
BUCHAREST (*in part*)
ROMANIA (*in part*)

D.T.D. Desmond Thomas Donovan. *Yates-Goldsmid Professor of Geology, University College, University of London. Editor of* Geology of Shelf Seas.
BISCAY, BAY OF
IRISH SEA

D.T.E. Dudley Tate Easby, Jr. (d. 1973). *Secretary, Metropolitan Museum of Art, New York, 1945–69; Chairman, Department of Primitive Art, 1969–71. Author of articles on pre-Columbian metalwork.*
METALWORK (*in part*)

D.T.F. Daniel T. Finkbeiner II. *Professor of Mathematics, Kenyon College, Gambier, Ohio. Author of* Matrices and Linear Transformations.
ANALYSIS, VECTOR AND TENSOR (*in part*)

D.t.H. Dirk ter Haar. *Reader in Theoretical Physics, University of Oxford; Fellow of Magdalen College, Oxford. Author of* Elements of Thermostatistics.
LANDAU, LEV DAVIDOVICH

D.T.J. Rev. Daniel T. Jenkins. *Reader in Religious Studies, University of Sussex, Brighton, England, 1970–73. Author of* The Christian Belief in God *and others.*
CONGREGATIONALISTS

D.T.R. David Talbot Rice (d. 1972). *Watson-Gordon Professor of the History of Fine Art, University of Edinburgh, 1934–72; Vice Principal, 1968–71. Author of* Byzantine Art *and others.*
VISUAL ARTS, WESTERN (*in part*)

D.V. Dora Vallier. *Art critic. Author of* Henri Rousseau: Catalogue raisonné de l'oeuvre; Henri Rousseau; *and others.*
ROUSSEAU, HENRI

D.V.B. David V. Bates, M.D. *Professor of Medicine and Physiology, University of British Columbia, Vancouver. Co-author of* Respiratory Function in Disease.
RESPIRATION, DISORDERS OF
RESPIRATORY SYSTEM DISEASES

D.V.C. Dorothy V. Carrington. *Fellow, Royal Historical Society and Royal Literary Society. Author of* Granite Island: A Portrait of Corsica; This Corsica; *and others.*
CORSICA

D.V.Co. Deryck V. Cooke (d. 1976). *Musicologist. Music Presentation Editor, British Broadcasting Corporation, London, 1965–76. Author of* Mahler, 1860–1911; *Completed Mahler's unfinished* 10th Symphony.
MAHLER, GUSTAV
WAGNER, RICHARD

D.V.D. Dimitrije V. Djordjevic. *Professor of History, University of California, Santa Barbara, Author of* Révolutions nationales des peuples balkaniques, 1804–1914 *and others.*
BALKANS, HISTORY OF THE (*in part*)

D.V.T. Dattatraya Vishwanath Tahmankar. *London Editor,* Deccan Herald, *Bangalore, India. Author of* Lokamanya Tilak *and others.*
TILAK, BAL GANGADHAR

D.W. Dorothy Whitelock. *Elrington and Bosworth Professor Emeritus of Anglo-Saxon, University of Cambridge. A leading authority on Anglo-Saxon England. Author of Beginnings of English Society; editor of* English Historical Documents c. 500–1042.
ALFRED THE GREAT, OF WESSEX
BRITAIN AND IRELAND, HISTORY OF (*in part*)
CANUTE THE GREAT, OF DENMARK AND ENGLAND
LITERATURE, WESTERN: *English; Medieval* (*in part*)

D.Wa. David Waines. *Assistant Professor of Islamic History, American University in Cairo. Author of* The Unholy War.
ṬABARĪ, AṬ-

D.W.C. David W. Crabb. *Associate Professor of Anthropology, Princeton University. Author of* Ekoid Bantu Languages of Ogaja (Eastern Nigeria).
AFRICAN LANGUAGES (*in part*)

D.We. Donald Weinstein. *Professor of History, Rutgers University, New Brunswick, New Jersey. Author of* Savonarola and Florence; Ambassador from Venice.
RENAISSANCE

D.W.F. Don W. Fawcett, M.D. *Hersey Professor of Anatomy, Harvard Medical School, Harvard University. Co-author of* Textbook of Histology.
CONNECTIVE TISSUE, HUMAN

D.W.G. David W. Goodall. *Senior Principal Research Scientist, Division of Land Resources Management, Commonwealth Scientific and Industrial Research Organization, Perth, Australia.*
DESERTS (*in part*)

D.W.I. Donald W. Insall. *Principal Architect, Donald W. Insall and Associates (architects and planning consultants), London. Member, the Historic Buildings Council for England. Author of* The Care of Old Buildings *and others.*
ART CONSERVATION AND RESTORATION (*in part*)

D.W.K. Daniel Wilhelmus Kruger (d. 1978). *Professor of History, University of the Transkei, Umtata. Author of* Paul Kruger *and others.*
KRUGER, PAUL

D.W.K.-J. Douglas W. Kent-Jones. *President, British Industrial Biological Research Association, Carshalton, England. Co-author of* Modern Cereal Chemistry.
CEREALS AND OTHER STARCH PRODUCTS

D.W.L. Donald William Lucas. *P.M. Laurence Reader Emeritus in Classics, University of Cambridge. Author of* The Greek Tragic Poets; A Commentary on Aristotle's Poetics.
LITERATURE, WESTERN: *Ancient Greek*

D.W.M. D.W. Maurer. *Emeritus Professor of Linguistics, University of Louisville, Kentucky. Author of* Whiz-Mob: A Correlation of the Argot of Professional Pick-Pockets with Their Behavior Patterns *and other books and articles on slang.*
SLANG (*in part*)

D.Wo. Douglas Woodruff (d. 1978). *Editor,* The Tablet, *London, 1936–67. Author of* Church and State in History *and others.*
PIUS V, SAINT AND POPE (*in part*)
PIUS IX, POPE (*in part*)

D.W.O'C. Rev. Daniel William O'Connor. *Charles A. Dana Professor of Religious Studies, Saint Lawrence University, Canton, New York. Author of* Peter in Rome: The Literary, Liturgical and Archeological Evidence.
PETER THE APOSTLE, SAINT

D.W.S. Denis William Stevens. *Professor of Musicology, Columbia University, 1964–76. Author of* Tudor Church Music.
CHORAL MUSIC
PALESTRINA

D.W.T. Donald W. Tinkle. *Professor of Zoology; Director, Museum of Zoology, University of Michigan, Ann Arbor. Author of* The Life and Demography of the Side-Blotched Lizard.
SPECIES AND SPECIATION

D.W.v.K. D.W. van Krevelen. *Professor of Chemical Engineering, Technological University of Delft, The Netherlands. Author of* Coal: Typology, Chemistry, Physics, and Constitution.
COALS

D.W.W. Donald Walter Wilkie. *Director, Aquarium-Museum, Scripps Institution of Oceanography, University of California, San Diego.*
AQUARIUM

D.Y. Dale Yoder. *Professor and Director, Bureau of Business Services and Research, California State University, Long Beach. Professor of Industrial Relations, Stanford University, California, 1959–66. Author of* Personnel Management and Industrial Relations.
PERSONNEL ADMINISTRATION

D.Y.-Y.H. David Yi-Yung Hsia, M.D. *Professor and Chairman, Department of Pediatrics, Stritch School of Medicine, Loyola University, Maywood, Illinois; Pediatrician in Chief, Loyola University Hospital. Author of* Inborn Errors of Metabolism.
METABOLISM, DISEASES OF

E.A. Eric Axelson. *Professor of History, University of Cape Town. Author of* Portugal and the Scramble for Africa *and others.*
CAPE TOWN

E.A.B. Ernest Amano Boateng. *Executive Chairman, Environmental Protection Council of Ghana, Accra. Vice Chancellor, University of Cape Coast, Ghana, 1971–73. President, Ghana Academy of Arts and Sciences, 1973–77. Author of* A Geography of Ghana.
GHANA (*in part*)
VOLTA RIVER

E.A.Bo. Edward Allen Boyden (d. 1976). *Research Professor, Department of Biological Structure, University of Washington, Seattle, 1956–76. Professor of Anatomy, University of Minnesota, Minneapolis, 1931–54. Author of* Segmental Anatomy of the Human Lung *and others.*
RESPIRATORY SYSTEM, HUMAN (*in part*)

E.A.D. Eugene A. Davidson. *Professor and Chairman, Department of Biological Chemistry, Milton S. Hershey Medical Center, Pennsylvania State University, Hershey. Author of* Carbohydrate Chemistry.
CARBOHYDRATE

E.A.E. Ernst Arnold Egli (deceased). *Professor of Urban Planning, Swiss Federal Institute of Technology, 1955–63. Author of* Geschichte des Stadtbaues; Die neue Stadt in Landschaft und Klima.
URBAN DESIGN (*in part*)

E.A.H. E. Adamson Hoebel. *Regents Professor Emeritus of Anthropology; Adjunct Professor of Law, University of Minnesota, Minneapolis. Authority on American Indians and on primitive law. Author of* The Law of Primitive Man.
PRIMITIVE LAW

E.A.Ha. Eric Alfred Havelock. *Sterling Professor Emeritus of Classics, Yale University. Author of* The Lyric Genius of Catullus *and others.*
CATULLUS

E.A.J.D. Ernest Albert John Davies. *Editor,* Traffic Engineering and Control. *Member of Parliament for Enfield East, England, 1945–59. Chairman, Labour Party Transport Committee, 1945–59. Author of* Traffic Engineering Practice.
CANALS AND INLAND WATERWAYS (*in part*)
TRANSPORTATION, HISTORY OF (*in part*)
TRANSPORTATION, WATER

E.A.K. E.A. Kracke, Jr. (d. 1976). *Professor of Chinese Literature and Institutions, University of Chicago, 1960–73. Author of* Civil Service in Early Sung China, 960–1067.
SUNG T'AI TSU

Ea.L. Earl Latham (d. 1977). *Joseph B. Eastman Professor of Political Science, Amherst College, Massachusetts, 1948–73. Author of* The Group Basis of Politics *and others.*
POLITICAL SCIENCE

E.Al. Edward Allworth. *Professor of Turco-Soviet Studies; Director, Program on Soviet Nationality Problems, Columbia University. Author of* Soviet Asia.
AZERBAIJAN SOVIET SOCIALIST REPUBLIC (*in part*)
KAZAKH SOVIET SOCIALIST REPUBLIC (*in part*)
KIRGIZ SOVIET SOCIALIST REPUBLIC (*in part*)
TADZHIK SOVIET SOCIALIST REPUBLIC (*in part*)
TURKMEN SOVIET SOCIALIST REPUBLIC (*in part*)
UZBEK SOVIET SOCIALIST REPUBLIC (*in part*)

E.A.M. Edith A. Müller. *Professor of Astrophysics, University of Geneva, Switzerland.*
SUN (*in part*)

E.A.O. Edwin A. Olson. *Professor of Earth Science, Whitworth College, Spokane, Washington. Co-editor of* Proceedings of the Sixth International Conference on Radiocarbon and Tritium Dating.
DATING, RELATIVE AND ABSOLUTE

E.A.P. Edwin A. Peel. *Professor and Head, Department of Educational Psychology, University of Birmingham, England. Editor,* Educational Review. *Author of* The Psychological Basis of Education.
PEDAGOGY

E.A.R. Rev. Edward A. Ryan, S.J. (d. 1964). *Rector, Our Lady of Martyrs Tertianship, Auriesville, New York, 1962–64. Professor of Church History, Woodstock College, Maryland, 1936–62.*
LOYOLA, SAINT IGNATIUS OF

E.A.R.B. Elizabeth A.R. Brown. *Professor of History, Brooklyn College, City University of New York.*
PHILIP IV THE FAIR, OF FRANCE

E.A.T. E.A. Thompson. *Professor of Classics, University of Nottingham, England. Author of* The Early Germans; A History of Attila and the Huns; *and others.*
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GERMANS, ANCIENT
STILICHO
THEODORIC THE GREAT

E.A.U. E. Ashworth Underwood, M.D. *Honorary Research Fellow, University College, University of London. Director, Wellcome Institute of the History of Medicine, 1946–64, London. Editor of* Science, Medicine and History.
HIPPOCRATES
MEDICINE, HISTORY OF (*in part*)
NIGHTINGALE, FLORENCE
REED, WALTER
VIRCHOW, RUDOLF

E.B. Edward Bridges, 1st Baron Bridges (d. 1969). *Privy Councillor, Permanent Secretary to H.M. Treasury, London, 1945–56. Author of* Portrait of a Profession.
CIVIL SERVICE (*in part*)

E.Ba. E. Badian. *Professor of History, Harvard University. Author of* Roman Imperialism in the Late Republic *and others.*
ROME, ANCIENT (*in part*)

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CARDIOVASCULAR SYSTEM DISEASES AND DISORDERS (*in part*)

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LITERATURE, WESTERN: *Caribbean*

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PREFABRICATION AND SHOP FABRICATION

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HISTORIOGRAPHY AND HISTORICAL METHODOLOGY

E.B.G. Elizabeth Belmont Gasking (d. 1973). *Senior Lecturer in the History and Philosophy of Science, University of Melbourne, Australia. Author of* Investigations into Generation, 1651–1828.
SPALLANZANI, LAZZARO

E.B.H. Earl B. Hunt. *Professor of Psychology, University of Washington, Seattle. Author of* Concept Learning.
CONCEPT FORMATION

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DÜRER, ALBRECHT

E.Br. Ernle Bradford. *Author of* The Wind Commands Me: A Life of Sir Francis Drake *and others.*
DRAKE, SIR FRANCIS

E.B.R. Elwyn B. Robinson. *University Professor Emeritus of History, University of North Dakota, Grand Forks. Author of* History of North Dakota.
GREAT PLAINS
NORTH DAKOTA (*in part*)

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SPECTROSCOPY, PRINCIPLES OF (*in part*)

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STEAM POWER

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PARAGUAY, HISTORY OF

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DUCCIO DI BUONINSEGNA

E.C.A. Ernst C. Abbe. *Emeritus Professor of Botany, University of Minnesota, Minneapolis.*
BETULALES
SALICALES

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HINDU MYSTICISM
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

E.C.Du. Elizabeth Corning Dudley. *Research Associate, Department of Zoology, University of Maryland, College Park.*
CELASTRALES

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MAZZINI, GIUSEPPE

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WASHINGTON

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CHINA SEA

E.C.N. E. Clifford Nelson. *Professor of Religion, St. Olaf College, Northfield, Minnesota. Author of* Lutheranism in North America, 1914–70 *and others.*
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ROMER, ALFRED SHERWOOD

Ed. The editors.

E.D. Edouard Delebecque. *Professor of Greek Language and Literature, University of Aix-Marseille I, Marseille, France. Author of* Thucydide et Alcibiade *and others.*
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KEPLER, JOHANNES

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AZERBAIJAN SOVIET SOCIALIST REPUBLIC (*in part*)

E.Du. Enrique Dussel. *Professor of Ethics, National University of Cuyo, Mendoza, Argentina. Professor of History and Philosophy, Central University of Ecuador, Quito. Author of* Les Évêques hispano-américaine (1504–1620) *and others.*
LAS CASAS, BARTOLOMÉ DE

E.E. Eliahu Elath. *Emeritus President, Hebrew University of Jerusalem. Chairman, Board of Governors, Afro-Asian Institute for Co-operative and Labour Studies, Tel Aviv, Israel. Ambassador of Israel to U.S., 1948–50, and to U.K., 1952–59. Author of* Israel and Her Neighbours.
ISRAEL

E.E.D.M.O. E.E. David M. Oates. *Professor of Western Asiatic Archaeology, Institute of Archaeology, University of London. Author of* Studies in the Ancient History of Northern Iraq.
BAGHDAD

E.E.E. E. Earle Ellis. *Research Professor of New Testament Literature, New Brunswick Theological Seminary, New Jersey. Author of* The Gospel of Luke *and others.*
LUKE, SAINT

E.Eg. Emil Egli. *Professor of Geography, Zürich Gymnasium. Lecturer, University of Zürich and Swiss Federal Institute of Technology, Zürich. Author of* Switzerland *and others.*
SWITZERLAND

E.E.N.D. Ellinor Elizabeth Nancy Draper. *Author of* Birth Control in the Modern World.
BIRTH CONTROL (*in part*)

E.E.R. Edgar Eugene Robinson (d. 1977). *Margaret Byrne Professor of American History, Stanford University, California, 1931–52. Author of* Evolution of American Political Parties *and others.*
UNITED STATES, HISTORY OF THE (*in part*)

E.E.S. Eustace E. Suckling. *Professor of Physiology, State University of New York Downstate Medical Center, Brooklyn. Author of* Bioelectricity; The Living Battery.
BIOELECTRICITY

E.E.Sn. Esmond E. Snell. *Professor of Microbiology, University of Texas at Austin. Editor of* Pyridoxal Catalysis: Enzymes and Model Systems; Annual Review of Biochemistry, *vol. 38 and 39.*
NUTRITION

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HERACLIUS

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PERSONALITY, THEORIES OF

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NERVI, PIER LUIGI

E.F.G. Edward F. Greene. *Professor of Chemistry, Brown University, Providence, Rhode Island. Co-author of* Chemical Reactions in Shock Waves.
MOLECULAR AND ATOMIC BEAMS

E.F.G.D. Emilio Fernando González Díaz. *Professor of Geomorphology, University of Buenos Aires.*
PATAGONIAN DESERT

E.F.S. Edward Fairbrother Strange (d. 1925). *Keeper of Woodwork, Victoria and Albert Museum, London. Author of* Chinese Lacquer *and others.*
LACQUERWORK (*in part*)

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HOLMES, OLIVER WENDELL

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EGYPT, HISTORY OF (*in part*)

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SLAVIC RELIGION

E.G.C. Edward Gordon Couzens (d. 1971). *Technical Director, Bexford Ltd., Manningtree, England, 1952–62. Co-author of* Plastics in the Modern World.
PLASTICS AND RESINS

E.Ge. Ettore Gelpi. *Director of life-long education program, United Nations Educational, Scientific and Cultural Organization* (UNESCO), *Paris. Author of* Storia dell'educazione *and others.*
EDUCATION, HISTORY OF (*in part*)

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INCOME TAX, PERSONAL

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E.G.My. Elizabeth Gard. *Editor, University of New Mexico Press, Albuquerque. Editorial Assistant, Geography,* Encyclopædia Britannica, *Chicago, 1970–71. Co-author of* The Arriba Readers.
IGUAÇU FALLS

E.G.P. Edwin G. Pulleyblank. *Professor of Chinese, University of British Columbia, Vancouver. Author of* The Background of the Rebellion of An Lu-shan; Chinese History and World History; *and others.*
AN LU-SHAN
CONFUCIANISM, HISTORY OF

E.Gr. Endre Grastyán, M.D. *Professor of Physiology, Medical University of Pécs, Hungary. Author of* Exp. Beiträge zur Pathogenese der Commotio Cerebri.
EMOTION

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ERASMUS, DESIDERIUS
LUTHER, MARTIN

Eg.S. Egon Schaden. *Professor of Communication and Arts, University of São Paulo, Brazil. Author of* Mitologia Heróica de Tribos Indígenas do Brasil.
SOUTH AMERICAN TROPICAL FOREST CULTURES

E.G.T. Eric Gardner Turner. *Professor of Papyrology, University College, University of London; Director, Institute of Classical Studies, 1953–63. Author of* Greek Papyri *and many other works on papyri.*
CALLIGRAPHY (*in part*)

E.Gu. Erna Gunther. *Former Professor and Chairman, Department of Anthropology, University of Alaska, College. Director, Washington State Museum, 1929–67. Author of* Art in the Life of the Northwest Coast Indians *and others.*
AMERICAN INDIAN PEOPLES, ARTS OF (*in part*)

E.G.W. Ernest Glen Wever. *Higgins Professor Emeritus of Psychology, Auditory Research Laboratories, Princeton University. Author of* Theory of Hearing.
SOUND RECEPTION

E.H. Erich Heinz, M.D. *Professor of Biochemistry; Chairman, Gustav Embden Center of Biological Chemistry, Johann Wolfgang Goethe University of Frankfurt, West Germany.*
MEMBRANE, BIOLOGICAL (*in part*)

E.Ha. Enriqueta Harris. *Honorary Fellow of the Warburg Institute, University of London. Author of* Spanish Painting; Goya.
GOYA, FRANCISCO DE
VELÁZQUEZ, DIEGO

E.H.C. Edward H. Carr. *Fellow of Trinity College, University of Cambridge. Author of* Michael Bakunin; A History of Soviet Russia; *and others.*
BAKUNIN, MIKHAIL ALEKSANDROVICH

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LORENZ, KONRAD

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TROMP, MAARTEN AND CORNELIS

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LABOUR ECONOMICS

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SOCIAL AND CULTURAL CHANGE

E.H.St. Elmer H. Stotz. *Professor of Biochemistry, School of Medicine and Dentistry, University of Rochester, New York. Editor of* Comprehensive Biochemistry.
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E.H.T. Elias H. Tuma. *Professor of Economics, University of California, Davis. Author of* Twenty-six Centuries of Agrarian Reform: A Comparative Analysis *and others.*
LAND REFORM AND TENURE

E.H.T.W. E.H. Timothy Whitten. *Professor of Geological Sciences, Northwestern University, Evanston, Illinois. Author of* Structural Geology of Folded Rocks.
ROCK DEFORMATION

E.H.W., Jr. Edmund H. Worthy, Jr. *Assistant Executive Director, American Historical Association, Washington, D.C. Founder,* Sung Studies Newsletter.
WANG AN-SHIH

E.I.G. Estill I. Green. *Management consultant. Formerly Executive Vice President, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.*
SOUND RECORDING AND REPRODUCING (*in part*)

Ei.H. Einar Haugen. *Victor S. Thomas Professor Emeritus of Linguistics and Scandinavian, Harvard University. Author of* Norwegian Language in America; Language Conflict and Language Planning: The Case of Modern Norwegian; *and others.*
GERMANIC LANGUAGES (*in part*)

E.I.J.R. Erwin I.J. Rosenthal. *Emeritus Reader in Oriental Studies, University of Cambridge. Author of* Political Thought in Medieval Islam; *editor of* Averroës' Commentary on Plato's Republic.
AVERROËS

E.I.U. *Economist Intelligence Unit,* The Economist, *London.*
ALGERIA (*in part*)
ARGENTINA (*in part*)
AUSTRALIA, COMMONWEALTH OF (*in part*)
BRAZIL (*in part*)
CANADA (*in part*)
CHINA (*in part*)
CZECHOSLOVAKIA (*in part*)
EGYPT, ARAB REPUBLIC OF (*in part*)
FRANCE (*in part*)
GERMAN DEMOCRATIC REPUBLIC (*in part*)
GERMANY, FEDERAL REPUBLIC OF (*in part*)
GREECE (*in part*)
INDIA (*in part*)
INDONESIA (*in part*)
ITALY (*in part*)
JAPAN (*in part*)
MEXICO (*in part*)
NIGERIA (*in part*)
PAKISTAN (*in part*)
POLAND (*in part*)
SOUTH AFRICA (*in part*)
SOVIET UNION (*in part*)
SPAIN (*in part*)
SUDAN, THE (*in part*)
TURKEY (*in part*)
UNITED KINGDOM (*in part*)
UNITED STATES OF AMERICA (*in part*)

E.J. Emrys Jones. *Professor of Geography, London School of Economics and Political Science, University of London. Author of* Social Geography of Belfast *and others.*
NORTHERN IRELAND

E.J.B. Ernest J. Briskey. *Vice President, Scientific Affairs, Campbell Soup Company, Camden, New Jersey; President, Technological Resources, Inc. Professor of Muscle Biology and Meat Science and Technology, University of Wisconsin, Madison, 1965–70. Co-editor of* The Physiology and Biochemistry of Muscle as a Food.
MEAT AND MEAT-PACKING

E.J.Bi. E.J. Bickerman. *Emeritus Professor of Ancient History, Columbia University. Author of* Chronology of the Ancient World.
CALENDAR (*in part*)

E.J.C.G. Edward J.C. Garden. *Professor and Head, Department of Music, University of Sheffield, England. Author of* Tchaikovsky; Balakirev.
TCHAIKOVSKY, PETER ILICH

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ELIZABETH I OF ENGLAND (*in part*)

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WIND INSTRUMENTS (*in part*)

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METALWORK (*in part*)

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PLEURONECTIFORMES

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SPACE PERCEPTION (*in part*)

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PETRONIUS ARBITER
TEXTUAL CRITICISM

E.J.M. Elbert John Minarcik. *Chief Metallurgist, Metal Division, NL Industries, Inc., Hightstown, New Jersey.*
LEAD PRODUCTS AND PRODUCTION

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LIN PIAO

E.J.S. Sir Edward James Salisbury. *Director, Royal Botanic Gardens, Kew, England, 1943–56. Author of* The Living Garden; The Reproductive Capacity of Plants; *and others.*
LINNAEUS

E.J.Si. Ernest J. Simmons (d. 1972). *Professor of Russian Literature; Chairman, Department of Slavic Languages, Columbia University, 1946–59. Author of* Dostoyevsky: The Making of a Novelist *and others.*
DOSTOYEVSKY, FYODOR
LITERATURE, WESTERN: *Russian; 20th century* (*in part*)
TOLSTOY, LEO

E.J.W. Edwin J. Westermann. *Professor of History, University of Missouri, Kansas City.*
MISSOURI

E.J.W.B. Ernest J.W. Barrington. *Emeritus Professor of Zoology, University of Nottingham, England. Author of* Introduction to General and Comparative Endocrinology.
HORMONE

E.J.Wi. E.J. Wiesenberg. *Member, Taylor–Schechter Cairo Genizah Research Unit, University of Cambridge Library. Former Reader in Hebrew, University College, University of London. Editor and translator of* Abraham Maimonides' Commentary on Genesis and Exodus.
CALENDAR (*in part*)
CHRONOLOGY (*in part*)

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FURNITURE AND ACCESSORY FURNISHINGS (*in part*)

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WRIGHT, FRANK LLOYD

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CLUPEIFORMES

E.Ke. Elie Kedourie. *Professor of Politics, London School of Economics and Political Science, University of London. Author of* Afghani and 'Abduh: An Essay on Religious Unbelief and Political Activism in Modern Islam *and others.*
JAMĀL AD-DĪN AL-AFGHĀNĪ

E.K.H. Earl K. Hyde. *Deputy Director, Lawrence Berkeley Laboratory, University of California, Berkeley. Co-author of* Nuclear Properties of the Heavy Elements.
SEABORG, GLENN THEODORE

E.K.-R. Elisabeth Kübler-Ross, M.D. *Medical Director, Ross Medical Associates, Flossmoor, Illinois. Author of* On Death and Dying *and others.*
DEATH

E.K.W. Ellis K. Waterhouse. *Director of Studies, Paul Mellon Centre for Studies in British Art, London. Barber Professor of Fine*

Arts; Director, Barber Institute of Fine Arts, University of Birmingham, England, 1952–70. Author of Italian Baroque Painting; Painting in Britain 1530–1790.
CORREGGIO

E.L. Edward Lockspeiser (d. 1973). *Writer and broadcaster on music. Author of* Debussy: His Life and Mind *and others.*
DEBUSSY, CLAUDE
DIAGHILEV, SERGEY
MENDELSSOHN, FELIX

E.L.B. Elias Lunn Bredsdorff. *Reader and Head, Department of Scandinavian Studies, University of Cambridge; Fellow of Peterhouse, Cambridge. Author of* Danish Literature in English Translation: A Bibliography; *editor of* Contemporary Danish Prose *and others. Reviewer:* LITERATURE, WESTERN (*in part*)

E.L. Du B. E. Lloyd Du Brul. *Professor of Anatomy; Professor and Head, Department of Oral Anatomy; University of Illinois, Chicago. Author of* Biomechanics of the Body *and others.*
FORM AND FUNCTION, BIOLOGICAL

E.L.H. Most Rev. Edward Louis Heston, C.S.C. (d. 1973). *Chairman, Pontifical Social Communications Commission, Vatican City, 1971–73. Author of* The Holy See at Work.
PAUL VI, POPE

E.Li. Edwin Lieuwen. *Professor of Latin American History, University of New Mexico, Albuquerque. Author of* Venezuela *and others.*
VENEZUELA, HISTORY OF

E.L.K. Edward Louis Keenan. *Professor of History, Harvard University. Author of* The Kurbskii-Groznyi Apocrypha: The Seventeenth-Century Genesis of the 'Correspondence' Between Ivan IV and A.M. Kurbskii.
RUSSIA AND THE SOVIET UNION, HISTORY OF (*in part*)

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WELLINGTON, DUKE OF

E.L.O.M. Ernesto La Orden Miracle. *Spanish Ambassador to Costa Rica, 1972–76.*
SPAIN (*in part*)

El.R. Elliott Rudwick. *Professor of Sociology; Senior Research Fellow, Center for Urban Regionalism, Kent State University, Ohio. Author of* W.E.B. Du Bois: Propagandist of the Negro Protest *and others.*
DU BOIS, W.E.B.

El.S. Eliot Stellar. *Professor of Physiological Psychology; Director, Institute of Neurological Sciences, University of Pennsylvania, Philadelphia. Co-editor of* Progress in Physiological Psychology.
PSYCHOLOGY, PHYSIOLOGICAL

E.L.T. Edward Lewis Turner, M.D. (d. 1960). *Secretary, Council on Medical Education and Hospitals, American Medical Association, Chicago, 1953–59. Professor of Medicine; Dean, School of Medicine, University of Washington, Seattle, 1945–53.*
MEDICAL EDUCATION (*in part*)

E.L.Y. Ellen Louise Young. *Historical research specialist (manufactures).*
METALWORK (*in part*)

E.M. Eric Mendoza. *Professor and Head, Department of Physics, University College of North Wales, Bangor, University of Wales. Editor of* Sadi Carnot's Reflections on the Motive Power of Fire.
CARNOT, SADI

E.Ma. Erich Matthias. *Professor of Contemporary History and Political Science, University of Mannheim, West Germany. Author of* Sozialdemokratie und Nation *and others.*
BEBEL, AUGUST

E.M.B. E. Margaret Burbidge. *Professor of Astronomy, University of California, San Diego. Director, Royal Greenwich Observatory, Herstmonceux, England, 1972–74. Co-author of* Quasi-Stellar Objects.
GALAXIES, EXTERNAL

E.McC. Elizabeth McClintock. *Research Associate, Department of Botany, University of California, Berkeley.*
LAMIALES

E.McN.E. Ernest McNeill Eller. *Rear Admiral, U.S. Navy (retired). Author of* The Soviet Sea Challenge *and others; co-editor of* Dictionary of American Naval Fighting Ships.
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E.M.G. Ernest M. Gifford, Jr. *Professor of Botany, University of California, Davis. Co-author of* Comparative Morphology of Vascular Plants.
LYCOPSIDA
PSILOPSIDA
SPHENOPSIDA

E.M.H. Edward M. Hutchinson. *Educational Consultant. Secretary, National Institute of Adult Education, London, 1947–71; Editor,* Adult Education *journal, 1949–71; Research Director and Editor,* Provision for Adult Education, *1971.*
ADULT EDUCATION

E.M.Ho. Ellen M. Horan. *Assistant Director for One Design Racing, U.S. Yacht Racing Union, Evanston, Illinois; Editor,* USYRU News.
BOATING AND YACHTING (*in part*)

E.M.J.C. Eila M.J. Campbell. *Professor and Head, Department of Geography, Birkbeck College, University of London.*
CARPINI, GIOVANNI DA PIAN DEL
GAMA, VASCO DA

Em.R. Emilio Romero. *President of the Geographical Society of Lima. Author of* Geografía económica del Perú *and others.*
LIMA

E.M.R. Edwin M. Ripin (d. 1975). *Assistant Curator, Musical Instruments Department, Metropolitan Museum of Art, New York City, 1970–73. Editor of* Keyboard Instruments.
KEYBOARD INSTRUMENTS

Em.Š. Emil Štampar. *Professor of Modern Serbo-Croatian Literature, University of Ljubljana, Yugoslavia.*
LITERATURE, WESTERN: *Croatian*

E.M.W. Edmund Merriman Wise (d. 1972). *Assistant to the Vice President of Research, International Nickel Company, New York City, 1955–61. Author of* Palladium: Recovery, Properties and Uses; *editor of* Gold: Recovery, Properties, and Applications; *co-editor of* Platinum Metals and Their Alloys.
GOLD PRODUCTS AND PRODUCTION
NICKEL PRODUCTS AND PRODUCTION
PLATINUM METALS, PRODUCTS AND PRODUCTION OF

E.M.Wn. Elizabeth M. Wilkinson. *Emeritus Professor of German, University of London. Co-author of* Goethe: Poet and Thinker *and others.*
GOETHE, JOHANN WOLFGANG VON

E.N. Edward Norbeck. *Professor of Anthropology, Rice University, Houston, Texas. Author of* Religion in Primitive Society *and others.*
ANCESTOR WORSHIP
PASSAGE RITES

E.N.A. Edward Noah Abrahart. *Former Assistant Research Manager, Clayton Aniline Co. Ltd., Manchester, England. Author of* Dyes and Their Intermediates.
DYES AND DYEING

E.N. da C.A. Edward Neville da Costa Andrade (d. 1971). *Quain Professor of Physics, University of London, 1928–50. Author of* Physics for the Modern World *and others.*
FARADAY, MICHAEL

En.S. Enid Starkie (d. 1970). *Reader in French Literature, University of Oxford; Fellow, Somerville College, Oxford, 1934–65. Author of* André Gide; Arthur Rimbaud; Baudelaire; *and others.*
BAUDELAIRE, CHARLES
GIDE, ANDRÉ
RIMBAUD, ARTHUR

E.N.S. Eric Norman Simons. *Author of* The Queen and the Rebel: Mary Tudor and Wyatt the Younger *and others.*
MARY I OF ENGLAND

E.O. Eberhard Otto (d. 1974). *Professor of Egyptology, Rupert Charles University of Heidelberg. Author of* Osiris und Amun; Gott und Mensch nach den ägyptischen Tempelinschriften der griechisch-römischen Zeit; *and others.*
EGYPTIAN RELIGION

E.O.D. Edward O. Dodson. *Professor of Biology, University of Ottawa, Ontario. Author of* Evolution: Process and Product; Genetics: The Modern Science of Heredity.
PHYLOGENY

E.O.G.T.-P. E.O.G. Turville-Petre. *Emeritus Professor and Vigfússon Reader in Ancient Icelandic Literature and Antiquities, University of Oxford. Author of* Myth and Religion of the North; Origins of Icelandic Literature; *and others.*
GERMANIC RELIGION AND MYTHOLOGY
LITERATURE, WESTERN: *Icelandic* (*in part*)

E.O.J. Rev. Edwin Oliver James (d. 1972). *Chaplain of All Souls College, University of Oxford. Professor of the History and Philosophy of Religion, University of London. Author of* Seasonal Feasts and Festivals *and numerous other works in the comparative study of religions.*
PRIESTHOOD
SACRAMENT

E.O.W. Edwin O. Willis. *Research Associate in Biology, Princeton University. Author of* The Behavior of Bicolored Antbirds.
SOCIAL BEHAVIOUR, ANIMAL

E.P. Eva Paproth. *Director, Geological Office of Nordrhein-Westfalen, Krefeld, West Germany.*
CARBONIFEROUS PERIOD, LOWER

E.P.A. E. Paul Albury, D.D.S. *President, Bahamas Historical Society, Nassau. Former Senator of The Bahamas.*
BAHAMAS

E.P.C. Edward P. Crowell, D.O. *Executive Director, American Osteopathic Association, Chicago.*
OSTEOPATHIC MEDICINE

E.Pe. Edward Pessen. *Distinguished Professor of History, Baruch College and the Graduate Center, City University of New York. Author of* Jacksonian America: Society, Personality and Politics *and others.*
UNITED STATES, HISTORY OF THE (*in part*)

E.P.G. Elias Panayiotis Gyftopoulos. *Ford Professor of Engineering, Massachusetts Institute of Technology, Cambridge. Co-author of* Thermionic Energy Conversion.
THERMODYNAMICS, PRINCIPLES OF (*in part*)

E.P.H. Eric P. Hamp. *Robert Maynard Hutchins Distinguished Service Professor of Linguistics and of Behavioral Sciences; Director, Center for Balkan and Slavic Studies,*

University of Chicago. Co-editor of Readings in Linguistics, *vol. 2.*
ALBANIAN LANGUAGE
GRAMMAR

E.P.Ha. Earl Parker Hanson. *Consultant, Department of State, Commonwealth of Puerto Rico, 1956–69. Professor of Geography; Chairman, Department of Geography and Geology, University of Delaware, Newark, 1949–56. Author of* The Amazon, a New Frontier *and others.*
VENEZUELA (*in part*)

E.Po. Ernesto Pontieri. *Professor of Medieval and Modern History, University of Naples. Author of* Tra i Normanni nell' Italia meridionale.
ITALY AND SICILY, HISTORY OF (*in part*)
ROBERT GUISCARD

E.P.O. Eugene P. Odum. *Alumni Foundation Distinguished Professor of Zoology; Director, Institute of Ecology, University of Georgia, Athens. Author of* Fundamentals of Ecology; Ecology.
ECOSYSTEM

E.R. Ernest Rabinowicz. *Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge. Author of* Friction and Wear of Materials.
TRIBOLOGICAL PHENOMENA

E.R.A.F. Enid R.A. Forde. *Lecturer in Geography, Fourah Bay College, University of Sierra Leone, Freetown.*
GAMBIA, THE
GAMBIA RIVER

E.R.C. Eli Rush Crews, M.D. (d. 1972). *Clinical Professor of Surgery, University of Texas Medical School at San Antonio. Chief of the Burn Service, Bexar County Teaching Hospital, Texas. Author of* A Practical Manual for the Treatment of Burns.
BURNS

E.R.G. Edna R. Green. *Head, Science Department, Philadelphia High School for Girls. Co-author of* Biology.
BIOLOGICAL SCIENCES (*in part*)

E.R.G.E. Ernst R.G. Eckert. *Regents' Professor Emeritus and Director, Thermodynamics and Heat Transfer, Department of Mechanical Engineering, University of Minnesota, Minneapolis, World authority in the field of heat transfer. Co-author of* Heat and Mass Transfer.
HEAT EXCHANGER

E.R.H. Edward R. Harrison. *Professor of Physics and Astronomy, University of Massachusetts, Amherst.*
UNIVERSE, ORIGIN AND EVOLUTION OF

E.R.Ha. Edward R. Hardy. *Fellow of Jesus College, University of Cambridge. Professor of Church History, Berkeley Divinity School, New Haven, Connecticut, 1947–69. Author of* Christian Egypt: Church and People; *editor of* Christology of the Later Fathers; Faithful Witnesses; *and others.*
ATHANASIUS, SAINT
BASIL THE GREAT, SAINT
GREGORY OF NAZIANZUS, SAINT
GREGORY OF NYSSA, SAINT

Er.L. Erik Lassen. *Director, Museum of Decorative Art, Copenhagen. Author of* Danish Furniture of the Classical Age *and others.*
FURNITURE AND ACCESSORY FURNISHINGS (*in part*)

E.R.-M. Emir Rodriguez-Monegal. *Professor of Latin American Literature; Chairman of Latin American Studies, Yale University. Author of* Borgès par lui-même *and others.*
BORGES, JORGE LUIS

Er.R. Erich Ruckgaber. *Editor,* Stuttgarter Zeitung, *West Germany.*
BADEN-WÜRTTEMBERG

E.R.R. Elmar Rudolf Reiter. *Professor of Atmospheric Science, Colorado State University, Ft. Collins. Author of* Jet-Stream Meteorology *and others.*
JET STREAMS

E.R.S. Ernest R. Sandeen. *Professor of History, Macalester College, St. Paul, Minnesota. Author of* The Roots of Fundamentalism: British and American Millenarianism 1800–1930.
FUNDAMENTALIST AND EVANGELICAL CHURCHES
MILLENNIALISM

E.R.Se. Elman R. Service. *Professor of Anthropology, University of California, Santa Barbara. Investigator of the economic and social organization of primitive cultures. Author of* Primitive Social Organization.
HUMAN CULTURES, PRIMITIVE AND NON-URBAN

E.Ru. Eleanor Ruggles. *Biographer. Author of* Prince of Players: Edwin Booth *and others.*
BOOTH, EDWIN

E.S. Egon Schwelb. *Former Principal Officer, Office of Legal Affairs, United Nations, New York City; Deputy Director, Division of Human Rights, 1947–62. Senior Fellow and Emeritus Lecturer in Law, Yale University. Author of* Human Rights and the International Community.
HUMAN RIGHTS

E.Sa. Emilio Sáez. *Professor of Medieval Spanish History, University of Barcelona, Spain. Author of* Colección diplomática de Sepúlveda.
ALFONSO V THE MAGNANIMOUS, OF ARAGON
ALFONSO VI OF CASTILE AND LEÓN
JAMES I THE CONQUEROR, OF ARAGON

E.S.A.J. Erik S.A. Jacobsen, M.D. *Professor of Pharmacology, Royal Danish School of Pharmacy, Copenhagen. Author of* The Comparative Pharmacology of Some Psychotropic Drugs.
SEDATIVE-HYPNOTIC DRUGS

E.S.D. Eleanor Shipley Duckett. (d. 1976). *Professor of Classical Languages and Literature, Smith College, Northampton, Massachusetts, 1928–49. Author of* The Gateway to the Middle Ages; Carolingian Portraits; *and others.*
CHARLES MARTEL
PEPIN THE SHORT

E.S.H. Eric S. Higgs. (d. 1976). *Director of Research, Faculty of Archaeology and Anthropology, University of Cambridge. Co-editor of* Science in Archaeology.
AGRICULTURE, HISTORY OF (*in part*)

E.Si. Edith Simon. *Historian and writer. Author of* The Making of Frederick the Great *and others.*
FREDERICK II THE GREAT, OF PRUSSIA

E.S.M. Edmund S. Muskie. *United States Senator from Maine. Author of* Journeys.
MAINE

E.S.Mi. Earl Schenck Miers (d. 1972). *Historian, editor, and writer. Author of* The General Who Marched to Hell; The American Civil War; *and many others.*
SHERMAN, WILLIAM TECUMSEH

E.S.P. Edward S. Perkins, M.D. *Professor of Experimental Ophthalmology, Institute of Ophthalmology, University of London. Co-author of* Atlas of Diseases of the Eye.
EYE DISEASES AND VISUAL DISORDERS

E.S.S. Ephraim S. Siker, M.D. *Director, Department of Anesthesiology, Mercy Hospital, Pittsburgh. Clinical Professor of Anesthesiology, University of Pittsburgh. Co-author of* Narcotics and Narcotic Antagonists.
NARCOTIC

E.St. Erwin Stengel, M.D. (d. 1973). *Professor of Psychiatry, University of Sheffield, England; President, International Association for Suicide Prevention. Author of* Suicide and Attempted Suicide.
SUICIDE

E.Sy. Edmond Sylvain. *Attorney. Former Editor and Publisher,* La Patrie (*daily newspaper*). *Former Rector, State University of Haiti, Port-au-Prince.*
HAITI

E.T. Ettore Toffoletto, M.D. *President of the Administration Council, Arts Academy, Bologna, Italy. Author of* Discorso sul Malpighi *and others.*
MALPIGHI, MARCELLO (*in part*)

E.T.B. Eric Temple Bell (d. 1960). *Professor of Mathematics, California Institute of Technology, Pasadena, 1926–60. Author of* Development of Mathematics; The Magic of Numbers; *and others.*
MATHEMATICS, HISTORY OF (*in part*)

E.t.H. Ernst ten Haaf. *Lecturer in General Geology, Utrecht University, The Netherlands.*
CONGLOMERATES AND BRECCIAS

E.To. Elisabeth Tooker. *Professor of Anthropology, Temple University, Philadelphia. Author of* An Ethnography of the Huron Indians, 1615–1649; The Iroquois Ceremonial of Midwinter.
EASTERN WOODLANDS INDIANS

E.T.S. Edward Togo Salmon. *Messecar Professor Emeritus of History, McMaster University, Hamilton, Ontario. Author of* A History of the Roman World from 30 B.C. to A.D. 138 *and others.*
ROME, ANCIENT (*in part*)

E.T.Sa. Emilie T. Sander (d. 1976). *Associate Professor of New Testament, Yale University, 1973–75. Co-editor and translator of* The Bible and the Role of Women.
BIBLICAL LITERATURE (*in part*)

E.T.W. Sir Edgar Trevor Williams. *Secretary, Rhodes Trust. Pro-Vice-Chancellor, University of Oxford; Fellow of Balliol College, Oxford. Editor of* Dictionary of National Biography.
VICTORIA, QUEEN

E.U.C. Edward U. Condon (d. 1974). *Professor of Physics; Fellow, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, 1963–70. Co-author of* Handbook of Physics.
MECHANICS, QUANTUM

E.U.E.-U. E.U. Essien-Udom. *Vice Chancellor, University of Maiduguri, Nigeria. Author of* Black Nationalism: A Search for an Identity in America *and others.*
BLACK MUSLIMS

Eu.G. Eugen Gerstenmaier. *President, Bundestag (lower house of the Federal Assembly), Federal Republic of Germany, 1954–69. Author of* New Nationalism? *and others.*
ADENAUER, KONRAD

Eu.M.A. Eufronio M. Alip. *President, Philippine National Historical Society. Editor,* Journal of History (*quarterly*). *President and Manager, Alip & Sons, Inc. (publishing firm), Manila. Author of* Political and Cultural History of the Philippines *and others.*
PHILIPPINES

E.V. Eugene Vanderpool. *Professor of Archaeology, American School of Classical Studies at Athens.*
ATHENS (*in part*)
OLYMPIA

E.Va. Ernesto Valgiglio. *Professor of Greek and Latin Grammar, University of Genoa. Author of* Silla e la crisi repubblicana.
SULLA, LUCIUS CORNELIUS

E.V.B.B. Eric V.B. Britter (d. 1977). *Foreign Correspondent,* The Times (*London*), *1944–69.*
GRENADA

E.v.H. Ernst van Heerden. *Poet. Professor of Afrikaans and Netherlands, University of the Witwatersrand, Johannesburg. Author of* Die klop *and many others.*
LITERATURE, WESTERN: *South African in Afrikaans*

E.Vi. Eugène Vinaver. *Emeritus Professor of French Language and Literature, Victoria University of Manchester. Author of* The Rise of Romance; *editor of* The Works of Sir Thomas Malory.
LITERATURE, WESTERN: *French; Medieval (in part)*
ROMANCE (LITERATURE) (*in part*)

Ev.S. Eva Schaper. *Professor of Logic, University of Glasgow, Scotland. Author of* Prelude to Aesthetics.
TROELTSCH, ERNST

Ev.W. Evert Werkman. *Editor,* Het Parool, *Amsterdam. Author of* Amsterdam, 'n stad op palen *and others.*
AMSTERDAM

E.W. Edward Weintal (d. 1973). *Diplomatic Correspondent, Chief European Correspondent, and Contributing Editor,* Newsweek *magazine, 1944–69. Co-author of* Facing the Brink: An Intimate Study of Crisis Diplomacy.
DULLES, JOHN FOSTER

E.W.A. Edward W. Anderson. *Navigational Adviser, Aviation Division, Smiths Industries Ltd., Cheltenham, England. Author of* Principles of Navigation.
NAVIGATION

E.W.B. Ernst Wilhelm Benz. *Emeritus Professor of Church History, Philipps University of Marburg, West Germany. Author of* Evolution and Christian Hope.
CHRISTIANITY

E.We. Eric Werner. *Emeritus Professor of Liturgical Music, Hebrew Union College–Jewish Institute of Religion, New York City. Consulting Professor, Tel Aviv University, Israel. Author of* The Sacred Bridge; Mendelssohn; *and others.*
JEWISH PEOPLES, ARTS OF (*in part*)

E.W.G. Eric William Gray. *Lecturer in Ancient History, University of Oxford; Official Student and Tutor in Roman History, Christ Church, Oxford, 1939–77. Editor of Greenidge and Clay's* Sources for Roman History (133–70 B.C.).
MAECENAS, GAIUS
POMPEY THE GREAT

E.Wi. Edward Wichers. *Associate Director, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C., 1958–62; Chief, Division of Chemistry, 1948–58. Author of papers on chemical reagents, pure substances, and atomic weights.*
ATOMIC WEIGHT (*in part*)

E. Wk. Edward Wasiolek. *Avalon Distinguished Service Professor of Slavic and Comparative Literature; Chairman, Committee on Comparative Studies in Literature, University of Chicago. Author of* Dostoevsky, the Major Fiction; Tolstoy's Major Fiction.
Reviewer: LITERATURE, WESTERN (*in part*)

E.W.Ke. Edward Washburn Kellogg (d. 1960). *Engineer and inventor. Group Supervisor, Advanced Development, Radio Corporation of America, 1930–48.*
SOUND RECORDING AND REPRODUCING (*in part*)

E.W.S. Edward W. Smykay. *Professor of Business Administration, Michigan State University, East Lansing. Co-author of* Physical Distribution Management.
MATERIALS HANDLING

E.Wt. Ernst Weigt. *Emeritus Professor of Economic Geography, Friedrich Alexander University of Erlangen-Nuremberg, Erlangen, West Germany.*
NÜRNBERG

E.W.W. Eric Walter White. *Former Assistant Secretary and Literature Director, Arts Council of Great Britain, London. Author of* Stravinsky: The Composer and His Works *and others.*
STRAVINSKY, IGOR

E.W.Z. Ernst Walter Zeeden. *Professor of Modern and Medieval History, Eberhard Karl University of Tübingen, West Germany.*
HARDENBERG, KARL VON
STEIN, KARL, FREIHERR VOM

E.Z. Erik Zürcher. *Professor of East Asian History, State University of Leiden, The Netherlands. Author of* The Buddhist Conquest of China.
CHINA, HISTORY OF (*in part*)

E.Z.H. E. Zudaire Huarte. *Instructor, Good Counsel Academy, Lecaroz, Spain. Author of* El conde-duque y Cataluña *and others.*
OLIVARES, CONDE-DUQUE DE

E.Zö. Erich Zöllner. *Professor of Austrian History, University of Vienna. Author of* Geschichte Österreichs von den Anfängen bis zur Gegenwart *and others.*
AUSTRIA, HISTORY OF (*in part*)

F.A. Frederick Alexander. *Emeritus Professor of Modern History, University of Western Australia, Nedlands. Author of* Australia Since Federation.
WESTERN AUSTRALIA

F.A.A. Francis A. Allen. *Edson R. Sunderland Professor of Law, University of Michigan, Ann Arbor. Author of* The Borderland of Criminal Justice.
BECCARIA, CESARE
ERSKINE, THOMAS ERSKINE, 1st BARON

F.A.B. Frank A. Brown, Jr. *Morrison Professor Emeritus of Biology, Northwestern University, Evanston, Illinois. Co-author of* Comparative Animal Physiology; The Biological Clock: Two Views.
COLORATION, BIOLOGICAL (*in part*)
PERIODICITY, BIOLOGICAL

F.A.C. F. Albert Cotton. *Robert A. Welch Professor of Chemistry, Texas A & M University, College Station. Author of* Chemical Applications of Group Theory.
TRANSITION ELEMENTS AND THEIR COMPOUNDS

F.A.H. Frederick Anthony Holland. *Professor and Chairman, Department of Chemical Engineering, University of Salford, England. Partner in Saldrem Associates (consulting chemical engineers). Co-author of* Pumping of Liquids.
PUMP

F.A.L. Frank Andrew Leeming. *Senior Lecturer in Geography, University of Leeds, England.*
LIAONING

F.A.P. Frank A. Paine. *Director, Packaging Division, Pira (reseach association for the paper and board, printing, and packaging industries), Leatherhead, England. Editor of* Fundamentals of Packaging.
PACKAGING

F.A.Po. Frederick A(lbert) Pottle. *Sterling Professor Emeritus of English, Yale University. Author of* James Boswell: The Earlier Years, 1740–1769; The Literary Career of James Boswell; *and others.*
BOSWELL, JAMES

F.A.V. Frederick Albert Valentine. *Professor of Mathematics, University of California, Los Angeles. Author of* Convex Sets.
GEOMETRY, EUCLIDEAN (*in part*)

F.B. François Bernard. *Maître des Requêtes, a judicial rank in the Council of State, Paris.*
FRANCE (*in part*)

F.Ba. Frank Barlow. *Emeritus Professor of History, University of Exeter, England. Author of* William I and the Norman Conquest *and others.*
WILLIAM I THE CONQUEROR, OF ENGLAND

F.B.B. Frank Bagnall Bessac. *Professor of Anthropology, University of Montana, Missoula. Author of* Culture Types of Northern and Western China.
EAST ASIAN CULTURES

F.B.C. Floyd Barton Chapman. *Ecologist, Harding Hospital, Worthington, Ohio. Author of* The Ruffed Grouse and Its Management in Ohio.
FALCONRY (*in part*)

F.Be. Fernando Benítez. *Editor,* La Cultura en México. *Professor of Journalism, National Autonomous University of Mexico, Mexico City. Author of* Los Indios de México *and others.*
MEXICO CITY

F.B.G. Frank B. Gibney. *Vice President for Planning and Development, Encyclopædia Britannica, Inc., Chicago. Vice Chairman, TBS-Britannica Company Ltd., Tokyo. Author of* The Khrushchev Pattern *and others.*
KHRUSHCHEV, NIKITA SERGEYEVICH

F.Br. Friedrich Blendinger. *Director of Archives, Augsburg, West Germany. Author of* Bevolkerungsgeschichte einer deutschen Reichsstadt im Zeitalter der Glaubenskämpfe.
FUGGER FAMILY

F.B.S. Frederick Bernard Singleton. *Chairman, Postgraduate School of Yugoslav Studies, University of Bradford, England. Author of* Twentieth Century Yugoslavia *and others.*
BELGRADE (*in part*)
YUGOSLAVIA (*in part*)

F.Bu. Felix Buttersack. *Editor of* Münchner Merkur (*newspaper*), *Munich.*
MUNICH (*in part*)

F.C. Françoise Choay. *Professor of Urban Studies, University of Paris VIII. Author of* Le Corbusier; Planning in the XIXth Century; *and others.*
CORBUSIER, LE

F.C.B. Frederick C. Barghoorn. *Professor of Political Science, Yale University. Author of* Politics in the U.S.S.R.
SOVIET UNION (*in part*)

F.C.C. Frederick C. Crews. *Professor of English, University of California, Berkeley. Author of* E.M. Forster: The Perils of Humanism; The Sins of the Fathers: Hawthorne's Psychological Themes.
LITERARY CRITICISM

F.C.D. III Frederick C. Durant III. *Assistant Director, Astronautics, National Air and Space Museum, Smithsonian Institution, Washington, D.C.*
BRAUN, WERNHER VON
ROCKETS AND MISSILE SYSTEMS
SPACE EXPLORATION

F.C.F. Sir Frank C. Francis. *Director and Principal Librarian, British Museum, London, 1959–68. Editor of* The Bibliographical Society, 1892–1942: Studies in Retrospect; The Treasures of the British Museum.
BIBLIOGRAPHY
LIBRARY

F.C.Gi. Frances Carney Gies. *Co-author of* Leonard of Pisa and the New Mathematics of the Middle Ages *and others.*
LEONARDO OF PISA

F.Ch. Frank Chapman. *Former Senior English Master, High School for Boys, Oswestry, England. Author of "Hardy the Novelist" in* Scrutiny.
HARDY, THOMAS

F.C.H. F. Clark Howell. *Professor of Anthropology, University of California, Berkeley. Author of* Early Man.
NEANDERTHAL MAN

F.C.Ke. Fenton Crosland Kelley. *Associate Professor of Zoology, Boise State University, Idaho.*
ELIMINATION

F.C.M. Frederick C. Mosher. *Doherty Professor of Government and Foreign Affairs, University of Virginia, Charlottesville. Author of* Democracy and the Public Service.
PUBLIC ADMINISTRATION

F.C.N. Frederick C. Nachod. *Director of Special Projects, Sterling-Winthrop Research Institute, Rensselaer, New York, 1974–78; Chemical Liaison Staff Director, 1964–74. Co-author of* Determination of Organic Structures by Physical Methods.
MOLECULAR STRUCTURE (*in part*)

F.C.O. Francis Christopher Oakley. *Professor of History; Dean of the Faculty, Williams College, Williamstown, Massachusetts. Author of* Council Over Pope? Towards a Provisional Ecclesiology *and others.*
PAPACY

F.C.P. Forrest C. Pogue. *Director, Dwight D. Eisenhower Institute for Historical Research, Smithsonian Institution, Washington, D.C. Director, George C. Marshall Research Library, Lexington, Virginia, 1964–74. Author of* George C. Marshall.
MARSHALL, GEORGE C.

F.D.G. Frank Denby Gunstone. *Professor of Chemistry, University of St. Andrews, Scotland. Author of* An Introduction to the Chemistry and Biochemistry of the Fatty Acids and Their Glycerides *and others.*
CARBOXYLIC ACIDS AND THEIR DERIVATIVES

F.D.H. F.D. Hobbs. *Head, Environmental Modelling and Survey Unit, University of Birmingham, England. Author of* Traffic Planning and Engineering.
TRAFFIC CONTROL

F.Do. Filippo Donini. *Cultural Expert, Cultural Relations Department, Italian Ministry of Foreign Affairs, Rome, 1972–76. Director, Italian Institute, London, 1961–72. Author of* Vita e poesia di Sergio Corazzini.
LITERATURE, WESTERN: *Italian (19th century)*

F.D.O. Francis D. Ommanney. *Reader in Marine Biology, University of Hong Kong, 1957–60. Scientific staff member, Discovery Committee (oceanographic research in Antarctic waters), 1929–39. Author of* South Latitude and North Cape *and others.*
BYRD, RICHARD E.

F.D.P. Franklin D. Parker. *Professor of History, University of North Carolina at Greensboro. Author of* The Central American Republics *and others.*
CENTRAL AMERICAN STATES, HISTORY OF (*in part*)
COSTA RICA

F.d.Pe. Franco della Peruta. *Professor of the History of the Risorgimento, University of Milan. Author of* I democratici e la rivoluzione italiana *and others.*
ITALY AND SICILY, HISTORY OF (*in part*)

F.Dr. Franz Dölger (d. 1968). *Emeritus Professor of Byzantine and Modern Greek Studies, University of Munich. Author of* Die byzantinische Dichtung in der Reinsprache.
LITERATURE, WESTERN: *Greek (Medieval Byzantine)*

F.E.A. Franz E. Anderson. *Associate Professor of Oceanography, University of New Hampshire, Durham.*
ESTUARIES (*in part*)

F.E.B. Frederick E. Bacon. *Former Metallurgical Engineer, Metals Division, Union Carbide Corporation, Niagara Falls, New York.*
CHROMIUM PRODUCTS AND PRODUCTION

F.E.Be. Forrest E. Beck. *Director, Technical Services Department, Parker Pen Company, Janesville, Wisconsin.*
WRITING IMPLEMENTS

F.E.G.C. Francis E.G. Cox. *Professor of Zoology, King's College, University of London. Co-author of* The Protozoa; Practical Invertebrate Zoology.
ACANTHOCEPHALA
NEMERTEA

F.E.K. Frank E. Keating. *Fishing Editor,* Newsday, *Garden City, New York. Contributor to publications on outdoors subjects.*
FISHING, SPORT (*in part*)

F.E.Ki. F.E. Kirby. *Professor of Music, Lake Forest College, Illinois. Author of* A Short History of Keyboard Music; An Introduction to Western Music; Bach, Beethoven, Wagner, Stravinsky.
MUSICAL FORM

F.E.M. Frank Edward Manuel. *Kenan Professor of History, New York University, New York City. Author of* Shapes of Philosophical History *and others.*
DEISM

F.E.McE. Frank E. McElroy. *Director, Technical Publications, National Safety Council, Chicago. Editor in Chief of* Accident Prevention Manual for Industrial Operations.
FIRE PREVENTION AND CONTROL

F.E.R. Frank E. Reynolds. *Associate Professor of Buddhist Studies and History of Religions, University of Chicago.*
ANGKOR
JAYAVARMAN VII

F.F. Franco Ferracuti, M.D. *Professor of Criminological Medicine and Forensic Psychiatry, University of Rome. Co-author of* The Subculture of Violence.
CRIME AND DELINQUENCY (*in part*)

F.F.B. Frederick Fyvie Bruce. *Rylands Professor of Biblical Criticism and Exegesis, Victoria University of Manchester, England. Author of* The Books and the Parchments *and others.*
EXEGESIS AND HERMENEUTICS, BIBLICAL

F.F.C. Frederick F. Cartwright. *Emeritus Senior Lecturer in the History of Medicine, King's College Hospital, University of London. Author of* Joseph Lister.
LISTER, JOSEPH

F.Fe. Fritz Fellner. *Professor of Modern History, University of Salzburg, Austria. Author of* Schicksaljahre Österreichs *and others.*
AUSTRIA, HISTORY OF (*in part*)

F.Fo. Frieda Fordham. *Analytical psychologist. Author of* An Introduction to Jung's Psychology.
JUNG, CARL (*in part*)

F.Fr. Frank Freidel. *Professor of History, Harvard University. Author of* America in the Twentieth Century; Franklin D. Roosevelt; *and others.*
ROOSEVELT, FRANKLIN D.
UNITED STATES, HISTORY OF THE (*in part*)

F.G. F. Grossmann. *Senior Professor Emeritus of Art History, University of Washington, Seattle. Author of* Bruegel: The Paintings *and others.*
BRUEGEL, PIETER, THE ELDER

F.G.A.S. F. Gordon A. Stone. *Professor of Inorganic Chemistry, University of Bristol, England. Editor of* Advances in Organometallic Chemistry.
ORGANOMETALLIC COMPOUNDS (*in part*)

F.Gi. Francesco Giunta. *Professor of Medieval History, University of Palermo. Author of* Sicilia spagnola *and others.*
PALERMO

F.Go. Frederick Goldbeck. *Critic and musicologist. Adviser for Music, Radiotélévision Française. Author of* The Perfect Conductor.
GOUNOD, CHARLES

F.Gre. Frank Greenaway. *Keeper, Department of Chemistry, Science Museum, London. Author of* John Dalton and the Atom; *editor of* Lavoisier's Essays, Physical and Chemical.
MENDELEYEV, DMITRY IVANOVICH

F.Gu. Rev. Franco Guerello, S.J. *Professor of Italian Literature, Social Institute, Turin, Italy. Editor of* Lettere di Innocenzo IV dai cartolari notarili genovesi.
INNOCENT IV, POPE

F.H. François Haverschmidt. *Ornithologist. Author of* Birds of Surinam *and numerous articles on the behaviour and ecology of neotropical birds.*
GALLIFORMES

F.Ha. Felix Haurowitz. *Distinguished Professor Emeritus of Chemistry, Indiana University, Bloomington. Author of* Chemistry and Function of Proteins.
PROTEIN

F.H.B. Frederick Henry Boland. *Chancellor, University of Dublin. Representative to the United Nations, 1956–64.*
IRELAND

F.H.M. Franz H. Michael. *Emeritus Professor of Far Eastern History and International Affairs, George Washington University, Washington, D.C. Author of* The Origin of Manchu Rule in China; The Taiping Rebellion; *and others.*
NURHACHI

F.H.O. Frederick Henry Osborn. *Former Director, Population Association of America and American Eugenics Society. Author of* Preface to Eugenics; *co-author of* Dynamics of Population.
EUGENICS

F.H.S. Frank Harold Spedding. *Principal Scientist, U.S. Atomic Energy Commission, Ames Laboratory, Iowa State University, Ames, 1968–74; Director, Ames Laboratory, 1947–68. Co-author of* The Rare Earths.
RARE-EARTH ELEMENTS AND THEIR COMPOUNDS

F.Hu. Frederick Fu Hung. *Emeritus Professor of Geography, University of Guelph, Ontario. Author of a geography series for schools (in Chinese) and others.*
CHEKIANG
FUKIEN (*in part*)
HEILUNGKIANG
HOPEH
KIANGSU
KIRIN

F.H.W. Fred H. Wilt. *Professor of Zoology, University of California, Berkeley. Editor of* Methods in Developmental Biology.
GROWTH

F.İ. Fahir İz. *Professor of Turkish Literature, Boğaziçi University, Istanbul. Author of* Ottoman Turkish Prose; Ottoman Turkish Verse.
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

F.I.T. Frederick Ichiro Tsuji. *Research Biologist, Department of Marine Biology, Scripps Institution of Oceanography, University of California at San Diego, La Jolla.*
BIOLUMINESCENCE (*in part*)

F.J.B. Fred J. Benson. *Vice President for Engineering and Non-Renewable Resources, Texas A & M University, College Station.*
ROADS AND HIGHWAYS

F.J.B.W. Sir F.J.B. Watson. *Director of the Wallace Collection, London, 1963–74. Surveyor of the Queen's Works of Art, 1963–72. Author of* Fragonard; Canaletto; *and others.*
FRAGONARD, JEAN-HONORÉ

F.J.D. Frederick J. Dockstader. *Museum consultant and art historian. Director, Museum of the American Indian, Heye Foundation, New York City, 1960–75. Author of* Indian Art in North America; Indian Art in Middle America; Indian Art in South America; *and others.*
AMERICAN INDIAN PEOPLES, ARTS OF (*in part*)

F.J.M. Francis J. Murray. *Professor of Mathematics, Duke University, Durham, North Carolina. Author of* Mathematical Machines.
MATHEMATICS AS A CALCULATORY SCIENCE (*in part*)

F.J.Ma. Frank J(oseph) Malina. *Past President; Trustee, International Academy of Astronautics, Paris. Founder–Editor,* Leonardo *(international journal of the contemporary artist). Editor of the first–fifth* Lunar International Laboratory Symposia.
KÁRMÁN, THEODORE VON

F.J.S. Frederick J. Streng. *Professor of the History of Religions, Southern Methodist University, Dallas, Texas. Author of* Emptiness: A Study of Religious Meaning; Understanding Religious Life.
NĀGĀRJUNA
SACRED OR HOLY

F.-J.Se. Franz-Josef Schmale. *Professor of Medieval History, University of the Ruhr, Bochum, West Germany. Editor of* Quellen zur Geschichte Kaiser Heinrichs IV.
HENRY IV, EMPEROR
HENRY V, EMPEROR

F.J.T. Fred J. Tickner. *Emeritus Professor of Political Science, State University of New York at Albany. Author of* Modern Staff Training *and others.*
APPRENTICESHIP AND EMPLOYEE TRAINING

F.J.V. Frederick J. Vine. *Professor of Geophysics; Dean, School of Environmental Sciences, University of East Anglia, Norwich, England. Among the first to provide proof of outward movement of the ocean floors from mid-ocean ridges.*
SEA-FLOOR SPREADING

F.J.W. Francis James West. *Planning Dean in Social Sciences; Professor of History and Government, Deakin University, Geelong, Australia. Author of* Political Advancement in the South Pacific *and others.*
FRENCH POLYNESIA (*in part*)
OCEANIA, HISTORY OF

F.K. Most Rev. Franz Cardinal König. *Archbishop of Vienna. Author of* Zarathustras Jenseitsvorstellungen und das Alte Testament *and others.*
ZOROASTER

F.Ka. Firuz Kazemzadeh. *Professor of History, Yale University. Former Chairman, National Spiritual Assembly of the Bahá'ís of the United States. Author of* Russia and Britain in Persia, 1864–1914 *and others.*
BAHÁ'Í FAITH

F.K.A. Franklin K. Anderson. *Research Environmental Scientist, University of Utah Research Institute, Salt Lake City. Associate Editor, Life Sciences (Botany),* Encyclopædia Britannica, *Chicago, 1970–72.*
URTICALES

F.K.H. F. Kenneth Hare. *University Professor and Director, Institute for Environmental Studies, University of Toronto. An authority on meteorology and the general circulation of the atmosphere. Author of* The Restless Atmosphere.
WINDS AND STORMS

F.K.L. Fang Kuei Li. *Emeritus Professor of Chinese Linguistics and Anthropology, University of Washington, Seattle. Emeritus Professor of Asian Linguistics, University of Hawaii, Honolulu. Authority on the languages of South China. Author of* The Tai Dialect of Lungchow.
TAI LANGUAGES

F.L. Fred Lukoff. *Associate Professor of Korean and of Linguistics, University of Washington, Seattle. Former Lecturer, Graduate School of Education, Seoul National University. Author of* Spoken Korean.
KOREAN LANGUAGE

F.La. François Lasserre. *Associate Professor of Classical Greek, University of Lausanne, Switzerland. Translator and editor of* Strabon, Géographie, *books 3–6, 10–12.*
STRABO

F.L.J. Frederick L. Jones. *Professor of English, University of Pennsylvania, Philadelphia. Co-author of* An Examination of the Shelley Legend; *editor of* The Letters of Percy Bysshe Shelley.
SHELLEY, PERCY BYSSHE

Fl.M. Florence Moog. *Professor of Biology, Washington University, St. Louis, Missouri. Author of* Structure and Development of Vertebrates.
CHORDATA

F.L.S. Fred L. Spalding. *Associate Professor of General Engineering, University of Illinois, Urbana.*
DRAFTING

F.M. Fosco Maraini. *Lecturer in Japanese, University of Florence. Author of* Where Four Worlds Meet *and others.*
HINDU KUSH MOUNTAINS
POLO, MARCO

F.Ma. Francesco Mazzoni. *Professor of Philology in Dante and the Middle Ages, University of Florence. President, Italian Dante Society. Author of* Contributi di filologia dantesca; Saggio di un nuovo commento alla Divina commedia.
DANTE

F.M.B. Fawn McKay Brodie. *Professor of History, University of California, Los Angeles. Author of* The Devil Drives: A Life of Sir Richard Burton.
BURTON, SIR RICHARD

F.M.C. Francisco Machado Carrion. *Professor of Geography, Federal University of Rio Grande do Sul, Pôrto Alegre, Brazil.*
RIO GRANDE DO SUL

F.McD. Forrest McDonald. *Professor of History, University of Alabama, University. Author of* E Pluribus Unum *and others.*
UNITED STATES, HISTORY OF THE (*in part*)

F.M.L. Sir Frederick M. Lea. *Director of Building Research, Department of Scientific and Industrial Research, England, 1946–65. Author of* The Chemistry of Cement and Concrete.
CEMENT

F.Mo. Francis (Frank) Moran (d. 1975). *Golf writer,* The Scotsman, *Edinburgh. President, Association of Golf Writers. Author of* Golfers' Gallery.
GOLF

F.M.S. Frank M. Shipman. *Member, Board of Directors, Brown-Forman Distillers Corporation, Louisville, Kentucky, 1951–70; Technical Director, 1940–1965; Vice President, 1945–65.*
DISTILLED LIQUOR

F.M.Sw. Frederick M. Swain. *Professor of Geology, University of Minnesota, Minneapolis. Author of* Non-Marine Organic Geochemistry.
VARVED DEPOSITS

F.M.V. Florence M. Voegelin. *Director, Archives of Languages of the World; Editor,* Anthropological Linguistics, *Indiana University, Bloomington. Co-author of* Classification and Index of the World's Languages *and others.*
LANGUAGES OF THE WORLD (*in part*)

F.N. Fritz Neumark. *Professor of Political Economy, Johann Wolfgang Goethe University of Frankfurt, Frankfurt am Main, West Germany. Author of* Grundsätze gerechter und ökonomisch rationaler Steuerpolitik.
TAXATION (*in part*)

F.Ne. Francis Netter. *Head, Department of the Linear Accelerator, Nuclear Research Centre, Saclay, France.*
CURIE FAMILY

F.N.H.R. Frank Neville H. Robinson. *Senior Research Officer, Clarendon Laboratory, University of Oxford; Fellow and Tutor in Physics, St. Catherine's College, Oxford. Author of* Noise and Fluctuations in Electronic Devices and Circuits *and others.*
ELECTRICITY

F.N.M. Fyodor Nikolayevich Milkov. *Head, Department of Physical Geography, Voronezh Lenin Komsomol State University, U.S.S.R.*
RUSSIAN STEPPE

F.N.S. Fyodor Nikolayevich Sukhopara. *Head of Section, Scientific Council on the Location of the U.S.S.R. Productive Forces, Academy of Sciences of the U.S.S.R., Moscow. Co-author of* Development of Large Economic Regions of the U.S.S.R.
MOLDAVIAN SOVIET SOCIALIST REPUBLIC (*in part*)

F.N.W. Fred N. White. *Professor of Physiology; Director, Physiological Research Laboratory, Scripps Institution of Oceanography, University of California, San Diego, at La Jolla. Co-author of* Animal Function: Principles and Adaptations.
RESPIRATION AND RESPIRATORY SYSTEMS

F.Om. Farouk Omar. *Assistant Professor of History, College of Arts, University of Baghdad, Iraq. Author of* The 'Abbasid Caliphate 132–170 A.H.
BARMAKIDS

F.O.W. Frank Osborne Wood. *Technical Director, Salt Institute, Alexandria, Virginia.*
SALT AND SALT PRODUCTION (*in part*)

F.O.Wa. Frederick O. Waage. *Emeritus Professor of the History of Art and Archaeology, Cornell University, Ithaca, New York; Chairman, Department of Fine Arts, 1942–60. Author of* Prehistoric Art *and others.*
MOSAIC (*in part*)

F.P. Fred Plum, M.D. *Anne Parrish Titzell Professor of Neurology, Medical College, Cornell University, New York City. Neurologist in Chief, New York Hospital. Associate editor for neurologic diseases and contributor of "Headache" and other chapters to* Cecil-Loeb Textbook of Medicine.
HEADACHE

F.P.B. Frederick P. Bargebuhr. *Emeritus Professor of Religion, University of Iowa, Iowa City. Emeritus Professor of Religion, Southern Illinois University, Carbondale. Author of* The Alhambra: A Cycle of Studies on the Eleventh Century in Moorish Spain.
IBN GABIROL

F.P.K. Frank P. Kolb. *Professor of Ancient History, Christian Albrecht University of Kiel, West Germany. Author of* Literarische

Beziehungen zwischen Cassius Dio, Herodian und der Historia Augusta.
CARACALLA

F.P.L. Fritz P. Loewe (d. 1974). *Senior Lecturer in Charge, Department of Meteorology, University of Melbourne, Australia, 1938–61. A world authority on the meteorology of the Southern Hemisphere. Author of* Études de glaciologie en Terre Adélie.
SNOW AND SNOWFLAKES

F.Po. Frederick Pohl. *Consultant, Bantam Books, Inc., New York City. Author of* Tiberius (*under the pseudonym Ernest Mason*).
TIBERIUS

F.P.S. Francis P. Shepard. *Emeritus Professor of Marine Geology, Scripps Institution of Oceanography, University of California, La Jolla. World authority on marine geology and submarine canyons. Co-author of* Submarine Canyons and Other Sea Valleys.
CANYONS, SUBMARINE

F.R. Fazlur Rahman. *Professor of Islāmic Thought, University of Chicago. Author of* Islam; Islamic Methodology in History; *and others.*
ISLĀM

Fr.A. Frank Angelo. *Associate Executive Editor,* Detroit Free Press.
DETROIT

F.R.A. Francis R. Aumann. *Emeritus Professor of Political Science, Ohio State University, Columbus. Co-author of* The Government and Administration of Ohio.
OHIO

F.R.Al. Frank Raymond Allchin. *Reader in Indian Studies, University of Cambridge. Author of "The Culture Sequence of Bactria" in* Antiquity; *co-author of* The Birth of Indian Civilization: India and Pakistan Before 500 B.C.
AFGHANISTAN, HISTORY OF (*in part*)
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

F.R.H. F. Reed Hainsworth. *Professor of Biology, Syracuse University, New York.*
PRESSURE AND TEMPERATURE, BIOLOGICAL EFFECTS OF

Fr.J.M. Francis J. Terence Maloney. *Product development executive. Author of* Glass in the Modern World.
GLASS PRODUCTS AND PRODUCTION

Fr.M. Frederick Mosteller. *Professor of Mathematical Statistics, Harvard University. Co-author of* Probability with Statistical Applications; Data Analysis and Regression.
STATISTICS (*in part*)

F.R.M. Frank R. Moraes (d. 1974). *Editor in Chief,* The Indian Express, *New Delhi, 1957–72. Author of* India Today; Jawaharlal Nehru: A Biography; *and numerous others.*
INDIA (*in part*)
NEHRU, JAWAHARLAL

F.S. Franklin Sherman. *Professor of Christian Ethics, Lutheran School of Theology at Chicago. Co-author of* The Place of Bonhoeffer.
BONHOEFFER, DIETRICH

F.S.A. Frederick S. Arkhurst. *Managing Director, Ideas Ltd., Accra, Ghana. Editor of* Africa in the Seventies and Eighties: Issues in Development *and others.*
AFRICA (*in part*)

F.Sc. Friedrich Schreyvogl. *Novelist and free-lance writer, Vice Director, Vienna Burgtheater, 1954–59. Author of* Ein Jahrhundert zu früh: das Schicksal Josephs II *and others.*
JOSEPH II, EMPEROR

F.Se. Francis Scarfe. *Critic, novelist, and poet. Director, British Institute in Paris. Professor of French, University of London. Author of* The Art of Paul Valéry *and others.*
LITERATURE, WESTERN: *French; (20th century)*

F.So. Friedrich Solmsen. *Moses Slaughter Professor Emeritus of Classical Studies, University of Wisconsin, Madison. Author of* Hesiod and Aeschylus.
HESIOD

F.S.P. Francis S. Pierce. *Senior Editor, Aretê Publishing Company, Princeton, New Jersey. Associate Editor, Economics,* Encyclopædia Britannica, *Chicago, 1967–73.*
VEBLEN, THORSTEIN
EXCHANGE AND PAYMENTS, INTERNATIONAL (*in part*)

F.T. Frederick Tepper. *General Manager, Catalyst Research Corporation, Baltimore, Maryland. Co-author of* Alkali Metal Handling and System Operating Techniques.
ALKALI METALS AND THEIR COMPOUNDS

F.Th. Friedrich Thöne (deceased). *Art historian. Author of* Lucas Cranach der Ältere *and others; co-author of* Thieme-Becker: Künstler-Lexikon.
CRANACH, LUCAS, THE ELDER

F.T.M. Fred T. Mackenzie. *Professor of Geology, Northwestern University, Evanston, Illinois. Co-author of* The Evolution of Sedimentary Rocks.
OCEANS, DEVELOPMENT OF

F.Tr. François Treves. *Professor of Mathematics, Rutgers University, New Brunswick, New Jersey. Author of* Topological Vector Spaces, Distributions and Kernels; Linear Partial Differential Equations with Constant Coefficients.
ANALYSIS, FUNCTIONAL (*in part*)

Fu.M. Fujimura Michio. *Professor of History, Sophia University, Tokyo. Author of* Yamagata Aritomo *and others.*
YAMAGATA ARITOMO

F.V.O.'C. Francis Valentine O'Connor. *Co-editor,* Jackson Pollock: A Catalogue Raisonné of Paintings, Drawings, and Other Works. *Senior Visiting Research Associate, National Collection of Fine Arts, Smithsonian Institution, Washington, D.C., 1970–72. Author of* Jackson Pollock; *editor of* The New Deal Art Projects; An Anthology of Memoirs.
DE KOONING, WILLEM
POLLOCK, JACKSON

F.W.C. Francis William Carter. *Joint Hayter Lecturer in the Geography of Eastern Europe, University College and School of Slavonic and East European Studies, University of London. Editor of* An Historical Geography of the Balkans.
BULGARIA (*in part*)

F.W.F. Frederick Ward Frey. *Professor of Political Science; Senior Staff Member, Center for International Studies, Massachusetts Institute of Technology, Cambridge. Author of* The Turkish Political Elite.
POLITICAL POWER

F.W.G. Frederick William Gibbs (d. 1966). *Deputy Secretary and Editor, Royal Institute of Chemistry, London.*
DAVY, SIR HUMPHRY

F.Wh. Frederick Whitehead (d. 1971). *Reader in Old French Language and Literature, Victoria University of Manchester. Editor of* La Chanson de Roland; La Chastelaine de Vergi.
LITERATURE, WESTERN: *French; Medieval* (*in part*)
ROMANCE (LITERATURE) (*in part*)

F.Wi. Frank Willett. *Professor of African Art, Northwestern University, Evanston, Illinois. Author of* African Art: An Introduction; Ife in the History of West African Sculpture.
AFRICAN PEOPLES, ARTS OF (*in part*)

F.W.K. Francis W. Karasek. *Professor of Chemistry, University of Waterloo, Ontario.*
INSTRUMENTATION

F.W.Kn. Franklin W. Knight. *Professor of History, Johns Hopkins University, Baltimore, Maryland. Author of* Slave Society in Cuba during the Nineteenth Century *and others.*
CUBA, HISTORY OF

F.W.W. Frank W. Walbank. *Rathbone Professor Emeritus of Ancient History and Classical Archaeology, University of Liverpool. Author of* A Historical Commentary on Polybius *and others.*
ALEXANDER III THE GREAT
GREEK CIVILIZATION, ANCIENT (*in part*)
PLUTARCH
POLYBIUS

F.W.We. Frits W. Went. *Emeritus Professor of Botany, Desert Research Institute, University of Nevada System, Reno. Author of* The Experimental Control of Plant Growth.
SCRUBLANDS

F.W.W.-S. Francis William Wentworth-Sheilds. (d. 1969). *Artist. Principal Lecturer, Department of Printing and Graphic Design, Twickenham College of Technology, Middlesex, England, 1966–69.*
VISUAL ARTS, WESTERN (*in part*)

F.X.M. Rev. Francis Xavier Murphy, C.SS.R. *Professor of Patristic Moral Theology, Alfonses Academy, Rome. Staff editor for patrology,* New Catholic Encyclopedia.
ALEXANDER VI, POPE
PAUL III, POPE

G.A. Giovanni Aquilecchia. *Professor of Italian, Bedford College, University of London. Author of* Giordano Bruno *and others; editor of Pietro Aretino's* Sei giornate.
ARIOSTO, LUDOVICO
BRUNO, GIORDANO
LITERATURE, WESTERN: *Italian; Medieval* (*in part*); *Renaissance* (*in part*)
TASSO, TORQUATO

G.A.A. Gould Arthur Andrews, M.D. *Director, Clinical Applications, Oak Ridge Associated Universities, Tennessee; Chairman, Medical Division, 1962–75. Editor of* Radioactive Pharmaceuticals.
RADIATION INJURY

G.A.B. Georg A. Borgstrom. *Professor of Food Science and of Geography, Michigan State University, East Lansing. Editor of* Fish as Food.
FISH AND MARINE PRODUCTS

G.A.C. G(ustav) Arthur Cooper. *Emeritus Paleobiologist, Smithsonian Institution, Washington, D.C. Author of* Chazyan and Related Brachiopods.
BRACHIOPODA

G.A.C.H. Geoffrey A.C. Herklots. *Colombo Plan Botanical Adviser to Government of Nepal, 1961–63. Principal and Director of Research, Imperial College of Tropical Agriculture, Trinidad, 1953–60. Author of* Vegetables in South-East Asia *and others.*
GARDENING (*in part*)

G.A.F.K. George Angus Fulton Knight. *President, Pacific Theological College, Suva, Fiji, 1965–72. Author of* A Christian Theology of the Old Testament; Deutero-Isaiah, a Theological Commentary; *and others.*
MACCABEES

G.A.G.M. G.A.G. Mitchell. *Professor of Anatomy; Director, Anatomical Laboratories, Victoria University of Manchester, 1946–74. Author of* The Anatomy of the Autonomic Nervous System *and others.*
EXCRETORY SYSTEM, HUMAN

G.Ak. George Akita. *Professor of History, University of Hawaii, Honolulu. Author of*

Foundations of Constitutional Government.
ITŌ HIROBUMI

G.A.K. Gregory A. Kimble. *Professor and Chairman, Department of Psychology, Duke University, Durham, North Carolina. Author of* Foundations of Conditioning and Learning.
LEARNING THEORIES

G.A.L. George Arthur Lindbeck. *Professor of Theology, Yale University. Author of* The Future of Roman Catholic Theology.
CREED AND CONFESSION

G.An. George Anastaplo. *Lecturer in the Liberal Arts, University of Chicago. Professor of Political Science and of Philosophy, Rosary College, Chicago. Author of* Human Being and Citizen *and others.*
GREECE (*in part*)

G.A.O. George A. Olah. *Professor of Chemistry, University of Southern California, Los Angeles. Author of* Friedel–Crafts and Related Reactions; *co-editor of* Carbonium Ions.
CARBONIUM IONS (*in part*)

Ga.P. Gary William Poole. *Associate Editor,* Encyclopædia Britannica, *Chicago, 1970–72.*
CHAMBERLAIN, JOSEPH
JOSEPHUS, FLAVIUS

G.A.P. George A. Pettitt. *Assistant to the President, University of California, Berkeley, 1936–66; Lecturer in Anthropology, 1940–66. Author of* Prisoners of Culture *and others.*
GESNER, CONRAD

G.A.S. George Albert Shepperson. *William Robertson Professor of Commonwealth and American History, University of Edinburgh. Author of* David Livingstone and the Rovuma.
LIVINGSTONE, DAVID

G.A.Sa. George A. Sacher. *Senior Biologist, Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Illinois. President, Gerontological Society, 1978–79. Co-editor of* Aging and Levels of Biological Organization.
AGING

G.A.Sm. George Alan Smith. *Arts consultant. Hiker and mountain climber. Author of* Introduction to Mountaineering; *co-editor of* The Armchair Mountaineer.
MOUNTAINEERING (*in part*)

G.A.So. G. Alan Solem. *Curator of Invertebrates, Field Museum of Natural History, Chicago. Author of* Land and Freshwater Mollusca of the New Hebrides.
GASTROPODA

G.B. Geoffrey Burbidge. *Professor of Physics, University of California, San Diego. Co-author of* Quasi-Stellar Objects.
QUASI-STELLAR SOURCES

G.B.-C. Graeme F. Bonham-Carter. *Former Assistant Professor of Geology, University of Rochester, New York. Co-author of* Computer Simulation in Geology.
RIVER DELTAS (*in part*)

G.B.Cl. George B. Clark. *Professor of Mining Engineering; Research Associate, Earth Mechanics Institute, Colorado School of Mines, Golden. Co-author of* Elements of Mining.
MINING AND QUARRYING

G.B.D. George B. Dantzig. *Professor of Operations Research and Computer Science, Stanford University, California. Author of* Linear Programming and Extensions.
OPTIMIZATION, MATHEMATICAL THEORY OF (*in part*)

G.Be. George Benneh. *Associate Professor of Geography, University of Ghana, Legon.*
CAMEROON

G.Bi. Garrett Birkhoff. *Putnam Professor of Pure and Applied Mathematics, Harvard University. Co-author of* A Survey of Modern Algebra; Algebra; *and others.*
ALGEBRAIC STRUCTURES (*in part*)

G.B.K. George Briscoe Kerferd. *Hulme Professor of Greek, Victoria University of Manchester.*
SOPHISTS

G.Bl. Georges Blond. *Novelist and historian. Author of* Pétain, 1856–1951 *and others.*
PÉTAIN, PHILIPPE

G.B.L. Gerhart B. Ladner. *Emeritus Professor of History, University of California, Los Angeles. Author of* The Idea of Reform; Die Papstbildnisse des Altertum und des Mittelalters.
BONIFACE VIII, POPE
INNOCENT III, POPE

G.B.L.W. George Bulkeley Laird Wilson. *Deputy Keeper, Department of Mechanical and Civil Engineering, Science Museum, London. Author of* Technical Gains During the Nineteenth Century *and others.*
LOCK

G.Bo. Gunnar Boalt. *Professor of Sociology, University of Stockholm. Adjunct Professor, Southern Illinois University, Carbondale.*
FAMILY AND MARRIAGE

G.Bor. Günther Bornkamm. *Professor of New Testament Studies, Rupert Charles University of Heidelberg. Author of* Jesus of Nazareth.
JESUS CHRIST

G.B.W. Geoffrey Buckle West. *Reader in Pharmacology, North East London Polytechnic, England. Co-author of* Textbook of Pharmacology.
HISTAMINE AND ANTIHISTAMINES

G.C. Guido Calogero. *Professor of Theoretical Philosophy, University of Rome. Author of* Studi sull'eleatismo *and others.*
ELEATICISM (*in part*)

G.Ca. Guillaume Cardascia. *Professor of the History of Ancient Private Law, University of Paris II. Author of* Droits cunéiformes.
CUNEIFORM LAW

G.Cai. Rev. George B. Caird. *Dean Ireland's Professor of Exegesis and Holy Scripture, University of Oxford. Author of* The Apostolic Age *and others.*
PAUL THE APOSTLE, SAINT

G.Car. Giovanni Carsaniga. *Reader in Italian, University of Sussex, Brighton, England.*
LITERATURE, WESTERN: *Italian; 20th century*

G.C.C. George C. Cromer. *Administrative Engineer, General Motors Advance Product Engineering, Warren, Michigan. Author of* Engineering Staff Technical Reports.
AUTOMOBILE (*in part*)

G.C.G. George C. Gorman. *Associate Professor of Biology, University of California, Los Angeles. Researcher on the evolution, behaviour, and systematics of lizards.*
SAURIA

G.C.H. Gerald C. Hickey. *Anthropologist. Research Anthropologist, The RAND Corporation, Saigon, 1964–71. Author of* Village in Vietnam *and others.*
VIETNAM, SOUTH

G.C.H.B. Göran C.H. Bauer, M.D. *Professor and Chairman, Department of Orthopedic Surgery, Medical School, University of Lund, Sweden.*
BONE DISEASES AND INJURIES

G.C.I. George C. Izenour. *Emeritus Professor of Theater Design and Technology, Yale University.*
THEATRES AND STAGES

G.C.K. George C. Kent, Jr. *Alumni Professor of Zoology, Louisiana State University, Baton Rouge. Author of* Comparative Anatomy of the Vertebrates.
REPRODUCTIVE SYSTEMS, ANIMAL

G.C.L.B. G.C.L. Bertram. *Former Senior Tutor, St. John's College, University of Cambridge. Author of* In Search of Mermaids: The Manatees of Guiana *and others; author of numerous articles on marine mammals.*
SIRENIA (*in part*)

G.C.N. Gerald C. Nelson. *Member of the Technical Staff, Sandia Laboratories, Albuquerque, New Mexico. Author of numerous papers on X-rays.*
X-RAYS

G.Cr. Gerhard Croll. *Professor of Musicology, University of Salzburg, Austria. General editor of* Christoph Willibald Gluck, Complete Edition of His Works.
GLUCK, CHRISTOPH

G.C.R. George Clarence Robinson (d. 1976). *Professor of Political Science, University of Northern Iowa, Cedar Falls. Editor of* Dictionary of Presidential Disapprovals.
POLK, JAMES K.

G.C.T. Gordon Conrad Thomasson. *Doctoral candidate in comparative religious education. Associate Editor,* Dialogue: Journal of Mormon Thought. *Editor of* War, Conscription, Conscience and Mormonism.
RELIGIOUS EDUCATION (*in part*)

G.D. Glanville Downey. *Distinguished Professor of History and of Classical Studies, Indiana University, Bloomington. Associate, Section of History and Literature, Royal Belgian Academy. Author of* A History of Antioch in Syria from Seleucus to the Arab Conquest *and others.*
ANTIOCH

G.d'A. Guido d'Agostino. *Instructor in History, University of Naples.*
ITALY AND SICILY, HISTORY OF (*in part*)

G.D.B. Georgy Dmitriyevich Bessarabov. *Head, Department of Agrarian Resources, Government Research Institute of Agrarian Resources, Moscow.*
KARAKORAM RANGE

G.D.C. Gerson D. Cohen. *Chancellor and Jacob H. Schiff Professor of History, The Jewish Theological Seminary of America, New York City. Editor and translator of Abraham ibn Daud's* Sefer ha-Kabbala.
JUDAISM, HISTORY OF (*in part*)

G.De. George G. Dekker. *Reader in Literature, University of Essex, Colchester, England. Author of* James Fenimore Cooper: The Novelist; Sailing After Knowledge: The Cantos of Ezra Pound.
COOPER, JAMES FENIMORE

G. de B. Sir Gavin de Beer (d. 1972). *Professor of Embryology, University College, University of London, 1945–50. Director, British Museum (Natural History), London, 1950–60. Author of* Charles Darwin; Atlas of Evolution; *and others.*
DARWIN, CHARLES
EVOLUTION
OWEN, SIR RICHARD

G. de R.-C. G. de Rohan-Csermak (deceased). *Professor of Sociology, King's College, University of Western Ontario, London. Founder and Editor,* Ethnologia Europaea. *Author of* Sturgeon Hooks and Eurasia.
EUROPEAN PEOPLES AND CULTURES

G. de S. Giorgio D. de Santillana (d. 1974). *Professor of the History and Philosophy of Science, Massachusetts Institute of Technology, Cambridge. Author of* The Crime of Galileo *and others.*
GALILEO

G.Det. Georges Dethan. *Archivist, French Foreign Ministry Archives, Paris. Chief Editor,* Revue d'Histoire Diplomatique. *Author of* Mazarin et ses amis *and others.*
MAZARIN, JULES, CARDINAL

G.Di. Gérard Diffloth. *Associate Professor of Linguistics, University of Chicago.*
AUSTRO-ASIATIC LANGUAGES

G.D.M. George Daniel Mostow. *James E. English Professor of Mathematics, Yale University. Editor,* American Journal of Mathematics. *Author of* Strong Rigidity of Locally Symmetric Spaces.
TOPOLOGICAL GROUPS AND DIFFERENTIAL TOPOLOGY (*in part*)

G.Dn. Gerhard Deissmann. *Former Collaborator and Assistant Director, Bremen Committee for Economic Research, West Germany.*
NIEDERSACHSEN (*in part*)

G.D.O'B. Gerald D. O'Brien. *Staff Geologist, Shell Oil Company. Co-editor of* Diapirism and Diapirs.
SALT DOMES

G.D.P. George Duncan Painter. *Former Assistant Keeper in charge of incunabula, Department of Printed Books, British Library, London. Author of* Proust: The Early Years; Proust: The Later Years; *and others.*
PROUST, MARCEL

G.Du. George Dubpernell. *Consultant, M & T Chemicals Inc., Southfield, Michigan; technical adviser, 1955–66. Author of a chapter on chromium in* Modern Electroplating.
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MUSIC, ART OF

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G.E.Me. George Emery Mendenhall. *Professor of Ancient and Biblical Studies, University of Michigan, Ann Arbor. Author of* Law and Covenant in Israel and the Ancient Near East *and others.*
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G.E.Mo. Gordon E. Moore. *President, Intel Corporation, Santa Clara, California. Co-author of* Microelectronics.
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G.E.P. G. Etzel Pearcy. *Professor of Geography, California State University, Los Angeles, 1969–73. Geographer, U.S. Department of State, 1950–69. Author of* World Sovereignty; *co-author of* An Introduction to Geography.
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G.E.T. Gordon Ernest Taylor. *Senior Scientific Officer, Royal Greenwich Observatory, Herstmonceux, England. President of the British Astronomical Association, 1968–70.*
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G.E.W. Glen E. Woolfenden. *Professor of Zoology, University of South Florida, Tampa.*
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Consultant, Lower Mekong Coordinating Committee, 1961–62. Co-author of The Lower Mekong.
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G.H.T.K. George H.T. Kimble. *Director, Survey of Tropical Africa, Twentieth Century Fund, New York City, 1953–60; Research Director, U.S. Geography Project, 1962–68. Professor of Geography, Indiana University, Bloomington, 1957–66. Author of* Tropical Africa.
VELD

G.H. von W. Georg Henrik von Wright. *Research Professor, Academy of Finland, Helsinki. Former Chancellor, Swedish University of Åbo, Finland. Professor of Philosophy, University of Helsinki, 1946–61. Author of* A Treatise on Induction and Probability *and others.*
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VESUVIUS (MOUNT)

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G.I.B. George I. Blanksten. *Professor of Political Science, Northwestern University, Evanston, Illinois. Author of* Perón's Argentina; Ecuador: Constitutions and Caudillos; *and others.*
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G.K.E. Geoffrey Kenyon Elliott. *Senior Lecturer in Forestry, University College of North Wales, University of Wales, Bangor.*
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G.K.G. G.K. Ghori. *Professor of Geography; Principal, Maharaja's College, University of Mysore, India.*
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CASIMIR IV OF POLAND
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WŁADYSŁAW II JAGIEŁŁO AND JADWIGA

G.K.W. Gunther K. Wertheim. *Head, Crystal Physics Research Department, Bell Telephone Laboratories, Murray Hill, New Jersey. Author of* Mössbauer Effect, Principles and Applications.
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G.L.K. Sir Geoffrey Langdon Keynes, M.D. *Honorary Librarian, Royal College of Surgeons of England. Consulting Surgeon, St. Bartholomew's Hospital, London. Author of* The Life of William Harvey; A Bibliography of the Writings of Dr. William Harvey.
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G.L.M. George Leslie Miller. *Research Manager, Murex Ltd., Rainham, England, 1934–69.*
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G.L.O. Grace L. Ostenso. *Director, Nutrition and Technical Services Staff, Food and Nutrition Service, U.S. Department of Agriculture, Washington, D.C.*
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G.Ma. Golo Mann. *Writer. Professor of History and Political Science, Technical University, Stuttgart, West Germany, 1960–64. Author of* Friedrich von Gentz *and others.*
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G.McC.McB. George McCutchen McBride (d. 1971). *Professor of Geography, University of California, Los Angeles. Visiting Professor, Carnegie Endowment for International Peace, South America, 1929–30; Central America 1938. Author of* Agrarian Indian Communities of Highland Bolivia *and others.*
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G.P. Gerhardt Preuschen. *Emeritus Director, Max Planck Institute for Agricultural Labour and Scientific Farming, Bad Kreuznach, West Germany. Author of* Die Technik im landwirtschaftlichen Betrieb.
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G.Pan. Guido Pannain. *Professor of the History of Music, S. Pietro a Maiella Conservatory of Music, Naples. Author of* Lineamento di storia della musica *and others.*
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G.Pe. George Pendle (d.1977). *Managing Director, Pendle & Rivett Ltd., London. Author of* A History of Latin America; South America: A Visual Geography; *and others.*
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HUMANISTIC SCHOLARSHIP, HISTORY OF

G.P.Gi. Giovanni Pietro Giorgetti. *Lecturer in Italian, Birkbeck College, University of London.*
LITERATURE, WESTERN: *Italian; Renaissance* (*in part*)

G.Pi. Sir George (White) Pickering, M.D. *Master of Pembroke College, Oxford; Regius Professor of Medicine, University of Oxford, 1956–68. Author of* High Blood Pressure.
OSLER, SIR WILLIAM

G.P.K. Gertrude Prokosch Kurath. *Research Fellow, Wenner-Gren Foundation for Anthropological Research, New York City. Former Co-ordinator, Dance Research Center, Ann Arbor, Michigan. Author of "Native Choreographic Areas of North America" in* American Anthropologist *and numerous other articles.*
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G.P.Ka. Gennadi Pavlovitch Kalinin. *Head, Hydrological Department, Geographical Faculty, Moscow M.V. Lomonosov State University. Correspondent member of the Academy of Sciences of the U.S.S.R. Author of* The Problems of Global Hydrology *and others.*
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MORE, SIR THOMAS

G.Po. Guido Pontecorvo. *Honorary Consultant Genetist, Imperial Cancer Research Fund, London. Professor of Genetics, University of Glasgow, 1955–68. Author of "Hermann Joseph Muller" in* Biographical Memoirs of Fellows of the Royal Society.
MULLER, HERMANN JOSEPH

G.P.R. Gerald P. Rodnan, M.D. *Professor of Medicine, University of Pittsburgh. Editor of* Primer on the Rheumatic Diseases.
CONNECTIVE TISSUE DISEASES (*in part*)

G.P.T. Sir George Paget Thomson (d. 1975). *Professor of Physics, University of London, 1930–52. Co-winner, Nobel Prize for Physics, 1937. Author of* J.J. Thomson and the Cavendish Laboratory *and others; co-author, with J.J. Thomson,* Conduction of Electricity Through Gases.
THOMSON, SIR JOSEPH JOHN

G.R. Graham Reynolds. *Keeper, Departments of Prints and Drawings, 1961–74, and of*

Paintings, 1959–74, Victoria and Albert Museum, London. Author of Constable, the Natural Painter *and others.*
CONSTABLE, JOHN

G.R.C. Gerald Roe Crone. *Librarian and Map Curator, Royal Geographical Society, 1945–66. Author of* Maps and Their Makers *and others.*
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MACKINDER, SIR HALFORD JOHN

G.R.Co. George R. Collins. *Professor of Art History, Columbia University. Director, Catalan Archive of Art and Architecture, New York. Author of* Antonio Gaudí; Bibliography of Gaudí and the Catalan Movement; *and others.*
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G.Re. George S. Rentz. *Emeritus Curator of the Middle East Collection, Hoover Institution on War, Revolution, and Peace, Stanford, California. Emeritus Lecturer in Islāmic History, Stanford University. Co-author and editor of* Oman and the Southern Shore of the Persian Gulf.
OMAN

G.R.E. Geoffrey R. Elton. *Professor of English Constitutional History, University of Cambridge. Author of* The Tudor Revolution in Government: Administrative Changes in the Reign of Henry VIII *and others.*
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CROMWELL, THOMAS
HENRY VIII OF ENGLAND

G.R.G. Geoffrey R. Gleeson. *Research Fellow, Polytechnic of North London. International Judo Consultant. Author of* Judo for the West; Anatomy of Judo; *and others.*
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G.R.H. G.R. Hawting. *Lecturer in the History of the Near and Middle East, School of Oriental and African Studies, University of London.*
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G.R.M.B. Germain René Michel Bazin. *Research Professor Emeritus of Fine Arts, York University, Toronto. Emeritus Curator, the Louvre Museum, Paris. Author of* History of World Sculpture *and others.*
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G.Ro. Gloria Robinson. *Research Associate in the History of Science and Medicine, Yale University. Assistant Editor,* Journal of the History of Medicine and Allied Sciences.
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G.R.P. George Richard Potter. *Emeritus Professor of Medieval History, University of Sheffield, England. Co-author of* A Short History of Switzerland.
SWITZERLAND, HISTORY OF

G.R.R. George Richard Rumney. *Professor of Geography, University of Connecticut, Storrs. Author of* Climatology and the World's Climates.
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G.R.S. George R. Strakosch. *Staff member, vertical transportation, Jaros, Baum and Bolles (consulting engineers), New York City. Former Manager, Elevators, General Sales, Otis Elevator Company, New York City. Author of* Vertical Transportation: Elevators and Escalators.
ELEVATOR

G.R.St. George R. Stibitz. *Emeritus Professor of Physiology, Dartmouth College, Hanover, New Hampshire. Author of* Mathematics in Medicine and the Life Sciences; *co-author of* Mathematics and Computers.
MATHEMATICS, HISTORY OF (*in part*)

G.R.Z. George R. Zug. *Chairman, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C.*
LOCOMOTION

G.S. Geoffrey Sawer. *Professor of Law, Australian National University, Canberra. Author of* Law in Society.
LEGAL PROFESSION

G.Sa. Gudmund Sandvik. *Professor of Legal History, University of Oslo. Author of* Prestegard og prestelønn.
SCANDINAVIA, HISTORY OF (*in part*)

G.S.A. George Sherman Avery. *Emeritus Director, Brooklyn Botanic Garden, New York. Author of numerous papers in plant science; co-author of* Growth Hormones in Plants; Hormones and Horticulture.
BOTANICAL GARDEN

G.Sc. Georg Schwarzenberger. *Professor of International Law, University of London. Author of* A Manual of International Law.
INTERNATIONAL LAW

G.Sh. Gordon Shillinglaw. *Professor of Accounting, Columbia University. Author of* Managerial Cost Accounting *and others.*
ACCOUNTING, PRINCIPLES OF

G.S.H. Gerald S. Hawkins. *Physicist and Astronomer, U.S. Information Agency, Washington, D.C. Author of* Splendor in the Sky *and others.*
BRADLEY, JAMES

G.S.Ha. Gordon S. Haight. *Emeritus Professor of English, Yale University. Author of* George Eliot: A Biography; *editor of* The George Eliot Letters.
ELIOT, GEORGE

G.Si. George Bertrand Silberbauer. *Senior Lecturer in Anthropology and Sociology, Monash University, Clayton, Australia. Author of* Bushman Survey Report.
KALAHARI (DESERT) (*in part*)
KHOISAN CULTURES OF AFRICA

G.S.K. Geoffrey S. Kirk. *Regius Professor of Greek, University of Cambridge. Author of* The Songs of Homer *and others.*
HOMER

G.S.Ke. G. Stuart Keith. *Research Associate, Department of Ornithology, American Museum of Natural History, New York City. Author of numerous scientific and popular articles on cranes.*
GRUIFORMES

G.S.L. George S. Lane. *Kenan Professor Emeritus of Germanic and Comparative Linguistics, University of North Carolina at Chapel Hill. Author of* Studies in Kuchean Grammar I.
TOCHARIAN LANGUAGE

G.S.Lo. George S. Losey. *Associate Professor of Zoology, University of Hawaii, Honolulu.*
COLORATION, BIOLOGICAL (*in part*)

G.S.M. Gerhard Strassmann Masur (d. 1975). *Professor of History, Sweet Briar College, Lynchburg, Virginia, 1948–66. Author of* Simón Bolívar *and others.*
BOLÍVAR, SIMÓN

G.S.P.F.-G. Greville Stewart Parker Freeman-Grenville. *Honorary Fellow, University of York, Heslington, England. Former Professor of African History, State University of New York College at New Paltz. Author of* The Medieval History of the Coast of Tanganyika *and others.*
SA'ĪD IBN SULṬĀN

G.St. George Speaight. *Former Editorial Director, George Rainbird Ltd. Author of* The History of the English Puppet Theatre; Punch and Judy: A History; *and others.*
PUPPETRY

G.T.F. George Thomas Fleming (d. 1977). *Member, English Bowling Association Council; Secretary, Northern Counties* (EBA) *Consultative Committee. Co-author of* Winning Bowls.
BOWLING (*in part*)

G.T.G. Guy Thompson Griffith. *Laurence Reader in Classics, University of Cambridge, 1951–75; Fellow of Gonville and Caius College, Cambridge. Co-author of* A History of Macedonia.
PHILIP II OF MACEDONIA

G.Ts. George Thomas Tsoumis. *Professor of Forest Utilization, Aristotelian University of Thessaloníki, Greece. Author of* Wood as Raw Material.
WOOD AND WOOD PRODUCTS

G.T.S. Glenn T. Seaborg. *University Professor of Chemistry; Associate Director, Lawrence Berkeley Laboratory, University of California, Berkeley; Chancellor, 1958–61. Chairman, Atomic Energy Commission, 1961–71. Co-winner, Nobel Prize for Chemistry, 1951. Author of* Man-Made Transuranium Elements.
TRANSURANIUM ELEMENTS

G.T.Se. Giles Timothy Severin. *Free-lance writer. Author of* Explorers of the Mississippi.
MISSISSIPPI RIVER

G.Tu. Glenn Tucker (d. 1976). *Free-lance writer and historian. Author of* Tecumseh: Vision of Glory *and others.*
TECUMSEH

G.U. George Unwin. *Reader, editor, and translator, George Allen & Unwin Ltd., London. Translator of* Sign, Symbol and Script *and others.*
PUBLISHING, HISTORY OF (*in part*)

Gu.B. Guglielmo Barblan (d. 1978). *Professor of Music History, University of Milan. Director of the Library, G. Verdi Conservatory of Music, Milan. Author of* Gaetano Donizetti; La musica in Milano; *and others.*
BOCCHERINI, LUIGI

Gü.P. Günther Patzig. *Professor of Philosophy and Director, Philosophical Seminar, Georg August University of Göttingen, West Germany. Author of* Aristotle's Theory of the Syllogism.
SYLLOGISTIC

Gu.W. Gunther Wolf. *Professor of History and Politics, Institute for Advanced Studies, Stuttgart, West Germany. Co-author and editor of* Stupor Mundi: Zur Geschichte Friedrichs II von Hohenstaufen.
FREDERICK II, EMPEROR

G.V. Georges Vajda. *Director of Studies, École pratique des Hautes études (Institute for Advanced Research), Paris. Author of* Recherches sur la philosophie et la Kabbale dans la pensée juive du Moyen-Âge *and others.*
JEWISH MYSTICISM

G.v.B. Gerhardt von Bonin, M.D. *Consultant in Neuroanatomy, Neurological Institute, Mt. Zion Hospital, San Francisco. Emeritus Professor of Anatomy, University of Illinois, Chicago. Author of* Essay on the Cerebral Cortex.
NERVOUS SYSTEM, HUMAN (*in part*)

G.V.G. Gerald V. Gibbs. *Professor of Mineralogy, Virginia Polytechnic Institute and State University, Blacksburg.*
AMPHIBOLES (*in part*)

G.V.K. German Viktorovich Kopanev. *Senior Research Associate, Scientific Council on the Location of U.S.S.R. Productive Forces, Academy of Sciences of the U.S.S.R., Moscow.*

Co-author of Central Asian Economic Region.
UZBEK SOVIET SOCIALIST REPUBLIC (*in part*)

G.V.M. Gerard V. Middleton. *Professor of Geology, University of McMaster, Hamilton, Ontario. A leading advocate of quantitative methods in studies of sediments.*
DENSITY CURRENTS

G.V.T.M. Geoffrey Vernon Townsend Matthews. *Director of Research, The Wildfowl Trust, Slimbridge, England. Author of* Bird Navigation.
ANSERIFORMES

G.W. George Woodcock. *Former Editor,* Canadian Literature *(quarterly), University of British Columbia, Vancouver. Author of* Anarchism; The Crystal Spirit: A Study of George Orwell; Pierre-Joseph Proudhon; *and others.*
ANARCHISM
ORWELL, GEORGE
PROUDHON, PIERRE-JOSEPH

G.W.A. Gösta W. Ahlström. *Professor of Old Testament and Ancient Palestinian Studies, University of Chicago. Author of* Aspects of Syncretism in the Israelite Religion.
PROPHECY

G.W.B. Geoffrey W. Bromiley. *Professor of Church History and Historical Theology, Fuller Theological Seminary, Pasadena, California. Editor and translator of* Zwingli and Bullinger *(Library of Christian Classics).*
ZWINGLI, HULDRYCH

G.W.Ba. Glen W. Baxter. *Senior Lecturer on East Asian Studies, Harvard University; Associate Director, Harvard-Yenching Institute. Author of* Index to the Imperial Register of Tz'u Prosody.
PAN KU

G.W.Bo. G.W. Bowersock. *Professor of Greek and Latin, Harvard University. Author of* Greek Sophists in the Roman Empire; Augustus and the Greek World.
AGRIPPA, MARCUS VIPSANIUS
GALEN
HADRIAN

G.W.H. Gerard Willem Huygens. *Professor of History and Dutch Literature, Rotterdam Lyceum, Rotterdam, The Netherlands. Author of* The Dutch Writer and His Public.
LITERATURE, WESTERN: *Dutch (in part)*

G.Wi. Geoffrey Wills. *Free-lance writer on antiques. Author of "Automata" in* The Concise Encyclopedia of Antiques.
AUTOMATA

G.Win. Gustaf Wingren. *Professor of Systematic Theology, University of Lund, Sweden. Author of* Man and the Incarnation: A Study in the Biblical Theology of Irenaeus *and others.*
IRENAEUS, SAINT

G.W.K. George Williams Keeton. *Professor of Law, Brunel University, Uxbridge, England. Emeritus Professor of English Law, University of London. Author of* Trusts.
TRUSTS, LAW OF

G.W.L. Gabriel W(ard) Lasker. *Professor of Anatomy, School of Medicine, Wayne State University, Detroit, Michigan; Editor in Chief,* Human Biology. *Author of* Physical Anthropology *and others.*
CONSANGUINITY

G.W.La. Gerald W. Lattin. *Dean, School of Hotel, Food and Travel Services, Florida International University, Miami. Author of* Modern Hotel and Motel Management.
HOTEL AND MOTEL INDUSTRY

G.Wn. Geo Widengren. *Professor of the History of Religions and Psychology of Religion, University of Uppsala, Sweden. Author of* The Great Vohu Manah and the Apostle of God: Studies in Iranian and Manichaean Religion *and others.*
IRANIAN RELIGIONS

G.W.P. Giles William Playfair. *Free-lance writer. Professor of Drama, Williams College, Williamstown, Massachusetts, 1956–63. Author of* Kean *and others.*
KEAN, EDMUND

G.Wr. Gordon Wright. *William H. Bonsall Professor Emeritus of History, Stanford University, California. Author of* France in Modern Times *and others.*
FRANCE, HISTORY OF (*in part*)

G.W.S.B. Geoffrey Wallis Steuart Barrow. *Professor of Scottish History, University of St. Andrews, Scotland. Author of* Feudal Britain *and others.*
RICHARD I THE LION-HEART, OF ENGLAND

G.W.W. Goddard Williams Winterbottom. *Director of Publications, The World Bank, Washington, D.C. Associate Editor, Arts,* Encyclopædia Britannica, *Chicago, 1967–72. Former Director of Theatre, Briarcliff College, Briarcliff Manor, New York.*
POPULAR THEATRE

H.A. Henri Arvon. *Professor, University of Paris X (Paris–Nanterre), Nanterre, France. Author of* Le Bouddhisme *and others.*
FA-HSIEN

Ha.A. Hans Aurenhammer. *Director, Austrian State Gallery, Vienna. Author of* J.B. Fischer von Erlach *and others.*
FISCHER VON ERLACH, JOHANN BERNHARD

H.A.A. Hamza A. Alavi. *Senior Lecturer in Sociology, Victoria University of Manchester. Author of numerous articles on Pakistan; co-editor of* Rural Development in Pakistan.
PAKISTAN (*in part*)

H.A.B.R. Helen Anne B. Rivlin. *Professor of History, State University of New York at Binghamton. Author of* The Agricultural Policy of Muḥammad 'Alī in Egypt *and others.*
MUḤAMMAD 'ALI PASHA

Ha.D. Harry Davis. *President, Systems Review Associates, Arlington, Virginia. Deputy Undersecretary of the Air Force (Systems Review), U.S. Department of Defense, Washington, D.C., 1968–73.*
WARNING AND DETECTIONS SYSTEMS, MILITARY

H.A.D. Harl Adams Dalstrom. *Professor of History, University of Nebraska at Omaha.*
NEBRASKA

Ha.G. Harvey S. Gross. *Professor of Comparative Literature, University of Southern California, Los Angeles. Author of* Sound and Form in Modern Poetry *and others.*
PROSODY

H.Ah. Hélène Ahrweiler. *Professor of the History of Byzantine Civilization; President, University of Paris I. Author of* Recherches sur l'administration de l'empire byzantin aux IX^{e}–XI^{e} siècles.
NICEPHORUS II PHOCAS

Ha.He. Hans Herzfeld. *Emeritus Professor of Modern History, Free University of Berlin. Author of* Die moderne Welt, 1789–1945 *and others.*
FREDERICK WILLIAM IV OF PRUSSIA

H.A.J.H. Herbert A.J. Hulugalle. *Chairman, Advisory Committee, National and Grindlays Bank, Sri Lanka Branch, Colombo. Ambassador of Ceylon to Italy, 1954–59. Editor,* Ceylon Daily News, *1931–48. Author of* The History of Colombo; Introducing Ceylon; *and others.*
COLOMBO

Ha.K. Harold Kurtz (d. 1972). *Author of* The Trial of Marshal Ney: His Last Years and Death *and others.*
NEY, MICHEL

H.A.L. Hubert Arthur Lechevalier. *Professor of Microbiology, Rutgers University, New Brunswick, New Jersey. Co-author of* Three Centuries of Microbiology.
COHN, FERDINAND JULIUS

Ha.M. Hans Moldenhauer. *Musicologist. Director, Moldenhauer Archives. President, Spokane Conservatory of Music and Allied Arts, Inc., Washington. Author of* Anton von Webern: A Chronicle of His Life and Work *and others.*
WEBERN, ANTON VON

H.A.M. Henry A. Millon. *Professor of History of Architecture, Massachusetts Institute of Technology, Cambridge. Author of* Baroque and Rococo Architecture *and others.*
VISUAL ARTS, WESTERN (*in part*)

Ha.Ma. Harry Magdoff. *Co-editor,* Monthly Review. *Author of* The Age of Imperialism *and others.*
COLONIALISM (*in part*)

H.A.Mi. Hassan Ali Mirreh. *Government Civil Servant, Somalia; Secretary of State for Education, 1969–70.*
SOMALIA

Ha.P. Hans H. Penner. *John Phillips Professor of Religion, Dartmouth College, Hanover, New Hampshire. Author of articles on structuralism, myth, and ritual.*
RITUAL

Ha.R. Hans Ramberg. *Professor and Head, Department of Mineralogy and Petrology, University of Uppsala, Sweden. Author of* The Origin of Metamorphic and Metasomatic Rocks.
ROCK METAMORPHISM, PRINCIPLES OF

H.Ar. Hassan Arfa. *Major General, Iranian Army (retired). Author of* Under Five Shahs *and others.*
REZA SHAH PAHLAVI OF IRAN

Ha.Ro. Hans Roos. *Emeritus Professor of East European History, University of the Ruhr, Bochum, West Germany. Author of* A History of Modern Poland *and others.*
POLAND, HISTORY OF

Ha.S. Hans Saner. *Free-lance writer. Personal Assistant to Professor Karl Jaspers, 1962–69. Author of* Karl Jaspers.
JASPERS, KARL

H.A.S. H. Arthur Steiner. *Emeritus Professor of Political Science, University of California, Los Angeles. Editor of* Report on China; Chinese Communism in Action.
CHINA (*in part*)

Ha.Se. Hamzah Sendut. *Former Vice Chancellor, University of Science, Minden, Malaysia.*
BRUNEI (*in part*)

H.A.T. H. Anthony Taylor. *Free-lance aviation writer. Air Transport Editor,* Flight International, *1964–69. Air Transport Editor,* The Aeroplane, *1951–64. Author of* Modern Airlines and Airliners *and others.*
TRANSPORTATION, HISTORY OF (*in part*)

H.A.W. Herbert A. White (d. 1972). *Editor, Metals and Foundry Practice Section,* Engineering Index, *New York City.*
IRON MINING AND PROCESSING

Ha.We. Hans Fritz Welzel. *Professor of Penal Law and of the Philosophy of Law, Rhenish Friedrich Wilhelm University of Bonn, West Germany. Author of* Die Naturrechtslehre Samuel Pufendorfs.
PUFENDORF, SAMUEL VON

H.B. Hans Bobek. *Emeritus Professor of Geography, University of Vienna. Author of* Iran: Probleme eines unterentwickelten Landes alter Kultur.
ELBURZ MOUNTAINS
URMIA, LAKE

H.Ba. Howard Bass. *Winter sports correspondent,* Daily Telegraph (*London*); The Christian Science Monitor (*Boston*). *Sports broadcaster, British Broadcasting Corporation World Service. Author of* Winter Sports; This Skating Age; *and others.*
WINTER SPORTS

H.B.A. Harry Burrows Acton (d. 1974). *Professor of Moral Philosophy, University of Edinburgh, 1964–74.*
CONDORCET, MARQUIS DE
SPENCER, HERBERT

H.Bi. Haralds Biezais. *Professor of the History of Comparative Religions, Swedish University of Åbo, Finland. Author of* Die Gottesgestalt der lettischen Volksreligion.
BALTIC RELIGION

H.B.K. Herbert B. Knechtel. *President, Knechtel Laboratories, Inc. (consultants to the candy industry), Skokie, Illinois.*
CONFECTIONERY AND CANDY PRODUCTION (*in part*)

H.B.-M. Hubert Beuve-Méry. *Founder of* Le Monde. *Author of* Le Suicide de la IV[e] République.
FRANCE (*in part*)

H.Bo. Harold Borko. *Professor and Associate Dean, Graduate School of Library and Information Science, University of California, Los Angeles. Editor of* Computer Applications in the Behavioral Sciences.
INFORMATION PROCESSING (*in part*)

H.Br. Hellmut Brunner. *Professor of Egyptology, Eberhard Karl University of Tübingen, West Germany. Author of* Altägyptische Erziehung; Die Geburt des Gottkönigs.
HIEROGLYPHIC WRITING

H.B.R. Helen B. Redl. *Professor of Early Child Education, North Adams State College, Massachusetts. Editor and translator of* Soviet Educators on Soviet Education.
PRESCHOOL EDUCATION

H.Bre. Henri Bresson. *Assistant Director of Research and New Techniques, Gas of France, Paris.*
NATURAL GAS (*in part*)

H.B.Ro. Harry Brian Rodgers. *Professor of Geography, Victoria University of Manchester. Co-author of* Lancashire, Cheshire and Isle of Man.
MANCHESTER

H.B.W. Harry B. Whittington. *Woodwardian Professor of Geology, Sedgwick Museum, University of Cambridge. World authority on trilobites and Lower Paleozoic stratigraphy.*
ORDOVICIAN PERIOD

H.C. Rev. Henri Chambre, S.J. *Associate Director of the Laboratory, College of France, Paris. Author of* De Karl Marx à Lénine et Mao Tsé-toung *and others.*
MARXISM

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REPRODUCTIVE SYSTEMS, PLANT

H.C.H. H. Carl Haywood. *Professor of Psychology and Special Education; Director, John F. Kennedy Center for Research on Education and Human Development, George Peabody College for Teachers, Nashville, Tennessee. Editor,* American Journal of Mental Deficiency. *Editor of* Psychometric Intelligence.
INTELLIGENCE, DISTRIBUTION OF

H.Cha. Very Rev. Henry Chadwick. *Dean of Christ Church, University of Oxford. Author of* The Early Church; Origen contra Celsum; *and others.*
CHRISTIANITY BEFORE THE SCHISM OF 1054
JOHN THE APOSTLE, SAINT
ORIGEN

H.C.Ho. Harold C(arpenter) Hodge. *Professor of Pharmacology, University of California, San Francisco. Co-author of* Clinical Toxicology of Commercial Products.
POISONS AND POISONING

H.-C.P. Henri-Charles Puech. *Emeritus Professor of History of Religions, College of France, Paris. Director of Religious Studies, École Pratique des Hautes Études (Institute for Advanced Research), Paris. Author of* Le Manichéisme: Son fondateur, sa doctrine *and others.*
MANICHAEISM

H.C.R.L. H.C. Robbins Landon. *Free-lance writer and music historian. Author of* Mozart *and others; co-editor of* The Mozart Companion.
MOZART, WOLFGANG AMADEUS

H.D. Hariprasanna Das. *Professor and Head, Department of Geography, Gauhāti University, Assam, India. Author of* Geography of Assam.
ASSAM (*in part*)

H.Da. Hugh Davson. *Honorary Research Associate and Fellow, Department of Physiology, University College, University of London. Author of* Physiology of the Eye; *editor of* The Eye.
EYE AND VISION, HUMAN

H. de la C. Horst M.A. de la Croix. *Professor of Art, San Jose State University, California. Co-author and co-editor of Helen Gardner's* Art Through the Ages (*5th and 6th ed.*).
VISUAL ARTS, WESTERN (*in part*)

H. de V.-B. Hugues de Varine-Bohan. *Research Consultant, Ministry of Culture, France. Former Director, International Council of Museums, Paris. Editor of* The Problems of Museums in Countries Undergoing Rapid Change.
MUSEUM

H.D.F.K. H.D.F. Kitto. *Emeritus Professor of Greek, University of Bristol, England. Author of* Greek Tragedy; Form and Meaning in Drama.
EURIPIDES

H.-D.H.W. Hans-Dietrich H. Weigmann. *Associate Director of Research, Textile Research Institute, Princeton, New Jersey.*
FIBRES, NATURAL

H.Di. Heide Dienst. *Assistant, Institute of Austrian History Research, University of Vienna. Author of* Babenberger Studien *and others.*
LEOPOLD I, EMPEROR

H.D.I. Hans Dietrich Irmscher. *Professor of Modern German Literary Criticism, University of Cologne. Author of* Probleme der Herder-Forschung.
HERDER, JOHANN GOTTFRIED VON

H.D.L. Hywel David Lewis. *Emeritus Professor of History and Philosophy of Religion, King's College, University of London. Chairman of the Council of the Royal Institute of Philosophy. Author of* Our Experience of God; The Elusive Mind; *and others.*
THEISM

H.D.S. Helmut Dietmar Starke. *Doctoral candidate in Modern European History, University of Chicago.*
GERMANY, HISTORY OF (*in part*)
LUXEMBURG, ROSA

H.D.T. Hong Djin Tjia. *Professor and Head, Department of Geology, National University of Malaysia, Kuala Lumpur. Author of* Latihan peta kajibumi.
MALACCA, STRAIT OF

H.E. Heinz Eulau. *Professor of Political Science, Stanford University, California. Author of* Micro-Macro Political Analysis: Accents of Inquiry.
ELECTORAL PROCESSES (*in part*)

He.B. Hermann Bengtson. *Professor of Ancient History, University of Munich. Author of* Griechische Geschichte von den Anfängen bis in die römische Kaiserzeit *and others.*
SELEUCID KINGDOM

He.Ba. Hélène J. Balfet. *Teaching assistant, University of Aix-Marseille II, Aix-en-Provence, France. Former staff member for comparative technology, Musée de l'Homme, Paris. Author of "Basketry: A Proposed Classification" in* Papers on Californian Archaeology.
BASKETRY

He.F. Herbert Friedmann. *Emeritus Director, Los Angeles County Museum of Natural History. Researcher on the evolution and ecology of brood parasites among birds. Author of* The Honey-Guides; The Symbolic Goldfinch.
CUCULIFORMES

He.Gu. Henri Guillemin. *Professor of History of French Literature, University of Geneva. Author of* Lamartine, l'homme et l'oeuvre; Lamartine en 1848; *and others.*
LAMARTINE, ALPHONSE DE

He.H. Heinz Heinen. *Professor of Ancient History, University of Trier, West Germany. Editor,* Historia (*journal of ancient history*). *Author of* Untersuchungen zur hellenistischen Geschichte des 3. Jahrhunderts vor Chr. *and others.*
PTOLEMY II PHILADELPHUS

H.E.H. Hans Egon Holthusen. *Professor of German, Northwestern University, Evanston, Illinois. Author of* A Portrait of Rilke *and others.*
RILKE, RAINER MARIA

He.K. Hermann Kresse. *Editor in Chief, Saarland Edition,* Rhein-Saar-Spiegel. *Reporter,* Saarbrücker Zeitung.
SAARLAND

H.E.K. Harry Edward Korab. *Technical Director, National Soft Drink Association, Washington, D.C.*
SOFT DRINKS

H.El. Herbert Elftman. *Emeritus Professor of Anatomy, Columbia University.*
MUSCLE SYSTEM, HUMAN

H.E.L.-H. Hellmut E. Lehmann-Haupt. *Professor of Bibliography and Rare Book Consultant, University of Missouri, Columbia. Author of* Gutenberg and the Master of the Playing Cards.
GUTENBERG, JOHANNES

He.M. Hershel Markovitz. *Professor of Mechanics and Polymer Science, Carnegie-Mellon University, Pittsburgh. Co-author of* Viscometric Flows of Non-Newtonian Fluids.
DEFORMATION AND FLOW

He.Mi. Hermann Mittelberger. *Professor, Institute for Comparative Linguistics, University of Graz, Austria.*
ANCIENT EPIGRAPHIC REMAINS

H.E.Mo. Harold E. Moore, Jr. *Professor of Botany, L.H. Bailey Hortorium, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. Author of several articles on the palm order.*
ARECALES

H.En. Henrik Enander. *Lecturer in History, University of Stockholm.*
SCANDINAVIA, HISTORY OF (*in part*)

He.P. Hermann Pálsson. *Reader in Icelandic, University of Edinburgh. Author of* Art and Ethics in Hrafnkel's Saga; *translator of* Hrafnkel's Saga *and other Icelandic stories.*
SAGA

He.R. Helmuth Rogge. *Chief Archivist, National Records Office, Potsdam, Germany, 1921–45. Author of* Friedrich von Holstein, Lebensbekenntnis in Briefen an eine Frau *and several other books on Holstein.*
HOLSTEIN, FRIEDRICH VON

H.E.R. Hugh E. Richardson. *Member, Indian Civil Service, 1930–50; Indian Trade Agent, Gyantse, and Officer in Charge, Indian Mission, Lhasa, 1936–40 and 1946–50. Author of* Tibet and Its History *and others.*
TIBET, HISTORY OF

He.Ro. Henry Rosemont, Jr. *Professor of Philosophy, St. Mary's College of Maryland. Co-editor of* Work, Technology and Education.
HSÜN-TZU

H.E.Ro. Henry E. Roys. *Chief Engineer, Record Division, Radio Corporation of America, Indianapolis, Indiana, 1956–66.*
SOUND RECORDING AND REPRODUCING (*in part*)

He.S. Henri Stern. *Director of Research, National Centre of Scientific Research, Paris. Author of* Le Calendrier de 354; L'Art byzantin.
VISUAL ARTS, WESTERN (*in part*)

H.E.T. Harold E. Thomas. *Research Hydrologist, Water Resources Division, Geological Survey, U.S. Department of the Interior, 1962–72. Author of* Conservation of Ground Water *and other books.*
SPRINGS AND WELLS (*in part*)

He.Th. Helmuth Thomsen. *Principal Curator, Museum for the History of Hamburg, 1957–71. Author of* Liebes altes Hamburg; *editor of* Hamburg.
HAMBURG

He.W. Hellmut Wilhelm. *Emeritus Professor of Chinese History and Literature, University of Washington, Seattle. Author of* Change: Eight Lectures on the I Ching *and others.*
CHINESE MYTHOLOGY

H.E.W. Harold E. Wethey. *Emeritus Professor of the History of Art, University of Michigan, Ann Arbor. Author of* Colonial Architecture and Sculpture in Peru; El Greco and His School; The Complete Paintings of Titian.
GIORGIONE
GRECO, EL
TITIAN
VISUAL ARTS, WESTERN (*in part*)

H.Ey. Henry Eyring. *Distinguished Professor of Chemistry and Professor of Metallurgy, University of Utah, Salt Lake City. Co-author of* Quantum Chemistry; Theory of Rate Processes.
CHEMICAL KINETICS, PRINCIPLES OF

H.F. Hermann Friedrich. *Former Director, Overseas Museum, Bremen, West Germany. Author of* Marine Biology.
ELBE RIVER
WESER RIVER

H.F.A. Héctor Fernando Avila. *Senior Economist, International Monetary Fund Institute, Washington, D.C.*
SOUTH AMERICA (*in part*)

H.F.C. Howard F. Cline (d. 1971). *Director, Hispanic Foundation, Library of Congress, Washington, D.C., 1952–1971. Author of* Mexico: Revolution to Evolution, 1940–1960 *and others.*
MEXICO, HISTORY OF

H.Fe. Herbert Feigl. *Regents' Professor Emeritus of Philosophy; Director, Minnesota Center for Philosophy of Science, University of Minnesota, Minneapolis. Fellow of the American Academy of Arts and Sciences. Original member of the Vienna Circle, which developed the Positivist movement. Author of "The Wiener Kreis in America" in* The Intellectual Migration: Europe and America, 1930–1960.
POSITIVISM AND LOGICAL EMPIRICISM

H.Fec. Hans Fecher. *Professor of Finance; Director, Institute of Public Finance, Ludwig Maximilian University of Munich. Author of* Probleme der Zweckbindung öffentlicher Einnahmen.
PROPERTY TAX (*in part*)

H.F.J. Herbert Felix Jolowicz (d. 1954). *Regius Professor of Civil Law, University of Oxford, 1948–54. Professor of Roman Law, University of London, 1931–48; Dean, Faculty of Law, 1937–38. Author of* Historical Introduction to the Study of Roman Law *and others.*
ROMAN LAW (*in part*)

H.F.K. H.F. Koeper. *Professor of Architectural History, California State Polytechnic University, Pomona. Author of* Illinois Architecture.
AALTO, ALVAR
GROPIUS, WALTER
SAARINEN, EERO
SULLIVAN, LOUIS

H.F.M. Herman F. Mark. *Emeritus Dean, Polytechnic Institute of New York, Brooklyn. Director, Polymer Research Institute, 1946–64. World authority on polymers and polymerization processes. Editor of* Encyclopedia of Polymer Science and Technology.
POLYMERS

H.Fn. Herbert Friedman. *Superintendent, Space Science Division, Naval Research Laboratory, Washington, D.C.*
X-RAY SOURCES, ASTRONOMICAL

H.F.O. Harry F. Olson. *Adviser,* RCA *Laboratories, Princeton, New Jersey; Staff Vice President, 1966–70. Author of* Music, Physics and Engineering.
SOUND RECORDING AND REPRODUCING (*in part*)

H.F.P. H.F. Pearson (deceased). *Author of* A Popular History of Singapore; This Other India: A Biography of Sir Thomas Stamford Raffles.
RAFFLES, SIR THOMAS STAMFORD

H.Fr. Herbert Franke. *Professor of Far Eastern Studies, Ludwig Maximilian University of Munich. Author of* Geld und Wirtschaft in China unter der Mongolen *and others.*
CHINA, HISTORY OF (*in part*)

H.Fra. Heinrich Fraenkel. *Free-lance writer. Author of* The Other Germany; *co-author of* Hermann Göring *and many others.*
GÖRING, HERMANN (*in part*)

H.F.W. Harold F. Walton. *Professor of Chemistry, University of Colorado, Boulder. Co-author of* Ion Exchange in Analytical Chemistry.
ION-EXCHANGE REACTIONS

H.F.We. Heinz Fritz Wermuth. *Curator of Herpetology, State Museum of Natural History, Ludwigsburg, West Germany. Co-author of* Schildkröten, Krokodile, Brückenechsen.
CROCODILIA

H.G. Herbert V. Guenther. *Professor and Head, Department of Far Eastern Studies, University of Saskatchewan, Saskatoon. Author of* The Life and Teaching of Nāropa; Tibetan Buddhism Without Mystification; *and others.*
BUDDHIST MYSTICISM
BUDDHIST SACRED LITERATURE

H.-G.B. Hans-Georg Beck. *Professor of Byzantine and Modern Greek Philology, University of Munich.*
Reviewer: LITERATURE, WESTERN (*in part*)

H.G.D. H. Grady Davis (d. 1975). *Former Professor of Functional Theology, Lutheran School of Theology at Chicago. Co-author of* The Gospels in Study and Preaching.
BIBLICAL LITERATURE (*in part*)

H.G.Do. Herndon G. Dowling. *Research Associate in Herpetology, American Museum of Natural History, New York City. Adjunct Professor of Zoology, University of Rhode Island, Kingston. Adjunct Professor of Biology, New York University, New York City. Editor,* Yearbook of Herpetology. *Curator of Reptiles, New York Zoological Park, 1960–67.*
REPTILIA (*in part*)

H.G.E. Heinrich Gustav Euler. *Professor of Modern History, University of Würzburg, West Germany. Author of* Napoleon III. in seiner Zeit, *vol. 1 and others.*
NAPOLEON III

H.G.F. Henry George Forder. *Emeritus Professor of Mathematics, University of Auckland, New Zealand. Author of* The Foundations of Euclidean Geometry.
GEOMETRY, EUCLIDEAN (*in part*)

H.G.G. Hans G. Güterbock. *Tiffany and Margaret Blake Distinguished Service Professor Emeritus of Hittitology, Oriental Institute, University of Chicago. Author of* Siegel aus Boğazköy *and others.*
BOĞAZKÖY

H.G.K. Helmut Georg Koenigsberger. *Professor of History, King's College, University of London. Author of* The Habsburgs and Europe, 1516–1660; *co-author of* Europe in the Sixteenth Century.
ALBA, DUKE OF
JIMÉNEZ DE CISNEROS, FRANCISCO, CARDINAL
PHILIP II OF SPAIN
SPAIN, HISTORY OF (*in part*)

H.G.N. Herbert G. Nicholas. *Rhodes Professor of American History and Institutions, University of Oxford; Fellow of New College, Oxford. Author of* Britain and the U.S.A. *and others.*
CHURCHILL, SIR WINSTON

H.Go. Hermann Goetz (d. 1976). *Director, Baroda Museum and Picture Gallery, Baroda, India, 1940–53. Curator, National Gallery of Modern Art, New Delhi, 1953–55. Author of* The Art of India *and other works on the art of South Asia.*
METALWORK (*in part*)

H.G.R. Henry Godfrey Roseveare. *Lecturer in History, King's College, University of London. Author of* The Treasury: The Evolution of a British Institution.
CHARLES II OF GREAT BRITAIN

H.Gu. Henri Guitton. *Professor of Economics, University of Paris I. Editor in Chief,* La Revue d'Économie Politique. *Author of* Fluctuations et croissance économiques.
BUSINESS CYCLES

H.H. Helmut Hölder. *Professor of Paleontology; Director, Geological-Paleontological Institute, University of Münster, West Germany.*
JURASSIC PERIOD

H.Ha. Harold Hart. *Professor of Chemistry, Michigan State University, East Lansing. Co-author of* Organic Chemistry.
HYDROCARBONS
ISOMERISM

H.H.A. H. Harvard Arnason. *Art historian. Vice President for Art Administration, Solomon R. Guggenheim Foundation, New York City,*

1961–69. Author of History of Modern Art; *co-author of two books on Alexander Calder; and others.*
CALDER, ALEXANDER

H.H.A.B. Hans H.A. Bielenstein. *Professor of Chinese History, Columbia University. Author of "The Restoration of the Han Dynasty" in* Bulletin of the Museum of Far Eastern Antiquities.
WANG MANG

H.H.B. Henry H. Billings. *Free-lance writer, illustrator, and mural painter. Author of* Bridges *and others.*
ROEBLING, JOHN AUGUSTUS AND WASHINGTON AUGUSTUS

H.H.Bh. Hans H. Boesch. *Professor of Geography, University of Zürich. Author of* Geography of World Economy.
ZÜRICH

H.H.B.-S. Haim Hillel Ben-Sasson. *Professor of Jewish Medieval History, Hebrew University of Jerusalem. Editor of* Peraqim be-toldot ha-Yehudim bi-yeme ha-benayim, *3 vol.; author of vol. 2.*
ELIJAH BEN SOLOMON

H.He. Herbert Hensel. *Professor of Physiology; Director, Institute of Physiology, Philipps University of Marburg, West Germany. Co-author of* Temperatur und Leben.
THERMORECEPTION

H.Hei. Helmut Heiber. *Assistant, Institute for Contemporary History, Munich. Author of* Joseph Goebbels *and others.*
GOEBBELS, JOSEPH

H.H.F. Henry Hubbard Foster, Jr. *Emeritus Professor of Law, New York University, New York City. Co-author of* Society and the Law *and others.*
HEALTH AND SAFETY LAWS

H.H.H. Hilda H. Hookham (d. 1971). *Senior Lecturer in Sociology, Goldsmiths' College, University of London. Author of* Tamburlaine the Conqueror *and others.*
TIMUR

H.H.Hu. Herbert Henry Huxley. *Professor of Classics, University of Victoria, British Columbia. Editor of Virgil's* Georgics *(Books I and IV) and others.*
MARTIAL

H.Hi. Howard Hibbard. *Professor of Art History, Columbia University. Author of* Bernini *and others.*
BERNINI, GIAN LORENZO

H.Hj. Hakon Hjelmqvist. *Associate Professor of Botany, University of Lund, Sweden. Author of* Studies on the Floral Morphology and Phylogeny of the Amentiferae.
FAGALES

H.-H.J. Hans-Heinrich Jescheck. *Professor of Law, Albert Ludwig University of Freiburg, Freiburg im Breisgau, West Germany; Director, Max Planck Institute for Foreign and International Criminal Law, Freiburg. Author of* Lehrbuch des Strafrechts.
CRIMINAL LAW

H.H.K. Howard H. Kendler. *Professor of Psychology, University of California, Santa Barbara. Author of* Basic Psychology.
TRANSFER OF TRAINING

H.H.L. Hubert Horace Lamb. *Director, Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, England. Investigator of climatic variation from the viewpoint of general atmospheric circulation. Author of* Climate: Present, Past and Future *and others.*
CLIMATE

H.H.M. H. Houston Merritt, M.D. *Moses Professor Emeritus of Neurology; Emeritus Dean and Emeritus Vice President, Faculty of Medicine, College of Physicians and Surgeons, Columbia University. Consultant in Neurology, Neurological Institute, Columbia-Presbyterian Medical Center, New York City. Author of* A Textbook of Neurology *and others.*
NERVOUS SYSTEM DISEASES

H.H.R. Harry Howe Ransom. *Professor of Political Science, Vanderbilt University, Nashville, Tennessee. Author of* The Intelligence Establishment.
INTELLIGENCE AND COUNTERINTELLIGENCE

H.H.S. Howard Hayes Scullard. *Emeritus Professor of Ancient History, University of London. Author of* Roman Politics, 220-150 B.C. *and others.*
PUNIC WARS (*in part*)
SCIPIO AEMILIANUS
SCIPIO AFRICANUS

H.H.W. Hyatt H. Waggoner. *Professor of English, Brown University, Providence, Rhode Island. Author of* Hawthorne: A Critical Study; American Poets, from the Puritans to the Present; *and others.*
HAWTHORNE, NATHANIEL

H.I. Halil Inalcik. *Professor of History, University of Chicago. Author of "Mehmed the Conqueror (1432–1481) and His Time" in* Speculum, *and others.*
KÖPRÜLÜ FAMILY
MEHMED II

H.I.A. Hyacinth Iheanyichuku Ajaegbu. *Reader and Head, Department of Geography, University of Jos, Nigeria.*
IBADAN

H.-I.M. Henri-Irénée Marrou. *Professor of the History of Ancient Christianity, University of Paris. Author of* De la connaissance historique.
EDUCATION, HISTORY OF (*in part*)

Hi.Mo. Hiroyuki Momo. *Emeritus Professor and former Director, Historiographical Institute, University of Tokyo.*
CHRONOLOGY (*in part*)

H.Is. Hildebert Isnard. *Professor of Geography, University of Nice, France. Professor of Geography, University of Aix-Marseille II, Aix-en-Provence, France, 1947–70. Author of* Géographie du Maghreb; Afrique tropicale; *and others.*
ATLAS MOUNTAINS

H.I.S. Harold I. Sharlin. *Professor of History, Iowa State University, Ames. Author of* The Making of the Electrical Age; Lord Kelvin: Dynamic Victorian.
KELVIN, LORD
STEINMETZ, CHARLES PROTEUS

H.J.B. H. John Butcher. *Professor of Educational Psychology, University of Sussex, Brighton, England. Author of* Human Intelligence.
INTELLIGENCE, THEORIES OF

H.J.Bi. Harold J. Bissell. *Professor of Geology, Brigham Young University, Provo, Utah.*
SEDIMENTARY ROCKS

H.J.C. Henry J. Cadbury (d. 1974). *Hollis Professor of Divinity, Harvard University, 1934–54. Chairman, American Friends Service Committee, 1928–34; 1944–60.*
FOX, GEORGE

H.J.D. Hubert Jules Deschamps. *Emeritus Professor of Modern History of Black Africa, University of Paris. Colonial Administrator, Madagascar, 1926–36. Author of* History of Madagascar *and others.*
MADAGASCAR, HISTORY OF

H.J.De. Henri J. Delporte. *Curator, Museum of National Antiquities, Saint-Germain-en-Laye, France.*
CRO-MAGNON MAN

H.J. de B. Harm J. de Blij. *Professor of Geography, University of Miami, Coral Gables, Florida. Author of* Mozambique *and others.*
MOZAMBIQUE

H.J. de V. Herman Jean de Vleeschauwer. *Emeritus Professor of Philosophy, University of South Africa, Pretoria. Author of* L'Évolution de la pensée kantienne; *editor of* Kantstudien.
KANTIANISM

H.J.E. Hans Jurgen Eysenck. *Professor of Psychology, University of London. Author of* Sense and Nonsense in Psychology.
PARAPSYCHOLOGICAL PHENOMENA, THEORIES OF

H.J.Er. Hubert Joseph Erb. *Berlin Correspondent, Associated Press.*
BERLIN

H.J.H. Herbert James Hunt (d. 1973). *Professor of French Language and Literature, Royal Holloway College, University of London, 1944–66. Author of* Honoré de Balzac: A Biography *and others.*
BALZAC, HONORÉ DE

H.-J.I. Heinz-Jürgen Ipfling. *Professor of Educational Theory, University of Regensburg, West Germany. Author of* Jugend und Illustrierte *and others.*
EDUCATION, HISTORY OF (*in part*)

H.-J.K. Hans-Joachim Kramm. *Professor of Economic Geography, College of Education, Potsdam, East Germany. Author of* Ökonomische Geographie der DDR.
GERMAN DEMOCRATIC REPUBLIC (*in part*)
LEIPZIG (*in part*)

H.J.S. Howard James Stains. *Professor of Zoology, Southern Illinois University, Carbondale. Author of "Carnivores and Pinnipeds" in* Recent Mammals of the World.
CARNIVORA

H.J.Sp. Herbert John Spiro. *Fellow, Woodrow Wilson International Center for Scholars, Smithsonian Institution, Washington, D.C. U.S. Ambassador to Cameroon, 1975–77. Author of* Government by Constitution *and others.*
CONSTITUTION AND CONSTITUTIONAL GOVERNMENT

H.J.T. Howard J. Taubenfeld. *Professor of Law; Director, Institute of Aerospace Law, Southern Methodist University, Dallas, Texas. Co-author of* The Law Relating to Activities of Man in Space.
SPACE LAW

H.J.W. Hans Julius Wolff. *Emeritus Professor of Roman Law, Albert Ludwig University of Freiburg, Freiburg im Breisgau, West Germany. Author of* Roman Law: An Historical Introduction.
GREEK LAW

H.J.Wi. Howard J. Wiarda. *Professor of Political Science, University of Massachusetts, Amherst. Author of* The Dominican Republic: Nation in Transition *and others.*
DOMINICAN REPUBLIC, HISTORY OF THE

H.K. Hans Kohn (d. 1971). *Professor of History, City College, City University of New York, 1949–62. Author of* Political Ideologies of the Twentieth Century *and others.*
FASCISM
NATIONALISM (*in part*)

H.Ka. Harry Kalven, Jr. (d. 1974). *Harry A. Bigelow Professor of Law, University of Chicago, 1953–74. Co-author of* The American Jury.
JURY (*in part*)

H.K.B. Howard Kent Birnbaum. *Professor of Physical Metallurgy, University of Illinois, Urbana. Author of numerous papers on the physics and mechanics of solids.*
SOLID STATE OF MATTER (*in part*)

H.K.G. Harry K. Girvetz (d. 1974). *Professor of Philosophy, University of California, Santa Barbara, 1951–74. Author of* The Evolution of Liberalism.
LIBERALISM

H.K.Gr. Henry Kirk Greer. *Attorney. Coach of the U.S. Olympic Hockey team, 1948 and 1956.*
HOCKEY (FIELD)

H.Ki. Heinz Kindermann. *Emeritus Professor of Drama, University of Vienna. Chairman, Commission for the History of the Austrian Theatre, Austrian Academy of Sciences, Vienna. Vice President, International Institute for Theatrical Research, Vienna. Author of* Theatergeschichte Europas.
COMMEDIA DELL'ARTE

H.Kie. Hans Kiefner. *Professor of German Civil Law, Roman Law and Canon Law, University of Münster, West Germany. Author of treatises on Roman medieval law and private law of the 19th century.*
SAVIGNY, FRIEDRICH KARL VON

H.K.M.S. H.K. Manmohan Singh. *Professor and Head, Department of Economics; Dean, Faculty of Arts and Social Sciences, Punjabi University, Patiala, India.*
PUNJAB (INDIA)

H.Ko. Horst Koegler. *Music Editor,* Stuttgarter Zeitung. *Editor,* Ballett *(annual), 1965–77. Author of* Concise Oxford Dictionary of Ballet.
DANCE, WESTERN

H.Kü. Hans Kühner. *Historian and free-lance writer. Specialist on the history of the Roman Catholic Church and the Papacy. Author of* Imperium der Päpste; Encyclopedia of the Papacy; *and others.*
GREGORY I, SAINT AND POPE
JULIUS II, POPE

H.K.V. Hans K. Vogt. *Emeritus Professor of General Linguistics, University of Oslo. Author of numerous articles on the Armenian language;* Grammaire du géorgien moderne; *and others.*
ARMENIAN LANGUAGE

H.L. Henri Laoust. *Professor of Sociology of Islām, College of France, Paris. Editor and translator of* Le Traité de droit public d'Ibn Taimīya *and others.*
IBN TAYMĪYAH

H.La. Henri Lavondès. *Lecturer, University of Paris X, Nanterre. Former Director of Papeete Centre, Overseas Office of Scientific and Technological Research, Tahiti, French Polynesia.*
FRENCH POLYNESIA *(in part)*

H.L.A.H. Herbert Lionel Adolphus Hart. *Principal of Brasenose College, Oxford; Professor of Jurisprudence, University of Oxford, 1952–68. Author of* The Concept of Law; Law, Liberty and Morality.
AUSTIN, JOHN

H.L.B. Henry Lewis Barnett, M.D. *Professor of Pediatrics, Albert Einstein College of Medicine, Yeshiva University, Bronx, New York. Associate Editor of* Pediatrics.
CHILDHOOD DISEASES *(in part)*

H.L.C. Hampton L. Carson. *Professor of Genetics, University of Hawaii, Honolulu. Author of* Heredity and Human Life.
GENETICS, HUMAN

H.L.C.J. Hans L.C. Jaffé. *Professor of Modern Art History, University of Amsterdam. Author of* Piet Mondrian; Picasso.
MONDRIAN, PIET

H.Le. Howard Levene. *Professor of Mathematical Statistics and Biology, Columbia University. Co-author of "Theodosius Dobzhansky Up to Now" in* Essays in Evolution and Genetics in Honor of Theodosius Dobzhansky.
DOBZHANSKY, THEODOSIUS

H.L.E. Herbert Leeson Edlin (d. 1976). *Publications Officer, Forestry Commission of Great Britain, London. Author of* Trees, Woods and Man *and others.*
FORESTRY

H.-L.-É.T. Henri-Louis-Étienne Terrasse (d. 1971). *Curator, Historic Monuments of Morocco, 1935–57. Director, Institute for Advanced Moroccan Studies, Rabat, Morocco, 1941–57. Chairman, Department of Islāmic Archaeology, University of Algiers, 1945–57. Director, Casa de Velázquez, Ciudad University, Madrid, 1957–65. Author of* Histoire du Maroc: Des origines à l'établissement du protectorat français *and others.*
'ABD AL-MU'MIN
NORTH AFRICA, HISTORY OF *(in part)*

H.Li. Heinz Lieberich. *General Director, Bavarian State Archives, Munich. Author of* Ludwig der Bayer als Gesetzgeber *and others.*
LOUIS IV, EMPEROR

H.L.K. Hans L. Kornberg. *Sir William Dunn Professor and Head, Department of Biochemistry, University of Cambridge. Co-author of* Energy Transformations in Living Matter; *editor of* Essays in Cell Metabolism.
METABOLISM

H.L.Ke. Herbert Leon Kessler. *Professor and Chairman, Department of the History of Art, Johns Hopkins University, Baltimore. Author of* French and Flemish Illuminated Manuscripts in Chicago Collections *and others.*
EYCK, JAN AND HUBERT VAN
WEYDEN, ROGIER VAN DER

H.L.M. Hanns Leo Mikoletzky. *General Director, Austrian State Archives, Vienna. Professor of History, University of Vienna. Author of* Kaiser Heinrich II und die Kirche *and others.*
HENRY III, EMPEROR

H.L.S. Rev. Harry Lismer Short (d. 1975). *Principal, Manchester College, University of Oxford, 1965–74. Author of* Dissent and the Community; *co-author of* Essays in Unitarian Theology.
UNITARIANS AND UNIVERSALISTS

H.M. Hermann Mannheim. *Honorary Fellow, London School of Economics and Political Science; Reader in Criminology, University of London, 1946–55. Author of* Comparative Criminology *and others.*
CRIMINOLOGY

H.Ma. Henry Margenau. *Eugene Higgins Professor Emeritus of Physics and Natural Philosophy, Yale University. Author of* Nature of Physical Reality; *co-author of* Mathematics of Physics and Chemistry *and others.*
FIELDS, THEORY OF, IN PHYSICS

H.M.A. Harold Maurice Abrahams (d. 1978). *Broadcaster and Journalist. Chairman, British Amateur Athletic Board. Olympic Gold Medalist (100-metre dash), 1924. Author of* The Olympic Games, 1896-1952.
ATHLETIC GAMES AND CONTESTS

H.M.D. Horton Marlais Davies. *Henry W. Putman Professor of the History of Christianity, Princeton University. Author of* The English Free Churches *and others.*
FREE CHURCHES

H.Me. Harold Merskey, M.D. *Professor of Psychiatry, University of Western Ontario, London. Co-author of* Pain: Psychological and Psychiatric Aspects.
PAIN, THEORIES OF

H.M.K. Horace M. Kallen (d. 1974). *Professor of Social Philosophy, New School for Social Research, New York City, 1919–52. Author of the Introduction to* The Philosophy of William James, Drawn from His Own Works.
JAMES, WILLIAM

H.M.L. Henry M. Leicester. *Emeritus Professor of Biochemistry, University of the Pacific, San Francisco. Co-author of* Source Book in Chemistry 1400–1900.
LIEBIG, JUSTUS VON
WÖHLER, FRIEDRICH

H.M.M. Harold M. Mayer. *Professor of Geography; Associate Director, Center for Great Lakes Studies, University of Wisconsin, Milwaukee. Author of* The Port of Chicago and the St. Lawrence Seaway; *co-author of* Chicago, Growth of a Metropolis.
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H.M.P. Henri M. Peyre. *Professor, Graduate Center, City University of New York. Sterling Professor Emeritus of French, Yale University. Author of* Literature and Sincerity *and many others; contributor to* Émile Durkheim, 1858–1917.
DURKHEIM, ÉMILE
LITERATURE, NONFICTIONAL PROSE

H.M.S. Harold M. Somers. *Professor of Economics, University of California, Los Angeles; Dean, Division of Social Sciences, 1967–70. Author of* Capital Gains, Death and Gift Taxation.
DEATH AND GIFT TAXES

H.Mu. Hugo Munsterberg. *Professor of Oriental Art, State University of New York College at New Paltz. Author of* The Arts of Japan *and others.*
OGATA KŌRIN
SESSHŪ
SŌTATSU

H.M.V.D. Hobart Merritt Van Deusen (d. 1976). *Archbold Assistant Curator, Department of Mammalogy, American Museum of Natural History, New York City, 1958–75. Co-author of "Marsupials" in* Recent Mammals of the World.
MARSUPIALIA *(in part)*

H.M.W. Helen Margaret Wallis. *Superintendent of the Map Room, British Museum, London. Editor of* Carteret's Voyage Round the World *and others.*
TASMAN, ABEL JANSZOON

H.My. Hla Myint. *Professor of Economics, London School of Economics and Political Science, University of London. Author of* Economic Theory and the Underdeveloped Countries.
ECONOMIC DEVELOPMENT
ECONOMIC PLANNING *(in part)*

H.N. Heinrich Nagel. *Lecturer in Civil and International Civil Procedure, Georg August University of Göttingen, West Germany. Former Presiding Judge, Hanseatic Court of Appeals, Bremen. Author of* Die Grundzüge des Beweisrechts im europäischen Zivilprozess *and others.*
EVIDENCE, LAW OF

H.Na. Hajime Nakamura. *Director, Eastern Institute, Inc., Tokyo. Emeritus Professor of Indian and Buddhist Philosophy, University of Tokyo. Author of* Ways of Thinking of Eastern Peoples *and others.*
BUDDHIST PHILOSOPHY
JAPANESE PHILOSOPHY

H.Ne. Howard Nemerov. *Poet and novelist. Professor of English, Washington University, St. Louis, Missouri. Author of* Poetry and Fiction: Essays; Reflexions on Poetry and Poetics; *and others.*
POETRY

H.N.G. Harry Norwood Ginns. *Deputy Chief Engineer, Highways Engineering Division, Ministry of Transport, London, 1963–69.*
TRANSPORTATION, HISTORY OF *(in part)*

H.Ni. Helmut A. Nickel. *Curator of Arms and Armor, Metropolitan Museum of Art, New York. Author of* Warriors and Worthies; Arms and Armor in Africa; *and others.*
ARMS DESIGN AND DECORATION

H.O. Harold Oldroyd. *Former Senior Principal Scientific Officer, British Museum (Natural History), London. Author of* The Natural History of Flies *and others.*
DIPTERA

Ho.B. Howard Bay. *Stage and film designer. Professor of Theatre Arts, Brandeis University, Waltham, Massachusetts. Author of* Stage Design.
STAGING AND STAGE DESIGN (*in part*)

Ho.I.P. Hovhanness Israel Pilikian. *Theatre director. Founder and Artistic Director of Hana-no Mask-Theatre Company. Author of* The Prince of Darkness *and others.*
REINHARDT, MAX

H.P. Heinrich Potthoff. *Contributor, Commission for the History of Parliamentarism and Political Parties, Bonn. Author of* Die deutsche Politik Beusts *and others.*
BEUST, FRIEDRICH VON

H.Pa. Hans Patze. *Professor of German History; Director, Institute for Historical Research, Georg August University of Göttingen, West Germany. Author of* Die Entstehung der Landesherrschaft in Thüringen *and others.*
FREDERICK I BARBAROSSA, EMPEROR

H.P.D. Henry P. David. *Director, Transnational Family Research Institute, Bethesda, Maryland. Associate Clinical Professor of Psychology, School of Medicine. University of Maryland, Baltimore. Editor of* International Trends in Mental Health.
MENTAL HEALTH AND HYGIENE

H.Pe. Harry Perry. *Energy consultant. Senior Specialist, Congressional Research Service, Library of Congress, Washington, D.C.*
GASES, INDUSTRIAL AND DOMESTIC

H.Pl. Henry Pleasants. *London Music Critic,* International Herald Tribune, *Paris. London Editor,* Stereo Review, *New York City. Author of* The Great Singers, from the Dawn of Opera to Our Own Time; The Great American Popular Singers; *and others.*
SINGING (*in part*)

H.P.L. H. P. Laughlin, M.D. *Psychiatrist. Founder and First President, American College of Psychiatrists. Author of* The Neuroses; The Ego and Its Defenses.
PSYCHONEUROSES

H.P.La. Harriet Pratt Lattin. *Historian. Author of* The Peasant Boy Who Became Pope; *translator of* The Letters of Gerbert, with His Papal Privileges as Sylvester II.
SYLVESTER II, POPE

H.Pr. Helmut Preidel. *Historian. Author of* Das grossmährische Reich im Spiegel der Bodenfunde; Handel und Handwerk im frühgeschichtlichen Mitteleuropa; *and others.*
CHARLES IV, EMPEROR

H.-p.T. Hsu-pai Tseng. *Chairman of the Board, Central News Agency, Taipei. Professor of Journalism, National Chengchi University, Taipei. Dean, Sun Yat-sen Memorial Research Institute, College of Chinese Culture, Taipei. Editor of* History of Chinese Journalism.
TAIPEI

H.P.Tr. Hamilton P. Traub. *Editor,* Plant Life, *American Plant Life Society, La Jolla, California. Author of* The Amaryllis Manual *and others.*
LILIALES

H.P.V. Homero Pozo Vélez. *Professor of History and Geography; Dean, Faculty of Educational Science, National University of Loja, Ecuador.*
ECUADOR

H.R. Helmer Ringgren. *Professor of Old Testament Exegesis, University of Uppsala, Sweden. Author of* Israelite Religion; Messiah in the Old Testament; *and various articles on theological concepts in the Qur'ān.*
QUR'ĀN

H.Ra. Hassanein Muhammad Rabie. *Associate Professor of History, University of Cairo. Author of* The Financial System of Egypt: A.H. 564–741/A.D. 1169–1341.
BAYBARS I

H.R.B. Horace R. Byers. *Emeritus Professor of Meteorology, Texas A & M University, College Station. Author of* General Meteorology; Elements of Cloud Physics.
FROST

H.R.C. Henry R. Clauser. *Consultant,* Materials Engineering *magazine; Editor-Publisher, 1965–69; Editor, 1958–64; Associate Editor and Managing Editor, 1946–57. Author of* Industrial and Engineering Materials.
MATERIALS PROCESSING

H.Re. Hans Reichardt. *Emeritus Professor of Mathematics, Humboldt University of Berlin. Editor of* C.F. Gauss Gedenkband anlässlich des 100. Todestages am 23. Februar 1855.
GAUSS, CARL FRIEDRICH

H.R.H. Heribert R. Hutter. *Director, Gallery of the Academy of Fine Arts, Vienna. Author of* Drawing: History and Technique *and others.*
DRAWING

H.Ro. Herbert H. Rowen. *Professor of History, Rutgers, the State University, New Brunswick, New Jersey. Author of* John de Witt, Grand Pensionary of Holland, 1625–1672 *and others.*
LOW COUNTRIES, HISTORY OF (*in part*)

H.R.O. Horace Russell Ogden. *Associate Manager, Department of Process and Physical Metallurgy, Battelle Memorial Institute, Columbus, Ohio.*
TITANIUM PRODUCTS AND PRODUCTION

H.R.R. H. Rocke Robertson, M.D. *Principal and Vice Chancellor, McGill University, Montreal, 1962–70. Author of "The Wound and Its Care" in* Christopher's Textbook of Surgery.
WOUND

H.R.T. Hugh Russell Tinker. *Professor of Politics, University of Lancaster, England. Author of* India and Pakistan: A Political Analysis; Experiment with Freedom, India and Pakistan; *and others.*
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

H.R.W. Henry R. West. *Professor of Philosophy, Macalester College, St. Paul, Minnesota.*
UTILITARIANISM

H.S. Helmut Sick. *Naturalist, Department of Birds, National Museum, Rio de Janeiro, Brazil. Author of numerous papers on neotropical birds.*
TINAMIFORMES

H.Sa. Heinrich Satter. *Free-lance writer. Author of* Paul Ehrlich, Begründer der Chemotherapie *and others.*
EHRLICH, PAUL

H.S.A. Henrik S. Ahnlund. *Director, Archaeological Department, Stockholm Municipal Museum. Co-author of* Historia kring Stockholm.
STOCKHOLM

H.Sc. Heinrich Schiffers. *Lecturer in Geography, Preparatory College for Foreign Students, University of Cologne, 1965–70. Lecturer in Geography, secondary schools of Aachen and Cologne, 1930–65. Author of* Die Sahara und die Syrtenländer; The Quest for Africa.
SAHARA (DESERT) (*in part*)

H.Se. Humphrey Searle. *Composer. Professor of Composition, Royal College of Music, London. Author of* The Music of Liszt *and others.*
LISZT, FRANZ

H.S.H. Helen Sawyer Hogg. *Emeritus Professor of Astronomy, University of Toronto. Astronomy columnist,* Toronto Daily Star.
STAR CLUSTERS AND STELLAR ASSOCIATIONS

H.S.K. Herbert S. Klein. *Professor of History, Columbia University. Author of* Parties and Political Change in Bolivia, 1880–1952 *and others.*
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H.S.Kn. Hugh S. Knowles. *Director of Research, Industrial Research Products, Elk Grove Village, Illinois. Author of "Microphones" and "Effects of Acoustic Medium" in* Wiley Handbook Series *and others.*
SOUND RECORDING AND REPRODUCING (*in part*)

H.S.L. Howard S. Levie. *Colonel, U.S. Army (retired). Emeritus Professor of Law, St. Louis University, Missouri.*
WAR CRIMES

H.Sm. Harlan James Smith. *Professor and Chairman, Department of Astronomy; Director, McDonald Observatory, University of Texas at Austin. Co-editor of* Planetary Atmospheres.
URANUS

H.S.M. H.S. Morris. *Reader in Anthropology, London School of Economics and Political Science, University of London. Author of* Indians in Uganda.
MINORITIES AND ETHNIC GROUPS

H.S.MacD.C. H.S. MacDonald Coxeter. *Professor of Mathematics, University of Toronto. Author of* Non-Euclidean Geometry.
GEOMETRY, NON-EUCLIDEAN

H.S.N. H.S. Narayana. *Reader in Botany, University of Rājasthān, Jaipur, India.*
CAPPARALES

H.Sp. Herbert Spiegelberg. *Emeritus Professor of Philosophy, Washington University, St. Louis, Missouri. Author of* The Phenomenological Movement.
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H.S.P. H. Steffen Peiser. *Chief, Office of International Relations, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. Author of* X-Ray Diffraction by Polycrystalline Materials.
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H.Sr. Hugo Stehkämper. *Director, Historical Archives, Cologne.*
COLOGNE (*in part*)

H.S.R. Hans Siegbert Reiss. *Professor of German, University of Bristol, England. Author of* Goethe's Novels *and others.*
LITERATURE, WESTERN: *German (19th, 20th century)*

H.Ss. Halsey Stevens. *Composer. Emeritus Professor of Music, University of Southern California, Los Angeles. Author of* The Life and Music of Béla Bartók
BARTÓK, BÉLA

H.S.Sc. Herbert S. Schell. *Emeritus Dean of the Graduate School, University of South Dakota, Vermillion; former Professor of History. Author of* South Dakota, Its Beginning and Growth; History of South Dakota.
SOUTH DAKOTA

H.S.-Sm. Sir Hubert Shirley-Smith. *Consulting Engineer to W.V. Zinn & Associates, London. President, Institute of Civil Engineers, 1967. Author of* The World's Great Bridges.
BRIDGES, CONSTRUCTION AND HISTORY OF

H.St. Hans Sturmberger. *Director, Upper Austrian Provincial Archives, Linz. Author of* Kaiser Ferdinand II *and others.*
FERDINAND II, EMPEROR

H.S.T. H.S. Thayer. *Professor of Philosophy, City College, City University of New York. Author of* Meaning and Action: A Critical History of Pragmatism.
PRAGMATISM

H.Sta. Sir Hugh S. Taylor (d. 1974). *Professor of Chemistry, 1922–58; Dean of the Graduate School, 1945–58, Princeton University. Co-author of* Catalysis in Theory and Practice
CATALYSIS

H.S.-W. Hugh Seton-Watson. *Professor of Russian History, University of London. Author of* The Russian Empire, 1801-1917 *and others.*
RUSSIA AND THE SOVIET UNION, HISTORY OF (*in part*)

H.S.Y. Hatten Schuyler Yoder, Jr. *Director and Petrologist, Geophysical Laboratory, Carnegie Institution of Washington, D.C. Investigator of mineral properties and structures through experimental studies.*
MICAS

H.T. Holger Thesleff. *Professor of Greek, University of Helsinki. Author of* An Introduction to the Pythagorean Writings of the Hellenistic Period.
PYTHAGOREANISM

H.Ta. Hugh Tait. *Deputy Keeper, Department of Medieval and Later Antiquities, British Museum, London. Author of* Porcelain *and others.*
ENAMELWORK (*in part*)

H.T.C. Hiden T. Cox. *Professor of Biology, California State University, Long Beach.*
ERICALES

H.T.D. Harry T. Dickinson. *Reader in History, University of Edinburgh. Author of* Bolingbroke *and others.*
BOLINGBROKE, HENRY ST. JOHN, 1ST VISCOUNT

H.T.F. Harold T. Friermood. *Chairman, USOC–International Olympic Academy Committee. Editor of* Handball: Official, Unified-Playing Rules; When Volleyball Began; *and others.*
HANDBALL AND FIVES (*in part*)
VOLLEYBALL

H.t.H. H. ter Heide. *Deputy Head, Research Department, Government Physical Planning Agency, The Hague, The Netherlands. Author of* Binnenlandse migratie in Nederland.
MIGRATION, HUMAN

H.Th. Helmut Thielicke. *Professor of Systematic Theology; Director, Seminar for Systematic Theology, University of Hamburg. Author of* Theological Ethics.
THEOLOGY

H.To. Hagiwara Takahiro. *Emeritus Professor of Earthquake Research Institute, University of Tokyo. Author of* Prediction of Earthquakes.
SEISMOGRAPH

H.T.P. Hugh T. Patrick. *Professor of Far Eastern Economics, Yale University. Author of* Monetary Policy and Central Banking in Contemporary Japan.
MONEY MARKET (*in part*)

H.Ty. Hugh Tracey (d. 1977). *Founder and Director, International Library of African Music, Roodepoort, South Africa; Editor,* African Music, *1954-70. Author of* Chopi Musicians *and others.*
AFRICAN PEOPLES, ARTS OF (*in part*)

H.U. Homer Ulrich. *Emeritus Professor of Music Literature, University of Maryland; former Head, Department of Music. Author of* Chamber Music *and others.*
CHAMBER MUSIC

H.-U.H. Hanns-Ulrich Haedeke. *Director, German Sword Museum, Solingen, West Germany. Author of* Metalwork *and others.*
METALWORK (*in part*)

Hu.M. Hugh Sinclair Morrison. *Leon E. Williams Professor Emeritus of Art, Dartmouth College, Hanover, New Hampshire. Author of* Early American Architecture; Louis Sullivan.
VISUAL ARTS, WESTERN (*in part*)

Hu.S. Hudson Strode (d. 1976). *Professor of English, University of Alabama. Tuscaloosa, 1924–63. Author of* Jefferson Davis *and others.*
DAVIS, JEFFERSON

H.U.S. Harald Ulrik Sverdrup (d. 1957). *Director, Norwegian Polar Institute, Oslo, 1948–57. Director, Scripps Institution of Oceanography, University of California, La Jolla, 1936–48. Author of* Oceanography for Meteorologists *and others.*
ATLANTIC OCEAN (*in part*)
NANSEN, FRIDTJOF

Hu.Wa. Hugh Wakefield. *Former Keeper, Department of Circulation, Victoria and Albert Museum, London. Author of* Nineteenth Century British Glass; Victorian Pottery.
GLASS, HISTORY OF (*in part*)

H.V. Hans Volkmann (deceased). *Professor of Ancient History, University of Cologne.*
ANTIGONUS I MONOPHTHALMUS
ANTIGONUS II GONATAS
ANTIOCHUS III THE GREAT
ANTIOCHUS IV EPIPHANES

H. van W. H. van Werveke (d. 1974). *Professor of the History of Belgium, State University of Ghent. Author of* Jacques van Artevelde *and others.*
ARTEVELDE, JACOB VAN

H.V.L. Harold V. Livermore. *Professor of Spanish and Portuguese; Head, Department of Hispanic and Italian Studies, University of British Columbia, Vancouver. Author of* A History of Portugal *and others.*
ALBUQUERQUE, AFONSO DE
COVILHÃ, PÊRO DA
DIAS, BARTOLOMEU
JOHN I OF PORTUGAL
JOHN II OF PORTUGAL
MANUEL I OF PORTUGAL
PORTUGAL, HISTORY OF

H.Wa. Hao Wang. *Professor of Mathematical Logic, The Rockefeller University, New York City. Author of* A Survey of Mathematical Logic.
METALOGIC

H.W.B. Hendrik W. Bode. *Gordon McKay Professor Emeritus of Systems Engineering, Harvard University. Author of* Network Analysis and Feedback Amplifier Design.
SYSTEMS ENGINEERING

H.W.Br. Harold Whitman Bradley. *Emeritus Professor of History, Vanderbilt University, Nashville, Tennessee. Member, Tennessee House of Representatives, 1964–72. Author of* The United States, 1492-1877 *and others.*
JACKSON, ANDREW
UNITED STATES, HISTORY OF THE (*in part*)

H.We. Herbert Weinstock (d. 1971). *Consulting Editor, Alfred A. Knopf, Inc., New York City, 1963–71; Executive Editor, 1943–59. Author of* The Opera; Music as an Art; *and many biographies of composers.*
OPERA

H.W.E. H.W. Eldermans. *Journalist. Former Editor,* Rotterdamsch Nieuwsblad.
ROTTERDAM

H.W.F. Hubert William Frings. *David Ross Boyd Professor of Zoology, University of Oklahoma, Norman. Co-author of* Animal Communication.
CHEMORECEPTION

H.W.F.S. Henry W.F. Saggs. *Professor of Semitic Languages, University College, Cardiff, University of Wales. Author of* The Greatness That Was Babylon *and others.*
BABYLON
NEBUCHADREZZAR II
SENNACHERIB

H.W.G. Herman W. Goult (d. 1977). *Editor,* Cyprus Mail, *Nicosia. Cyprus correspondent,* The Times (*London*). *Writer on Cyprus affairs.*
CYPRUS

H.W.H. H.W. Herbert. *Consulting Economist, Economic Services, Brisbane, Australia.*
QUEENSLAND

H.Wi. Hermann Wiesflecker. *Professor of Austrian History, University of Graz, Austria. Author of* Maximilian I, Österreich, das Reich und Europa an der Wende zur Neuzeit (*vol. 1–3*) *and others.*
MAXIMILIAN I, EMPEROR

H.W.J. H.W. Janson. *Professor of Fine Arts, Washington Square College of Arts and Science, New York University, New York City. Author of* The Sculpture of Donatello; History of Art.
DONATELLO

H.W.K. Harold W. Kuhn. *Professor of Mathematical Economics, Princeton University. Senior consultant, Mathematica, Inc. Author of articles on linear programming and the theory of games; co-editor of* Contributions to the Theory of Games.
OPTIMIZATION, MATHEMATICAL THEORY OF (*in part*)

H.W.L. Herbert W. Levi. *Agassiz Professor of Zoology; Curator of Arachnology, Museum of Comparative Zoology, Harvard University. Co-author of* A Guide to Spiders and Their Kin; *co-translator and co-editor of* Invertebrate Zoology *by A. Kaestner.*
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H.W.M. Horace Winchell Magoun. *Emeritus Professor of Anatomy, University of California, Los Angeles. Author of* The Waking Brain *and others.*
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H.W.P. Herbert William Parke. *Professor of Ancient History, Trinity College, University of Dublin, 1934–73. Author of* Greek Mercenary Soldiers *and others.*
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H.W.S. Henry William Spiegel. *Emeritus Professor of Economics, Catholic University of America, Washington, D.C. Author of* The Brazilian Economy.
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H.W.T. Harold Walter Turner. *Director, Project for New Religious Movements in Primal Societies, University of Aberdeen, Scotland. Author of* African Independent Church *and others.*
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H.W.W. Harold W. Wardman. *Professor of French Studies, University of Lancaster, England. Author of* Ernest Renan: A Critical Biography.
RENAN, ERNEST

Hy.K. Hyman Kaufman. *Professor of Mathematics, McGill University, Montreal. Co-author of* Table of Laplace Transforms.
ANALYSIS, REAL (*in part*)

H.Z. Hans Zeisel. *Emeritus Professor of Law and Sociology, University of Chicago. Co-author of* The American Jury.
JURY (*in part*)

H.Z.D. Haim Zalman Dimitrovsky. *Lieberman Professor of Talmudic Exegesis, Jewish Theological Seminary of America, New York City. Editor and translator of* Bava metzia.
TALMUD AND MIDRASH

H.Z.H. H.Z. Hirschberg. *Former Professor of Jewish History in Muslim Countries, Bar-Ilan University, Ramat Gan, Israel. Editor and contributor to* Religion in the Middle East. *Author of* A History of the Jews in North-Africa from Antiquity to Our Time *and others.*
DRUZES

I. Archbishop Iakovos (James A. Coucouzes). *Archbishop of the Greek Orthodox Church in North and South America; Exarch of the Ecumenical Patriarchate of Constantinople.*
ECUMENISM

I.A. Isaac Asimov. *Science writer. Associate Professor of Biochemistry, Boston University. Author of* Asimov's Biographical Encyclopedia of Science and Technology *and many others.*
MICHELSON, A.A.

I.A.A.-L. Ibrahim A. Abu-Lughod. *Professor of Political Science, Northwestern University, Evanston, Illinois. Author of* Arab Rediscovery of Europe: A Study in Cultural Encounters.
IRAQ (*in part*)

I.A.Y. Ivan Alekseyevich Yerofeyev. *Associate Professor of Economic Geography, All-Union Extra-Mural Institute of Finance and Economics. Author of* Southwestern Economic Region; *co-author of* Kiev.
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I.B. Ivan Barnes. *Research Geochemist, Water Resources Division, Geological Survey, U.S. Department of the Interior, Menlo Park, California. An authority on the geochemistry of freshwaters.*
FRESHWATER, GEOCHEMICAL PROPERTIES OF

I.Be. Ian D. Bent. *Professor of Music, University of Nottingham, England. Author of numerous articles in musicological journals; Text Editor of* Grove's Dictionary of Music and Musicians, *6th ed.*
MUSICAL NOTATION

I.B.K. Irving B. Kravis. *Professor of Economics, University of Pennsylvania, Philadelphia. Co-author of* Price Competitiveness in World Trade.
PRICES, STATISTICS OF

I.B.S. Isaac Bashevis Singer. *Short-story writer and novelist. Author of* The Family Moskat *and others.*
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I.Bt. Irving Brant (d. 1976). *Former Member, Advisory Board, James Madison Papers, University of Chicago. Council Member, Institute of Early American History and Culture, 1959–62. Author of* James Madison (*6 vol.*) *and others.*
MADISON, JAMES

I.C.B. Rev. Ignatius Charles Brady, O.F.M. *Director of the theological section, College of St. Bonaventura, Grottaferrata, Italy. Editor and translator of* The Marrow of the Gospel.
FRANCIS OF ASSISI, SAINT

I.C.C. Ian C. Clingan. *Engineer in Chief, Trinity House Lighthouse Service, London.*
LIGHTHOUSE

I.C.Cn. Ivor Cecil Coffin. *Executive Officer, Economics Department, Lloyds Bank International Ltd., London.*
URUGUAY (*in part*)

I.D'O.E. Sir Ivo D'Oyly Elliott (d. 1961). *Indian Civil Service, 1906–32.*
TURENNE, HENRI DE

I.E. *Specialists, Institute of Economics, University of Havana.*
CUBA (*in part*)
HAVANA (*in part*)

I.E.-E. Irenäus Eibl-Eibesfeldt. *Director, Research Unit for Human Ethology, Max Planck Institute for Physiology of Behaviour, Seewiesen, West Germany. Author of* Galápagos: The Noah's Ark of the Pacific *and others.*
GALÁPAGOS ISLANDS

I.F. Ingo Findenegg (d. 1974). *Head, International Biological Program Laboratory, Austrian Academy of Sciences, Klagenfurt. Author of* Die Gewässer Österreichs.
ALPINE LAKES
BALATON, LAKE

I.F.B. Ivor F. Burton. *Senior Lecturer in Public Administration, Bedford College, University of London. Author of* The Captain-General: The Career of John Churchill, Duke of Marlborough, from 1702-1711 *and others.*
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PIUS V, SAINT AND POPE (*in part*)
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I.F.G.B. Ian F.G. Baxter. *Professor of Law, University of Toronto; former Director of Family Law Study.*
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I.Fl. Ian Fletcher, *Professor of English Literature, University of Reading, England. Author of* Beaumont and Fletcher.
BEAUMONT AND FLETCHER

I.G. Isabella Gordon. *Head, Crustacea Section, British Museum (Natural History), London, 1928–66. Co-editor of* Crustaceana.
CRUSTACEA (*in part*)

I.G.S. Irwin G. Sarason. *Professor of Psychology, University of Washington, Seattle. Author of* Personality: An Objective Approach.
PERSONALITY, MEASUREMENT OF

I.G.W. Ivor G. Wilks. *Professor of African History, Northwestern University, Evanston, Illinois.*
NKRUMAH, KWAME

I.H. Ichiro Hori (d. 1974). *Professor of History of Religion, Seijo University and Kokugakuin University, Tokyo. President, Japanese Association for Religious Studies. Author of* Folk Religion in Japan *and others.*
JAPANESE RELIGION

I.Hr. Ivan Hrbek. *Member, Oriental Institute, Czechoslovak Academy of Sciences, Prague. Author of "The Chronology of Ibn Battute's Travels" in* Archiv Orientalni.
IBN BAṬṬUṬAH

I.Hy. Isabelle Hyman. *Associate Professor of Fine Arts, Washington Square College of Arts and Science, New York University, New York City.*
BRUNELLESCHI, FILIPPO

I.J. Ivar K. Johansson. *Emeritus Professor of Animal Breeding, Agricultural College of Sweden, Uppsala. Author of* Genetic Aspects of Dairy Cattle Breeding; *co-author of* Genetics and Animal Breeding.
ANIMAL BREEDING

I.J.G. Ignace J. Gelb. *Frank P. Hixon Distinguished Service Professor Emeritus, Oriental Institute and Departments of Linguistics and of Near Eastern Languages and Civilizations, University of Chicago. Author of* A Study of Writing *and many others.*
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WRITING, FORMS OF

I.Jo. Inge Jonsson. *Professor of Comparative Literature, University of Stockholm. Author of* Emanuel Swedenborg *and others.*
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I.K. Irving Kaplansky. *George Herbert Mead Distinguished Service Professor of Mathematics, University of Chicago. Author of* Commutative Rings.
GALOIS, ÉVARISTE
HILBERT, DAVID
NUMBER THEORY (*in part*)

I.K.F. Ian Keith Ferguson. *Government Botanist and Principal Scientific Officer, Royal Botanic Gardens, Kew, England. Assistant Editor of* Flora Europaea *(vol. 2–3).*
DIPSACALES

I.K.M. Ivan Kirillovich Myachin. *Head of Section, Mysl Publishing House, Moscow. Author of* Moskva.
MOSCOW: *Bibliography (in part)*

I.Ko. Igor Kopytoff. *Professor of Anthropology, University of Pennsylvania, Philadelphia. Author of various articles on African anthropology.*
CONGO, CULTURES OF THE

I.K.P. Ismail K. Poonawala. *Associate Professor of Arabic and Islāmic Studies, University of California, Los Angeles.*
ʿALI

I.L.M. Ian Lauder Mason. *Consultant on Animal Genetic Resources, Food and Agriculture Organization, United Nations, Rome. Author of* A World Dictionary of Livestock Breeds.
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I.L.W. Ira L. Wiggins. *Emeritus Professor of Biology, Stanford University, California. Research Associate, Department of Botany, California Academy of Sciences, San Francisco.*
CONIFER

I.M.D. Igor Mikhailovich Diakonoff. *Head, Near Eastern Department and Ancient Oriental Languages Group, Institute of Oriental Studies, Academy of Sciences of the U.S.S.R., Leningrad. Author of* Semito-Hamitic Languages *and many others.*
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I.M.G. Ivan M. Goodbody. *Professor of Zoology, University of the West Indies, Mona, Kingston, Jamaica.*
TUNICATA

I.M.L. I.M. Lewis. *Professor and Chairman, Department of Anthropology, London School of Economics and Political Science, University of London. Author of* A Pastoral Democracy; The Modern History of Somaliland from Nation to State.
ETHIOPIAN AND SOMALIAN CULTURES

I.M.P. Ingrid Margareta Jonsson. *Staff Research Editor,* Encyclopædia Britannica, *Chicago, 1969–73.*
ATLANTIC OCEAN (*in part*)

I.M.P. do A. Ilídio Melo Peres do Amaral. *Rector; Professor of Geography, University of Lisbon. Researcher, Overseas Human and Physical Geography Mission, Overseas Research Council. Author of numerous publications on geography of Portugal and its colonies.*
PORTUGAL (*in part*)

I.N.S. Ian Naismith Sneddon. *Simson Professor of Mathematics, University of Glasgow. Author of* Elements of Partial Differential Equations *and others.*
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I.O. Iona Opie. *Folklorist. Co-author of* The Oxford Dictionary of Nursery Rhymes; The Lore and Language of Schoolchildren; Children's Games in Street and Playground.
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I.P. Indra Pal. *Reader in Geography, University of Rājasthān, Jaipur, India. Co-author of* World in Its Natural Regions.
RĀJASTHĀN

I.P.G. Innokentii Petrovich Gerasimov. *Director, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow. An authority on the physical geography and geology of the Soviet Union.*
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I.P.H. Ian P. Howard. *Professor of Psychology, York University, Toronto. Co-author of* Human Spatial Orientation.
PERCEPTION OF MOVEMENT

I.P.S. Ivan Peter Shaw. *Fellow and Secretary, King's College, University of London. Author of* Nationality and the Western Church Before the Reformation.
EDWARD, THE BLACK PRINCE

I.R.C. Ian R. Christie. *Professor of Modern British History, University College, University of London. Author of* Wilkes, Wyvill and Reform *and others.*
WILKES, JOHN

Ir.W. Irving Wallace. *Novelist and biographer. Author of* The Fabulous Showman: The Life and Times of P.T. Barnum; The Man; *and many others.*
BARNUM, P.T.

I.S.C. Ivan Stoddard Coggeshall. *Fellow, Institute of Electrical and Electronics Engineers. Assistant Vice President, Western Union Telegraph Company, New York City, 1959; Director of International Communications, 1951–58.*
TELEGRAPH

I.S. de S. Isbelia M. Sequera de Segnini. *Professor of Economics and Agrarian Geography; Coordinator of Graduate Studies in Geography, Central University of Venezuela, Caracas. Author of* La productividad en la agricultura *and others.*
VENEZUELA (*in part*)

I.S.L. Irwin Solomon Lerner. *President, Lerner Laboratories, Stamford, Connecticut. Former Director of Applied Research, Royal McBee Corporation, West Hartford, Connecticut.*
TYPEWRITER

I.T. Isadore Twersky. *Littauer Professor of Hebrew Literature and Philosophy, Harvard University. Author of* Rabad of Posquières *and others.*
RASHI

I.T.R. Rt. Rev. Ian Thomas Ramsey (d. 1972). *Lord Bishop of Durham, England, 1966–72. Nolloth Professor of the Philosophy of Christian Religion, University of Oxford, 1951–66. Author of* Religious Language; Christian Discourse.
RELIGION, PHILOSOPHY OF

I.V.Ko. Innokenty Varfolomeevich Kozlov. *Deputy Principal Editor, Geography, Mysl Publishing House, Moscow. Author of* Sovetskiye subtropiki *and others.*
SOVIET UNION (*in part*)

I.V.N. Israel Vladimirovich Nestyev. *Chief Scientist, Research Institute of History of Arts, Moscow. Author of* Prokofiev.
PROKOFIEV, SERGEY

I.V.P. Igor Vladimirovich Popov. *Senior Scientist, Leningrad Hydrological Institute. Author of* Basic Methods for the Study of Riverbed Processes.
HUANG HO (RIVER)
LENA RIVER

I.W. Immanuel Wallerstein. *Distinguished Professor of Sociology, State University of New York at Binghamton. Author of* Africa: The Politics of Independence.
LUMUMBA, PATRICE

I.W.H. Inez Whitaker Hunt. *Lecturer and free-lance writer. Teacher of creative writing, University of Colorado, Colorado Springs, 1963–66. Co-author of* Lightning in His Hand: The Life Story of Nikola Tesla.
TESLA, NIKOLA

I.Z. Imre Zoltán, M.D. *Professor of Gynecology and Obstetrics; Prorector, Semmelweis Medical University, Budapest, Hungary. Co-author of* Semmelweis élete és munkássága.
SEMMELWEIS, IGNAZ PHILIPP

J.A. Jack Andresen. *Consulting Engineer. Underwater Photographer. World champion figure water skier, 1950. Author of* Skiing on Water.
SWIMMING AND AQUATIC SPORTS (*in part*)

J.A.A. J.A. Andrups. *Author of* Latvian Literature *and others.*
LITERATURE, WESTERN: *Latvian*

Ja.B. Jan Bollema. *Public Relations Officer, Municipality of The Hague.*
HAGUE, THE (*in part*)

J.A.B. James Alan Bassham. *Deputy Head, Chemical Biodynamics Division, Lawrence Berkeley Laboratory; Adjunct Professor of Biochemistry, University of California, Berkeley. Co-author of* Photosynthesis of Carbon Compounds.
PHOTOSYNTHESIS

J.A.Ba. John A. Bailey. *Partner, Louis T. Klauder and Associates (consulting engineers), Philadelphia. Director, Transportation Center, Northwestern University, Evanston, Illinois, 1967–75.*
TRANSPORTATION, URBAN

J.A.Bo. John Andrew Boyle. *Professor and Head, Department of Persian Studies, Victoria University of Manchester. Editor and contributor to* Cambridge History of Iran, *vol. 5.*
FERDOWSĪ
GHĀZĀN, MAḤMŪD

J.A.B.v.B. J.A.B. van Buitenen. *Distinguished Service Professor of Sanskrit and Indic Studies, University of Chicago. Author of* Tales of Ancient India.
CALENDAR (*in part*)
HINDU MYTHOLOGY
HINDU SACRED LITERATURE
RĀMĀNUJA
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

Ja.C. Jan Christensen. *Financial Editor,* Verdens Gang, *Oslo. Co-author of* Norge i årene, *1961–67.*
NORWAY

J.A.Ca. Jorge A. Camacho. *Free-lance writer. Staff member, British Broadcasting Corporation, 1938–69; Head of Talks and Current Affairs (Radio), 1961–69.*
BROADCASTING

J.A.C.B. J.A.C. Brown. *Professor of Applied Economics, University of Oxford. Co-author of* The Lognormal Distribution.
CONSUMPTION, ECONOMIC

J.A.Cr. John Anthony Crook. *Reader in Roman History and Law, University of Cambridge; Fellow of St. John's College, Cambridge. Fellow of the British Academy. Author of* Law and Life of Rome.
MARCUS AURELIUS

Ja.D. Janusz Durko. *Director, Historical Museum of Warsaw. Editor of* Bibliography of Warsaw.
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J.Ad. Jean Adhémar. *Curator of Prints, Bibliothèque Nationale, Paris. Author of* Honoré Daumier *and others.*
DAUMIER, HONORÉ

Ja.F. James E. Faller. *Fellow, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder.*
GRAVITATION (*in part*)

J.A.H. John A. Haywood. *Former Reader in Arabic, University of Durham, England. Author of* Arabic Lexicography; *co-author of* A New Arabic Grammar of the Written Language.
FAKHR AD-DĪN AR-RĀZĪ
JA'FAR IBN MUḤAMMAD
MAS'ŪDĪ, AL-

J.A.Ha. John A. Harrison. *Senior Academic Dean, University of Miami, Coral Gables, Florida. Editor,* The Journal of Asian Studies, *1969–72. Author of* New Light on Early and Medieval Japanese History.
HŌJŌ FAMILY

Ja.H.B. James H. Bready. *Editorial Writer and Book Columnist,* The Sun *newspapers, Baltimore.*
MARYLAND

J.A.Ho. James A. Hodges. *Professor of History, Wooster College, Wooster, Ohio.*
TENNESSEE

Ja.H.W. Jack H. Wernick. *Head, Solid State Chemistry Research Department, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.*
THERMOELECTRIC DEVICES (*in part*)

Ja.J.S. James Joseph Stilwell. *Rear Admiral, U.S. Navy (retired). Labour arbitrator and consulting engineer.*
SHIP

Ja.K. Jan Kazimour. *President, Federal Statistical Office of Czechoslovakia, Prague.*
PRAGUE (*in part*)

J.A.K. Jerzy A. Kondracki. *Professor of Physical Geography, University of Warsaw. Director, Geographical Institute, Warsaw. Author of* Geografia fizyczna Polski.
CARPATHIAN MOUNTAINS
POLAND (*in part*)

J.A.Ke. Rev. John Arthur Kemp, S.J. (d. 1963). *Professor of Medieval History, Loyola University, Chicago, 1959–63. Author of* History of Europe to 1500.
ANSELM OF CANTERBURY, SAINT

Ja.Kn. Jan Knappert. *Lecturer in Bantu, School of Oriental and African Studies, University of London. Author of* Myths and Legends of the Congo; Traditional Swahili Poetry; *and others.*
AFRICAN PEOPLES, ARTS OF (*in part*)

Ja.L. James Laver (d. 1975). *Keeper, Departments of Engraving, Illustration and Design, and of Paintings, Victoria and Albert Museum, London, 1938–59. Author of* A Concise History of Costume *and others.*
DRESS (*in part*)

J.A.L. Joseph Albert Lauwerys. *Emeritus Director, Atlantic Institute of Education, Halifax, Nova Scotia. Emeritus Professor of Comparative Education, University of London. Co-editor,* World Year Book of Education, *1947–70.*
EDUCATION, HISTORY OF (*in part*)

Ja.La. Janko Lavrin. *Emeritus Professor of Russian Literature, University of Nottingham, England. Author of* Gogol; Russian Writers; *and others.*
GOGOL, NIKOLAY

J.A.Le. James A. Lee. *Consultant, Brick Institute of America, Atlanta, Georgia. Author of articles in* American Ceramic Journal *and other journals.*
BRICK AND TILE PRODUCTION

Ja.L.S. Jason Lewis Saunders. *Professor and Chairman, Department of Philosophy, City*

College; Professor of Philosophy, Graduate Center, City University of New York. Author of Early Stoic Philosophy.
STOICISM

Ja.M. Jacques Millot. *Professor, National Museum of Natural History, Paris, 1943–67. Researcher on the anatomy of coelacanths and their fossil relatives.*
CROSSOPTERYGII (*in part*)

J.A.M. J.A. Mabbutt. *Professor of Geography, University of New South Wales, Kensington, Australia. An authority on geomorphology of arid lands. Author of* Desert Landforms.
PEDIMENTS

J.A.M.K.I. Jozef A.M.K. IJsewijn. *Professor of Neo-Latin, Catholic University of Louvain, Belgium. Editor,* Humanistica Lovaniensia *(journal of neo-Latin studies).*
GROTIUS, HUGO

J.A.Mo. John A. Monick. *Research Associate, Colgate-Palmolive Company, Piscataway, New Jersey. Author of* Alcohols: Their Chemistry, Properties and Manufacture.
ALCOHOLS, PHENOLS, AND ETHERS

J.A.Mu. John A. Munroe. *H. Rodney Sharp Professor of History, University of Delaware, Newark. Editor,* Delaware History. *Author of* Federalist Delaware, 1775–1815.
DELAWARE

J.A.O. Juan A. Oddone. *Professor of History, Autonomous Metropolitan University, Mexico City. Author of* La formación del Uruguay moderno *and others.*
URUGUAY, HISTORY OF

J.A.O'K. John A. O'Keefe. *Astronomer, Laboratory for Astronomy and Solar Physics, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland. Author of* Tektites and Their Origin.
TEKTITE

J.A.P. James A. Peters (d. 1972). *Curator and Supervisor, Division of Reptiles and Amphibians, National Museum of Natural History, Smithsonian Institution, Washington, D.C., 1966–72. Specialist on the taxonomy of snakes. Author of* Dictionary of Herpetology *and others.*
SERPENTES

J.Ar. John Armitage. *London Editor,* Encyclopædia Britannica, *1949–1965. President, Rugby Fives Association, London, 1955–60.*
GAMES, HISTORY OF
HANDBALL AND FIVES (*in part*)

J.A.R. James Arthur Ramsay. *Emeritus Professor of Comparative Physiology, University of Cambridge. Author of* Physiological Approach to the Lower Animals *and others.*
EXCRETION AND EXCRETORY SYSTEMS

Ja.S. Jacques Soustelle. *Professor of Social Anthropology, School of Advanced Studies in the Social Sciences, Paris. Author of* La Vie quotidienne des Aztèques *and others.*
AZTEC RELIGION
MAYAN RELIGION

J.A.S. Jorge A. Suárez. *Professor of Amerindian Linguistics and of Contemporary Linguistics, National Autonomous University of Mexico, Mexico City. Co-author of* A Description of Colloquial Guaraní.
SOUTH AMERICAN INDIAN LANGUAGES

J.A.S.G. John A.S. Grenville. *Professor of Modern History, University of Birmingham, England. Author of* Lord Salisbury and Foreign Policy *and others.*
SALISBURY, ROBERT CECIL, 3RD MARQUESS OF

J.A.Sh. Jerome A. Shaffer. *Professor and Head, Department of Philosophy, University of Connecticut, Storrs. Author of* Philosophy of Mind.
MIND, PHILOSOPHY OF

J.Au. Jeannine Auboyer. *Curator in chief, Museum Guimet, Paris. Author of* La Vie quotidienne dans l'Inde ancienne.
CEREMONIAL AND RITUALISTIC OBJECTS

Ja.W. Jan Wojnowski. *Senior Editor, Polish Scientific Publishers, Warsaw. Editor,* Wielka Encyklopedia Powszechna, *Warsaw, 1962–70. Co-author and editor of* Companion to Polish Literature.
LITERATURE, WESTERN: *Polish* (*in part*)

J.A.W. Sir Jack Allan Westrup (d. 1975). *Professor of Music, University of Oxford, 1946–71; Fellow of Wadham College, Oxford, 1947–71. Author of* Purcell *and many others.*
MUSICAL INSTRUMENTS
PURCELL, HENRY

J.A.Wi. John Alden Williams. *Professor of Arab Studies, American University in Cairo. Professor of Art and Islamic Studies, University of Texas at Austin. Editor of* Islam *and others.*
ISLĀM, HISTORY OF

J.A.Y. Jay A. Young. *Hudson Professor of Chemistry, Auburn University, Alabama.*
CHEMICAL REACTIONS

J.B. John Boyd. *Consulting Engineer, Electro Mechanical Division, Westinghouse Electric Corporation, Cheswick, Pennsylvania. Co-editor of* Standard Handbook of Lubrication Engineering.
LUBRICATION

J.Ba. Jacques Barzun. *University Professor Emeritus, Columbia University; Dean of Faculties and Provost, 1958–67. Author of* Berlioz and the Romantic Century; Darwin, Marx, Wagner; *and others.*
BERLIOZ, HECTOR
EUROPEAN CULTURE SINCE 1800
FLAUBERT, GUSTAVE (*in part*)
POE, EDGAR ALLAN (*in part*)

J.B.B. John Bernard Beer. *Fellow of Peterhouse, Cambridge; Reader in English Literature, University of Cambridge. Author of* Coleridge, the Visionary; Blake's Humanism; Blake's Visionary Universe; *and others.*
COLERIDGE, SAMUEL TAYLOR
FORSTER, E.M.

J.-B.Ba. Jean-Bertrand Barrère. *Professor of French Literature, University of Cambridge; Fellow of St. John's College, Cambridge. Author of* Hugo, l'homme et l'oeuvre *and other works on Victor Hugo.*
HUGO, VICTOR

J.B.C. J(ohn) B. Condliffe. *Staff Scientist, Stanford Research Institute, Menlo Park, California, 1961–67. Professor of Economics, University of California, Berkeley, 1940–58. Author of* The Commerce of Nations *and others.*
UNITED NATIONS (*in part*)

J.B.Co. Jerome B. Cohen. *Professor of Materials Science and Engineering, Northwestern University, Evanston, Illinois. Author of* Diffraction Methods in Materials Science.
CRYSTALLOGRAPHY

J.Be. Jeremy Bernstein. *Professor of Physics, Stevens Institute of Technology, Hoboken, New Jersey. Author of* Elementary Particles and Their Currents.
SCHRÖDINGER, ERWIN
YANG, CHEN NING

J.B.F. John Bailey Fernald. *Theatre Director. Principal, Royal Academy of Dramatic Art, London, 1955–65. Professor of Dramatic Art, Oakland University, Rochester, Michigan, 1966–70. Author of* Sense of Direction; The Play Produced.
DIRECTING

J.B.-G. Jacqueline Beaujeu-Garnier. *Professor of Geography, University of Paris. Author of* Géographie de la population.
FRANCE (*in part*)

J.B.Gl. Sir John Bagot Glubb. *Lieutenant General (retired); Chief of General Staff, The Arab Legion, Amman, Jordan, 1939–56. Author of* War in the Desert *and others.*
IBN SA'ŪD

J.B.H. John B. Heywood. *Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Co-author of* Open-Cycle MHD Power Generation.
MAGNETOHYDRODYNAMIC DEVICES

J.B.He. James B. Hendrickson. *Professor of Chemistry, Brandeis University, Waltham, Massachusetts. Author of* The Molecules of Nature; *co-author of* Organic Chemistry.
WOODWARD, ROBERT BURNS

J.B.Ho. Joseph Bixby Hoyt. *Former Professor of Geography; Chairman, Social Science Division, Southern Connecticut State College, New Haven. Author of* The Connecticut Story.
CONNECTICUT

J.B.I. John B. Irwin. *Former Associate Professor of Astronomy, Kean College of New Jersey, Union.*
TELESCOPE

J.B.-J. John Buettner-Janusch. *Professor and Chairman, Department of Anthropology, New York University, New York City. Author of* Origins of Man.
HOMINIDAE

J.B.M. John Barron Mays. *Professor and Head, Department of Sociology, University of Liverpool. Author of* The Young Pretenders: Teenage Culture in Contemporary Society *and others.*
YOUTH, SOCIAL ASPECTS OF

J.B.Mi. Jean Brown Mitchell. *Fellow, Newnham College, Cambridge, 1934–68; Lecturer in Geography, University of Cambridge, 1945–68. Author of* Historical Geography.
GEOGRAPHY (*in part*)

J.B.N. John B(oyer) Noss. *Emeritus Professor of Philosophy, Franklin and Marshall College, Lancaster, Pennsylvania. Adjunct Professor of World Religions and the Christian Faith, Lancaster Theological Seminary, Pennsylvania. Author of* Man's Religions.
SACRED SCRIPTURES

J.B.P. J. Bruce Pluckhahn. *Project Director, National Bowling Hall of Fame and Museum, Greendale, Wisconsin. Co-author of* Pins and Needlers.
BOWLING (*in part*)

J.B.Pa. James Bayard Parsons. *Emeritus Professor of Chemistry, University of Chicago. Co-author of* The Study of the Physical World.
SODIUM AND POTASSIUM PRODUCTS AND PRODUCTION (*in part*)

J.Br. J(acob) Bronowski (d. 1974). *Senior Fellow and Trustee; Director, Council for Biology in Human Affairs, Salk Institute for Biological Studies, San Diego, California, 1964–74. Author of* William Blake and the Age of Revolution *and others.*
BLAKE, WILLIAM

J.B.R. Jean B. Richard. *Dean, Faculty of Letters and Human Sciences, University of Dijon, France. Author of* Histoire de la Bourgogne *and others.*
BURGUNDY, HISTORY OF

J.B.Ra. John Bell Rae. *Emeritus Professor of the History of Technology, Harvey Mudd College, Claremont, California. Author of*

American Automobile Manufacturers: The First Forty Years *and others.*
AUTOMOTIVE INDUSTRY

J.B.Ro. Juan M. Bonelli Rubio. *Permanent Secretary, Royal Geographical Society, Madrid.*
GUADALQUIVIR RIVER
TAGUS RIVER

J.Bru. Jean Bruhat. *Professor, Institute of Political Science; Instructor, University of Paris VIII-Vincennes. Author of* Les Journées de février 1848 *and others.*
BLANQUI, AUGUSTE

J.B.Sc. Joseph B. Schechtman (d. 1970). *President, United Zionist Revisionists of America. Author of* European Population Transfers 1939–1945; The Refugee in the World; *and others.*
REFUGEES

J.B.Sm. J(enkyn) Beverley Smith. *Senior Lecturer in Welsh History, University College of Wales, Aberystwyth, University of Wales.*
BRITAIN AND IRELAND, HISTORY OF (*in part*)

J.B.Sp. J. Brookes Spencer. *Associate Professor of the History of Science, Oregon State University, Corvallis. Editor of* The Collected Works of Niels Bohr.
PHYSICAL SCIENCES, HISTORY OF (*in part*)

J.Bu. Joseph Buttinger. *Free-lance writer. Author of* Vietnam: A Dragon Embattled *and others.*
VIETNAM, HISTORY OF

J.B.W. John Bruce Waterhouse. *Dorothy Hill Professor of Stratigraphy and Paleontology, University of Queensland, St. Lucia, Australia. Author of* Permian Stratigraphy and Faunas of New Zealand.
PALEOZOIC ERA, UPPER

J.B.Wi. John Bernard Wilkinson. *Former Head, Unilever Research Laboratory, Isleworth, England. Editor of* Modern Cosmeticology.
COSMETICS INDUSTRY

J.C. Jozef Cohen. *Professor of Psychology, University of Illinois, Urbana. Author of* Eyewitness Series in Psychology.
PSYCHOLOGY

J.C.A. John C. Ayres. *D.W. Brooks Distinguished Professor of Food Science, University of Georgia, Athens. Co-editor of* Chemical and Biological Hazards in Foods *and others.*
EGG PRODUCTION, COMMERCIAL

J.C.An. Joseph Chapman Anderson. *Professor of Electrical Materials, Imperial College of Science and Technology, University of London. Author of* Magnetism and Magnetic Materials.
MAGNETS AND ELECTROMAGNETS

J.C.B. Jon Charles Barlow. *Curator, Department of Ornithology, Royal Ontario Museum, Toronto. Associate Professor of Zoology, University of Toronto. Researcher on the biology and taxonomy of vireos. Author of "Edentates and Pholidotes" in* Recent Mammals of the World.
EDENTATA

J.C.Be. John C. Bennett. *Emeritus President, Union Theological Seminary, New York City. Senior Contributing Editor,* Christianity and Crisis. *Author of* Christians and the State.
NIEBUHR, REINHOLD

J.C.D. John C. Dewdney. *Reader in Geography, University of Durham, England. Author of* A Geography of the Soviet Union.
SOVIET UNION (*in part*)

J.C. de C. Jacques Chastenet de Castaing (d. 1978). *Historian and journalist. Member of the French Academy. Author of* Léon Gambetta *and others.*
GAMBETTA, LÉON

J.C. de F. José Carlos de Figueiredo. *Emeritus Professor of Geography of Brazil, Federal University of Paraná, Curitiba, Brazil.*
PARANÁ

J.C. de G.-J. John Coleman de Graft-Johnson (d. 1977). *Editor,* Economic Bulletin of Ghana. *Research Associate Professor of Economics, University of Ghana. Author of* African Glory: The Story of Vanished Negro Civilizations *and others.*
MANSA MŪSĀ OF MALI

J.C.F. Jean Claude Froelich (d. 1972). *Director, Center for Advanced Studies on Modern Africa and Asia, University of Paris. Author of* Les Musulmans d'Afrique noire; "al-*Ḥādjdj 'Umar b. Sa'ïd b. 'Uthmān Tāl*" *in* The Encyclopaedia of Islam.
ḤĀJJ 'UMAR, AL-

J.C.Gi. J. Calvin Giddings. *Professor of Chemistry, University of Utah, Salt Lake City. Author of* Dynamics of Chromatography.
CHROMATOGRAPHY (*in part*)

J.C.Gr. Jerald C. Graue. *Associate Professor of Musicology and Music History, Eastman School of Music, University of Rochester, New York.*
SCALES, MUSICAL

J.Ch. John Cherry. *Assistant Keeper, Department of Medieval and Later Antiquities, British Museum, London.*
SIGILLOGRAPHY (*in part*)

J.C.H. J.C. Holt. *Professor of Medieval History, University of Cambridge. Author of* King John *and others.*
JOHN OF ENGLAND

J.C.J. John Calhoun Jamieson. *Professor of Geophysics, University of Chicago.*
HIGH-PRESSURE PHENOMENA

J.C.J.M. John Callan James Metford. *Professor and Head, Department of Hispanic and Latin American Studies, University of Bristol, England. Author of* San Martín the Liberator *and others.*
SAN MARTÍN, JOSÉ DE

J.C.K. John C. Krantz, Jr. *Emeritus Professor of Pharmacology, University of Maryland. Co-author of* Pharmacologic Principles of Medical Practice.
PHARMACY

J.C.L. Joseph Collins Lawrence. *Assistant Professor of History, University of British Columbia, Vancouver. Author of* A Brief History of Sooke and District.
BRITISH COLUMBIA

J.C.M.C. José Candido de Melo Carvalho. *Professor, National Museum, Rio de Janeiro. Author of* Notas de Viagem ao Rio Negro *and others.*
ACRE
AMAZONAS

J.Co. Jean L. Comhaire. *Former Professor and Head, Department of Sociology and Anthropology, University of Nigeria, Nsukka. Former Sociologist, United Nations Economic Commission for Africa. Author of* Urban Administration in Africa.
IVORY COAST

J.-C.P. Jean-Charles Pichon. *Author of* Saint-Néron; Historie des mythes; *and others.*
NERO

J.Cr. John Cruickshank. *Professor of French, University of Sussex, Brighton, England. Author of* Albert Camus and the Literature of Revolt *and others; editor of* French Literature and Its Background.
CAMUS, ALBERT

J.C.-R. Jules-Marie Chaix-Ruy. *Professor of Philosophy, University of Nice, France, 1965–67. Author of* J.-B. Vico et l'illuminisme athée; Vie de J.-B. Vico.
VICO, GIAMBATTISTA

J.C.Rd. John Cowie Reid (d. 1972). *Professor of English, University of Auckland, New Zealand. Author of* Mind and Art of Coventry Patmore; Francis Thompson: Man and Poet; *and others.*
HOPKINS, GERARD MANLEY

J.C.Re. John C. Reilly, Jr. *Historian, Naval History Division, Office of the Chief of Naval Operations, U.S. Department of the Navy, Washington, D.C. Co-author of* Capital Ships: A Handbook of United States Battleships and Battle Cruisers 1896–1969.
NAVAL SHIPS AND CRAFT (*in part*)

J.C.Ry. J. Coert Rylaarsdam. *Emeritus Professor of Old Testament Theology, University of Chicago. Professor of Theology, Marquette University, Milwaukee. Author of* Revelation in Jewish Wisdom Literature *and others.*
BIBLICAL LITERATURE (*in part*)
DAVID

J.C.S. James C. Spalding. *Professor of Protestant Theology; Administrative Director, School of Religion, University of Iowa, Iowa City. Author of* The Demise of English Presbyterianism.
PURITANISM
REFORMED AND PRESBYTERIAN CHURCHES

J.C.T. James Chase Tyler. *Associate Curator of Ichthyology, Academy of Natural Sciences, Philadelphia. Author of* A Monograph on Plectognath Fishes of the Superfamily Triacanthoidea.
TETRAODONTIFORMES

J.Cul. James Cullen. *Assistant Keeper, Royal Botanic Garden, Edinburgh. Co-author of* The Identification of Flowering Plant Families.
ARISTOLOCHIALES
RANUNCULALES
THEALES

J.C.V. J. Charles Verlinden. *Emeritus Professor of History, State University of Ghent. Director, Belgian Historical Institute, Rome. Author of* En Flandre sous Philippe II *and others.*
LOW COUNTRIES, HISTORY OF (*in part*)

J.D.A. Jean Daniel Anthony. *Professor, Laboratory of Comparative Anatomy, National Museum of Natural History, Paris. Co-author of* Anatomie de Latimeria Chalumnae.
CROSSOPTERYGII (*in part*)

J. da S.R.F. José da Silva Ribeiro Filho. *Professor of Criminal Law, Federal University of Sergipe, Aracaju, Brazil. Secretary, Public Security of the State of Sergipe.*
SERGIPE

J.D.B.M. John Donald Bruce Miller. *Professor of International Relations, Australian National University, Canberra. Author of* The Commonwealth in the World *and others.*
BRITISH EMPIRE AND COMMONWEALTH

J.D.C. Jesse Dunsmore Clarkson (d. 1973). *Professor of History, Brooklyn College, City University of New York, 1945–67. Author of* A History of Russia *and others.*
SPERANSKY, MIKHAIL MIKHAYLOVICH

J.D.Cl. James D. Clarkson. *Associate Professor of Geography; Research Associate, Department of Population Planning, University of Michigan, Ann Arbor. Author of* The Cultural Ecology of a Chinese Village.
CULTURAL AREAS, THEORIES ABOUT

J.D.C.R. Jose Daniel Contreras R. *Head, Department of History, University of San Carlos of Guatemala. Author of* Breve historia de Guatemala.
GUATEMALA

J.De. Jean Descola. *Historian. Director, Ibero-American Center for Study and Research, Paris. Author of* The Conquistadors *and others.*
SOTO, HERNANDO DE

J. de E. Joaquín de Entrambasaguas. *Professor of Spanish Literature, University of Madrid. Author of* Estudios sobre Lope de Vega.
VEGA CARPIO, LOPE FÉLIX DE

J. de M.C. Juan de M. Carriazo. *Professor of Ancient and Medieval Spanish History, University of Seville, 1927–69. Author of* Anecdorario sevillano del siglo XV *and others.*
SEVILLE

J. de S. Jorge de Sena. *Professor of Portuguese and Comparative Literature, University of California, Santa Barbara. Author of* A Poesia de Camões *and others.*
CAMÕES, LUÍS DE

J.D.F. John Donnelly Fage. *Professor of African History; Director, Centre of West African Studies, University of Birmingham, England. Author of* A History of West Africa *and others.*
WEST AFRICA, HISTORY OF

J.D.-G. Jacques Duchesne-Guillemin. *Professor of Indo-Iranian Studies, State University of Liège, Belgium. Author of* The Religion of Ancient Iran *and others.*
ZOROASTRIANISM AND PARSIISM

J.D.H. James Daniel Hardy, M.D. *Professor and Chairman, Department of Surgery, University of Mississippi Medical Center; Surgeon in Chief, University Hospital, Jackson.*
BODY CAVITIES AND MEMBRANES, HUMAN (*in part*)

J.Di. James Dickie. *Former Lecturer in Islāmic Studies, University of Lancaster, England. Editor of* Dīwān Ibn Shuhaid al-Andalusi.
RELIGIOUS DRESS AND VESTMENTS (*in part*)

J.D.J.H. John David Jayne Havard, M.D. *Barrister at Law. Principal Deputy Secretary, British Medical Association, London. Consultant to World Health Organization* (WHO), *Organization for Economic Cooperation and Development* (OECD), *and Council of Europe. Author of* Detection of Secret Homicide.
MEDICAL JURISPRUDENCE

J.D.L. John David Legge. *Dean, Faculty of Arts, Monash University, Clayton, Australia. Author of* Central Authority and Regional Autonomy in Indonesia *and others.*
INDONESIA, HISTORY OF (*in part*)

J.D.M. Jürgen D. Moltmann. *Professor of Systematic Theology, Eberhard Karl University of Tübingen, West Germany. Author of* Theology of Hope *and others.*
ESCHATOLOGY

J.D.Mu. J. Derral Mulholland. *Research Scientist, McDonald Observatory and Department of Astronomy, University of Texas at Austin.*
MOON (*in part*)

J.D.N. James D. Nelson. *Professor of Church History, United Theological Seminary, Dayton, Ohio. Author of* Herrnhut: Friedrich Schleiermacher's Spiritual Homeland.
MORAVIAN CHURCH

J.D.P. Joseph D. Phillips. *Associate Scientist, Massachusetts Institute of Technology, Cambridge.*
ROCK MAGNETISM (*in part*)

J.D.Po. Jean D. Pottier. *Associate Director of Research and New Techniques, Gas of France, Paris.*
NATURAL GAS (*in part*)

J.D.Pr. John Douglas Pringle. *Editor, Sydney Morning Herald, 1965–70. Author of* Australian Accent *and others.*
AUSTRALIA, COMMONWEALTH OF (*in part*)
NEW SOUTH WALES
SYDNEY

J.D.Pro. Jules David Prown. *Professor of the History of Art, Yale University. Author of* John Singleton Copley; American Painting from Its Beginnings to the Armory Show; *and others.*
EAKINS, THOMAS
HOMER, WINSLOW

J.D.R. John D. Ryder. *Emeritus Professor of Electrical Engineering, Michigan State University, East Lansing. Author of* Engineering Electronics *and others.*
ELECTRICAL AND ELECTRONICS ENGINEERING

J.D.Ro. Jack D. Rogers. *Professor of Business Administration, University of California, Berkeley; Director, San Francisco Masters in Business Administration Program.*
FORD, HENRY

J.D.S. James Duane Squires. *Emeritus Professor of History, Colby–Sawyer College, New London, New Hampshire. Chairman, New Hampshire American Revolution Bicentennial Commission. Member, Governor's Task Force for Study of New Hampshire, 1970.*
NEW HAMPSHIRE

J.D.Sc. John D. Schmidt. *Assistant Professor of History, Columbia University.*
CALENDAR (*in part*)

J.D.Sm. James Desmond Smyth. *Professor of Parasitology, Imperial College of Science and Technology, University of London. Author of* Physiology of Cestodes; Physiology of Trematodes.
PLATYHELMINTHES

J.D.W. John D. Weaver. *Free-lance writer. West Coast Editor,* Travel & Leisure. *Author of* The Brownsville Raid *and of numerous articles on Los Angeles.*
LOS ANGELES

J.E. Jens Engberg. *Professor of History, University of Århus, Denmark. Author of* Det slesvigske spørgsmål 1850–1853 *and others.*
CHRISTIAN IV OF DENMARK AND NORWAY

Je.B. Jean Bouvier. *Professor of Economics, University of Paris I. Author of* Finances et financiers de l'Ancient Régime *and others.*
ROTHSCHILD FAMILY
TURGOT, ANNE-ROBERT-JACQUES

J.E.B. John Edward Bowle. *Professor of Political Theory, College of Europe, Bruges, Belgium, 1950–67. Author of* Politics and Opinion in the 19th Century.
POLITICAL PHILOSOPHY

Je.Bo. Jeremy Boissevain. *Professor of Social Anthropology, University of Amsterdam. Author of* Hal-Farrug: A Village in Malta.
MEDITERRANEAN FOLK CULTURES, WESTERN (*in part*)

J.E.Bu. John Everett Butt (d. 1965). *Regius Professor of Rhetoric and English Literature, University of Edinburgh, 1959–65. Author of* Pope's Poetical Manuscripts; *co-editor of* Letters of Alexander Pope; *and others.*
POPE, ALEXANDER

Je.C. Jean Cousin. *Professor of Latin Language and Literature, University of Besançon, France. Author of* Études sur Quintilien; Destin de Rome; *and others.*
DIOCLETIAN

J.E.C. John E. Carruthers. *Assistant General Manager, Refineries Department, British Petroleum Company Ltd., London, 1964–69.*
PETROLEUM REFINING (*in part*)

J.E.Ca. James Edward Canright. *Professor of Botany, Arizona State University, Tempe. Author of* Fossil Plants of Indiana.
MAGNOLIALES

Je.Ch. Jerome Ch'en. *Professor of East Asian History, York University, Toronto. Author of* Yuan Shih-k'ai, 1859–1916 *and others.*
YÜAN SHIH-K'AI

J.E.C.H. J.E. Christopher Hill. *Master of Balliol College, University of Oxford, 1965–78. Author of* Intellectual Origins of the English Revolution *and others.*
PYM, JOHN

J.E.Co. J.E. Coates (d. 1973). *Professor of Chemistry, University College of Swansea, University of Wales, 1920–48. Author of the* Chemical Society memorial lecture on Haber.
HABER, FRITZ

J.E.C.W. J.E. Caerwyn Williams. *Professor of Irish; Director, Centre for Advanced Welsh and Celtic Studies, University College of Wales, Aberystwyth, University of Wales. Editor,* Studia Celtica *(annual);* Y Traethodydd *(quarterly); and* Ysgrifau Beirniadol *(annual). Author of* Y Storiwr Gwyddeleg *and others; consulting editor of* Penguin Book of Welsh Verse.
LITERATURE, WESTERN (*in part*)

Je.D. Jean Dresch. *Professor of Geography, University of Paris VII. Author of* Recherches sur l'évolution du relief dans le Haut-Atlas *and others.*
CHAD, LAKE
MADAGASCAR (*in part*)

J.E.E. John E. Englekirk. *Emeritus Professor of Spanish, University of California, Los Angeles. Author of* Poe in Hispanic Literature; *co-author of* La narrativa uruguaya.
LITERATURE, WESTERN: *Latin American*

J.E.F. John E. Fagg. *Professor of History, New York University, New York City. Author of* Cuba, Haiti, and the Dominican Republic *and others.*
TOUSSAINT-LOUVERTURE

J.E.F.P. João Epitácio Fernandes Pimenta (d. 1972). *Judge, First District of Natal, Brazil, 1954–57. Member, Electoral Tribunal of Rio Grande do Norte, 1953–57.*
RIO GRANDE DO NORTE

J.E.H. Joseph E. Hawkins, Jr. *Professor of Otorhinolaryngology (Physiological Acoustics), Medical School, University of Michigan, Ann Arbor. Editor of* Otophysiology.
EAR AND HEARING, HUMAN

Je.Ho. Jerome Holtzman. *Baseball writer,* Chicago Sun-Times. *Columnist,* The Sporting News. *Author of* No Cheering in the Press Box.
BASEBALL (*in part*)

J.E.I. Joseph E. Illick. *Professor of History, San Francisco State University. Author of* William Penn the Politician *and others.*
PENN, WILLIAM

Je.M. Jean Mitry. *Professor and Director, Cinema Division, Institute of Art and Archaeology, University of Paris I (Panthéon-Sorbonne). Author of* Esthétique et psychologie du cinéma; Historie du cinéma; S.M. Eisenstein.
EISENSTEIN, SERGEY
RAY, SATYAJIT

J.E.M. John Edgar Morison, M.D. *Honorary Professor of Histopathology, Queen's University of Belfast, Northern Ireland. Consultant in Histopathology, Belfast City Hospital. Author of* Foetal and Neonatal Pathology.
BIRTH DEFECTS AND CONGENITAL DISORDERS

Jé.Ma. José Maceda. *Professor and Chairman, Department of Music Research, University of the Philippines, Quezon City. Author of* The Music of the Magindanao in the Philippines.
SOUTHEAST ASIAN PEOPLES, ARTS OF (*in part*)

J.E.Ma. Joseph E. Mayer. *Emeritus Professor of Chemistry, University of California, San Diego. Author of* Equilibrium Statistical Mechanics; *co-author of* Statistical Mechanics.
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

Je.-M.B. Jean-Marie Brugière. *Director, Overseas Office of Scientific and Technical Research, Centre at Cayenne, French Guiana.*
FRENCH GUIANA

J.E.McG. Joseph E. McGrath. *Professor of Psychology, University of Illinois, Urbana. Co-author of* Small Group Research: A Synthesis & Critique of the Field.
SOCIAL GROUPS

J.E.McM. James Edward McMurtrey, Jr. *Collaborator, Tobacco and Sugar Crops Research Branch, Agricultural Research Service, U.S. Department of Agriculture, Plant Science Research Division, Beltsville, Maryland; formerly Leader of Tobacco Investigations.*
TOBACCO PRODUCTION

J.E.Mo. John Edward Morton. *Professor of Zoology, University of Auckland, New Zealand. Author of* Molluscs *and others.*
MOLLUSCA

J.E.O. Jack E. Oliver. *Professor and Chairman, Department of Geological Sciences, Cornell University, Ithaca, New York.*
ISLAND ARCS

Je.P. Jerzy Pruchnicki. *Associate Professor, Technical University of Warsaw.*
ODER RIVER (*in part*)
VISTULA RIVER (*in part*)

J.Ep. Joseph Epstein. *Literary critic and essayist. Visiting Lecturer in the Department of English, Northwestern University.*
LITERATURE, WESTERN: *American; 20th century (in part)*

Je.-P.H. Jean-Paul Harroy. *Professor of Zairian, Rwandan and Burundian Economics, Free University of Brussels. Author of* Afrique, terre qui meurt.
ITURI FOREST

Je.S. Jean Selz. *Art historian and critic. Member, International Association of Art Critics, Paris. Author of* Modern Sculpture: Origins and Evolution; Matisse; *and others.*
BRANCUSI, CONSTANTIN

J.E.S. John E. Shelton. *Supervisory Physical Scientist, Bureau of Mines; U.S. Department of the Interior, Washington, D.C.*
MERCURY PRODUCTS AND PRODUCTION

J.E.Sa. John E. Sadler. *Head, Education Department, City of Birmingham College of Education, University of Birmingham, England, 1950–67. Author of* J.A. Comenius and the Concept of Universal Education.
COMENIUS, JOHN AMOS

J.E.Sm. John Edwin Smith. *Clark Professor of Philosophy, Yale University. Author of* Experience and God *and others.*
RELIGIOUS EXPERIENCE

J.E.Sn. James E. Snyder. *Professor of Art History, Bryn Mawr College, Pennsylvania. Author of* Bosch in Perspective.
MEMLING, HANS

Je.St. Jerry Stannard. *Professor of History of Science and Medicine, University of Kansas, Lawrence.*
HOOKER FAMILY
PLINY THE ELDER

J.E.St. John E. Stark, M.D. *Physician, Adden-brookes Hospital, Cambridge, England.*
THERAPEUTICS (*in part*)

J.E.S.T. Sir Eric Thompson (d. 1975). *Staff Member, Department of Archaeology, Carnegie Institution of Washington, D.C., 1935–58. Author of* The Rise and Fall of Maya Civilization *and others.*
CHRONOLOGY (*in part*)

J.Ev. Joan Evans (d. 1977). *President, Society of Antiquaries, London, 1959–64. Author of* John Ruskin *and many others.*
RUSKIN, JOHN

J.F. Jan Filip. *Professor of Pre-history and Proto-history; Director, Archaeological Institute, Charles University, Prague, Czechoslovakia. Author of* Celtic Civilization and Its Heritage *and others.*
CELTS, ANCIENT

J.Fa. Jean Fages. *Director of Research, Papeete Centre, Overseas Office of Scientific and Technological Research, Tahiti, French Polynesia.*
FRENCH POLYNESIA (*in part*)

J.F.B. John Fleming Brock, M.D. *Emeritus Professor of Medicine, University of Cape Town, South Africa. Author of* Recent Advances in Human Nutrition, with Special Reference to Clinical Medicine.
NUTRITIONAL DISEASES AND DISORDERS

J.F.Br. John Fleetwood Baker, Baron Baker of Windrush. *Emeritus Professor of Mechanical Sciences, University of Cambridge; Fellow of Clare College, Cambridge. Author of* Differential Equations of Engineering Science; *co-author of* The Analysis of Engineering Structures.
MECHANICAL ENGINEERING (*in part*)
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

J.F.C. James F. Cahill. *Professor of the History of Art, University of California, Berkeley. Author of* Chinese Painting; Hills Beyond a River; *and others.*
HSIA KUEI

J.F.C.C. J.F.C. Conn. *Emeritus Professor of Naval Architecture, University of Glasgow.*
SHIP DESIGN AND CONSTRUCTION (*in part*)

J.F.D. John F. Due. *Professor of Economics, University of Illinois, Urbana. Author of* Government Finance.
PUBLIC DEBT

J.Fe. John Ferguson. *Professor, Dean, and Director of Studies in Arts, The Open University, Milton Keynes, England. Editor of* Studies in Cicero *and others.*
CICERO (*in part*)

J.F.E. John F. Elliott. *Professor of Metallurgy, Massachusetts Institute of Technology, Cambridge. Co-author of* Thermochemistry for Steelmaking.
STEEL PRODUCTION

J.F.H. Jerry F. Hardy. *Coordinator for Gymnastics, Amateur Athletic Union of the United States; Member, U.S. Men's Olympic Gymnastic Committee, 1952–68.*
GYMNASTIC AND WEIGHTLIFTING SPORTS (*in part*)

J.F.Ha. John F. Hayward. *Associate Director, Sotheby Parke-Bernet and Company, London and New York City. Deputy Keeper, Victoria and Albert Museum, London, 1946–65. Author of* Virtuoso Goldsmiths; Art of the Gunmaker; *and others.*
METALWORK (*in part*)

J.Fi. James Smith Findley. *Professor of Biology; Curator of Mammals, Museum of Southwestern Biology, University of New Mexico, Albuquerque. Author of "Insectivores and Dermopterans" in* Recent Mammals of the World; *numerous journal articles on mammals.*
INSECTIVORA

J.F.M. John F.M. Middleton. *Professor of African Anthropology, University of London. Author of* Black Africa: Its Peoples and Their Culture Today; Lugbara Religion; *and others. Editor of* Magic, Witchcraft and Curing.
AFRICAN PEOPLES AND CULTURES
MAGIC

J.F.Ma. J.F. Matthews. *Lecturer in the Middle and Late Roman Empire, University of Oxford; Official Fellow of Queen's College, Oxford.*
CONSTANTINE THE GREAT

J.F.McD. James F. McDivitt. *Director of the* UNESCO *Field Science Office for Southeast Asia, Djakarta.*
INDONESIA (*in part*)

J.F.Me. John F. Mee. *Mead Johnson Professor of Management; Dean, Division of General and Technical Studies, Indiana University, Bloomington. Author of* Management Thought in a Dynamic Economy.
TAYLOR, FREDERICK WINSLOW

J.Fo. Jean Fourastié. *Professor of Economics, National Conservatory of Arts and Crafts, Paris. Member of the Academy of Moral and Political Sciences, Institute of France. Author of* The Causes of Wealth.
EMPLOYMENT AND UNEMPLOYMENT

J.F.O'C. Joseph F. O'Callaghan. *Professor of Medieval History, Fordham University, New York City.*
SPAIN, HISTORY OF (*in part*)

J.F.O'G. James Francis O'Gorman. *Grace Slack McNeil Professor of American Art, Wellesley College, Massachusetts. Author of* H.H. Richardson and His Office: Selected Drawings; *editor and translator of Paul Frankl's* Principles of Architectural History.
RICHARDSON, HENRY HOBSON

Jf.Pi. Josef Pieper. *Professor of Philosophical Anthropology, University of Münster, West Germany. Author of* Scholasticism *and others.*
SCHOLASTICISM

J.F.Q. John Francis Quinn. *Professor of Philosophy, Pontifical Institute of Mediaeval Studies, Toronto. Author of "The Historical Constitution of St. Bonaventure's Philosophy," in* Medieval Texts and Studies.
BONAVENTURE, SAINT

J.Fr. Joseph Frankel. *Professor of Politics, University of Southampton, England. Author of* The Making of Foreign Policy *and others.*
WAR, THEORY OF

J.F.S. Joseph Frederick Scott (d. 1971). *Vice Principal; Principal Lecturer in Mathematics, St. Mary's College, Strawberry Hill, England. Author of* A History of Mathematics.
NAPIER, JOHN

J.F.W. J. Fred Weston. *Professor of Business Economics and Finance, University of California, Los Angeles. Author of* The Scope and Methodology of Finance *and others.*
FINANCE, BUSINESS

J.G. Joseph Gentilli. *Former Reader in Geography, University of Western Australia, Nedlands. An authority on general climatology. Author of* Sun, Climate, Life *and others.*
HURRICANES AND TYPHOONS
MONSOONS

J.Ga. Joan Kelly-Gadol. *Professor of History, City College, City University of New York, and Sarah Lawrence College, Bronxville, New York. Author of* Leon Battista Alberti: Universal Man of the Early Renaissance.
ALBERTI, LEON BATTISTA

J.G.B. J. Guthrie Brown (d. 1976). *Senior Consultant, Sir Alexander Gibb & Partners, Consulting Engineers. President, International Commission on Large Dams, 1964–67. Co-author of* Power from Water.
DAM

J.G.C. John Garry Cuninghame. *Principal Scientific Officer, Chemistry Division, Atomic*

Energy Research Establishment, Harwell, England. Author of Chemical Aspects of the Atomic Nucleus.
NUCLEAR FISSION

J.G.Co. James Gordon Cook. *Director, Merrow Publishing Company Ltd., Newcastle upon Tyne, England. Author of* Handbook of Textile Fibres.
FIBRES, MAN-MADE

J.G.Cr. J.G. Crowther. *Author of* Famous American Men of Science; Science in Modern Society; *and others.*
GIBBS, J. WILLARD

J.G.D. Rev. J. Gordon Davies. *Edward Cadbury Professor and Head, Department of Theology, University of Birmingham, England. Author of* The Early Christian Church *and others.*
NESTORIUS

J.G.D.C. John Grahame Douglas Clark. *Disney Professor Emeritus of Archaeology, University of Cambridge. Author of* Prehistoric Europe: The Economic Basis *and others.*
EUROPE, ANCIENT

J.G.G. John G. Gallaher. *Associate Professor of History, Southern Illinois University, Edwardsville. Author of "Leo X" in* New Catholic Encyclopedia.
LEO X, POPE

J.G.H. John C. Hargrave. *Author of* The Life and Soul of Paracelsus *and others.*
PARACELSUS

J.Gi. Rev. Joseph Gill, S.J. *Tutor in Modern History, Campion Hall, University of Oxford. Author of* The Council of Florence *and others.*
PIUS II, POPE
NICHOLAS V, POPE

J.Go. Jacques Godechot. *Professor of Modern and Contemporary History; Honorary Dean, Faculty of Letters, University of Toulouse II, France. Author of* Les Révolutions, 1770–1799; Napoléon; *and others.*
NAPOLEON
TALLEYRAND

J.Gol. Judah Goldin. *Professor of Post-Biblical Hebrew Literature, University of Pennsylvania, Philadelphia. Author of* The Fathers According to Rabbi Nathan; *articles on Hillel and Johanan ben Zakkai in scholarly journals.*
HILLEL
JOHANAN BEN ZAKKAI

J.Gr. Jane Gray. *Professor of Biology, University of Oregon, Eugene.*
POLLEN STRATIGRAPHY

J.Gra. Jack Gray. *Senior Lecturer in Modern History, University of Glasgow. Executive Secretary, Consultative Committee on Chinese Studies. Co-author of* Chinese Communism in Crisis: Maoism and the Cultural Revolution.
CHINA, HISTORY OF (*in part*)

J.Gre. J. Green. *Professor of Zoology, Westfield College, University of London. Author of* The Biology of Estuarine Animals.
BRANCHIOPODA
ESTUARIES (*in part*)

J.Gt. Jean Guiart. *Dean of Social Sciences, University of Paris-V (René-Descartes). Author of* Oceania.
OCEANIAN PEOPLES, ARTS OF (*in part*)

J.G.T. John G. Turnbull. *Professor of Economics, University of Minnesota, Minneapolis. Author of* The Changing Faces of Economic Insecurity.
WELFARE AND SECURITY PROGRAMS

J.G.Th. John Gareth Thomas. *Registrar, University of Wales, Cardiff. Co-author of* Wales.
WALES

J.Gu. John Gulick. *Professor of Anthropology, University of North Carolina at Chapel Hill.*
IRANIAN CULTURES

J.G.W. J. Garth Watson. *Secretary, Institution of Civil Engineers, London.*
CIVIL ENGINEERING

J.G.W.De V. Johan G.W. de Vries. *Consul General of Suriname, New York City.*
SURINAM

J.H. Jakob Houtgast. *Associate Professor of Astronomy, Astronomical Institute, Utrecht University, The Netherlands. Co-author of* Photometric Atlas of the Solar Spectrum.
ECLIPSE, OCCULTATION, AND TRANSIT

J.Ha. Jack Halpern. *Louis Block Professor of Chemistry, University of Chicago. Author of papers on transition metal ions and complexes.*
COORDINATION COMPOUNDS

J.H.A. John H. Adler. *Former Director, Programming and Budgeting Department, International Bank for Reconstruction and Development, Washington, D.C. Co-author of* Public Finance in a Developing Country *and others.*
UNITED NATIONS (*in part*)

J.-H.B. Jacques-Henry Bornecque. *Professor of Modern and Contemporary French Literature, University of Paris-XIII (Paris-Nord). Author of* Les Années d'apprentissage d'Alphonse Daudet; Verlaine par lui-même.
DAUDET, ALPHONSE

J.H.Be. John Herbert Beynon. *Royal Society Research Professor, University College of Swansea, University of Wales. Author of* Mass Spectrometry and Its Application to Organic Chemistry.
MASS SPECTROMETRY

J.H.B.I. John H.B. Irving. *Director, Education Division, WGBH Educational Foundation, Boston.*
IRVING FAMILY

J.H.Br. John H. Bryant, M.D. *Director, Office of International Health, Deputy Assistant Secretary for Health, Department of Health, Education, and Welfare, Rockville, Maryland. Author of* Health and the Developing World.
PUBLIC HEALTH SERVICES

J.H.C. James H. Cone. *Charles A. Briggs Professor of Systematic Theology, Union Theological Seminary, New York City. Author of* Black Theology and Black Power *and others.*
NEGRO CHURCHES (IN THE UNITED STATES)

J.He. John Herivel. *Reader in the History and Philosophy of Science, Queen's University of Belfast, Northern Ireland. Author of* The Background to Newton's Principia.
HUYGENS, CHRISTIAAN

J.H.-H. John Heslop-Harrison. *Royal Society Research Professor, Welsh Plant-Breeding Station, University College of Wales, Aberystwyth, University of Wales. Author of* New Concepts in Flowering Plant Taxonomy *and numerous papers on development in plants.*
DEVELOPMENT, PLANT

J.H.Hi. John Hugh Hill. *Emeritus Professor of Medieval History, University of Houston, Texas. Co-author of* Raymond IV, Count of Toulouse *and others.*
BOHEMOND I, PRINCE OF ANTIOCH (*in part*)

J.H.Hy. John H. Humphrey, M.D. *Professor of Immunology, Royal Postgraduate Medical School, University of London.*
IMMUNITY

J.H.J. John Holmes Jellett (d. 1971). *Civil engineer. Director, Anglo Dutch Dredging Company Ltd., Beaconsfield, England. Docks engineer, Southampton, England, 1946–66.*
HARBOURS AND SEA WORKS

J.H.K. Joseph Henry Keenan (d. 1977). *Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, 1939–66. Author of* Thermodynamics; *co-author of* Principles of General Thermodynamics.
THERMODYNAMICS, PRINCIPLES OF (*in part*)

J.H.M. J. Howard Middlemiss, M.D. *Professor of Radiology, University of Bristol, England. Director of Radiology, United Bristol Hospitals. Consultant Radiologist, University of the West Indies. Author of* Radiology as a Diagnostic Aid in Clinical Surgery *and others.*
RADIOLOGY

J.Ho. James Houston. *Principal, Regent College, Vancouver, British Columbia. Special Lecturer, University of British Columbia, Vancouver. Author of* The Western Mediterranean World.
TIBER RIVER

J.H.P. J.H. Plumb. *Professor of Modern English History, University of Cambridge; Master of Christ's College, Cambridge. Fellow of the British Academy. Author of* England in the Eighteenth Century; Sir Robert Walpole; *and others.*
WALPOLE, ROBERT

J.H.R. John H. Rizley. *Manager, Materials Research and Process Engineering, General Dynamics Corporation, Pomona, California. Co-author of* Metals Handbook.
MAGNESIUM PRODUCTS AND PRODUCTION

J.H.Ro. Jonathan H. Robbins, M.D. *Public Health Service, U.S. Department of Health, Education, and Welfare, New Orleans.*
DISEASE, HUMAN (*in part*)

J.H.S. James Henderson Scott, M.D. (d. 1970). *Professor of Dental Anatomy, Queen's University of Belfast, Northern Ireland, 1964–70. Author of* Dento-Facial Growth and Development; *co-author of* Introduction to Dental Anatomy.
TEETH AND GUMS, HUMAN

J.H.Sh. J.H. Shennan. *Professor of European Studies, University of Lancaster, England. Author of* Government and Society in France, 1461–1661 *and others.*
FRANCE, HISTORY OF (*in part*)

J.H.S.L. Brigadier Joseph Harold Spence Lacey. *Secretary, Institution of Royal Engineers, Chatham, England; Editor,* Royal Engineers Journal.
ENGINEERING, MILITARY

J.H.Sm. Rev. James Hutchinson Smylie. *Professor of American Church History, Union Theological Seminary, Richmond, Virginia. Editor,* Journal of Presbyterian History.
ADVENTISTS
NEW THOUGHT

J.H.-s.S. Rev. Joseph Hsing-san Shih. *Professor of Missions and Sinology, Pontifical Gregorian University, Rome. Author of* Studia Missionalia.
RICCI, MATTEO

J.H.St. John Harris Stewart. *Research Geologist, Geological Survey, U.S. Department of the Interior, Menlo Park, California.*
PLATEAUS AND BASINS

J.H.W. John Humphreys Whitfield. *Serena Professor Emeritus of Italian Language and Literature, University of Birmingham, England. Author of* Petrarch and the Renascence; A Short History of Italian Literature; *and others.*
PETRARCH
PIRANDELLO, LUIGI

J.H.Wa. James Hamilton Ware, Jr. *Professor of Philosophy and Religion; Chairman, Asian*

Studies Program, Austin College, Sherman, Texas. Translator of The Sayings of Chuang Chou.
CHUANG-TZU

J.H.We. John H. Wellington. *Emeritus Professor of Geography, University of the Witwatersrand, Johannesburg. Author of* Southern Africa *and others.*
OKAVANGO RIVER
ORANGE RIVER

J.H.Ws. John Howard Watkins. *Senior Lecturer in French and Romance Studies, University College of North Wales, Bangor, University of Wales, 1953–77.*
LITERATURE, WESTERN: *French; Medieval (in part)*

J.Hy. John Holloway. *Poet. Professor of Modern English, University of Cambridge; Fellow of Queens' College, Cambridge. Author of* The Victorian Sage *and others.*
LITERATURE, WESTERN: *English (20th century)*

J.H.Z. James Herbert Zumberge. *President, Southern Methodist University, Dallas, Texas. Author of* Elements of Geology; The Lakes of Minnesota.
GLACIATION, LANDFORMS PRODUCED BY

J.I.M.S. John I.M. Stewart. *Reader in English Literature, University of Oxford. Author of* Rudyard Kipling.
KIPLING, RUDYARD

J.J. Jules Janick. *Professor of Horticulture, Purdue University, West Lafayette, Indiana. Author of* Horticultural Science.
HORTICULTURE

J.-J.C. Jean-Jacques Chevallier. *Emeritus Professor of the History of Political Thought, University of Paris. Member of the Institute of France; President, Academy of Ethics and Politics. Author of* Mirabeau, un grand destin manqué *and others.*
MIRABEAU, COMTE DE

J.J.Cr. John Julius Cooper, 2nd Viscount Norwich. *Author of* The Normans in the South; The Kingdom in the Sun.
ROGER II OF SICILY

J.J.C.S. John Jamieson Carswell Smart. *Professor of Philosophy, Institute of Advanced Studies, Australian National University, Canberra. Hughes Professor Emeritus of Philosophy, University of Adelaide, Australia. Author of* Philosophy and Scientific Realism; *editor of* Problems of Space and Time.
MATERIALISM
TIME (*in part*)

J.-J.H. Jean-Jacques Hatt. *Professor of National and Rhenish Antiquities, University of Strasbourg, France. Author of* Histoire de la Gaule romaine *and others.*
GAUL

J.J.Ha. James J. Haggerty. *Free-lance writer, specializing in aviation and space technology. Editor,* Aerospace Yearbook, *1966–70. Author of* Apollo: Lunar Landing.
AEROSPACE INDUSTRY

J.J.Ho. John J. Honigmann (d. 1977). *Professor of Anthropology, University of North Carolina, Chapel Hill, 1955–77. Author of* World of Man.
AMERICAN SUB-ARCTIC CULTURES

J.J.J. Joy Juanita Jackson. *Professor of History, Southeastern Louisiana University, Hammond. Author of* New Orleans in the Gilded Age: Politics and Urban Progress, 1880–1896.
NEW ORLEANS

J.J.L. J.J. Lagowski. *Professor of Chemistry, University of Texas at Austin. Author of* The Chemical Bond.
CHEMICAL ELEMENTS

J.J.M. James J. Murphy. *Professor and Chairman, Department of Rhetoric, University of California. Editor of* Demosthenes' On the Crown: A Critical Case Study of a Masterpiece of Ancient Oratory.
DEMOSTHENES

J.J.M.T. Jan Joseph Marie Timmers. *Former Professor of the History of Art, Jan van Eyck Academy, Maastricht, The Netherlands. Author of* Dutch Life and Art; A Handbook of Romanesque Art.
VISUAL ARTS, WESTERN (*in part*)

J.J.No. J. Jeremy Noble. *Associate Professor of Music, State University of New York at Buffalo.*
BYRD, WILLIAM

J.J.P. Jan J. Poelhekke. *Professor of Modern History, Catholic University of Nijmegen, The Netherlands. Author of* De Vrede van Munster *and others.*
FREDERICK HENRY, PRINCE OF ORANGE
OLDENBARNEVELT, JOHAN VAN

J.J.Pa. J.J. Papike. *Professor of Crystallography, State University of New York at Stony Brook. Editor of* Pyroxenes and Amphiboles: Crystal Chemistry and Phase Petrology.
SILICATE MINERALS

J.J.Pe. Jaroslav Jan Pelikan. *Sterling Professor of History and Religious Studies, Yale University. Author of* The Christian Tradition: A History of the Development of Doctrine; The Riddle of Roman Catholicism; *and others.*
MARY
ROMAN CATHOLICISM, HISTORY OF (*in part*)

J.J.S. John J. Stoudt. *Professor of Philosophy, Kutztown State College, Pennsylvania, 1965–70. Free-lance writer and researcher. Author of* Jacob Boehme: His Life and Thought *and others.*
BÖHME, JAKOB

J.J.Se. Jean J. Seznec. *Marshal Foch Professor Emeritus of French Literature, University of Oxford. Author of* Marcel Proust et les dieux *and others.*
MICHELET, JULES

J.J.Sp. Joseph J. Spengler. *James B. Duke Professor Emeritus of Economics, Duke University, Durham, North Carolina. Author of* Population Economics *and others.*
RICARDO, DAVID

J.J.St. Jane J. Stein. *Free-lance science writer. Author of articles on pollution and health problems.*
POLLUTION CONTROL (*in part*)

J.J.Z. J.J. Zuckerman. *Professor of Chemistry, University of Oklahoma, Norman. Co-editor of* Determination of Organic Structures by Physical Methods.
MOLECULAR STRUCTURE (*in part*)

J.K. Jerome Kagan. *Professor of Human Development, Harvard University. Author of* Birth to Maturity; *co-author of* Child Development and Personality.
HUMAN BEHAVIOUR, DEVELOPMENT OF

J.Ke. James Kerney, Jr. *Emeritus Editor, Trenton Times Newspapers, New Jersey.*
NEW JERSEY (*in part*)

J.Ki. Jay Kinsbruner. *Professor of History, Queens College, City University of New York. Author of* Bernardo O'Higgins *and others.*
O'HIGGINS, BERNARDO

J.K.J. J. Knox Jones, Jr. *Vice President for Research and Graduate Studies, Texas Tech University, Lubbock. Researcher on the biology of a variety of mammals. Co-editor of* Recent Mammals of the World: A Synopsis of Families.
MAMMALIA (*in part*)

J.K.L. John K. Loosli. *Emeritus Professor of Animal Nutrition, Cornell University, Ithaca, New York. Visiting Professor of Animal Science, University of Florida, Gainesville. Co-author of* Animal Nutrition.
ANIMAL FEED

J.K.La. John Kingsley Lattimer, M.D. *Professor and Chairman, Department of Urology, Columbia University. Director, Squier Urological Clinic, Presbyterian Hospital, New York City.*
REPRODUCTIVE SYSTEM DISEASES (*in part*)

J.Kn. John Knowelden, M.D. *Professor of Community Medicine, University of Sheffield, England. Co-author of* Principles of Epidemiology.
QUARANTINE AND ISOLATION

J.K.P. Josephine Ketcham Piercy. *Emeritus Professor of English, Indiana University, Bloomington. Author of* Studies in Literary Types in Seventeenth Century America, 1607–1710 *and others.*
MATHER FAMILY

J.Kr. Julian Krzyżanowski (d. 1976). *Professor of the History of Polish Literature, University of Warsaw, 1934–66. President, Mickiewicz Literary Society. Member, Polish Academy of Sciences, Warsaw. Author of* Polish Romantic Literature *and others.*
LITERATURE, WESTERN: *Polish (in part)*

J.K.R. Janet K. Roach. *Instructor in Sociology, Eastern Connecticut State College, Willimantic. Co-editor of* Readings in Poverty.
POVERTY (*in part*)

J.K.S. James Kenneth Sutherland. *Professor of Organic Chemistry, Victoria University of Manchester.*
CONFORMATIONAL ANAYLSIS, PRINCIPLES OF (*in part*)

J.K.Sh. John K.G. Shearman. *Professor of the History of Art, Courtauld Institute of Art, University of London. Author of* Andrea del Sarto *and others.*
ANDREA DEL SARTO

J.Ku. Job Kuijt. *Professor of Botany, University of Lethbridge, Alberta. Author of* The Biology of Parasitic Flowering Plants.
SANTALALES

J.K.W. James King West. *Professor of Religion and Philosophy, Catawba College, Salisbury, North Carolina. Author of* Introduction to the Old Testament.
SAUL

J.L. Joseph Lortz (d. 1975). *Professor of the History of Religions, Johannes Gutenberg University of Mainz, West Germany. Director, Institute for European History, Mainz. Author of* Die Reformation in Deutschland *and others.*
ROMAN CATHOLICISM, HISTORY OF (*in part*)

J.La. Jean Lacouture. *Professor, Institute for Political Studies, University of Paris. Adviser, Éditions du Seuil, Paris. Author of* Ho Chi Minh *and others.*
HO CHI MINH

J.L.A.F. Jean L.A. Filliozat. *Professor of Indian Languages and Literatures, College of France, Paris. Member, Institute of France. Author of* Inde classique *and others.*
CHRONOLOGY (*in part*)

J.L.A.-L. Janet L. Abu-Lughod. *Professor of Sociology, Northwestern University, Evanston, Illinois. Author of* Cairo: 1001 Years of the City Victorious.
CAIRO

J.L.A.R. Jerome Laurence Alexander Roche. *Lecturer in Music, University of Durham, England. Author of* Palestrina; *editor of 10*

early Baroque Italian motets.
GABRIELI FAMILY

J.L.C. John L. Cornwall. *Professor of Economics, Dalhousie University, Halifax, Nova Scotia. Author of* Modern Capitalism: Its Growth and Transformation.
ECONOMIC GROWTH

J.-L.Ca. Jean-Louis Caussou. *Editor,* Opéra *(journal), Paris. Author of* Rossini.
ROSSINI, GIOACCHINO

J.-L.Ch. Jean-Léon Charles. *Professor of Military History, Belgian Royal Military Academy, Brussels. Author of* La Ville de Saint-Trond au Moyen-Âge *and others.*
FARNESE, ALESSANDRO, DUKE OF PARMA

J.L.Cl. James Lowry Clifford (d. 1978). *Professor of English, Columbia University, 1946–69. Author of* Young Sam Johnson *and others.*
JOHNSON, SAMUEL (*in part*)

J.L.C.-T. John Leonard Cloudsley-Thompson. *Professor of Zoology, Birkbeck College, University of London. Author of* Spiders, Scorpions, Centipedes and Mites *and many others.*
ARTHROPODA

J.L.D. Jack L. Dull. *Associate Professor of History; Chairman, Han Dynasty History Project, Institute for Comparative and Foreign Area Studies, University of Washington, Seattle. Editor of* Han Social Structure.
HAN WU TI

J.L. de L. José Lourenço de Lima. *Professor of Romance Languages, Federal University of Pernambuco, Recife; Professor of Romance Languages, Catholic University of Pernambuco, Recife.*
RECIFE

J.Le. Jacques Levron. *Honorary Chief Curator, Archives of France, Paris. Author of* Saint-Louis ou l'apogée du moyen-âge *and others.*
LOUIS IX OF FRANCE

J.L.-F. Juliet Lee-Franzini. *Professor of Physics; Director, Solid-State Spectrometer Group, State University of New York at Stony Brook. Co-author of numerous papers in particle physics.*
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J.L.Fi. John L. Fischer. *Professor of Anthropology, Tulane University, New Orleans. Co-author of* The Eastern Carolines.
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J.-L.-F.T. Jean-Léon-François Tricart. *Professor and Director, Centre of Applied Geography, University of Strasbourg I, France. Author of* Geomorphology of Cold Environments *and others.*
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J.L.G. Judson Linsley Gressitt. *Director, Wau Ecology Institute, Papua New Guinea. Distinguished Chair of Zoology, Bernice P. Bishop Museum, Honolulu. Co-author of* Chrysomelidae of China; Insects of Campbell Island.
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J.L.H. John Lawrence Howard. *Head, Magnetic Division, Admiralty Compass Observatory, Slough, England. Author of several compass manuals.*
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J.L.H.K. John L.H. Keep. *Professor of Russian History, University of Toronto. Author of* The Russian Revolution: A Study in Mass Mobilization.
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J.L.Ho. Jack Luin Hough. *Emeritus Professor of Meteorology and Oceanography and of Geology and Mineralogy, University of Michigan, Ann Arbor. Author of* Geology of the Great Lakes.
NIAGARA RIVER AND FALLS

J.-L.Hu. Jean-Louis Huot. *Teaching Assistant in Oriental Archaeology, University of Paris I. Author of* Iran.
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J.L.I.F. John Lister Illingworth Fennell. *Professor of Russian, University of Oxford. Author of* Ivan the Great of Moscow *and others.*
IVAN III THE GREAT, OF RUSSIA

J.L.K. James L. Kaplan. *Writer–Reporter,* Sports Illustrated, *New York City.*
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J.L.Ki. John Louis King, Jr. *Assistant Professor of History, University of the District of Columbia, Washington, D.C.*
CARVER, GEORGE WASHINGTON

J.L.M. John Lawrence Mero. *President, Ocean Resources, Inc., La Jolla, California. Author of* The Mineral Resources of the Sea.
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J.L.McK. Rev. John L. McKenzie, S.J. *Professor of Theology, DePaul University, Chicago. Author of* The World of the Judges; Dictionary of the Bible; *and others.*
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SAMUEL

J.L.Me. Julian Louis Meltzer. *Executive Vice Chairman, Yad Chaim Weizmann National Memorial; Director, Weizmann Archives, Rehovot, Israel. Managing editor of* Weizmann Letters and Papers.
WEIZMANN, CHAIM

J.L.Ra. John Lang Rawlinson. *Professor of History, Hofstra University, Hempstead, New York. Author of* China's Struggle for Naval Development, 1839–1895.
LI HUNG-CHANG

J.L.Ro. J. Lewis Robinson. *Professor of Geography, University of British Columbia, Vancouver. Author of* Resources of the Canadian Shield.
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MACKENZIE RIVER
YUKON RIVER

J.L.S. J.L. Styan. *Franklyn Bliss Snyder Professor of English Literature, Northwestern University, Evanston, Illinois. Author of* The Elements of Drama; Shakespeare's Stagecraft; Chekhov in Performance; *and others.*
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J.L.Sa. Jeffrey L. Sammons. *Professor of German, Yale University. Author of* Heinrich Heine, the Elusive Poet.
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J.L.T. John L. Thomas. *Professor of History, Brown University, Providence, Rhode Island. Author of* The Liberator: William Lloyd Garrison.
GARRISON, WILLIAM LLOYD

J.L.Te. John L. Teall. *Professor of History, Mount Holyoke College, South Hadley, Massachusetts. Co-author of* Atlas of World History.
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J.L.Ti. James L. Tigner. *Professor of History, University of Nevada, Reno. Author of* The Okinawans in Latin America.
MATO GROSSO

J.Ly. John Lyman (d. 1977). *Professor of Oceanography; Marine Sciences Coordinator, University of North Carolina at Chapel Hill, 1968–73. Co-author of* Ocean Sciences.
HYDROGRAPHIC CHARTING

J.Lyo. John Lyons. *Professor of Linguistics, University of Sussex, Brighton, England. Author of* Structural Semantics; Introduction to Theoretical Linguistics; *and others.*
LINGUISTICS

J.M. Rev. John Meyendorff. *Professor of Church History and Patristics, St. Vladimir's Orthodox Theological Seminary, Tuckahoe, New York. Professor of Byzantine and East European History, Fordham University, New York City. Author of* The Orthodox Church, Its Past and Its Role in the World Today *and others.*
EASTERN ORTHODOXY
EASTERN ORTHODOXY, HISTORY OF

J.Ma. Joseph Machlis. *Emeritus Professor of Music, Queens College, City University of New York. Author of* The Enjoyment of Music *and others.*
COPLAND, AARON

J.Mar. J. Marrast. *Engineer, French Institute of Petroleum, Rueil-Malmaison.*
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J.M.B. John Mayston Béchervaise. *Free-lance writer. Former Director of Studies, Geelong Grammar School, Corio, Victoria, Australia. Author of* Australia: World of Difference; *co-author of* ANARE: Australia's Antarctic Outposts.
AUSTRALIAN EXTERNAL TERRITORIES

J.M.-Br. Josef Müller-Brockmann. *Graphic designer, artist, lecturer, and writer. IBM European Design Consultant. Author of* The Graphic Artist and His Design Problems; A History of Visual Communication.
ADVERTISING DESIGN

J.M.Bu. Julian Medforth Budden. *External Services Music Organizer, British Broadcasting Corporation, London. Author of* The Operas of Verdi.
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J.M.C. James Malcolm Coleman. *Director, Coastal Studies Institute, Louisiana State University, Baton Rouge.*
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J.M.Ca. Janet M. Cartwright. *Management Consultant, U.S. Army Management Engineering Training Agency, Rock Island Arsenal, Illinois.*
ILLINOIS (*in part*)

J.M.C.I. José Maria Calpe Ibarz. *Secretary General, Official Chamber of Commerce, Industry, and Navigation of Barcelona.*
BARCELONA

J.McL. John McLaughlin. *Political Writer, Trenton Times Newspapers, New Jersey.*
NEW JERSEY (*in part*)

J.M.C.T. Jocelyn M.C. Toynbee. *Laurence Professor Emerita of Classical Archaeology, University of Cambridge. Author of* The Art of the Romans *and others.*
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J.M.F.P. José M.F. Pastor. *Town and regional planning expert. President, Town Planning Council, Buenos Aires. Author of* Urbanismo con planeamiento *and others.*
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J.M.H. Joan Mervyn Hussey. *Emeritus Professor of History, Royal Holloway College, University of London. Author of* The Byzantine World *and others; editor of* Cambridge Medieval History, *vol. 4, parts 1 and 2.*
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BASIL I THE MACEDONIAN
BASIL II BULGAROCTONUS
JUSTINIAN I

J.M.Hi. John M. Hills. *Professor of Geological Sciences, University of Texas at El Paso. Author of numerous articles on the petroleum and saline deposits of the Permian basin of western Texas and southeastern New Mexico.*
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J.Mi. Jacques Miège. *Professor of Systematic Botany, University of Geneva. Director, Conservatory and Botanical Garden, Geneva. Editor of* Candollea and Boissiera.
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J.Mir. Jeannette Mirsky. *Visiting Fellow, Department of East Asian Studies, Princeton University, 1970–74. Consultant in anthropology,* Encyclopædia Britannica. *Co-author of* The World of Eli Whitney.
WHITNEY, ELI

J.M.J.v.H. Baron Jean M.J. van Houtte. *Minister of State, Government of Belgium; Minister of Finance, 1950–52, 1958–61; Prime Minister, 1952–54. Emeritus Professor of Fiscal Law, State University of Ghent. Emeritus Professor of Penal Law, State University of Liège.*
TAX LAW

J.M.K. Joseph M. Kitagawa. *Professor of the History of Religions and of Far Eastern Languages and Civilizations; Dean, Divinity School, University of Chicago. Author of* Religions of the East *and others.*
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J.M.K.S. John M.K. Spurling. *Major General, British Army (retired). Military commentator and writer. Lecturer in Military History and Tactics, University of London and University of Southampton. Author of* Unconventional Faces.
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J.M.L. Jacob M. Landau. *Professor of Political Sciences, Hebrew University of Jerusalem. Author of* Studies in the Arab Theatre and Cinema *and others.*
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J.M.Lu. Joseph M. Lucker. *Editor in Chief,* De Tijd, *Amsterdam. Editorial Chairman of The Netherlands Newsreel,* Polygoon. *The Netherlands Delegate to* UNESCO.
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J.M.M.-R. J.M. Munn-Rankin. *Lecturer in Near Eastern History, University of Cambridge. Contributor to* The Cambridge Ancient History.
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J.Mo. Rev. Jacques Monet, S.J. *Associate Professor of History, University of Ottawa. Author of* The Last Cannon Shot: A Study of French-Canadian Nationalism.
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J.M.O. Jane M. Oppenheimer. *Professor of the History of Science, Bryn Mawr College, Pennsylvania. Author of* Essays in the History of Embryology and Biology.
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DRIESCH, HANS ADOLF EDUARD

J.M.P. John M. Prausnitz. *Professor of Chemical Engineering, University of California, Berkeley. Author of* Molecular Thermodynamics of Fluid-Phase Equilibria.
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J.M.R. Johannes M. Renger. *Professor of Assyriology, Free University of Berlin.*
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J.-M.-R.N. Jacques-M.-R. Nicolle (d. 1972). *Director, Laboratory of Isomeric Biochemistry, Collège de France, Paris. Author of* Louis Pasteur, a Master of Scientific Inquiry.
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J.Ms. Joseph Margolis. *Professor of Philosophy, Temple University, Philadelphia. Author of* The Language of Art and Art Criticism: Analytic Questions in Aesthetics *and others.*
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J.M.S. John M. Simpson. *Lecturer in Scottish History, University of Edinburgh.*
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J.M.S.T. Joyce M.S. Tompkins. *Reader in English, University of London, 1948–65. Author of* The Popular Novel in England, 1770–1800 *and others.*
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J.M.T. James M. Tanner, M.D. *Professor of Child Health and Growth, Institute of Child Health, University of London. Author of* Fetus into Man; Growth at Adolescence.
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J.M.Te. John M. Teal. *Senior Scientist, Woods Hole Oceanographic Institution, Massachusetts. Co-author of* Life and Death of the Salt Marsh.
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J.Mu. Joachim Müller. *Professor of German Literature, Friedrich Schiller University of Jena, East Germany. Editor of* Die Akte Adalbert Stifter.
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J.M.W. J. Marvin Weller (d. 1976). *Professor of Invertebrate Paleontology, University of Chicago, 1945–65. One of the first to describe and analyze rhythmic deposits of the central U.S. Author of* Stratigraphic Principles and Practice.
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J.M.W.-H. John Michael Wallace-Hadrill. *Chichele Professor of Modern History, University of Oxford; Fellow of All Souls College, Oxford. Author of* The Long-Haired Kings *and others.*
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J.M.Ws. James M. Wells. *Vice President and Custodian, John M. Wing Foundation on the History of Printing, Newberry Library, Chicago. Author of* The Scholar Printers; *"Book Typography in the U.S.A." in* Book Typography in Europe and the U.S.
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J.M.Y. Joseph M. Yoffey, M.D. *Visiting Professor of Anatomy, Herbrew University of Jerusalem. Emeritus Professor of Anatomy, University of Bristol, England. Co-author of* Lymphatics, Lymph and the Lymphomyeloid Complex.
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J.M.Yi. J. Milton Yinger. *Professor of Sociology and Anthropology, Oberlin College, Ohio. Author of* The Scientific Study of Religion *and others.*
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DEW

J.Na. Jerome Namias. *Research Meteorologist, Scripps Institute of Oceanography, University of California at San Diego, La Jolla. Chief, Extended Forecast Division, National Weather Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, D.C., 1941–71. Author of "30-Day Forecasting," American Meteorological Society Monograph.*
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J.N.B. John N. Burrus. *Distinguished Professor of Sociology, University of Southern Mississippi, Hattiesburg. Author of* Life Opportunities: An Analysis of Differential Mortality in Mississippi.
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J.N.D. James Norman Davidson (d. 1972). *Gardiner Professor of Biochemistry, University of Glasgow, 1957–72. Author of* Biochemistry of the Nucleic Acids.
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J.N.D.K. Rev. John N.D. Kelly. *Principal of St. Edmund Hall, Oxford; Former Lecturer in Patristic Studies, University of Oxford. Author of* Early Christian Creeds; Early Christian Doctrines; *and others.*
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J.N.S. Johannes Nicolaas Scheepers. *Professor and Chairman, Department of Geography, Rand Afrikaans University, Johannesburg. Author of* A Cartographic Analysis of the Man-Land Ratio: An Adventure into the Population Geography of the Transvaal.
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J.O. Rev. Joseph Owens, C.SS.R. *Professor of Philosophy, Pontifical Institute of Mediaeval Studies, University of Toronto. Author of* The Doctrine of Being in the Aristotelian Metaphysics.
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AKHENATON

Jo.B. José Bonilla. *Town and regional planning expert. Co-director, Regional and Urban Planning Institute, Buenos Aires.*
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Jo.Be. John Beresford Bentley. *Managing Editor,* Air-Cushion Vehicles (*bimonthly*); *Editor,* Hoverfoil News.
AIR-CUSHION MACHINES

Jo.Bo. John Boardman. *Professor of Classical Art and Archaeology, University of Oxford. Fellow of the British Academy. Author of* Greek Art; The Greeks Overseas; *and others.*
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Jo.Br. John Bright. *Emeritus Professor of Hebrew and the Interpretation of the Old Testament, Union Theological Seminary, Richmond, Virginia. Author of* A History of Israel *and others.*
EZRA

Jo.Bu. Rev. John Burnaby. *Regius Professor Emeritus of Divinity, University of Cambridge. Author of* Amor Dei: A Study in the Religion of St. Augustine *and others.*
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Jo.C. John Cogley (d. 1976). *Senior Fellow, Center for the Study of Democratic Institutions, Santa Barbara, California, 1967–76; Editor,* The Center Magazine, *1967–74. Author of* The Layman and the Council *and others.*
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Jo.Ch. Joan Chissell. *Assistant Music Critic,* The Times, *London. Author of* Chopin; Schumann; *and others.*
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Jo.E.C. John Edwards Caswell. *Professor of History, California State College, Stanislaus, Turlock, California. Author of* Arctic Frontiers: U.S. Explorations in the Far North.
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Jo.E.M. John E. Mawby. *Associate Dean, Deep Springs College, Deep Springs, California.*
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Jo.E.S. Joseph E. Spencer. *Emeritus Professor of Geography, University of California, Los Angeles. Co-author of* Asia, East by South.
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FUKIEN (*in part*)

J.O.Fl. Joseph O. Fletcher. *Deputy Director, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Boulder, Colorado.*
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Jo.Ho. John Hospers. *Professor of Philosophy, University of Southern California, Los Angeles. Author of* Artistic Expression *and others.*
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Jo.L. Joan Lawson. *Specialist Teacher of History of Ballet, Classical and National Dance, Royal Ballet School, London. Contributor to* The Dancing Times, *London. Author of* European Folk Dance *and others.*
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Jo.La. Jorgen Laessoe. *Professor of Assyriology, University of Copenhagen. Author of* People of Ancient Assyria *and others.*
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J.O'M.B. John O'M. Bockris. *Professor of Chemistry, Flinders University of South Australia, Adelaide. Co-author of* Fuel Cells: Their Electrochemistry; Modern Electrochemistry.
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Jo.N. John Naisbitt. *Chairman of the Board, Center for Policy Process, Washington, D.C. Co-author of* Right On!: A Documentary of Student Protest in America.
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Jo.P. John Edgar Prudhoe (d. 1977). *Senior Lecturer in Drama, Victoria University of Manchester, England. Author of* The Theatre of Goethe and Schiller.
PAGEANT AND PARADE

Jo.R. John A. Rowe. *Associate Professor of African History, Northwestern University, Evanston, Illinois.*
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J.Or. Jean Orcibal. *Director of Studies, Religious Sciences Division, Institute for Advanced Research, Paris.*
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J.O.R. John O. Rasmussen, Jr. *Professor of Chemistry, University of California, Berkeley. Author of "Alpha Decay" in* Alpha-, Beta-, and Gamma-Ray Spectroscopy.
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Jo.S. Rev. John Stacey. *Secretary, Local Preachers' Office, British Methodist Church, London. Author of* John Wyclif and Reform *and others.*
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J.O.S. John Oliver Stoner, Jr. *Professor of Physics, University of Arizona, Tucson.*
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LIQUID STATE

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Jo.W. John H. Wickstead. *Senior Principal Scientific Officer, Marine Biological Association of the United Kingdom, Plymouth, England. Author of* An Introduction to the Study of Tropical Plankton; Marine Zooplankton.
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Jö.We. Jörgen Weibull. *Professor of History, Göteborg University, Sweden. Author of* Carl Johan och Norge 1810–1814 *and others.*
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Jo.W.P. John Whitney Pickersgill. *President, Canadian Transport Commission, Ottawa. Co-author of* The Mackenzie King Record.
KING, W.L. MACKENZIE

J.P. Jan Pen. *Professor of Economics, State University of Groningen, The Netherlands. Author of* Income Distribution *and others.*
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J.Pa. Juan Papadakis. *Professor, University of Buenos Aires. Author of* Soils of the World.
SOILS

J.P.A.G. Johannes P.A. Gruijters. *Minister of Housing, The Netherlands. Author of numerous publications on politics and social research.*
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J.P.D. Jean P. Dorst. *Professor, National Museum of Natural History, Paris. Author of* The Migration of Birds *and others.*
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J.P.Do. Jean P. Doresse. *Research Master, French National Centre for Scientific Research. Author of* Ethiopia *and others.*
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J.-P.E. Jean-Pierre Erpelding (d. 1977). *President, Section of Arts and Literature, Grand-Ducal Institute, Luxembourg, 1962–68. Author of* Luxemburg 1000 Jahre.
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J.P.Hy. J. Philip Hyatt (d. 1972). *Professor of Old Testament, Vanderbilt University, Nashville, Tennessee, 1944–72. Author of* Jeremiah: Prophet of Courage and Hope *and others.*
JEREMIAH

J.Pi. John Pincus. *Manager, California Program, Rand Corporation, Santa Monica, California. Author of* Trade, Aid and Development.
FOREIGN AID PROGRAMS

J.Piv. Jean Piveteau. *Professor of Palaeontology, University of Paris. Editor of* Oeuvres philosophiques de Buffon.
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J.P.K. John P. Kenyon. *Professor of Modern History, University of Hull, England. Author of* The Stuarts.
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J.-p.L. Jung-pang Lo. *Professor of History, University of California, Davis. Author of* K'ang Yu-wei: A Biography and a Symposium.
CHENG HO
K'ANG YU-WEI

J.Pl. Jaan Puhvel. *Professor of Classics and Indo-European Studies, University of California, Los Angeles.*
EPIGRAPHY

J.P.M. John Preston Moore. *Emeritus Professor of History, Louisiana State University, Baton Rouge. Author of* The Cabildo in Peru Under the Bourbons *and others.*
PERU, HISTORY OF

J.P.M.S. J. Patricia Morgan Swenson. *Free-lance writer and editor. Author of* Hawaii: A Book to Begin On *and others.*
HAWAII

J.P.N. Jan P. Norbye. *International Editor,* Automotive News. *Author of* The Wankel Engine; Chassis Tuning; *and others.*
MOTOR SPORTS

J.P.P. Justo Pastor Prieto. *Attorney. Former Minister of Foreign Affairs, Paraguay; Minister of Justice and Public Education, 1931–36. Rector, National University of Asunción, 1929–31. Author of* Paraguay, la provincia gigante de las Indias *and others.*
PARAGUAY

J.P.Pl. John P. Plamenatz (d. 1975). *Chichele Professor of Social and Political Theory, University of Oxford, 1967–75; Fellow of All Souls College, Oxford. Author of* The English Utilitarians.
BENTHAM, JEREMY

J.Pr. Jean Prevost. *Professor, Laboratory of Ecology and General Biology, University of Limoges, France. Researcher on the biology of Antarctic seabirds, especially penguins. Author of* Le Manchot empereur; *co-editor of* Biologie antarctique.
SPHENISCIFORMES

J.P.R. Jean Pierre Rouch. *Director of Research, National Centre for Scientific Research, Paris. Author of* Les Songhay.
MOHAMMED I ASKIA OF SONGHAI

J.Pro. James Alan Proudlove. *Professor of Transport Studies, University of Liverpool. Author of* Roads.
UNITED KINGDOM (*in part*)

J.P.S. James Patrick Saville. *Former Manager, Information Services, The Metals Society, London.*
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J.P.-V. Javier Pulgar-Vidal. *Emeritus Professor of Geography, National University of San Marcos, Lima. Author of* Geografía del

Peru: Las ocho regiones naturales.
PERU

J.P.V.D.B. John P.V. Dacre Balsdon (d. 1977). *Fellow of Exeter College, University of Oxford, 1928–69. Author of* Life and Leisure in Ancient Rome *and others.*
CICERO (*in part*)
MARIUS, GAIUS
ROME, ANCIENT (*in part*)

J.P.W. J. Paul Williams (d. 1973). *Professor of Religion, Mt. Holyoke College, South Hadley, Massachusetts, 1945–66. Author of* What Americans Believe and How They Worship.
SPIRITUALIST GROUPS

J.R. Jack L. Roach. *Professor of Sociology, University of Connecticut, Storrs. Co-editor of* Social Stratification in the United States.
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J.R.A. John R. Abrahams. *Director of Development, Perkin-Elmer Data Systems of Canada Ltd., Toronto. Author of* Information Processing in Society; *co-author of* Semi-Conductor Circuits; *and others.*
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J.R.Al. John Richard Alden. *James B. Duke Professor Emeritus of History, Duke University, Durham, North Carolina. Author of* A History of the American Revolution.
ADAMS, SAMUEL

J.R.B. James R. Brandon. *Professor of Drama and Theatre, University of Hawaii, Honolulu. Author of* Kabuki: Five Classic Plays; Theatre in Southeast Asia; *and others.*
DANCE AND THEATRE, EAST ASIAN
SOUTHEAST ASIAN PEOPLES, ARTS OF (*in part*)

J.R.Br. John Russell Brown. *Professor of English, University of Sussex, Brighton, England. Author of* Shakespeare and His Comedies; Shakespeare's Dramatic Style; *and others.*
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J.R.D. J. Robert Dodd. *Professor of Geology, Indiana University, Bloomington.*
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J.R.H. J.R. Heirtzler. *Senior Scientist, Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Massachusetts.*
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J.R.Ha. John R. Hagely. *Projects Manager, Battelle-Columbus Laboratories, Columbus, Ohio.*
BUILDING CONSTRUCTION (*in part*)

J.R.J. Jay Richard Judson. *Professor of Art History, Smith College, Northampton, Massachusetts. Author of* Catalogue of Paintings: Rembrandt After Three Hundred Years *and others.*
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J.R.K. John Robert Kell. *Consulting engineer. Author of* Heating and Air-Conditioning of Buildings.
HEATING, VENTILATING, AND AIR CONDITIONING

J.R.Kr. John Richard Krueger. *Professor of Uralic and Altaic Studies, Indiana University, Bloomington. Co-author of* Introduction to Classical Mongolian.
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

J.R.L.H. J.R.L. Highfield. *Fellow of Merton College, Oxford; Lecturer in Modern History, University of Oxford. Editor of* Spain in the Fifteenth Century; *co-editor of* Europe in the Middle Ages.
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ISABELLA I THE CATHOLIC, OF CASTILE

J.R.M. John Richard Meyer. *Associate Professor of Education, University of Windsor, Ontario.*
BERNARD OF CLAIRVAUX, SAINT

J.R.Me. José Ramón Medina. *President, Association of Venezuelan Writers. Director of the literary supplement of the newspaper* El Nacional; *President, Council of Judicature of Venezuela. Author of* Cincuenta años de literatura venezolana.
CARACAS

J.R.Mn. J. Ronald Munson. *Associate Professor of Philosophy, University of Missouri, St. Louis. Editor of* Man and Nature: Philosophical Issues in Biology.
NATURE, PHILOSOPHY OF (*in part*)

J.R.M.R. J. Roberto Moncada R. *Civil Engineer. Director General of the National Geographic Institute, Tegucigalpa, Honduras, 1969–71.*
HONDURAS

J.R.N. J.R. Napier. *Director, Unit of Primate Biology, Birkbeck College, University of London. Researcher on locomotion of primates. Co-author of* A Handbook of Living Primates.
PRIMATES

J.Ro. Joan Violet Robinson. *Emeritus Professor of Economics, University of Cambridge. Author of* Theory of Imperfect Competition *and others.*
MARKETS

J.R.P. John R. Pierce. *Professor of Engineering, California Institute of Technology, Pasadena. Author of* The Beginnings of Satellite Communications *and others.*
SATELLITE COMMUNICATION

J.R.R. Jerome R. Ravetz. *Reader in the History and Philosophy of Science, University of Leeds, England. Author of* Scientific Knowledge and Its Social Problems.
SCIENCE, HISTORY OF

J.R.-S. John Graham Royde-Smith. *Associate Editor, History,* Encyclopædia Britannica, *London.*
BOURBON, HOUSE OF
HABSBURG, HOUSE OF
WORLD WARS

J.R.Sp. John R. Spencer. *Professor and Chairman, Department of Art, Duke University, Durham, North Carolina. Editor of L.B. Alberti's* On Painting.
CIMABUE
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J.R.Su. James R. Sutherland. *Emeritus Professor of Modern English Literature, University of London. Author of* Defoe; English Literature of the Late Seventeenth Century.
DRYDEN, JOHN

J.R.T. John Russell Taylor. *Professor of Cinema, University of Southern California, Los Angeles. Author of* Cinema Eye, Cinema Ear: Some Key Film-Makers of the Sixties *and others.*
ANTONIONI, MICHELANGELO
BERGMAN, INGMAR

J.R.T.P. John Richard Thornhill Pollard. *Senior Lecturer in Classics, University College of North Wales, University of Wales, Bangor. Author of* Seers, Shrines and Sirens: The Greek Religious Revolution in the Sixth Century B.C.; Helen of Troy; *and others.*
GREEK MYTHOLOGY
GREEK RELIGION

J.R.V.P. J.R.V. Prescott. *Reader in Geography, University of Melbourne. Author of* Frontiers and Boundaries.
MELBOURNE
VICTORIA

J.R.W. Joseph Reed Washington, Jr. *Professor of Religious Studies, University of Pennsylvania, Philadelphia. Author of* Black Religion: The Negro and Christianity in the United States.
NEGRO CULTS (IN THE UNITED STATES)

J.R.We. John Ritchie Wilkie. *Professor of German, University of Aberdeen, Scotland. reviewer:* LITERATURE, WESTERN (*in part*)

J.S. John Scarne. *President, John Scarne Games, Inc., North Bergen, New Jersey. Authority on gambling. Author of* Scarne's Complete Guide to Gambling; Scarne on Dice; *and others.*
DICE AND DICE GAMES
ROULETTE

J.Sa. Jonathan Sanger. *Former Associate Editor,* Américas *magazine.*
BOGOTÁ

J.S.A. James Stephen Atherton. *Former Lecturer in English Literature, Wigan and District Mining and Technical College, England. Author of* The Books at the Wake.
JOYCE, JAMES

J.S.Ac. James S. Ackerman. *Professor of Fine Arts, Harvard University. Author of* The Architecture of Michelangelo; Palladio.
ARCHITECTURE, ART OF (*in part*)

J.S.B. Joe S. Bain. *Professor of Economics, University of California, Berkeley. Author of* Industrial Organization; Barriers to New Competition.
MONOPOLY AND COMPETITION

J.S.Bo. John S. Bowman. *Free-lance writer and editor. Editor, "Monuments of Civilization" Series. Author of* Traveler's Guide to Crete.
CRETE

J.S.Br. Rev. Joseph Stanislaus Brusher, S.J. (d. 1972). *Professor of History, University of San Francisco, 1968–72. Author of* Popes Through the Ages.
GREGORY VII, SAINT AND POPE

J.Sc. Jefim H. Schirmann. *Emeritus Professor of Hebrew Literature, Hebrew University of Jerusalem. Member, Israel National Academy of Sciences. Author of* The Hebrew Poetry in Spain and Provence.
JUDAH HA-LEVI

J.S.D. John S. Driscoll. *Assistant Executive Editor,* Boston Globe.
MASSACHUSETTS

J.Se. Jakob Seibert. *Professor of Ancient History, Ludwig Maximilian University of Munich. Author of* Historische Beiträge zu den dynastischen Verbindungen in hellenistischer Zeit *and others.*
SELEUCUS I NICATOR

J.S.E. John S(amuel) Ezell. *David Ross Boyd Professor of History; Curator, Western History Collections, University of Oklahoma, Norman. Author of* The South Since 1865.
OKLAHOMA

J.S.G.W. John Stuart Gladstone Wilson. *Professor of Economics and Commerce, University of Hull, England. Co-editor of* Essays in Money and Banking.
BANKS AND BANKING

J.Sh. Jose Shercliff. *Lisbon Correspondent of* The Times, *London, and the British Broadcasting Corporation.*
ANGOLA
PORTUGAL (*in part*)

J.Shi. James Shiel. *Reader in the History of Hellenic Thought, University of Sussex, Brighton, England. Author of* Greek Thought and the Rise of Christianity.
BOETHIUS

J.Si. Josef Silverstein. *Professor and Chairman, Department of Political Science, Rutgers, the State University, New Brunswick, New Jersey. Editor and author of* The Political Legacy of Aung San.
LAOS

J.Sm. **Jack Smith.** *Associate Editor,* Yachting *magazine, New York City. Editor of* Boating Ideas.
BOATING AND YACHTING (*in part*)

J.S.M. **John S. Mathis.** *Professor of Astronomy, University of Wisconsin, Madison.*
NEBULA

J.S.Ma. **John S. Marshall.** *Emeritus Professor of Philosophy, University of the South, Sewanee, Tennessee. Author of* Hooker's Polity in Modern English; Hooker and the Anglican Tradition.
HOOKER, RICHARD

J.S.McE. **Rev. James Stevenson McEwen.** *Professor of Church History, University of Aberdeen, Scotland. Author of* The Faith of John Knox *and others.*
KNOX, JOHN

J.Sn. **Joshua Stern.** *Lecturer in Physics, University of Maryland, College Park. Associate Editor,* Review of Scientific Instruments.
MEASUREMENT, PRINCIPLES AND INSTRUMENTS OF

J.So. **Jacob Solinger.** *Management consultant. Author of* Apparel Manufacturing Analysis; *associate editor,* Man-Made Textile Encyclopedia.
CLOTHING AND FOOTWEAR INDUSTRY

J.S.O. **Jerry S. Olson.** *Senior Research Adviser, Ecological Sciences Division, Oak Ridge National Laboratory, Tennessee. Editor of* Ecological Studies.
TERRESTRIAL ECOSYSTEM

J.S.R. **John S. Ryland.** *Professor of Zoology, University College of Swansea, University of Wales. Author of* Bryozoans.
BRYOZOA
ENTOPROCTA

J.S.Ro. **James Scott Robson, M.D.** *Professor of Medicine, University of Edinburgh; Consultant Physician, Edinburgh Royal Infirmary. Author of "Disturbances in Water and Electrolyte Balance and in Hydrogen Ion Concentration" in* Principles and Practice of Medicine *and others.*
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J.S.S. **John Stanley Sawyer.** *Former Director of Research, Meteorological Office, Bracknell, England. Author of* The Ways of the Weather.
CYCLONES AND ANTICYCLONES

J.St. **James Stevenson.** *Emeritus Fellow of Downing College, Cambridge; formerly University Lecturer in Divinity, University of Cambridge. Editor of* A New Eusebius; Creeds, Councils, and Controversies.
EUSEBIUS OF CAESAREA

J.S.T. **James S. Tassie.** *Professor of French-Canadian Literature, Carleton University, Ottawa.*
LITERATURE, WESTERN: *Canadian in French*

J.Ste. **Johannes Steudel** (d. 1973). *Professor of the History of Medicine, Rhenish Friedrich Wilhelm University of Bonn, West Germany.*
MÜLLER, JOHANNES PETER

J.Su. **John Sutton.** *Professor of Geology, Royal School of Mines, Imperial College of Science and Technology, University of London.*
PRECAMBRIAN TIME

J.Sum. **Sir John (Newenham) Summerson.** *Curator, Sir John Soane's House and Museum, London. Author of* Inigo Jones; Sir Christopher Wren; Architecture in Britain, 1530–1830; *and others.*
JONES, INIGO
WREN, SIR CHRISTOPHER

J.S.W. **John Steven Watson.** *Principal and Vice Chancellor, University of St. Andrews, Scotland. Author of* The Reign of George III.
GEORGE III OF GREAT BRITAIN

J.T. **Jacques Truchet.** *Professor of French Literature, University of Paris-IV. Author of* La Prédication de Bossuet *and others.*
BOSSUET, JACQUES-BÉNIGNE

J.T.A. **John Thomas Amber.** *Editor in Chief, D.B.I. Books, Inc., Northfield, Illinois; editor of* Gun Digest, Handloader's Digest, Cartridges of the World, Gun Digest Treasury, Single Shot Actions and Rifles, *and others.*
SHOOTING

J.T.B. **Joseph T. Butler.** *Curator, Sleepy Hollow Restorations, Tarrytown, New York. American Editor,* The Connoisseur. *Adjunct Associate Professor of Architecture, Columbia University. Author of* American Antiques 1800–1900 *and others.*
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J.T.Bo. **John Tyler Bonner.** *Professor of Biology, Princeton University. Author of* Size and Cycle *and others.*
REPRODUCTION

J.T.C. **J. Terry Copp.** *Associate Professor of History, Wilfrid Laurier University, Waterloo, Ontario. Co-author of* Confederation: 1867; The Canadian Response to the First World War, 1914–17.
BORDEN, SIR ROBERT LAIRD

J.T.C.L. **James T.C. Liu.** *Professor of History and of East Asian Studies, Princeton University. Author of* Reform in Sung China *and others.*
CHINA, HISTORY OF (*in part*)

J.T.G.O. **Jan Theodoor Gerard Overbeek.** *Professor of Physical Chemistry, Utrecht University, The Netherlands. Co-author of* Theory of the Stability of Lyophobic Colloids.
COLLOIDS

J.Th. **John Patrick Thomas.** *Singer and composer. Former Assistant Professor of Music, State University of New York at Buffalo.*
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J.T.H. **James T. Harris.** *Former Regional Representative for West Africa (Lagos, Nigeria) for the African-American Institute, New York City.*
UNITED STATES OF AMERICA (*in part*)

J.T.M. **Joe T. Marshall.** *Zoologist, National Fish and Wildlife Laboratory, National Museum of Natural History, Washington, D.C. Co-author of* Birds of Arizona.
STRIGIFORMES

J.T.N. **John Thomas Nichol.** *Professor of History; Vice President for Academic Affairs, Bentley College, Waltham, Massachusetts. Author of* Pentecostalism.
HOLINESS CHURCHES
PENTECOSTAL CHURCHES

J.T.Ne. **James T. Neal.** *Lieutenant Colonel, Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico. An authority on the geology, geomorphology, and hydrology of playas.*
PLAYAS, PANS, AND SALINE FLATS

J.T.P. **James T. Peterson.** *Supervisory Meteorologist, Air Resources Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado.*
URBAN CLIMATES

J.T.Pa. **John T. Paoletti.** *Professor of Art History, Wesleyan University, Middletown, Connecticut.*
PISANO, NICOLA AND GIOVANNI
UCCELLO, PAOLO

J.T.R. **John Talbot Robinson.** *Professor of Zoology, University of Wisconsin, Madison. Author of* Early Hominid Posture and Locomotion.
AUSTRALOPITHECUS

J.T.S. **Joseph T. Shipley.** *Writer and editor. Drama critic, Radio Station WEVD, New York City. Author of* Playing with Words *and others.*
WORD AND LETTER GAMES

J.T.Sc. **Jacob T. Schwartz.** *Chairman, Department of Computer Science, Courant Institute of Mathematical Sciences, New York University, New York City. Author of* Mathematical Methods in Analytical Economics; *co-author of* Linear Operators.
ANALYSIS, FUNCTIONAL (*in part*)

J.T.W. **J. Tuzo Wilson.** *Director General, Ontario Science Centre, Don Mills. A leading advocate of continental drift and sea floor spreading.*
OCEANIC RIDGES

J.U. **Jürgen Untermann.** *Professor of Comparative Philology, University of Cologne. Author of* Die venetischen Personennamen *and numerous articles on the Italic languages.*
ITALIC LANGUAGES

Ju.H. **Julius S. Held.** *Emeritus Professor of Art History, Barnard College, Columbia University. Author of* Flemish Painting *and others.*
VAN DYCK, SIR ANTHONY

Ju.S. **Julius Stone.** *Challis Professor of Jurisprudence and International Law, University of Sydney, Australia. Academic Director, Truman Research Institute, Jerusalem. Author of* Legal System and Lawyers' Reasoning *and others.*
LAW, WESTERN PHILOSOPHY OF

Ju.S.B. **Julia S. Berrall.** *Free-lance lecturer and writer. Author of* Flowers and Table Settings; The Garden: An Illustrated History; A History of Flower Arrangement.
FLORAL DECORATION

J.V. **John Vaizey, Baron Vaizey.** *Professor of Economics, Brunel University, Uxbridge, England. Author of* The Economics of Education *and others.*
EDUCATION, ECONOMICS OF

J.v.D. **Jacques van Doorn.** *Professor of Sociology, Netherlands School of Economics, Rotterdam. Editor of* Armed Forces and Society.
ARMED FORCES

J.V. de K. **Josefina Zoraida Vázquez.** *Professor of History, The College of Mexico, Mexico City. Author of* Nacionalismo y educación en México.
EDUCATION, HISTORY OF (*in part*)

J.v.E. **Josef van Ess.** *Professor of Islamic Studies and Semitic Languages, Eberhard Karl University of Tübingen, West Germany. Author of* Die Erkenntnislehre des 'Aḍudaddīn al-Īci.
MUḤĀSIBĪ, AL-

J.V.G. **Juan Vernet Ginés.** *Professor of Arabic, University of Barcelona. Author of* Los Musulmanes españoles *and others.*
SPAIN, HISTORY OF (*in part*)

J.v.H. **Jan S.F. van Hoogstraten.** *Church World Service Director, Africa Department, National Council of the Churches of Christ in the U.S.A.*
CENTRAL AFRICAN REPUBLIC
GABON

J.Vi. **Jean Vidalenc.** *Professor of Contemporary History, University of Rouen, France. Author of* Louis Blanc; La Restauration (1814–1830); *and others.*
BLANC, LOUIS
MARAT, JEAN-PAUL
THIERS, ADOLPHE

J.V.K. **John V. Killheffer.** *Associate Editor, Science,* Encyclopædia Britannica, *Chicago.*
CHEMICAL INDUSTRY (*in part*)
NUCLEOTIDES
ORGANIC SULFUR COMPOUNDS

J.V.M. John V. Murra. *Professor of Anthropology, Cornell University, Ithaca, New York. Author of* Formaciones económicas y políticas del mundo andina.
ANDEAN CULTURES (*in part*)

J.V.N. Joseph Veach Noble. *Director, Museum of the City of New York, New York City. Author of* The Techniques of Painted Attic Pottery; *co-author of* An Inquiry into the Forgery of the Etruscan Terracotta Warriors in the Metropolitan Museum of Art.
ARTS, FRAUDULENCE IN THE (*in part*)

J.V.R. Jan L.R. Van Roey. *Archivist, City Archives, Antwerp.*
ANTWERP

J.V.S. Joseph V. Smith. *Louis Block Professor of Physical Sciences, University of Chicago. An authority on phase equilibria in mineral systems and on crystal structure.*
FELDSPATHOIDS
MINERALS

J.V.W. James V. Warren, M.D. *Professor and Chairman, Department of Medicine, Ohio State University, Columbus. Contributor to* Textbook of Medicine; The Heart.
CARDIOVASCULAR SYSTEM DISEASES AND DISORDERS (*in part*)

J.W.B. Jesse W. Beams (d. 1977). *Professor of Physics, University of Virginia, Charlottesville, 1930–69. Co-author of* Tests of the Theory of Isotope Separation by Centrifuging.
CENTRIFUGE
GRAVITATION (*in part*)

J.W.Ba. John Walton Barker, Jr. *Professor of History, University of Wisconsin, Madison. Author of* Justinian and the Later Roman Empire *and others.*
BELISARIUS

J.W.C. John W. Caughey. *Emeritus Professor of American History, University of California, Los Angeles. Author of* McGillivray of the Creeks *and others.*
MCGILLIVRAY, ALEXANDER

J.W.D. John W. Dudderidge. *President of Honour, British Canoe Union. Board Member, International Canoe Federation. Vice President, British Olympic Association.*
BOATING AND YACHTING (*in part*)

J.W.Du. J. Wyatt Durham. *Emeritus Professor of Paleontology; Curator of Mesozoic and Cenozoic Invertebrates, University of California, Berkeley.*
TERTIARY PERIOD

J.We. Jac Weller. *Weapons Engineer, military historian, and free-lance writer. Author of* Weapons and Tactics; *co-author of* Firearms Investigation, Identification, and Evidence; *and others.*
GUNS, SPORTING AND TARGET
SMALL ARMS, MILITARY
WEAPONS AND DELIVERY SYSTEMS

J.W.F. J. W. Fiegenbaum. *Associate Professor of Religion, Mount Holyoke College, South Hadley, Massachusetts.*
HALLĀJ, AL-
IBN ḤAZM

J.W.Ha. John W. Harbaugh. *Professor of Geology, Stanford University, California. Co-author of* Computer Simulation in Geology.
GEOLOGICAL SCIENCES

J.W.Hu. John W. Huffman, M.D. *Emeritus Professor of Obstetrics and Gynecology, Medical School, Northwestern University, Chicago. Author of* Gynecology and Obstetrics.
PARTURITION, HUMAN (*in part*)
PREGNANCY

J.Wi. J. Williams. *Assistant Director, Atomic Energy Research Establishment, Harwell, England.*
URANIUM PRODUCTS AND PRODUCTION

J.W.L. Justin W. Leonard (d. 1975). *Professor of Natural Resources and of Zoology; Research Associate, Museum of Zoology, University of Michigan, Ann Arbor, 1964–75. Co-author of* Mayflies of Michigan Trout Streams.
EPHEMEROPTERA

J.W.Le. John Wilson Lewis. *William Haas Professor of Chinese Politics, Stanford University, California. Author of* Leadership in Communist China *and others.*
CHINA (*in part*)
CHINA, HISTORY OF (*in part*)

J.W.McF. James Walter McFarlane. *Professor of European Literature, University of East Anglia, Norwich, England. Author of* Ibsen and the Temper of Norwegian Literature; *editor and translator of* The Oxford Ibsen.
IBSEN, HENRIK
LITERATURE, WESTERN: *Norwegian*

J.Wo. John Woodward. *Former Keeper, Birmingham City Museum and Art Gallery, Birmingham, England. Author of* A Picture History of British Painting.
REYNOLDS, SIR JOSHUA

J.W.O. John W. Osborne. *Professor of History, State University of Rutgers, New Brunswick, New Jersey. Author of* William Cobbett: His Thought and His Times *and others.*
COBBETT, WILLIAM

J.W.P. John W. Parry (d. 1976). *Author of* Spices; The Spice Handbook.
SPICES, HERBS, AND FLAVOURINGS

J.W.P.-H. Sir John Wyndham Pope-Hennessy. *Consultative Chairman, Department of European Paintings, Metropolitan Museum of Art, New York City. Professor of Art, New York University. Author of* Italian Renaissance Sculpture *and others.*
CELLINI, BENVENUTO

J.W.R. James Wilmot Rowe. *Executive Director, New Zealand Employers' Federation, Wellington. Co-author of* New Zealand.
NEW ZEALAND (*in part*)

J.W.R.T. John W.R. Taylor. *Editor,* Jane's All the World's Aircraft. *Author of* Combat Aircraft of the World; History of Aerial Warfare; *and others.*
AIRCRAFT, MILITARY

J.W.T. John Walford Todd, M.D. *Former Consultant Physician, Frimley Park and Farnham Hospitals, Farnham, England. Author of* Health and Humanity.
MEDICINE AND SURGERY, PRACTICE OF

J.W.Th. John W. Thieret. *Professor and Chairman, Faculty of Biological Sciences, Northern Kentucky University, Highland Heights.*
GYMNOSPERM
SCROPHULARIALES

J.W.W. James Wreford Watson. *Professor of Geography, University of Edinburgh. Author of* North America: Its Countries and Regions.
NORTH AMERICA

J.Y.S. John Y. Simon. *Professor of History, Southern Illinois University, Carbondale. Executive Director, Ulysses S. Grant Association. Editor of* The Papers of Ulysses S. Grant.
GRANT, ULYSSES S.

J.Z.S. Jonathan Zittell Smith. *William Benton Professor of Religion and the Human Sciences, University of Chicago.*
ANIMALS AND PLANTS IN MYTH AND LEGEND
HEALING CULTS
HELLENISTIC RELIGIONS

K.A.B. Kenneth A. Ballhatchet. *Professor of the History of South Asia, University of London. Author of* Social Policy and Social Change in Western India, 1817–1830.
AKBAR
DALHOUSIE, JAMES RAMSAY, 1ST MARQUESS OF

K.A.H. Keith Arnold Hitchins. *Professor of History, University of Illinois, Urbana.*
MOLDAVIAN SOVIET SOCIALIST REPUBLIC (*in part*)

K.A.J.W. Keith Arthur John Wise. *Entomologist, Auckland Institute and Museum, New Zealand.*
APTERYGOTE
NEUROPTERAN
TRICHOPTERA

K.A.M. Kazimiers Antano Meskauskas. *Member and Chief Learned Secretary of the Presidium, Lithuanian S.S.R. Academy of Sciences. Co-author of* Lithuania's Half-Century of New Epoch.
LITHUANIAN SOVIET SOCIALIST REPUBLIC (*in part*)

K.A.R.K. Kenneth A.R. Kennedy. *Associate Professor of Physical Anthropology, Cornell University, Ithaca, New York. Field researcher on the physical anthropology of early man in South Asia. Author of* Neanderthal Man *and others.*
ASIANS, PREHISTORIC

K.A.S. Kaj Aa. Strand. *Former Scientific Director, U.S. Naval Observatory, Washington, D.C. Editor of* Basic Astronomical Data; Vistas in Astronomy.
PARALLAX, ASTRONOMICAL

K.A.W.C. Keith A.W. Cook. *Reader in Geology, Australian National University, Canberra. An authority on sandstones and their significance. Co-author of* Geological Evolution of Australia and New Zealand.
GRAYWACKES

K.B. Knut Bergsland. *Professor of Finno-Ugric Languages, University of Oslo. Scholar who discovered the connection between the Eskimo and Aleut languages. Author of "Aleut Dialects of Atka and Attu" in* Transactions of the American Philosophical Society.
ESKIMO-ALEUT LANGUAGES

K.Ba. Kurt Badt (deceased). *Art historian. Author of* Die Kunst des Nicolas Poussin; John Constable's Clouds; The Art of Cézanne; *and others.*
POUSSIN, NICOLAS

K.B.D. Kwamina Busumafi Dickson. *Head, Department of Geography, University of Ghana, Legon. Author of* A Historical Geography of Ghana.
ACCRA
AFRICA (*in part*)

K.Be. Karl Beckson. *Professor of English, Brooklyn College, City University of New York. Editor of* Aesthetes and Decadents of the 1890's; Oscar Wilde: The Critical Heritage.
WILDE, OSCAR

K.-b.L. Ki-baik Lee. *Professor of History, Sogang University, Seoul, Korea. Author of* Hankuksa sillon.
KOREA, HISTORY OF (*in part*)

K.B.M. Karl B. Michael. *Emeritus Swimming Coach, Dartmouth College, Hanover, New Hampshire. U.S. Olympic Team Men's Diving Coach, 1956.*
SWIMMING AND AQUATIC SPORTS (*in part*)

K.Br. Keith Brace. *Literary Editor and Chief Feature Writer,* The Birmingham Post, *England. Author of* Portrait of Bristol.
BIRMINGHAM

K.C.B. Kevin Charles Beck. *Assistant Professor of Geographical Sciences, Georgia Institute of Technology, Atlanta. Co-author of* Clay Water Diagensis During Burial: How Mud Becomes Gneiss.
SHALES

K.-c.H. Kung-chuan Hsiao. *Emeritus Professor of the History of Chinese Thought, University of Washington, Seattle. Author of* Rural China: Imperial Control in the Nineteenth Century *and others.*
HAN-FEI-TZU

K.C.P. Kenneth C. Parkes. *Curator of Birds, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania. Author of numerous articles on the biology and systematics of birds.*
APODIFORMES

K.C.Pr. Keshab C. Pradhan. *Conservator of Forests, Government of Sikkim.*
SIKKIM

K.-D.G. Karl-Dietrich Gundermann. *Professor of Organic Chemistry, Technical University of Clausthal, West Germany. Author of* Chemilumineszenz organischer Verbindungen.
LUMINESCENCE

K.E. Kendall Emerson, Jr., M.D. *Emeritus Professor of Medicine, Harvard Medical School, Harvard University. Author of "Diseases of the Breast" in Harrison's* Principles of Internal Medicine.
MAMMARY GLANDS, HUMAN

K.E.Bo. Kenneth E. Boulding. *Distinguished Professor of Economics, University of Colorado, Boulder. Author of* Economics as a Science; A Primer on Social Dynamics.
CAPITAL AND INTEREST

K.E.H. Kenneth E. Hofer, Jr. *Senior Research Engineer, Materials Engineering, Illinois Institute of Technology Research Institute, Chicago.*
MATERIALS TESTING

K.E.P. Kenyon Edwards Poole. *Emeritus Professor of Economics, Northwestern University, Evanston, Illinois. Author of* Public Finance and Economic Welfare.
PRODUCTION AND CONSUMPTION, GOVERNMENT'S ROLE IN

K.F.B.H. Kenneth F.B. Hempel. *Former Senior Sculpture Restorer, Victoria and Albert Museum, London.*
ART CONSERVATION AND RESTORATION (*in part*)

K.G. Karl Geiringer. *Emeritus Professor of Music, University of California, Santa Barbara. Author of* Brahms: His Life and Work; *co-author of* Haydn: A Creative Life in Music.
BRAHMS, JOHANNES
HAYDN, JOSEPH

K.Ga. Kenneth Garrad. *Professor of Spanish, Flinders University of South Australia, Bedford Park (Adelaide).*
CÓRDOBA

K.Gr. Kenneth I. Greisen. *Professor of Physics and Astronomy, Cornell University, Ithaca, New York.*
VAN ALLEN RADIATION BELTS (*in part*)

K.G.T. Kennedy G. Tregonning. *Headmaster, Hale School, Wembley Downs, Western Australia. Raffles Professor of History, University of Singapore, 1958-66. Author of* A History of Modern Malaya *and others.*
MALAYA, HISTORY OF

K.Hä. Karl H. Häuser. *Professor of Political Economy, Johann Wolfgang Goethe University of Frankfurt, Frankfurt am Main, West Germany. Co-author of* The German Economy, 1870 to the Present.
SALES AND EXCISE TAXES

K.H.D.H. K.H.D. Haley. *Professor of Modern History, University of Sheffield, England. Author of* The First Earl of Shaftesbury.
SHAFTESBURY, ANTHONY ASHLEY COOPER, 1ST EARL OF

K.H.L. Karl Heinz Lüling. *Chairman, Department of Ichthyology, Zoological Research Institute and Alexander Koenig Museum, Bonn, West Germany. Researcher on the physiology and behaviour of lungfishes.*
DIPNOI

Kh.Mo. Khosrow Mostofi. *Professor of Political Science; Director, Middle East Languages and Area Center, University of Utah, Salt Lake City. Author of* Aspects of Nationalism: A Sociology of Colonial Revolt.
IRAN

K.Ho. Keigo Hogetsu. *Honorary Professor of Literature, University of Tokyo. Author of* Nihon shi gairon *and others.*
TAIRA FAMILY

K.H.V. Karel Hendrik Voous. *Emeritus Professor of Systematic Zoology and Zoogeography, Free University, Amsterdam, The Netherlands. Author of* Atlas of European Birds.
BIOGEOGRAPHIC REGIONS

K.I. Keith Irvine. *President, Reference Publications, Inc., Algonac, Michigan. Principal Editor, Geography,* Encyclopædia Britannica, *Chicago, 1969–72. Research Officer, Permanent Mission of Ghana to the United Nations, New York City, 1958–69. Author of* The Rise of the Colored Races.
LEE KUAN YEW

K.I.M. Kenneth I. Melville, M.D. (d. 1974). *Professor of Pharmacology and Therapeutics, McGill University, Montreal. Contributor to* Pharmacology in Medicine.
DRUG AND DRUG ACTION

K.Iw. Kenkichi Iwasawa. *Eugene Higgins Professor of Mathematics, Princeton University. Author of* Lectures on p-adic L-functions.
ANALYSIS, COMPLEX (*in part*)

K.J. Karl H.E. Jordan. *Emeritus Professor of Medieval and Modern History, Christian Albrecht University of Kiel, West Germany. Editor of* Die Urkunden Heinrichs des Löwen.
HENRY THE LION, DUKE OF SAXONY

K.J.H. Keith J. Hancock. *Professor of Economics, Flinders University of South Australia, Bedford Park.*
SOUTH AUSTRALIA

K.J.Hi. K. Jaakko J. Hintikka. *Research Professor, Academy of Finland, Helsinki. Professor of Philosophy, Stanford University, California. Author of* Logic, Language-Games and Information *and others.*
LOGIC, PHILOSOPHY OF

K.J.L. K.J. Leyser. *Official Fellow and Tutor in History, Magdalen College, University of Oxford.*
GERMANY, HISTORY OF (*in part*)

K.J.N. Karl J. Narr. *Professor and Director, Seminary for Prehistory and Protohistory; Director, Institute for Early Medieval Studies, University of Münster, West Germany. Author of* Urgeschichte der Kultur; *editor of* Handbuch der Urgeschichte.
PREHISTORIC RELIGION

K.J.R. Kenneth John Rea. *Professor of Economics, University of Toronto. Author of* The Political Economy of the Canadian North.
NORTHWEST TERRITORIES
YUKON TERRITORY

K.K. Kumar Krishna. *Research Associate, Department of Entomology, American Museum of Natural History, New York City. Professor of Biology, City College, City University of New York. Co-editor of* Biology of Termites.
ISOPTERA

K.K.J. K.K. Jacob. *Principal, Udaipur School of Social Work, India. Author of* Methods and Fields of Social Work in India.
SOCIAL AND WELFARE SERVICES

K.K.S.C. Kenneth K.S. Chen. *Emeritus Professor of Oriental Languages, University of California, Los Angeles. Author of* Buddhism in China *and others.*
HSÜAN-TSANG

K.Ku. Karthigesapillai Kularatnam. *Professor and Head, Department of Geography, University of Sri Lanka (Ceylon), Colombo. Author of "Ceylon" in* Developing Countries of the World.
SRI LANKA (CEYLON)

K.L. Kevin Lynch. *City planner. Former Professor of City Planning, Massachusetts Institute of Technology, Cambridge. Author of* The Image of the City; Site Planning; *and others.*
URBAN DESIGN (*in part*)

K.La. Kenneth Lamott. *Journalist. Author of* Anti-California *and numerous other books and magazine articles.*
SAN FRANCISCO

K.L.K.L. Kai L.K. Laitinen. *Associate Professor of Finnish Literature, University of Helsinki. Author of* Suomen kirjallisuus 1917–1967; *editor of* Suomen kirjallisuuden antologia.
LITERATURE, WESTERN: *Finnish*

K.L.N. Kenneth L. Nordtvedt, Jr. *Professor of Physics, Montana State University, Bozeman.*
GRAVITATION (*in part*)

K.Lo. Dame Kathleen Lonsdale (d. 1971). *Professor of Chemistry, University of London, 1949–68. Editor and part author of Vols. I, II, III,* International Tables for X-Ray Crystallography.
BRAGG, SIR LAWRENCE
BRAGG, SIR WILLIAM

K.L.O. Keith Langford Osborne. *Honorary Editor of* British Rowing Almanack. *Author of* Boat Racing in Britain, 1715–1975.
BOATING AND YACHTING (*in part*)

K.Ma. Kitajima Masamoto. *Professor of Japanese History, Tokyo Metropolitan University. Author of* Structure of Power in the Edo Shogunate *and others.*
JAPAN, HISTORY OF (*in part*)

K.M.A.G. Kurt Moritz Artur Goldammer. *Professor of Comparative History of Religions, and of the History of Religious Art, Philipps University of Marburg, West Germany. Author of* Kultsymbolik des Protestantismus *and others.*
SYMBOLISM AND ICONOGRAPHY, RELIGIOUS

K.Mi. Kazimierz Michałowski. *Professor of Mediterranean Archaeology, University of Warsaw. Director, Polish Centre for Mediterranean Archaeology, Cairo-Heliopolis. Director, Research Centre for Mediterranean Archaeology, Polish Academy of Sciences, Warsaw. Vice Director, National Museum, Warsaw. Author of* Art of Ancient Egypt *and others.*
VISUAL ARTS, WESTERN (*in part*)

K.M.K. Dame Kathleen Mary Kenyon (d. 1978). *Principal, St Hugh's College, University of Oxford, 1962–73. Director, British School of Archaeology, Jerusalem, 1951–66. Author of* Archaeology in the Holy Land; Digging Up Jericho; *and others.*
JERICHO
SYRIA AND PALESTINE, HISTORY OF (*in part*)

K.M.L. Kathleen Marguerite Lea. *Emeritus Fellow of Lady Margaret Hall, University of Oxford; Vice Principal of Lady Margaret Hall, Oxford, 1947–71.*
BACON, FRANCIS

K.M.S. Kazimierz Maciej Smogorzewski. *Founder and Editor,* Free Europe, *1939–45. Foreign Correspondent, 1919–39. Author of*

Joseph Pilsudski, soldat de la Pologne restaurée *and others.*
PIŁSUDSKI, JÓZEF KLEMENS

K.M.W. Karl M. Waage. *Professor of Geology; Curator of Invertebrate Paleontology, Peabody Museum of Natural History, Yale University. Co-author of* Historical Geology.
DANA, JAMES DWIGHT

K.N. Keiji Nagahara. *Professor of History, Hitotsubashi University, Tokyo. Author of* Minamoto no Yoritomo *and others.*
MINAMOTO YORITOMO

K.Na. Kusum Nair. *Research Associate, College of Agriculture, University of Missouri, Columbia. Author of* The Lonely Furrow: Farming in the United States, Japan, and India *and others.*
AGRICULTURE, HISTORY OF (*in part*)

K.N.L. Karl Nickerson Llewellyn (d. 1962). *Professor of Law, University of Chicago, 1951–62. Betts Professor of Jurisprudence, Columbia University, 1930–51.*
MANSFIELD, WILLIAM MURRAY, 1ST EARL OF

K.No. Kazuo Noda. *Vice Chairman, Japan Research Institute, Tokyo. Author of* Sengo keiei shi *and others.*
CORPORATION, BUSINESS (*in part*)

K.Ob. Kalervo Oberg (d. 1973). *Professor of Anthropology, Oregon State University, Corvallis. Author of* Indian Tribes of Northern Mato Grosso, Brazil.
SOUTH AMERICAN NOMAD CULTURES

K.O.v.A. Karl Otmar, Baron von Aretin. *Professor of Contemporary History, Technical University of Darmstadt, West Germany. Director, Institute for European History, Mainz, West Germany. Author of* Heiliges römisches Reich 1776–1806 *and others.*
FRANCIS JOSEPH I
METTERNICH

K.P.S. Karl Patterson Schmidt (d. 1957). *Chief Curator of Zoology, Field Museum of Natural History, Chicago, 1941–55. Co-author of* Ecological Animal Geography.
CHINA (*in part*)

K.R. Klaus Ring. *Professor of Microbiological Chemistry, Institute of Physiological Chemistry, Johann Wolfgang Goethe University of Frankfurt, West Germany.*
MEMBRANE, BIOLOGICAL (*in part*)

K.Re. Kenneth Rexroth. *Poet, writer, and painter. Special Lecturer, University of California, Santa Barbara. Author of* Collected Shorter Poems; Classics Revisited; *and others.*
LITERATURE, ART OF

K.-r.L. Kwang-rin Lee. *Professor of History, Sogang University, Seoul, Korea. Author of* History of Enlightenment in Korea.
KOREA, HISTORY OF (*in part*)

K.R.S. Kenneth Reginald Sturley. *Professor of Telecommunications, Ahmadu Bello University, Zaria, Nigeria, 1968–71. Chief Engineer, External Broadcasting, British Broadcasting Corporation, London, 1963–68. Author of* Radio Receiver Design *and others.*
RADIO

K.Ru. Karl Ruppert. *Professor and Head, Institute for Economic Geography, Ludwig Maximilian University of Munich.*
BAYERN (*in part*)

K.R.V.H. Kent R. Van Horn. *Vice President, Research and Development, Aluminum Company of America, Pittsburgh, 1962–70; Director of Research, 1952–62; Research Metallurgist, 1929–62. Co-author of* Aluminum in Iron and Steel; *editor of* Aluminum.
ALUMINUM PRODUCTS AND PRODUCTION

K.S. Khushwant Singh. *Editor,* Illustrated Weekly of India, *Bombay. Author of* A History of the Sikhs *and others.*
RANJIT SINGH
SIKHISM

K.S.A.J. Kamel S. Abu Jaber. *Professor and Dean, Faculty of Economics and Commerce, University of Jordan, Amman. Author of* The Arab Ba'th Socialist Party: History, Ideology, and Organization.
JORDAN

K.S.D. Keith S. Donnellan. *Professor of Philosophy, University of California, Los Angeles. Author of articles in various philosophical journals, particularly on the theory of reference.*
ANALYTIC AND LINGUISTIC PHILOSOPHY

K.S.G. Karl S. Guthke. *Professor of German Literature, Harvard University. Author of* Das Leid im Werke Gerhart Hauptmanns; Gerhart Hauptmann: Weltbild im Werk; *and others.*
HAUPTMANN, GERHART

K.Si. Kate Silber. *Senior Lecturer in German, University of Edinburgh. Author of* Pestalozzi: The Man and His Work.
PESTALOZZI, JOHANN HEINRICH

K.S.L. Kenneth S. Lane. *Editorial Board Member, Underground Space. Consulting Engineer for dams and tunnels, and soils and rock engineering. Editor of Proceedings of the North American Rapid Excavating and Tunneling Conference, 1972; Proceedings of the* ASCE *symposium on Underground Rock Chambers, 1971.*
TUNNELLING AND UNDERGROUND EXCAVATION

K.S.N. Kenneth Stafford Norris. *Professor of Natural History, University of California, Santa Cruz. Director, Oceanic Institute, Waimanalo, Hawaii, 1968–71. Researchers on the biology of cetaceans, with emphasis on sound communications. Editor of* Whales, Dolphins and Porpoises.
WHALE (*in part*)

K.S.R. Kelvin S. Rodolfo. *Associate Professor of Geological Sciences, University of Illinois, Chicago.*
ANDAMAN SEA

K.S.S. Kamal Suleiman Salibi. *Professor of History, American University of Beirut. Author of* The Modern History of Lebanon.
SYRIA AND PALESTINE, HISTORY OF (*in part*)

K.St. Krister Stendahl. *John Lord O'Brien Professor of Divinity; Dean, Divinity School, Harvard University. Author of* Paul Among Jews and Gentiles *and others.*
BIBLICAL LITERATURE (*in part*)

K.S.-U.A. Kazi Saied-Uddin Ahmad (d. 1970). *Professor of Geography, University of the Punjab, Lahore, Pakistan.*
LAHORE (*in part*)

K.S.W. Kathrine Sorley Walker. *Free-lance writer, editor, and dance critic. Author of* Dance and Its Creators; Eyes on the Ballet; *and others.*
BALANCHINE, GEORGE
FOKINE, MICHEL
PAVLOVA, ANNA

Ku.R. Kurt Reindel. *Professor of History, University of Regensburg, West Germany.*
OTTO I THE GREAT, EMPEROR

K.v.Fr. Kurt von Fritz. *Emeritus Professor of Classical Philosophy, Ludwig Maximilian University of Munich. Author of* Die griechische Geschichtesschreibung, *vol. I, and numerous others.*
PHILOSOPHY, HISTORY OF WESTERN (*in part*)

K.V.J.v.F. Kai V.J. von Fieandt. *Emeritus Professor of Psychology, University of Helsinki. Author of* The World of Perception.
SPACE PERCEPTION (*in part*)

K.V.S. Keith Vollmer Slack. *Research Limnologist, Water Resources Division, Geological Survey, U.S. Department of the Interior, Menlo Park, California.*
SPRINGS AND WELLS (*in part*)

K.V.Su. K.V. Sundaram. *Joint Director, Planning Commission, Government of India, New Delhi.*
DELHI (*in part*)

K.Vy. Kenneth Varty. *Stevenson Professor and Head, Department of French, University of Glasgow. Author of* Reynard the Fox *and others.*
LITERATURE, WESTERN: *French; Renaissance*

K.V.Z. Kamil V. Zvelebil. *Professor of Dravidology, Utrecht University, The Netherlands. Author of* Comparative Dravidian Phonology.
DRAVIDIAN LANGUAGES

K.W.B. Karl W. Butzer. *Professor of Anthropology and Geography, University of Chicago. Specialist on the interrelationships among environment, prehistoric cultures, and human evolution. Author of* Environment and Archeology *and others; co-author of* Desert and River in Nubia.
CLIMATIC CHANGE

K.W.Bo. Kees W. Bolle. *Professor of History, University of California, Los Angeles. Author of* The Freedom of Man in Myth.
MYTH AND MYTHOLOGY

K.W.Br. Kenneth W. Britt. *Paper Research Consultant, Empire State Paper Research Institute, State University of New York College of Environmental Science and Forestry, Syracuse. Editor of* Handbook of Pulp and Paper Technology.
PAPER AND PAPER PRODUCTION

K.W.C. Kenneth Walter Cameron. *Emeritus Associate Professor of English, Trinity College, Hartford, Connecticut. Former Secretary of the Emerson Society. Author of* Emerson the Essayist; Young Emerson's Transcendental Vision; *editor of* Emerson Among His Contemporaries.
EMERSON, RALPH WALDO

K.W.K. Kathryn Weichert Kranbuhl, M.D. *Assistant Professor of Radiation Oncology, University of Cincinnati, Ohio.*
ORGANS AND ORGAN SYSTEMS, ANIMAL (*in part*)

K.W.M. Karl W. Meyer. *Chancellor, University of Wisconsin, Superior. Author of* Karl Liebknecht: Man Without a Country.
LIEBKNECHT, WILHELM AND KARL

K.W.P. Ken W. Purdy (d. 1972). *Free-lance writer. Author of* Kings of the Road; Motorcars of the Golden Past.
AUTOMOBILE (*in part*)

L.A. Lev Artsimovitch (d. 1973). *Head of the Plasma Physics Division, Kurchatov Institute of Atomic Energy, Moscow.*
NUCLEAR FUSION

La.B.S. Lacey Baldwin Smith. *Professor of English History, Northwestern University, Evanston, Illinois. Author of* Tudor Prelates and Politics *and others.*
BRITAIN AND IRELAND, HISTORY OF (*in part*)

L.A.C. Lewis A. Coser. *Distinguished Professor of Sociology, State University of New York at Stony Brook. Author of* The Functions of Social Conflict *and others.*
SOCIALISM

L.A.Cr. Lawrence A. Cremin. *Frederick A.P. Barnard Professor of Education, Teachers College, Columbia University. Author of* American Education: The Colonial Experience; The Transformation of the School: Progression in American Education, 1876–1957.
MANN, HORACE

La.G. Lawrence Gowing. *Slade Professor of Fine Art, University College, University of London. Author of* Vermeer; Turner; Imagination and Reality.
VISUAL ARTS, WESTERN (*in part*)

L.A.G. Lucien Albert Gerardin. *Research Director, Future Studies, Groupe Thomson, Paris. Author of* Bionics.
BIONICS

La.L. Laurence Elliot Libin. *Harpsichordist. Associate Curator of Musical Instruments, Metropolitan Museum of Art, New York City.*
SYMPHONY

L.-A.L. Luce-Andrée Langevin. *Honorary Professor; former teacher of physical science, Lycée Fenelon, Paris. Author of* Lomonossov.
LOMONOSOV, MIKHAIL VASILYEVICH

L.A.M. Leslie A. Marchand. *Emeritus Professor of English, Rutgers, the State University, New Brunswick, New Jersey. Author of* Byron: A Biography; Byron's Poetry: A Critical Introduction; *and others.*
BYRON, LORD

L.A.Ma. L. Andrew Mannheim. *Technical editor, writer, and consultant. Author of* Leica Way *and others; co-author of* Colour Photography in Practice; *editor of* Focal Encyclopedia of Photography.
PHOTOGRAPHY, TECHNOLOGY OF

L.A.N. Leonid Alekseyevich Nikiforov. *Senior Scientific Associate, Institute of History, Academy of Sciences of the U.S.S.R., Moscow. Author of* Anglo-Russian Relations in the Reign of Peter I.
PETER I THE GREAT, OF RUSSIA

L.A.R. Lionel A. Rogg. *Professor of Organ, Counterpoint, Styles, and Form, Geneva Conservatory.*
FUGUE

La.S. Lawrence Sternstein. *Senior Lecturer in Geography, Australian National University, Canberra. Former Municipal Advisor, Bangkok Municipality, Thailand. Author of* Settlement in Thailand: Patterns of Development.
BANGKOK

L.A.S. Lionel Astor Sheridan. *Professor of Law, University College, University of Wales, Cardiff. Co-author of* Equity.
LEGAL EDUCATION

L.A.W. Leslie A. White (d. 1975). *Professor of Anthropology, University of Michigan, Ann Arbor. Author of* The Science of Culture; The Evolution of Culture.
HUMAN CULTURE

L.A.Wa. Lionel A. Walford. *Emeritus Director, Sandy Hook Marine Laboratory, Highlands, New Jersey. Author of* Living Resources of the Sea.
SELACHII

L.B. Liliana Brisby. *Author of* Les Relations russo-bulgares, 1878–1886.
LITERATURE, WESTERN: *Bulgarian* (*in part*)

L.Ba. Lawrence Badash. *Associate Professor of the History of Science, University of California, Santa Barbara. Author of several papers on Becquerel's work.*
BECQUEREL, HENRI

L.B.A. Leslie B. Arey. *Robert L. Rea Professor Emeritus of Anatomy, Medical School, Northwestern University, Chicago. Author of* Developmental Anatomy.
EMBRYOLOGY, HUMAN

L.B.As. Larned B. Asprey. *Staff Member, Los Alamos Scientific Laboratory, New Mexico. Author of numerous papers on the actinide, rare-earth, transuranium, and halogen elements.*
ACTINIDE ELEMENTS AND THEIR COMPOUNDS

L.Be. Lyman (David) Benson. *Emeritus Professor of Botany; Director of the Herbarium, Pomona College, Claremont, California. Author of* Plant Classification; Plant Taxonomy, Methods and Principles *and others.*
CACTALES
CARYOPHYLLALES

L.Bo. Luis Bonilla. *Member, International Association of Literary Critics. Author of* Historia de la esclavitud *and others.*
SLAVERY, SERFDOM, AND FORCED LABOUR (*in part*)

L.Br. Leon Bramson. *Professor of Sociology, Swarthmore College, Pennsylvania. Author of* The Political Context of Sociology.
MASS SOCIETY (*in part*)

L.B.S. Leonard Bertram Schapiro. *Professor of Political Science (Russian Studies), London School of Economics and Political Science, University of London. Author of* The Communist Party of the Soviet Union.
COMMUNISM

L.B.Sm. Lyman B. Smith. *Emeritus Botanist, Smithsonian Institution, Washington, D.C. Author of* Bromeliaceae—North American Flora.
BEGONIALES (*in part*)
BROMELIALES

L.B.W. Larissa Bonfante. *Author of* Etruscan Dress.
DRESS (*in part*)

L.C. Leonard W. Conversi. *Lecturer in English, Yale University.*
TRAGEDY (*in part*)

L.Ca. Luigi Carluccio. *Member of the arts editorial staff,* La Gazzetta del popolo, *Turin, Italy. Author of* Giacometti: A Sketchbook of Interpretative Drawings.
CARAVAGGIO

L.C.B. Lawrence C. Bliss. *Professor and Chairman, Department of Botany, University of Washington, Seattle. Author of* Alpine Zone of the Presidential Range.
TUNDRA

L.C.D. L.C. Dunn (d. 1974). *Professor of Zoology, 1928–62; Senior Research Associate in Biological Sciences, 1962–74, Columbia University, New York City. Author of* Heredity and Evolution in Human Populations *and others.*
MALFORMATION, BIOLOGICAL (*in part*)
MENDEL, GREGOR JOHANN (*in part*)

L.C.F. Louis C. Faron. *Professor of Anthropology, State University of New York at Stony Brook. Co-author of* Native Peoples of South America *and others.*
SOUTH AMERICAN PEOPLES AND CULTURES

L.C.G. L. Carrington Goodrich. *Dean Lung Professor Emeritus of Chinese, Columbia University. Author of* A Short History of the Chinese People *and others; editor of* Ming Biographical Dictionary.
CHINA, HISTORY OF (*in part*)

L.Ch. Luciano Chiappini. *Teacher. President, Ferrarese Delegation for the History of Italy and Academy of Sciences of Ferrara. Author of* Eleonora d'Aragona, prima duchessa di Ferrara; Gli Estensi.
ESTE, HOUSE OF

L.Ci. Li Chi. *Emeritus Director, Institute of History and Philology, Academia Sinica, Taipei. Director of Excavations at An-yang. Author of* The Beginnings of Chinese Civilization: Three Lectures Illustrated with Finds at An-yang; Anyang; *and others.*
AN-YANG

L.C.O. Leonard C. Overton. *Country Representative, Asia Foundation, Phnom Penh, Cambodia, 1955–59, 1961–64; Saigon, South Vietnam, 1965–67.*
CAMBODIA

L.C.P. Linus C. Pauling. *Research Professor, Linus Pauling Institute of Science and Medicine, Menlo Park, California. Professor of Chemistry, Stanford University, California, 1969–74. Nobel Prize for Chemistry, 1954; Nobel Prize for Peace, 1962. Author of* The Nature of the Chemical Bond *and others.*
PERIODIC LAW

L.C.V. Letterio Carlo Villari. *Director, International Institute of Volcanology, Catania, Italy.*
VOLCANOES

L.D. Lovat Dickson. *Writer. Director, Macmillan & Company Ltd., London, 1941–64. Author of* H.G. Wells *and others.*
WELLS, H.G.

L.D.C. Lambros Demetrios Callimahos (d. 1977). *Cryptologist for the U.S. Government. Author of several books and numerous monographs and papers on cryptologic subjects.*
CRYPTOLOGY

L.De. Ludwig Denecke. *Director, Murhard Library of the City of Kassel and State Library; Head of the Brothers Grimm Museum, Kassel, West Germany, 1959–68. Author of* Jacob Grimm und sein Bruder Wilhelm; *editor of* Brüder Grimm Gedenken.
GRIMM BROTHERS

L. de R. Leendert de Ruiter. *Professor of Comparative Animal Physiology, State University of Groningen, The Netherlands.*
FEEDING BEHAVIOUR

L.D.F. Larry D. Faller. *Assistant Professor of Chemistry, Wesleyan University, Middletown, Connecticut. Author of papers on the application of relaxation techniques to rapid chemical processes.*
RELAXATION PHENOMENA

L.D.S. Sir Laurence Dudley Stamp (d. 1966). *Professor of Social Geography, University of London, 1948–58. Author of* Asia, a Regional and Economic Geography *and others.*
ASSAM (*in part*)

L.Du. Louis Dupree. *Adjunct Professor of Anthropology, Pennsylvania State University, University Park. Associate, American Universities Field Staff; field research in Afghanistan, India, Pakistan, and Bangladesh, 1972–74. Author of* Afghanistan.
ASIAN PEOPLES AND CULTURES

L.D.V. Leroy David Vandam, M.D. *Professor of Anesthesia, Harvard Medical School, Harvard University. Co-author of* Introduction to Anesthesia.
ANESTHETIC

L.E. Linn Emrich. *Manager, Skyport Airfield, Issaquah, Washington. Professional balloonist, parachutist, and pilot. Author of* The Complete Book of Sky Sports.
AERIAL SPORTS

L.E.C. Leighton E. Cluff, M.D. *Vice President, Robert Wood Johnson Foundation, Princeton, New Jersey. Professor and Chairman, Department of Medicine, University of Florida, Gainesville, 1966–76. Co-editor of* Principles and Practice of Medicine.
ALLERGY AND ANAPHYLACTIC SHOCK

L.Ed. Leon Edel. *Henry James Professor Emeritus of English and American Letters, New York University, New York City. Citizens Professor Emeritus of English, University of Hawaii, Honolulu. Author of* The Life of Henry James; *editor of* The Complete Tales of Henry James; The Modern Psychological Novel.
JAMES, HENRY

L.-E.H. Louis-Edmond Hamelin. *Professor of Geography, Laval University, Quebec city. Author of* Canada.
SAINT LAWRENCE, GULF OF
SAINT LAWRENCE RIVER

L.El. Lajos Elekes. *Professor of the Medieval History of Hungary, Eötvös Loránd University, Budapest. Corresponding Member of the Hungarian Academy of Sciences. Author of* Hunyadi; Mátyás és kora; *and others.*
HUNYADI, JÁNOS
MATTHIAS I CORVINUS

Le.M. Leonard Mosley. *Author of* Curzon: The End of an Epoch *and others.*
CURZON, LORD

L.E.M. Leonard E. Mason. *Emeritus Professor of Anthropology, University of Hawaii, Honolulu. Author of* Relocation of the Bikini Marshallese.
PACIFIC ISLANDS

L.E.Mo. Laurence E. Morehouse. *Professor of Kinesiology, University of California, Los Angeles. Author of* Physiology of Exercise.
EXERCISE AND PHYSICAL CONDITIONING

L.E.R. Leo E. Rose. *Lecturer in Political Science, University of California, Berkeley. Editor,* Asian Survey. *Co-author of* The Politics of Nepal.
NEPAL, HISTORY OF

Le.S. Lee Strasberg. *Artistic Director, Actors Studio. Head, Lee Strasberg Theatre Institute, New York City. Author of* Strasberg at the Actors Studio.
ACTING

L.E.S. L.E. Sweet. *Professor of Anthropology, University of Manitoba, Winnipeg. Author of* Tell Toqaan: A Syrian Village.
MIDDLE EASTERN AND NORTH AFRICAN PEOPLES AND CULTURES

L.F. Linwood Fredericksen. *Head, Program Division, Rotary International, Evanston, Illinois. Associate Editor, Religion,* Encyclopædia Britannica, *Chicago, 1969–73. Author of* A Christian Witness in a Non-Christian Culture According to Clement of Alexandria.
ANGELS AND DEMONS
BIBLICAL LITERATURE (*in part*)
CHRISTIAN MYTH AND LEGEND
CLEMENT OF ALEXANDRIA, SAINT
FEAST AND FESTIVAL

L.F. de B. Lieven Ferdinand de Beaufort (d. 1968). *Professor of Zoogeography, University of Amsterdam, 1929–49. Director, Zoological Museum, Amsterdam, 1922–49. Author of* Zoogeography of the Land and Inland Waters.
ASIA (in part)

L.F.K.W. Lothar F.K. Wickert. *Professor of Ancient History, University of Cologne. Author of* Theodor Mommsen: Eine Biographie; Drei Vorträge über Theodor Mommsen; *and others.*
MOMMSEN, THEODOR

L.F.L. Léo F. Laporte. *Professor of Earth Sciences, University of California, Santa Cruz. Author of* Ancient Environments.
PALEOGEOGRAPHY

L.Fo. Lukas Foss. *Composer and pianist. Conductor, Brooklyn (New York) Philharmonia. Composer of* Timecycle *and many other works.*
MUSICAL PERFORMANCE (*in part*)

L.F.R.-W. Laurence Frederic Rushbrook-Williams. *Editorial Adviser, The Pakistan Society, London. Vice President, Indo-British Historical Association. Adviser for Contemporary Indian History,* Keesing's Contemporary Archives. *Author of* A Sixteenth-Century Empire Builder *and others.*
AFGHANISTAN, HISTORY OF (*in part*)

L.F.S. Leo F. Solt. *Dean, Graduate School; Professor of History, Indiana University, Bloomington. Author of* Saints in Arms: Puritanism and Democracy in Cromwell's Army.
BRITAIN AND IRELAND, HISTORY OF (*in part*)

L.G. Leo Gross. *Professor of International Law, Tufts University, Medford, Massachusetts. Editor of* International Law in the Twentieth Century.
INTERNATIONAL AGREEMENTS

L.Ge. Leo Gershoy (d. 1975). *Professor of History, New York University, New York City, 1946–70. Author of* From Despotism to Revolution, 1763–1789 *and others.*
EUROPEAN DIPLOMACY AND WARS (*c. 1500–1914*)

L.G.J.B. Ludwig G.J. Bieler. *Emeritus Professor of Palaeography and Late Latin, University College, Dublin, National University of Ireland. Author of* Boethii Philosophiae Consolatio.
IGNATIUS OF ANTIOCH, SAINT

L.Go. Ludwig Goldscheider. *Art historian. Former director and designer of books for Phaidon Press Ltd., London. Author of* Kokoschka; Michelangelo; *and numerous other classic works on the art of antiquity, the Italian Renaissance, the Baroque, and the late 19th and early 20th centuries.*
KOKOSCHKA, OSKAR

L.G.P. Leslie Gilbert Pine. *Writer and lecturer. Former Editor,* Burke's Peerage. *Author of* The Genealogist's Encyclopedia; The Story of Heraldry; *and many others.*
GENEALOGY
HERALDRY

L.Gr. Lois Graham. *Professor of Mechanical Engineering, Illinois Institute of Technology, Chicago. Author of articles on thermodynamics, heat transfer, and combustion.*
HEAT

L.G.S. Lloyd Grenfell Stevenson, M.D. *William H. Welch Professor of the History of Medicine; Director, Institute of the History of Medicine, Johns Hopkins University, Baltimore. Author of* Sir Frederick Banting.
KOCH, ROBERT

L.G.T. Laurence G. Thompson. *Professor of East Asian Languages and Cultures, University of Southern California, Los Angeles. Author of* Chinese Religion: An Introduction *and others.*
CHINESE RELIGION

L.H. Leslie Harris. *Academic Vice President, Memorial University of Newfoundland, St. John's. Author of* A Short History of Newfoundland and Labrador.
NEWFOUNDLAND

L.H.A. Lawrence Hugh Aller. *Professor of Astronomy, University of California, Los Angeles. Author of* Atoms, Stars, and Nebulae.
STAR

L.H.B. Leslie Hilton Brown. *Ornithologist, naturalist, and consultant on range management, land use, and planning. Specialist on the ecology of birds and mammals of East Africa. Author of* Africa: A Natural History; African Birds of Prey; Eagles; *co-author of* Eagles, Hawks and Falcons of the World.
AFRICA (*in part*)
FALCONIFORMES

L.H.Ba. Lawrence Howard Bannister. *Senior Lecturer in Biology and Anatomy, Guy's Hospital Medical School, University of London.*
CIRCULATION AND CIRCULATORY SYSTEMS (*in part*)

L.H.Bu. Lyman H. Butterfield. *Emeritus Editor in Chief,* The Adams Papers, *Massachusetts Historical Society, Boston. Editor of* Letters of Benjamin Rush.
RUSH, BENJAMIN

L.H.E. Luther Harris Evans. *Director, International Collections, Columbia University, 1962–71. Director General,* UNESCO, *1953–58. Librarian of Congress, 1945–53. Author of* The Virgin Islands from Naval Base to New Deal.
VIRGIN ISLANDS

L.H.F. Louis H. Feldman. *Professor of Classics, Yeshiva University, New York City. Author of* Scholarship on Philo and Josephus, 1937–1962; *editor and translator of* Josephus, *vol. 9,* Jewish Antiquities.
JUDAISM, HISTORY OF (*in part*)
PHILO OF ALEXANDRIA

L.H.H. Ludwig Heinrich Heydenreich. *Honorary Professor of the History of Art, Ludwig Maximilian University of Munich. Emeritus Director, Central Institute for the History of Art, Munich. Author of* Leonardo da Vinci; Leonardo architetto.
LEONARDO DA VINCI

L.Hi. Lejaren Hiller. *Frederick B. Slee Professor of Music; Co-Director, Center for Creative and Performing Arts, State University of New York at Buffalo. Author of* Informationstheorie und Computermusik; *co-author of* Experimental Music.
ELECTRONIC MUSIC AND INSTRUMENTS

L.H.S. Lou Hackett Silberman. *Hillel Professor of Jewish Literature and Thought, Vanderbilt University, Nashville, Tennessee. Author of* American Impact; *editor of* Rabbinic Essays.
JUDAISM

L.H.St. Lawrence H. Starkey. *Lecturer in Philosophy and Religion, North Dakota State University, Fargo. Associate Editor, Philosophy,* Encyclopædia Britannica, *Chicago, 1968–72.*
ELEATICISM (*in part*)
REALISM (*in part*)

L.H.W. Leon H. Weaver. *Professor of Criminal Justice, Michigan State University, East Lansing. Editor of* Industrial Personnel Security *and others.*
SECURITY AND PROTECTION SYSTEMS

L.I. Laurence Irving. *Advisory Scientific Director; Professor of Zoophysiology, Institute of Arctic Biology, University of Alaska, College. Author of* Arctic Life of Birds and Mammals *and others.*
ACCLIMATIZATION

Li.L. Libero Lenti. *Professor of Statistics, University of Milan. Author of* Inventario dell'economia italiana.
ITALY (*in part*)

L.I.S. L.I. Sedov. *Professor and Head, Department of Hydrodynamics, Moscow M.V. Lomonosov State University. Member, Academy of Sciences of the U.S.S.R. Author of* Similarity and Dimensional Methods in Mechanics *and others.*
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

L.J. Lucien Jerphagnon. *Professor of Philosophy, University of Caen, France. Administrator of the International Institute of Philosophy, Paris; Editor,* Bibliographie de la Philosophie. *Author of* Le Caractère de Pascal *and others.*
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L.J.A. Leonard James Arrington. *Director, History Division, Church of Jesus Christ of Latter-day Saints, Salt Lake City. Former Professor of Economics and of History, Utah State University, Logan. Author of* Great Basin Kingdom; An Economic History of the Latter-day Saints.
UTAH

L.J.B. Louis J. Battan. *Professor of Atmospheric Sciences; Director, Institute of Atmospheric Physics, University of Arizona, Tucson. World authority on radar meteorology*

and its applications. Author of Radar Meteorology; The Nature of Violent Storms; *and others.*
THUNDERSTORMS
WEATHER MODIFICATION

L.J.Be. Leslie John Beck. *Tutor in Philosophy, Merton College, University of Oxford, 1954–54. Author of* The Method of Descartes; The Metaphysics of Descartes.
DESCARTES, RENÉ

L.J.C. Lawrence James Chisholm. *Metric consultant. Former Special Assistant, Bureau of Product Safety, Food and Drug Administration, U.S. Department of Health, Education, and Welfare, Washington, D.C. Author of* Units of Weight and Measure.
WEIGHTS AND MEASURES

L.J.F.Y. Lawrence J.F. Youlten, M.D. *Research Fellow, Department of Medicine, Guy's Hospital Medical School, University of London. Editor of* Lymphatics and Lymph Circulation.
LYMPHATIC SYSTEM DISEASES

L.J.G. Leo John Gleeson. *Reader in Mathematics, Monash University, Clayton, Australia.*
INTERPLANETARY MEDIUM

L.J.K. Leonie Judith Kramer. *Professor of Australian Literature, University of Sydney. Editor of* Australian Poetry.
LITERATURE, WESTERN: *Australian*

L.J.S. Lewis Judson Stannard, Jr. *Emeritus Taxonomist, Illinois Natural History Survey, Urbana. Author of* The Phylogeny and Classification of the North American Genera of the Suborder Tubulifera (Thysanoptera).
THYSANOPTERA

L.J.T. L.J. Trinterud. *California Professor of Church History, San Franciso Theological Seminary, San Anselmo, and Graduate Theological Union, Berkeley, California. Editor of* Elizabethan Puritanism.
BUCER, MARTIN

L.J.W. Louis Jolyon West, M.D. *Professor and Chairman, Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles; Medical Director, Neuropsychiatric Institute; Psychiatrist in Chief, U.C.L.A. Hospital and Clinics. Author of* Hallucinations.
ILLUSIONS AND HALLUCINATIONS

L.K. Lawrence Kaplan. *Professor of Biology, University of Massachusetts, Boston.*
LIFE-SPAN (*in part*)

L.K.L. Lawrence K. Lustig. *Former Vice President and Editor in Chief; Aretê Publishing Company, Princeton, New Jersey. Senior Editor, Earth Sciences,* Encyclopædia Britannica, *Chicago, 1968–73. An authority on fluvial processes in arid regions.*
ALLUVIAL FANS
DESERTS (*in part*)
EVAPORITES
LANDFORM EVOLUTION
WATERFALLS

L.K.M. Liliya Konstantinovna Malik. *Senior Scientist, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow. Author of* The Characteristic of the Snow Cover as One of the Factors of the Formation of High Waters in the Basin of the Ob River.
OB RIVER

L.Ko. Lionel Kochan. *Bearsted Reader in Jewish History, University of Warwick, England. Author of* Russia in Revolution, 1890–1918 *and others.*
WITTE, SERGEY YULYEVICH

L.Kr. Lawrence Krader. *Director, Ethnological Institute, Free University of Berlin. Author of* Peoples of Central Asia; Social Organization of Mongol-Turkic Pastoral Nomads; *and others.*
CENTRAL ASIAN CULTURES

L.L. Laurence Lockhart (d. 1975). *Member of the Faculty of Oriental Studies, University of Cambridge. Author of* Persian Cities *and others.*
ISFAHAN

L.Le. Lewis Leary. *William Rand Kenan, Jr., Professor Emeritus of English, University of North Carolina at Chapel Hill. Author of* Mark Twain; *editor of* A Casebook on Mark Twain's Wound *and others.*
TWAIN, MARK

L.L.H. Laurita L. Hill (deceased). *Writer and editor. Instructor in History, University of Texas, Austin, 1963–68. Co-author of* Raymond IV, Count of Toulouse *and others.*
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L.L.M. Ladislaus L. Marton. *Research Associate, Smithsonian Institution, Washington, D.C. Author of* Early History of the Electron Microscope; *editor of* Advances in Electronics & Electron Physics.
PHOTOELECTRIC EFFECT

L.L.S. Lester L. Short. *Curator, Department of Ornithology, American Museum of Natural History, New York City.*
PICIFORMES

L.L.Sl. L.L. Sloss. *Professor of Geology, Northwestern University, Evanston, Illinois. Co-author of* Stratigraphy and Sedimentation.
SEDIMENTARY FACIES

L.M. Luis Michelena. *Professor of Indo-European Linguistics, University of Salamanca, Spain. Author of* Fonética histórica vasca; *editor of* Textos arcaicos vascos.
BASQUE LANGUAGE

L.Ma. Leopold Marquard (deceased). *Publisher. President, South African Institute of Race Relations, 1957–58, 1968. Author of* The Story of South Africa *and others.*
SMUTS, JAN

L.M.A. Lewis M. Alexander. *Professor and Chairman, Department of Geography and Marine Affairs, University of Rhode Island, Kingston. Author of* Offshore Geography of Northwestern Europe.
GULF STREAM
NORTH SEA

L.M.At. Lewis Malcolm Atherden (d. 1973). *Lecturer in Pharmaceutical Chemistry, University of Bath, England. Editor of* Bentley and Driver's Textbook of Pharmaceutical Chemistry.
PHARMACEUTICALS, PRODUCTION OF

L.M.B. Laurie M. Brown. *Professor of Physics and Astronomy, Northwestern University, Evanston, Illinois.*
CONSERVATION LAWS AND SYMMETRY

L.M.F. Luch Mikhaylovich Fomin. *Head, Laboratory of Sea Currents, Southern Division, Institute of Oceanography, Academy of Sciences of the U.S.S.R., Gelendzhik.*
BLACK SEA (*in part*)

L.M.G. Leland Matthew Goodrich. *James T. Shotwell Professor Emeritus of International Relations, Columbia University. Author of* The United Nations; *co-author of* Charter of the United Nations: Commentary and Documents.
UNITED NATIONS (*in part*)

L.M.K. Lewis M. Killian. *Professor of Sociology, University of Massachusetts, Amherst. Author of* The Impossible Revolution; *co-author of* Collective Behavior.
SOCIAL MOVEMENTS

L.M.L. Ludwig M. Landgrebe. *Professor of Philosophy, University of Cologne. Director of the Husserl Archives, Cologne. Member of the International Institute of Philosophy, Paris. Author of* Phaenomenologie und Geschichte.
HUSSERL, EDMUND

L.M.M. Leonard M. Marcus. *Editor in Chief,* High Fidelity *magazine. Editorial Director,* Musical America.
MUSIC, RECORDING OF

L.Mo. Lynn Montross (d. 1961). *Historian, United States Marine Corps, 1950–61. Author of* War Through the Ages *and others.*
WARFARE, CONDUCT OF (*in part*)

L.M.-P. Lorenzo Minio-Paluello. *Emeritus Reader in Mediaeval Philosophy, University of Oxford; Fellow of Oriel College, Oxford, 1962–75. Director of Aristoteles Latinus, 1959–72. Editor of numerous works of Aristotle.*
ARISTOTELIANISM

L.Ms. Luciano Martins. *Assistant Professor, Federal University of Rio de Janeiro. Research Assistant, National Centre of Scientific Research, Paris. Author of* Industrialização, Burguesia Nacional e Desenvolvimento.
BRAZIL (*in part*)

L.M.W. Lillian M. Weber. *Chief Horticulture Assistant to the Senior Horticulture Specialist, New York Botanical Garden, Bronx. Collaborating Editor of* New Illustrated Encyclopedia of Gardening.
TREE (*in part*)

L.N.F. Lee Nathan Feigon. *Staff Writer, East Asian Affairs,* Encyclopædia Britannica, *Chicago, 1970–73.*
HUNG HSIU-CH'ÜAN

L.O.H. Lauri O. Honko. *Professor of Folkloristics and Comparative Religion, University of Turku, Finland. Author of* Geisterglaube in Ingermanland.
FINNO-UGRIC RELIGION

Lo.J.B. Lowell John Bean. *Professor of Anthropology, California State University, Hayward. Author of* Temalpah: An Ethnobotany of the Cahuilla Indians of Southern California; Mukat's People: An Ecological Study of the Cahuila Indians of Southern California.
CALIFORNIAN INDIANS

L.P.L. Lawrence P. Lessing. *Member, Board of Editors,* Fortune *magazine, New York City. Author of* Man of High Fidelity: Edwin Howard Armstrong.
ARMSTRONG, EDWIN H.

L.P.Le. Lucile P. Leone. *Chief Nurse Officer, Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D.C. 1949–66. Associate Dean, College of Nursing, Texas Woman's University, 1968–71. Author of* Statewide Planning for Nursing Education.
NURSING

L.P.S. L.P. Smith. *Former President, Commission for Agricultural Meteorology, World Meteorological Organization, Geneva. Author of* Seasonable Weather.
WEATHER LORE

L.P.V. Lalita P. Vidyarthi. *University Professor and Head, Department of Anthropology, University of Rānchī, Bihār, India. President, International Union of Anthropological and Ethnological Sciences. Author of* Socio-Cultural Implication of Industrialization in India *and others.*
SOUTH ASIAN CULTURES

L.P.W. L. Pearce Williams. *John Stambaugh Professor of the History of Science, Cornell University, Ithaca, New York, Author of* Michael Faraday: A Biography.
HELMHOLTZ, HERMANN VON

L.R.C. L. Russell Cook. *President, Chocolate and Confectionery Division, W.R. Grace &*

Company, New York City. Author of Chocolate Production and Use.
COCOA PRODUCTION

L.R.F. Lester R. Ford (d. 1967). *Professor of Mathematics, Illinois Institute of Technology, Chicago, 1940–52. President, Mathematical Association of America, 1947–48. Author of* Alignment Charts; Differential Equations; *and others.*
MATHEMATICS AS A CALCULATORY SCIENCE (*in part*)

L.R.K. Lawrence R. Klein. *Benjamin Franklin Professor of Economics, University of Pennsylvania, Philadelphia. Author of* A Textbook of Econometrics.
ECONOMETRICS

L.R.L. Lorna R. Levi. *Co-author of* A Guide to Spiders and Their Kin; *co-translator and co-editor of* Invertebrate Zoology *by A. Kaestner.*
ARANEIDA (*in part*)

L.R.M. Laurence Reginald (Bob) Mernagh. *Director, Institution of the Rubber Industry, London, 1966–70. Formerly Chief Chemist and Manager of Product Engineering, Firestone Tyre and Rubber Company Ltd. Editor of* Engineering Design—Rubber.
RUBBER

L.R.R. Leonard R. Rogers. *Head, Faculty of Three-Dimensional Design, College of Art and Design, Loughborough, England. Author of* Sculpture: Appreciation of the Arts; Relief Sculpture.
SCULPTURE, ART OF

L.R.T. Lawrance R. Thompson (d. 1973). *Holmes Professor of Belles-Lettres, Princeton University, 1968–73; Professor of English, 1951–73. Author of* Robert Frost: The Early Years, 1874–1915; Robert Frost: The Years of Triumph 1915–1938; *and others.*
FROST, ROBERT

L.S. Leon Sokoloff, M.D. *Professor of Pathology, State University of New York at Stony Brook. Author of* The Biology of Degenerative Joint Disease.
BURSA
JOINT DISEASES AND INJURIES

L.S.B. Louis Stanley Berenson. *Former President and General Manager, Miami Jai-Alai, Inc., Miami.*
JAI ALAI

L.S.El H. Laila Shukry El Hamamsy. *Director, Social Research Center, American University in Cairo.*
EGYPT, ARAB REPUBLIC OF (*in part*)

L.S.F. Lewis S. Feuer. *University Professor of Sociology and Humanities, University of Virginia, Charlottesville. Author of* Marx and the Intellectuals *and others.*
MARX, KARL

L.S.H. Louis Selig Harris. *Professor and Chairman, Department of Pharmacology, Medical College of Virginia, Richmond. Author or co-author of numerous papers on analgesics and other drugs.*
ANALGESIC

L.S.K. Lester S. King. M.D. *Contributing Editor,* Journal of the American Medical Association. *Professorial Lecturer in the History of Medicine, University of Chicago. Author of* The Growth of Medical Thought.
JENNER, EDWARD

L.St. Leif Størmer. *Professor of Historical Geology, University of Oslo.*
FOSSIL RECORD

L.Sur. Leo Suryadinata. *Research Associate, Centre for Southeast Asian Studies, Kyōto University, Japan. Author of* The Pre-World War II Peranakan Chinese Press of Java: A Preliminary Survey.
GAJAH MADA
KERTANAGARA

L.S.V. Lalgudi Sivasubramanian Venkataramanan. *Head, Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi, Author of* The Theory of Futures Trading.
FUTURES

L.T. Lewis Thorpe (d. 1977). *Professor of French, University of Nottingham, England, 1958–77. Editor and translator of* Two Lives of Charlemagne.
LOUIS I THE PIOUS, EMPEROR

L.T.C.R. L.T.C. Rolt (d. 1974). *Member, Executive Committee, American Society for the History of Technology. Chairman, Talyllyn Railway Company, England, 1963–68. Author of* Great Engineers *and many others.*
TREVITHICK, RICHARD

L.Th. Laura Thompson. *Consultant in applied anthropology. Field researcher on Hopi, Pagogo, Zuni, Navaho, and Sioux reservations. Co-author of* The Hopi Way.
SOUTHWEST AMERICAN INDIANS

L.T.N. Lennart T. Norman. *Archivist and historian.*
MARGARET OF DENMARK, NORWAY, AND SWEDEN

Lu.M. Luis Marden. *Former Chief, Foreign Editorial Staff,* National Geographic Magazine, *Washington, D.C.*
TITICACA, LAKE

L.V. Leo Vroman. *Physiologist, Medical Research Department, Veterans Administration Hospital, Brooklyn, New York. Author of* Blood.
BLOOD AND LYMPH

L.V.A. Lloyd Van Horn Armstrong (d. 1977). *Chief Engineer, Diesel Engine Department, Ingersoll Rand Company. Co-author of* The Diesel Engine.
DIESEL ENGINE

L.Ve. Louis Verniers. *Honorary Secretary, General Ministry of Education, Belgium. Author of* Un millénaire d'histoire de Bruxelles, des origines à 1830 *and others.*
BRUSSELS

L.v.G. Ludwig von Gogolák. *Author of* Csehszlovákia; *"T.G. Masaryks slowakische und ungarländische Politik: Ein Beitrag zur Vorgeschichte des Zerfalls Ungarns im Jahre 1918" in* Bohemia, Jahrbuch des Collegium Carolinum; *and others.*
MASARYK, TOMÁŠ

L.W. Louis Weinstein, M.D. *Professor of Medicine, Harvard University. Director, Clinical Service, Division of Infectious Disease, Peter Bent Brigham Hospital, Boston. Chief, Infectious Disease Service, West Roxbury Veterans Administration Hospital, Massachusetts. Author of* The Practice of Infectious Disease.
ANTIBIOTIC

L.We. Leo Weaver. *Director and General Manager, Institute for Solid Wastes, American Public Works Association, Washington, D.C. Technical editor of* Municipal Refuse Disposal; Refuse Collection Practice.
REFUSE DISPOSAL SYSTEMS

L.W.M. Laurence Woodward Martin. *Vice Chancellor, University of Newcastle upon Tyne, England. Former Professor of War Studies, King's College, University of London. Author of* Arms and Strategy *and others.*
WAR AND DEFENSE ECONOMICS

L.Wy. Sir (Charles) Leonard Woolley (d. 1960). *Archaeologist; excavated at Ur, 1922–34, and many other sites. Major contributor to knowledge of the Sumerians. Author of* Digging Up the Past; Excavations at Ur; *and others.*
UR (*in part*)

L.Z. Lev Zetlin. *Professor of Civil Engineering and Architecture, University of Virginia, Charlottesville. Author of* Structural Engineering Handbook on Concrete.
STADIUM

L.Zg. Ladislav Zgusta. *Professor of Linguistics and of Classics; Member, Center for Advanced Studies, University of Illinois, Urbana. Author of* Kleinasiatische Personennamen; Personennamen griechischer Staedte.
NAMES

M.A. Marcelle Auclair. *Writer. Author of* Enfances et mort de García Lorca; La Vie de Sainte Thérèse d'Avila; Le Livre du bonheur; *and others.*
GARCÍA LORCA, FEDERICO

Ma.A. Maurice Allais. *Professor of Economic Analysis, National College of Mines of Paris. Professor of Monetary Analysis, University of Paris. Author of* Traité d'économie pure.
CUSTOMS UNIONS AND TRADE AGREEMENTS

M.A.A. Maynard A. Amerine. *Emeritus Professor of Enology, University of California, Davis; Emeritus Enologist at the Agricultural Experiment Station. Author of* The Technology of Wine Making.
WINE MAKING

Ma.A.C. Margret A. Carey. *Former Assistant Keeper, Department of Ethnography, British Museum, London. Author of* Myths and Legends of Africa.
AFRICAN PEOPLES, ARTS OF (*in part*)

M.A.Al. Rev. Michel Adrien Allard, S.J. *Director, Institute of Oriental Studies, St. Joseph University, Beirut, Lebanon. Author of* Le problème des attributs divins en théologie musulmane.
ASH'ARI, AL-

Ma.B. Marino Berengo. *Professor of Modern History, University of Venice. Author of* La società veneta alla fine del 700 *and others.*
ITALY AND SICILY, HISTORY OF (*in part*)

Ma.Br. Martin Brett. *Fellow of Robinson College, University of Cambridge. Lecturer and Senior Lecturer in Medieval History, University of Auckland, New Zealand, 1964–71. Author of* English Church under Henry I.
MIDDLE AGES (*c.* 395–1500)

Ma.Bu. Martin Butlin. *Keeper of the British Collection, Tate Gallery, London. Author of* Turner Watercolours; *co-author of* The Paintings of J.M.W. Turner.
TURNER, J.M.W. (*in part*)

Ma.C. Malcolm Cowley. *Literary Adviser, The Viking Press. President, National Institute of Arts and Letters, New York City, 1956–59, 1961–64. Author of* The Faulkner-Cowley File; *editor of* The Portable Faulkner; *and others.*
FAULKNER, WILLIAM

M.A.C. Michael Anthony Carson. *Associate Professor of Geography, McGill University, Montreal. Co-author of* Hillslope Form and Process.
HILLSLOPES

M.A.Ca. Marcello A. Carmagnani. *Professor of Latin American History, University of Turin, Italy. Author of* El salariado minero en Chile colonial *and others.*
CHILE, HISTORY OF

M.A. de L. Miguel Alves de Lima. *Director for Geodesy and Cartography, Brazilian Institute of Geography. Professor of Physical Geography; Director, Earth Sciences Institute, State University of Rio de Janeiro. Co-author of* The West Central Plateau and Mato-Grosso "Pantanal."
PIAUÍ

M.A.E. M. Albert Evans. *Mining Consultant. Co-author of* Demonstration Mine Using

Longwall Mining Techniques; Technical Manual on Longwall Mining Systems.
COAL MINING

Ma.E.O. Mario E. Occhialino. *Assistant Professor of Law, Syracuse University, New York.*
PROCEDURAL LAW (*in part*)

Ma.F. Marvin Frankel. *Professor of Economics, University of Illinois, Urbana. Author of* British and American Manufacturing Productivity: A Comparison and Interpretation.
PRODUCTIVITY, ECONOMIC

Ma.Fu. Masutani Fumio. *Professor of the History of Religion, Taisho University, Tokyo.*
HŌNEN

Ma.G. Marcel Gingras. *Secretary, Public Service Commission of Canada, Ottawa.*
OTTAWA

M.Ag. Margarita Aguirre. *Writer. Author of* Las vidas de Pablo Neruda *and others.*
NERUDA, PABLO

M.A.G. Mahmud Ali Ghul. *Professor of Arabic and Semitic Languages, American University of Beirut.*
ARABIA, HISTORY OF (*in part*)
YEMEN (ADEN)

Ma.H. Marshall Hall, Jr. *Professor of Mathematics, California Institute of Technology, Pasadena. Author of* The Theory of Groups; Combinatorial Theory.
ALGEBRAIC STRUCTURES (*in part*)

M.A.H. Michael Anthony Hoskin. *Lecturer in History of Science, University of Cambridge; Fellow of Churchill College, Cambridge. Author of* William Herschel and the Construction of the Heavens.
HERSCHEL FAMILY
LOVELL, SIR BERNARD

Ma.Ha. Mamie Harmon. *Contributor to* Dictionary of Folklore, Mythology and Legend; *contributor and advisory editor to* Encyclopedia of World Art.
FOLK VISUAL ARTS

Ma.J. Marsden Jones. *Professor of Arabic Studies, American University in Cairo. Editor of* Kitāb al-maghāzī lil-Wāqidī.
EGYPT, ARAB REPUBLIC OF (*in part*)

Ma.J.M. Matthew James Moulton. *Chief Editorial Writer,* The Scotsman, *Edinburgh.*
SCOTLAND

Ma.K. Max Kaltenmark. *Director of Studies, École Pratique des Hautes Études (Institute for Advanced Research), Paris. Author of* Lao Tzu and Taoism.
LAO-TZU

M.Ak. Mustafa Akdağ (d. 1973). *Professor of Modern History, University of Ankara. Author of* Turkiyenin iktisadi ve ictimai tarihi.
ATATÜRK, KEMAL

Ma.Ka. Madoka Kanai. *Professor and Head, Department of Overseas Materials on Japanese History, Historiographical Institute, University of Tokyo.*
JAPAN, HISTORY OF: *Bibliography* (*in part*)

Ma.Ko. Margaret Kohl. *Free-lance writer and translator. Staff member, English Department, University of Munich, 1962–68.*
COLOGNE (*in part*)

Ma.L. Max Loehr. *Abby Aldrich Rockefeller Professor Emeritus of Oriental Art, Harvard University. Author of* Chinese Bronze Age Weapons; Chinese Landscape Woodcuts from an Imperial Commentary to the 10th Century Printed Edition of the Buddhist Canon.
CHINA, HISTORY OF (*in part*)

M.Al. Mohammad Ali (deceased). *Professor and Head, Department of History, Kābul University, Afghanistan. Author of* A Cultural History of Afghanistan; Afghanistan: Land of Glorious Past; *and many other works on Afghan history, culture, and economy.*
AFGHANISTAN, HISTORY OF (*in part*)
MAḤMŪD OF GHAZNĀ

Ma.M. Maurice Matloff. *Chief Historian, Center of Military History, U.S. Department of the Army, Washington, D.C. Author of* Strategic Planning for Coalition Warfare, 1943–1944; *editor of* American Military History.
WARFARE, CONDUCT OF (*in part*)

M.A.M. Maurice Alfred Millner. *Professor of Law, University College, University of London. Author of* Negligence in Modern Law.
ROMAN LAW (*in part*)

M.A.MacC. Michael A. MacConaill. *Emeritus Professor of Anatomy, University College, Cork, National University of Ireland. Co-author of* Synovial Joints; Muscles and Movements.
JOINT

Ma.N. Manning Nash. *Professor of Anthropology, University of Chicago. Specialist on economic development and cultural change. Author of* Machine-Age Maya.
MIDDLE AMERICAN PEOPLES AND CULTURES

Má.P. Márton Pécsi. *Director, Geographical Research Institute, Hungarian Academy of Sciences, Budapest. Author of* Ten Years of Physicogeographic Research in Hungary *and others.*
LOESS

Ma.R. Mary Rowlatt. *Free-lance writer on Egypt. Author of* Founders of Modern Egypt.
ALEXANDRIA

M.Ar. Michael Argyle. *Reader in Social Psychology, University of Oxford; Fellow of Wolfson College, Oxford. Author of* Social Interaction: The Scientific Study of Social Behaviour *and others.*
PSYCHOLOGY, SOCIAL

M.A.R. Margaret Ann Richardson. *Assistant Curator, Drawings Collection, Royal Institute of British Architects, London. Co-author of* Dictionary of Victorian Painters.
PALLADIO, ANDREA

M.A.Ro. Margaret Ann Rowe. *Part-Time Lecturer in English, Palmerston North Teachers' College, New Zealand. Co-author of* New Zealand.
NEW ZEALAND (*in part*)

M.As. Maurice Ashley. *Research Fellow, Loughborough University of Technology, England, 1967–70. Editor,* The Listener, 1958–67. *Author of* The Greatness of Oliver Cromwell *and others.*
CHARLES I OF GREAT BRITAIN
CROMWELL, OLIVER

M.A.S. M.A. Screech. *Fielden Professor of French Language and Literature, University College, University of London. Author of* The Rabelaisian Marriage: Aspects of Rabelais's Religion, Ethics and Comic Philosophy *and others.*
RABELAIS, FRANÇOIS

M.A.v.M. M.A. van Meerhaeghe. *Professor of Economics, State University of Ghent, Belgium. Author of* International Economic Institutions; International Economics.
COMMODITY TRADE, INTERNATIONAL

M.B. Minodhar Barthakur. *Reader in Geography, Gauhāti University, Assam, India. Author of numerous articles on geography.*
NĀGĀLAND

M.Ba. Michael Bar-Zohar. *Free-lance writer. Author of* Ben-Gurion: The Armed Prophet *and others.*
BEN-GURION, DAVID

M.B.C. Malcolm Breckenridge Carpenter, M.D. *Professor of Anatomy, College of Physicians and Surgeons, Columbia University. Co-author of* Human Neuroanatomy.
NERVOUS SYSTEM, HUMAN (*in part*)

M.Be. Manfred Bensing. *Professor of History, Karl Marx University, Leipzig. Author of* Thomas Müntzer.
MÜNTZER, THOMAS

M.Bg. Mark Blaug. *Professor of the Economics of Education, Institute of Education, University of London. Author of* Economic Theory in Retrospect.
ECONOMICS

M.B.G. Manuel Ballesteros Gaibrois. *Professor and Head, Section of American History, University of Madrid. Author of* Francisco Pizarro *and others.*
PIZARRO, FRANCISCO

M.Bi. Margarete Bieber (d. 1978). *Associate Professor of Art History and Archaeology, Columbia University, 1937–48; Special Lecturer, School of General Studies, 1949–54. Author of* The History of the Greek and Roman Theater; The Sculpture of the Hellenistic Age.
DRESS (*in part*)

M.B.J. Marius B. Jansen. *Professor of History, Princeton University. Author of* Sakamoto Ryōma and the Meiji Restoration *and others.*
JAPAN, HISTORY OF (*in part*)

M.Bl. Miroslav Blažek. *Professor of Human Geography and of Regional Economy, School of Economics, Prague. Author of* Economic Geography of Czechoslovakia.
CZECHOSLOVAKIA (*in part*)

M.Bo. Marc Bouloiseau. *Former Secretary, Commission for the Economic and Social History of the French Revolution. Emeritus Teaching Assistant in the History of the French Revolution, University of Paris. Author of* Robespierre *and others.*
ROBESPIERRE

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HENRY II OF ENGLAND
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COEUR, JACQUES
LOUIS XI OF FRANCE

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JESUS CHRIST (BIBLIOGRAPHY)

M.K. Marshall Kay (d. 1975). *Newberry Professor of Geology, Columbia University, 1967–73. Among the first to provide a synthesis of geological history in terms of geosynclines and their development. Author of* North American Geosynclines.
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M.Ko. Mieczyslaw Kolinski. *Editor,* Studies in Ethnomusicology *(journal). Author of "Classification of Tonal Structures, Illustrated by a Comparative Chart of American Indian, African Negro, Afro-American, and English-American Structures" in* Studies in Ethnomusicology *and many other musicological and ethnomusicological articles.*
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M.K.P. Macaire K. Pedanou. *Political Affairs Officer, Executive Office of the Secretary General, United Nations, New York City.*
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M.K.Sp. Monroe K. Spears. *Moody Professor of English, Rice University, Houston, Texas. Author of* The Poetry of W.H. Auden; Dionysus and the City; *editor of* W.H. Auden: A Collection of Critical Essays.
AUDEN, W.H.

M.Ky. Michael Kenny. *Professor of Social and Cultural Anthropology, Catholic University of America, Washington, D.C. Editor,* Anthropological Quarterly. *Co-author of "Europe and Its Cultures" in* Anthropological Quarterly.
EUROPEAN ATLANTIC COAST, FOLK CULTURES OF THE

M.L. Maurits Lindström. *Professor of Geology, Geological–Paleontological Institute, Philipps University of Marburg, West Germany. Author of* Conodonts.
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M.L.R. Miriam Louisa Rothschild. *Co-author of* An Illustrated Catalogue of the Rothschild Collection of Fleas (Siphonaptera) in the British Museum (Natural History) *and author of several articles on fleas.*
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M.M.A. Mikhail Mikhaylovich Adrov. *Former Chief Manager, Laboratory of Oceanology, Polar Research Institute of Marine Fisheries and Oceanography, Murmansk, U.S.S.R.*
BAFFIN BAY
BARENTS SEA
GREENLAND SEA
HUDSON BAY

M.McC. Malcolm McChesney. *Senior Lecturer in Mechancial Engineering, University of Liverpool. Co-author of* The Dynamics of Relaxing Gases.
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M.M.F. Merrill M. Flood. *President, Merrill Flood and Associates (computer services), Santa Monica, California. Emeritus Professor of Mathematical Biology, University of Michigan, Ann Arbor. Co-author of* Automation and the Library of Congress.
INFORMATION PROCESSING (*in part*)

M.Mi. Mairin Mitchell. *Free-lance writer. Author of* Elcano: the First Circumnavigator; The Odyssey of Acurio, Who Sailed with Magellan; *and others.*
MAGELLAN, FERDINAND

M.Ml. Michel Michel. *Geography Assistant, University of Paris I, Panthéon-Sorbonne.*
BRAZIL (*in part*)

M.M.M. Maynard Malcolm Miller. *Professor of Geology; Dean, College of Mines and Earth Resources; Chief, Idaho Bureau of Mines and Geology, University of Idaho, Moscow. Director, Foundation for Glacier and Environmental Research. Author of numerous monographs and journal articles.*
ALASKA
COLUMBIA ICEFIELD
FUNDY, BAY OF

M.Mn. Sir Max Mallowan (d. 1978). *Professor of Western Asiatic Archaeology, University of London, 1947–62. President, British School of Archaeology in Iraq, 1970–78. Archaeologist on staff of the British Museum Expedition to Nineveh, 1931–32; later led many other archaeological expeditions. Author of* Nimrud and Its Remains *and others.*
NINEVEH

M.M.S. Madan Mohan Singh. *Manager, Soil and Rock Mechanics Section, Illinois Institute of Technology Research Institute, Chicago.*
SOIL MECHANICS, APPLICATIONS OF

M.M.Sa. Mostafa Moh. Salah. *Director, Institute of Oceanography and Fisheries, Kayed Bey, Alexandria, Egypt. Author of numerous articles on oceanography.*
MEDITERRANEAN SEA (*in part*)

M.M.W. Maxwell M. Wintrobe, M.D. *Distinguished Professor of Internal Medicine, University of Utah, Salt Lake City. Author of* Clinical Hematology.
BLOOD DISEASES

M.N. Marcel Nicolet. *Professor of External Geophysics, Free University of Brussels. Author of numerous articles on the atmosphere.*
ATMOSPHERE

M.Na. Maurice Nadeau. *Editor,* Lettres Nouvelles *and* La Quinzaine Littéraire, *Paris. Author of* Histoire du surréalisme; *editor of the Marquis de Sade's* Oeuvres; *and others.*
SADE, MARQUIS DE

M.N.B. Marjorie Nice Boyer. *Associate Professor of History, York College, City University of New York, Jamaica. Author of "Mediaeval Suspended Carriages" in* Speculum; *"Medieval Pivoted Axles" in* Technology and Culture.
WAGONS AND CARRIAGES

M.N.D. Manmath Nath Das. *Professor and Head, Department of History, Utkal University, Bhubaneswar, Orissa, India.*
ORISSA

M.N.R. Maurice N. Richter, M.D. *Consulting Pathologist, Good Samaritan Hospital, Phoenix, Arizona. Professor of Pathology, New York University, New York City, 1947–62. Author of "Lymph Nodes, Spleen and Reticuloendothelial System" in W.A.D. Anderson's* Pathology.
RETICULOENDOTHELIAL SYSTEM, HUMAN

M.N.v.L. Maurits N. van Loon. *Professor of Prehistory and Archaeology of Western Asia, University of Amsterdam. Research Associate in Archaeology, Oriental Institute, University of Chicago. Author of* Urartian Art.
DRESS (*in part*)
URARTU AND ARMENIA, HISTORY OF (*in part*)

Mo.Gr. Moshe Greenberg. *Professor of Bible, Hebrew University of Jersalem. Author of* The Hab/piru *and others; editor and translator of* The Religion of Israel *by Yehezkel Kaufmann.*
JUDAISM, HISTORY OF (*in part*)

M.O.W.F. Martin Otto Walter Folkerts. *Assistant Scientist, Institute of Geography and Economic Geography, University of Hamburg.*
BREMEN

M.Pa. Marcel Pacaut. *Professor of the History of the Middle Ages; Director, Institute of Political Studies, University of Lyon. Author of* Louis VII et son royaume *and others.*
FRANCE, HISTORY OF (*in part*)
PHILIP II AUGUSTUS, OF FRANCE

M.P.B. Michael Parker Banton. *Professor of Sociology, University of Bristol, England. Author of* The Policeman in the Community.
POLICE

M.Ph. Melba Phillips. *Emeritus Professor of Physics, University of Chicago. Co-author of* Classical Electricity and Magnetism.
ELECTROMAGNETIC RADIATION

M.Pl. Maurice Platnauer (d. 1974). *Principal of Brasenose College, University of Oxford, 1956–60. Author of* Latin Elegiac Verse *and others; editor of Aristophanes'* Peace.
ARISTOPHANES

M.Pm. Dame Margery Perham. *Honorary Fellow of Nuffield College, Oxford; Reader in Colonial Administration, University of Oxford, 1939–48. Author of* Lugard; *co-editor of* The Diaries of Lord Lugard.
LUGARD, LORD

M.P.Pe. Mikhail Platonovich Petrov. *Professor, Leningrad State University. Member of the Turkmen S.S.R. Academy of Sciences. Author of* Pustyni Tsentralnoy Azi *("Deserts of Central Asia").*
GOBI (DESERT)
TAKLA MAKAN DESERT

M.Py. E. Michael Pye. *Lecturer in Religious Studies, University of Leeds, England. Author of* The Study of Kanji.
RELIGIOUS DRESS AND VESTMENTS (*in part*)

M.R. Mario Rossi. *Professor of the History of Philosophy, University of Siena, Italy. Author of* Marx e la dialettica hegeliana.
HEGELIANISM

M.Ra. Marc Raeff. *Professor of History, Columbia University. Author of* Origins of the Russian Intelligentsia *and others.*
RUSSIA AND THE SOVIET UNION, HISTORY OF (*in part*)

M.R.B. M. Robert Barnett. *Consultant, American Foundation for the Blind, Inc., New York City; Executive Director, 1949–74. Author of numerous articles on the psychological and social aspects of visual impairment.*
BRAILLE

M.R.D. Mary R. Dawson. *Associate Curator, Verebrate Fossils, Carnegie Museum of Natural History, Pittsburgh. Active in research on the biology and paleontology of rabbits.*
LAGOMORPHA

M.R.D.F. Michael Richard Daniell Foot. *Professor of History, Victoria University of Manchester, 1967–73. Editor of* The Gladstone Diaries.
GLADSTONE, WILLIAM EWART

M.Re. Marcel Reinhard (d. 1973). *Professor of History, University of Paris. Author of* Paris pendant la révolution française *and others.*
SAINT-JUST, LOUIS DE

M.R.G. Mark Richard Greene. *Distinguished Professor of Insurance, University of Georgia, Athens. Author of* Risk and Insurance.
INSURANCE

M.R.H. Michael R. House. *Professor of Geology, University of Hull, England.*
DEVONIAN PERIOD

M.-R.Ho. Michel-Rotislav Hofmann. *Musicologist. Author of* Moussorgski; Histoire de la musique en Russie.
MUSSORGSKY, MODEST

M.Ro. Michael Roberts. *Professor of Modern History, Queen's University of Belfast, Northern Ireland. Author of* Gustavus Adolphus: A History of Sweden, 1611–1632; The Early Vasas: A History of Sweden, 1523–1611; *and others.*
GUSTAVUS II ADOLPHUS, OF SWEDEN
OXENSTIERNA, AXEL, COUNT

M.S. Melvin Seeman. *Professor of Sociology, University of California, Los Angeles. Author of* Social Status and Leadership.
ALIENATION

M.Sa. Michele Sarà. *Professor of Zoology; Director, Institute of Zoology, University of Genoa, Italy. Author of* Zoologia; Biologia generale.
PORIFERA

M.S.A. Mikhail S. Arlazorov. *Staff member, Union of Cinematographers, Moscow. Author of* Tsiolkovsky.
TSIOLKOVSKY, KONSTANTIN EDUARDOVICH

M.Sal. Mario Salmi. *Emeritus Professor of the History of Medieval and Modern Art, University of Rome. Author of* Il Beato Angelico *and many monographs on Italian Renaissance artists.*
ANGELICO, FRA

M.Sc. Maria Schmundt. *Former Assistant Professor of Economics, University of Wisconsin, Madison.*
TAXATION (*in part*)

M.Sch. Mischa Schwartz. *Professor of Electrical Engineering, Columbia University. Co-author of* Communication Systems and Techniques.
TELEPHONE AND TELECOMMUNICATIONS SYSTEMS (*in part*)

M.S.D. Margaret Stefana Drower. *Reader in Ancient History, University College, University of London. Author of* Egypt in Colour; Nubia: A Drowning Land.
LITERATURE, WESTERN: *Ancient Egyptian*
THEBES (EGYPT)
THUTMOSE III

M.S.F. Mohamed Sediq Farhang. *Afghan Ambassador to Yugoslavia. Member, Afghan Parliament, 1965–69. Author of* History of the Saffarids.
AFGHANISTAN

M.S.F.H. M. Sinclair F. Hood. *Archaeologist. Director, British School of Archaeology, Athens, 1954–62. Author of* The Minoans: Crete in the Bronze Age *and others.*
AEGEAN CIVILIZATIONS

M.Sh. Minoru Shinoda. *Professor of History, University of Hawaii, Honolulu. Author of* The Founding of the Kamakura Shogunate 1180–1185.
DAIGO II
FUJIWARA FAMILY

M.S.H. Muhammad Shamsul Huq. *Presidential Adviser for Foreign Affairs, Bangladesh. Minister for Education and Scientific Research, Pakistan, 1969–71. Author*

of Education and Development Strategy in South and Southeast Asia.
EDUCATION, HISTORY OF (*in part*)

M.S.K. Michael Scott Kranbuhl, M.D. *Instructor in Pharmacology, University of Cincinnati, Ohio; Resident Physician in Pediatrics, Children's Hospital Medical Center.*
ORGANS AND ORGAN SYSTEMS, ANIMAL (*in part*)

M.S.Ki. Matia Semakula Mulumba Kiwanuka. *Former Professor and Head, Department of History, Makerere University, Kampala, Uganda. Author of* A History of Buganda.
UGANDA

M.S.M. Muhsin S. Mahdi. *James Richard Jewett Professor of Arabic, Harvard University. Author of* Ibn Khaldun's Philosophy of History *and others.*
ISLĀMIC THEOLOGY AND PHILOSOPHY

M.S.M.F. Michael S.M. Fordham. *Analytical psychologist. Co-editor of* The Collected Works of C.G. Jung.
JUNG, CARL (*in part*)

M.Sp. Matthew Spinka (d. 1972). *Professor of Church History, Hartford Seminary Foundation, Connecticut, 1943–58. Author of* John Hus: A Biography *and others.*
HUS, JAN

M.S.S. Mark S. Slobin. *Associate Professor of Music, Wesleyan University, Middletown, Connecticut. Author of* Music in the Culture of Northern Afghanistan *and others.*
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

M.St. Michel Strickmann. *Assistant Professor of Oriental Languages, University of California, Berkeley. Author of* Visions of the Golden Porte.
TAOISM, HISTORY OF
TAOIST LITERATURE

M.Su. Michael Sullivan. *Christensen Professor of Oriental Art, Stanford University, California. Author of* The Birth of Landscape Painting in China; The Arts of China.
MA YÜAN
VISUAL ARTS, EAST ASIAN (*in part*)

M.Sz. Mary Szilágyi. *Chemist and Research Worker, Institute of Isotopes, Hungarian Academy of Sciences, Budapest.*
OIL SHALES

M.T. Morris Tanenbaum. *Vice President, Engineering and Network Services, American Telephone and Telegraph Company, Basking Ridge, New Jersey. Co-editor of* Superconductors.
AUTOMATION
MASS PRODUCTION

M.Ta. Mohamed Talbi. *Professor, Faculty of Letters and Human Sciences, University of Tunis. Author of* L'Emirat aghlabide, histoire politique 800–909.
TUNIS
TUNISIA (*in part*)

M.T.F. Michael T. Florinsky. *Emeritus Professor of Economics, Columbia University. Author of* Russia: A History and an Interpretation *and others.*
ALEXANDER III OF RUSSIA

M.Ti. Matsui Taketoshi. *Professor of Human Geography, Nagoya University, Japan. Co-author of* Outline of Human Geography; *editor of* History of Aichi Prefecture in the Showa Era.
NAGOYA

M.T.J. Meirion T. Jones. *Principal Scientific Officer, Marine Information and Advisory Service, Institute of Oceanographic Sciences, Birkenhead, England.*
ADEN, GULF OF

M.T.O. Martin T. Orne, M.D. *Professor of Psychiatry, University of Pennsylvania, Philadelphia; Director, Unit for Experimental Psychiatry, Institute of Pennsylvania Hospital.*
HYPNOSIS (*in part*)

M.Tu. (George) Martin Turnell. *Writer. Head, Programme Contracts Department, BBC, London, 1959–69. Author of* The Art of French Fiction *and others.*
MAUPASSANT, GUY DE
ZOLA, ÉMILE

M.T.V. M. Tulio Velásquez. *Director, Institute of Andean Biology, National University of San Marcos, Lima. Co-author of* Physiological Effects of High Altitude.
ANDES MOUNTAIN RANGES

M.U. Michitaka Uda. *Emeritus Professor, Tokyo University of Fisheries. Author of* Umi *and of numerous articles on oceanography.*
JAPAN, SEA OF
YELLOW SEA

Mu.B. Mukhtar Mustafa Buru. *Governor of Tripolitania, Libya. Author of* Atlas of Libyan Arab Republic.
LIBYA

Mu.S. Murray Schumach. *Reporter,* The New York Times. *Author of* The Face on the Cutting Room Floor.
NEW YORK (CITY)

M.V. Milorad Vasović. *Professor of Regional Geography, University of Belgrade. Author of* Industrija Beograda *and others.*
BELGRADE (*in part*)

M.V.F. Marion Valerie Friedmann. *Editor and translator. Author of* The Slap; *editor of* I Will Still Be Moved: Reports from South Africa.
LITERATURE, WESTERN: *South African in English*

M.v.H. Maria van Hasselt. *Former Curator, History of The Hague Department, Municipal Museum of The Hague.*
HAGUE, THE (*in part*)

M.Vi. Marcelle Vioux. *Free-lance writer. Author of* François I; Henri IV; *and others.*
FRANCIS I OF FRANCE

M.V.O. Maynard V. Olson. *Research Associate in Genetics, University of Washington, Seattle. Author of papers on mechanisms of reactions of transition-metal compounds.*
OXIDATION-REDUCTION REACTIONS

M.W.B. Marshall W. Baldwin (d. 1975). *Professor of History, New York University, New York City, 1954–72. Co-editor of* A History of the Crusades.
CRUSADES

M.W.F. Marvin W. Formo. *Manager, Oil and Protein Research, Cargill Inc., Minneapolis, Minnesota. Contributor to* Industrial Fatty Acids.
OILS, FATS, AND WAXES (*in part*)

M.Wi. Mitchell Wilson (d. 1973). *Science writer and novelist. Author of* American Science and Invention *and others.*
MCCORMICK, CYRUS HALL

M.W.L. Maung Wai Lin. *Research Editor, Biology,* Encyclopædia Britannica, *Chicago, 1970–72.*
PERCIFORMES (*in part*)

M.W.L.K. Michael William Lely Kitson. *Reader in the History of Art, Courtauld Institute of Art, University of London. Author of* The Art of Claude Lorrain *and others.*
CLAUDE LORRAIN

M.Wo. Mary Woodall. *London Adviser, Felton Trust, Melbourne. Director, City Museum and Art Gallery, Birmingham, England, 1956–64. Author of* Gainsborough's Landscape Drawings; *editor of* The Letters of Thomas Gainsborough.
GAINSBOROUGH, THOMAS

M.W.R. Matilda White Riley. *Professor of Sociology, Bowdoin College, Brunswick, Maine. Co-author of* Aging and Society (*vol. I–III*).
OLD AGE, SOCIAL ASPECTS OF (*in part*)

M.Y.R. Max Y. Rheinstein (d. 1977). *Max Pam Professor of Comparative Law, University of Chicago, 1942–68. Authority and writer on comparative law. Co-author of* Law of Decedents' Estates.
CIVIL LAW (*in part*)
CONFLICT OF LAWS
INHERITANCE

M.Y.S. Margaret Yvonne Stant. *Principal Scientific Officer in Plant Anatomy, Jodrell Laboratory, Royal Botanic Gardens, Kew, England. Author of* Anatomy of the Butomaceae.
ALISMALES

M.Z. Moses Zucker. *Professor of Biblical Exegesis, Jewish Theological Seminary of America, New York City. Author of* Rav Saadya Gaon's Translation of the Torah.
SA'ADIA BEN JOSEPH

M.Z.K. Milton Z. Kafoglis. *Professor of Economics, University of South Florida, Tampa. Author of* Welfare Economics and Subsidy Programs.
SUBSIDIES

M.Zu. Matinuzzaman Zuberi. *Research Fellow, Indian Institute of Advanced Study, Simla, India.*
NEPAL (*in part*)

N.A. Nafis Ahmad. *Professor of Geography, University of Dacca, Bangladesh. Author of* Economic Geography of East Pakistan; *editor of* Oriental Geographer.
BRAHMAPUTRA RIVER
GANGES RIVER
INDUS RIVER

N.Ab. Nicola Abbagnano. *Professor of History of Philosophy, University of Turin, Italy. Foremost Italian existentialist philosopher. Author of* Critical Existentialism *and numerous other works.*
EXISTENTIALISM

N.A.B. N.A. Baloch. *Former Vice Chancellor, University of Sind, Hyderābād, Pakistan. Author of* Musical Instruments of the Lower Indus Valley of Sind.
BALUCHISTAN
SIND

N.A.C. Nancy A. Curtin. *Research Fellow in Physiology, University College, University of London.*
MUSCLE CONTRACTION (*in part*)

N.A.Ct. Nathan Altshiller Court (d. 1968). *Professor of Mathematics, University of Oklahoma, Norman, 1935–51. Author of* College Geometry; Mathematics in Fun and in Earnest.
GEOMETRY, ANALYTIC AND TRIGONOMETRIC (*in part*)

N.A.G. Nikolay Andreyevich Gvozdetsky. *Professor of Geography, Moscow M.V. Lomonosov State University. Author of* Kavkaz.
CAUCASUS MOUNTAINS (*in part*)

N.A.J. Nazir Ali Jairazbhoy. *Professor of Music, University of California, Los Angeles. Author of* The Rāgs of North Indian Music: Their Structure and Evolution.
SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

Na.M. Nancy Mitford. *Writer. Author of* Madame de Pompadour *and others.*
POMPADOUR, MADAME DE

N.A.M. Norman A. Malcolm. *Susan Linn Sage Professor of Philosophy, Cornell University, Ithaca, New York. Author of*

Ludwig Wittgenstein: A Memoir.
WITTGENSTEIN, LUDWIG

N.A.McQ. Norman Anthony McQuown. *Professor of Anthropology and of Linguistics, University of Chicago. Author of "A Planned Auxiliary Language" in Dell Hymes's* Language in Culture and Society.
INTERNATIONAL LANGUAGE

Na.Mo. Naoaki Maeno. *Professor of Chinese Literature, University of Tokyo. Author of* Poets in the T'ang Dynasty.
FABLE, PARABLE, AND ALLEGORY (*in part*)

N.An. Nikolay Andreyev. *Reader in Russian Studies, University of Cambridge; Fellow of Clare Hall, Cambridge. Author of* Studies in Muscovy *and others.*
IVAN IV THE TERRIBLE, OF RUSSIA

N.A.O. Ned Allen Ostenso. *Director, National Sea Grant Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, D.C. Leader or participant in several polar expeditions. Author of* Geophysical Investigations of the Arctic Ocean Basin.
ARCTIC OCEAN

N.A.R. Nesca A. Robb (d. 1976). *Free-lance writer and lecturer. Author of* William of Orange: A Personal Portrait *and others.*
WILLIAM III OF GREAT BRITAIN

N.A.Ro. Nicholas A. Romas, M.D. *Associate Professor of Clinical Urology, Columbia University.*
REPRODUCTIVE SYSTEM DISEASES (*in part*)

N.A.W. Nixon A. Wilson. *Professor of Biology, University of Northern Iowa, Cedar Falls. Author of numerous papers on mites and ticks.*
ACARINA

N.A.Z. Nicola Abdo Ziadeh. *Emeritus Professor of Arab History, American University of Beirut. Author of* Origins of Nationalism—Tunisia *and others.*
BOURGUIBA, HABIB
CALENDAR (*in part*)
CHRONOLOGY (*in part*)

N.B. Nevill Barbour (d. 1972). *Assistant Head, Eastern Services, British Broadcasting Corporation, 1944–56. Author of* Morocco; *editor of* A Survey of North West Africa (the Maghrib).
NORTH AFRICA, HISTORY OF (*in part*)

N.C.G. Neil C. Gustafson. *Executive Director, Commission on Minnesota's Future, Minneapolis.*
MINNESOTA

N.C.H. Nicholas Carr Hightower, M.D. *Senior Consultant, Department of Gastroenterology, Scott and White Clinic and Scott and White Memorial Hospital, Temple, Texas. Contributor of "Digestion" in Best and Taylor,* The Physiological Basis of Medical Practice (*8th ed.*).
DIGESTION, HUMAN
DIGESTIVE SYSTEM, HUMAN

N.C.N. N. Chandrasekharan Nair. *Regional Botanist, Botanical Survey of India, Calcutta. Author of* Flora of the Punjab Plains.
EUPHORBIALES
RUTALES

N.C.P. Norman C. Polmar. *Vice President, Santa Fe Corporation, Arlington, Virginia. Editor, U.S. section,* Jane's Fighting Ships, *1967–77. Author of* Atomic Submarines *and others.*
SUBMARINE

N.Ds. Norman Davis. *Merton Professor of English Language and Literature, University of Oxford. Director, Early English Text Society. Co-editor of* English and Medieval Studies.
LITERATURE, WESTERN: *English; Medieval* (*in part*)

N.E. Nikita Elisséeff. *Professor of Islamic History and Archaeology, University of Lyon II. Author of* Nūr ad Dīn, un grand prince musulman de Syrie au temps des Croisades *and others.*
ALEPPO

N.E.N. Niels Erik Nörlund. *Emeritus Professor of Mathematics, University of Copenhagen. Author of* Differenzenrechnung; Séries d'interpolation.
NUMERICAL ANALYSIS (*in part*)

N.E.S. Neil E. Salisbury. *Professor of Geography, University of Iowa, Iowa City. Co-author of "Growth and Decline of Iowa Villages" and "The Valleys of Iowa,"* Iowa Studies in Geography.
IOWA

N.F.C. Norman F. Childers. *M.A. Blake Professor of Horticulture, Rutgers, the State University, New Brunswick, New Jersey. Author of* Modern Fruit Science.
FRUITS AND FRUIT FARMING

N.G. Norman Gash. *Professor of History, St. Salvator's College, University of St. Andrews, Scotland. Author of* Sir Robert Peel *and others.*
GREY, CHARLES GREY, 2ND EARL
PEEL, SIR ROBERT

N.G.J. Norman Gardner Johnson (d. 1973). *Industry Manager, Explosives Department, Du Pont de Nemours and Company, Wilmington, Delaware, 1960–67; Technical Specialist, Technical Service Section, 1943–60. Author of* Safety in the Transportation, Storage, Handling and Use of Explosives.
EXPLOSIVES

N.G.L.H. Nicholas G.L. Hammond. *Henry Overton Wills Professor Emeritus of Greek, University of Bristol, England. Author of* A History of Greece to 322 B.C. *and others; editor of* Cambridge Ancient History, *3rd edition.*
GRECO-PERSIAN WARS
PELOPONNESIAN WAR
XENOPHON

N.Go. (Trevor) Noël Goodwin. *Music and Dance Critic,* London Daily Express. *Associate Editor,* Dance and Dancers, *London. Area Editor,* Grove's Dictionary of Music and Musicians, 6th ed. *Co-author of* London Symphony: Portrait of an Orchestra.
MUSIC, THEATRICAL

N.G.S. Neal Griffith Smith. *Biologist, Smithsonian Tropical Research Institute, Balboa, Canal Zone.*
REPRODUCTIVE BEHAVIOUR

N.H. Naofusa Hirai. *Professor of Shintō Studies, Kokugakuin University, Tokyo. Author of* Japanese Shinto.
SHINTŌ

N.H.G. Norman H. Gibbs. *Chichele Professor of the History of War, University of Oxford, 1953–77; Emeritus Fellow of All Souls College, Oxford. Author of* The Origins of the Committee of Imperial Defence *and others.*
FRENCH REVOLUTIONARY AND NAPOLEONIC WARS

N.H.R. Norman H. Russell. *Professor of Biology, Central State University, Edmond, Oklahoma. Author of* An Introduction to the Plant Kingdom.
VIOLALES

N.I. Nobutaka Ike. *Professor of Political Science, Stanford University, California. Author of* The Beginnings of Political Democracy in Japan *and others.*
II NAOSUKE

N.I.M. Nikolay Ivanovich Mikhaylov. *Professor of Geography, Moscow M.V. Lomonosov State University. Author of* Gory Yuzhnoy Sibiri.
ALTAI MOUNTAINS

N.It. Norman Itzkowitz. *Professor of Near Eastern Studies, Princeton University. Author of* Ottoman Empire and Islamic Tradition.
ANKARA

N.J.B. N.J. Berrill. *Strathcona Professor of Zoology, McGill University, Montreal, 1946–65. Author of* Sex and the Nature of Things *and others.*
SEX AND SEXUALITY

N.J.C. Noel James Coulson. *Professor of Oriental Laws, University of London. Author of* A History of Islamic Law *and others.*
ISLĀMIC LAW

N.J.H. Nicholas Joseph Healy. *Adjunct Professor of Law, New York University. Attorney, Healy & Baillie, New York City. Co-author of* Healy & Sharpe's Cases and Materials on Admiralty.
MARITIME LAW

N.J.L. Norman Jones Lamb. *Senior Lecturer in Portuguese and Spanish, University of Liverpool.*
LITERATURE, WESTERN: *Portuguese* (*in part*)

N.J.P. Norman J. Padelford. *Emeritus Professor of Political Science, Massachusetts Institute of Technology, Cambridge. Author of* The Panama Canal in Peace and War.
PANAMA CANAL

N.Ka. Nobuo Kanda. *Professor of East Asian History, Meiji University, Tokyo. Co-author of* Glory of the Forbidden City in Peking *and others.*
K'ANG-HSI

N.K.G. Nikolai Kallinikovich Gudzii (d. 1965). *Professor of Old Russian Language and Literature, Moscow M.V. Lomonosov State University. Member, Academy of Sciences of the U.S.S.R. Author of* History of Early Russian Literature *and others.*
LITERATURE, WESTERN: *Russian; Medieval, Renaissance, 17th century*

N.K.S. N.K. Sinha (d. 1974). *Professor and Head, Department of History, University of Calcutta, 1955–68. Author of* Rise of the Sikh Power *and others.*
BOSE, SUBHAS CHANDRA
CALCUTTA

N.L.G. Nancie L. González. *Vice Chancellor for Academic Affairs; Professor of Anthropology, University of Maryland, College Park. Author of* Santiago: Ethnography of a Dominican City *and others.*
DOMINICAN REPUBLIC

N.L.N. Norman L. Nicholson. *Senior Professor of Geography, University of Western Ontario, London. Author of* Canada in the American Community; The Boundaries of Canada: Its Provinces and Territories.
CANADA (*in part*)

N.M. Nobuhiro Matsumoto. *Emeritus Professor of Oriental History, Keio University, Tokyo. Author of* Essai sur la mythologie japonaise.
JAPANESE MYTHOLOGY

N.Ma. Nemesio Marqués. *General Secretary to the Bishop of Urgel, Co-Prince of Andorra.*
ANDORRA

N.M.C. Nydia María Cardoze. *Professor of Geography, University of Panama, Panama City. Author of* Notas de geografía.
PANAMA

N.Mo. Neil Morgan. *Free-lance writer and syndicated newspaper columnist. Author of* The California Syndrome *and others.*
CALIFORNIA

N.M.S. Nicholas M. Short. *Geologist, Earth Observations Branch, Goddard Space Flight*

Center, National Aeronautics and Space Administration, Greenbelt, Maryland. Co-author of Volcanic Landforms and Surface Features: A Photographic Atlas and Glossary.
METEORITE CRATERS

N.M.Sa. Nahum M. Sarna. *Golding Professor of Biblical Studies, Brandeis University, Waltham, Massachusetts. Author of* Understanding Genesis *and others.*
BIBLICAL LITERATURE (*in part*)

N.M.Su. N.M. Sutherland. *Lecturer in History, Bedford College, University of London. Author of* The Massacre of St. Bartholomew and the European Conflict, 1559–1572 *and others.*
CATHERINE DE MÉDICIS

N.N.G. Nahum N. Glatzer. *Samuel Lane Professor Emeritus of Jewish History and Social Ethics, Brandeis University, Waltham, Massachusetts. University Professor, Boston University. Author of* Franz Rosenzweig: His Life and Thought *and others.*
AKIBA BEN JOSEPH
ROSENZWEIG, FRANZ

N.O.H. Neal O. Hines. *Director of Information, National Association of College and University Business Officers, Washington, D.C. Author of* Proving Ground: An Account of the Radiobiological Studies in the Pacific, 1946–1961.
BIKINI

N.O.S. Norman Obed Smith. *Professor of Chemistry, Fordham University, New York City. Co-author of* The Phase Rule and Its Applications.
PHASE CHANGES AND EQUILIBRIA

N.P. Norman Perrin (d. 1976). *Professor of New Testament, University of Chicago, 1969–76. Author of* The Promise of Bultmann *and others.*
BULTMANN, RUDOLF

N.Pa. Ntsomo Payanzo. *Assistant Professor of Sociology, National University of Zaire, Lubumbashi.*
ZAIRE, REPUBLIC OF

N.P.A. Nagarajan Panchapagesan Ayyar. *Professor of Geography, Shivaji University, Kolhāpur, India.*
MADHYA PRADESH

N.P.As. N. Philip Ashmole. *Lecturer in Zoology, University of Edinburgh. Author of numerous papers on the population ecology of seabirds.*
PELECANIFORMES

N.P.M. Nicos Panayiotou Mouzelis. *Senior Lecturer in Sociology, London School of Economics and Political Science, University of London. Author of* Organisation and Bureaucracy: An Analysis of Modern Theories.
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N.R.W. Nelson Raymond Williams. *Principal Technical Adviser to Assistant Director, U.S. Air Force Technical Applications Center, Virginia, 1961–63. Meteorologist, U.S. Weather Bureau, 1940–46. Contributor to* The Encyclopedia of Atmospheric Sciences and Astrogeology.
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N.Sm. Ninian Smart. *Professor of Religious Studies, University of Lancaster, England, and University of California, Santa Barbara. Author of* The Religious Experience of Mankind; Philosophers and Religious Truth; *and others.*
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N.T. Nicholas Temperley. *Professor of Musicology, University of Illinois, Urbana. Editor of Berlioz'* Symphonie fantastique.
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N.T.M.D. Nigel T.M. Dennis. *Technical Manager, Edwards High Vacuum (Division of the British Oxygen Company Ltd.), Crawley, England. Co-author of* Vacuum System Design.
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N.W. Norman Ward. *Britnell Professor of Political Science, University of Saskatchewan, Saskatoon. Author of* The Public Purse: A Study in Canadian Democracy.
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N.W.S. Nathan Wetherill Shock. *Emeritus Scientist, Gerontology Research Center, National Institute of Aging, U.S. Department of Health, Education, and Welfare, Baltimore City Hospitals. Author of* Trends in Gerontology; *editor of* Perspectives in Experimental Gerontology.
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N.Y.A. Nina Yakovlevna Arsenyeva. *Senior Member in Science, Leningrad Department, State Institute of Oceanography. Author of many articles on the White Sea.*
WHITE SEA

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O.A. Oskar Anweiler. *Professor of Education, University of the Ruhr, Bochum, West Germany. Author of* Geschichte der Schule und Pädagogik in Russland, vom Ende des Zarenreiches bis zum Beginn der Stalin-Ära.
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O.B.G. O. Benjamin Gerig (d. 1976). *Director, Office of Dependent Area Affairs, U.S. Department of State, 1945–62.*
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O.E.Z. Oleksa Eliseyovich Zasenko. *Head, Department of the History of Ukrainian Prerevolutionary Literature, Institute of Literature, Ukrainian S.S.R. Academy of Sciences, Kiev. Co-author of* History of Ukrainian Literature, *vol. 8.*
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O.G. Owen Gingerich. *Professor of Astronomy and of the History of Science, Harvard University. Astrophysicist, Smithsonian Institution Astrophysical Observatory, Cambridge, Massachusetts. Co-author of* Solar and Planetary Longitudes from −2500 to +2000.
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O.L. Otto Leichter (d. 1973). *Correspondent for United Nations and U.S. Affairs,* Arbeiter-Zeitung, *Vienna; and* Neue Ruhr-Zeitung, *Essen, West Germany. Author of* Zwischen zwei Diktaturen.
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O.La. Owen Lattimore. *Emeritus Professor of Chinese Studies, University of Leeds, England. Foreign Member, Academy of Sciences of the Mongolian People's Republic. Author of* Mongols of Manchuria; Inner Asian Frontiers of China; *and others.*
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O.Or. Oystein Ore (d. 1968). *Sterling Professor of Mathematics, Yale University, 1931–68. Author of* Cardano: The Gambling Scholar *and others.*
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P.A.S. Paul A. Schwartz. *Research Associate, Rancho Grande Biological Research Station, Ministry of the Environment and Renewable Natural Resources, Venezuela.*
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P.B.N. Philip B. Neisser. *Technical adviser on coinage operations to developing nations. Technical Consultant to the Director of the Mint, U.S. Department of the Treasury, Washington, D.C., 1958–71.*
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P.C. Preston Cloud. *Professor of Biogeology, University of California, Santa Barbara. Biogeologist, Geological Survey, U.S. Department of the Interior. World authority on Precambrian events and conditions in Earth history. Author of* Cosmos, Earth, and Man.
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P.Ca. Pedro Calmon. *President, Brazilian Historical and Geographical Institute, Rio de Janeiro. Author of* História do Brasil.
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P.C.-B. Peter Cannon-Brookes. *Keeper, Department of Art, National Museum of Wales, Cardiff. Co-author of* European Sculpture; Baroque Churches.
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P.C.J. Philip C. Jessup. *Judge, International Court of Justice, The Hague, The Netherlands, 1961–70. Author of* A Modern Law of Nations *and others.*
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KWANGSI
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P.D. P. Dayal. *Professor and Head, Department of Geography, University of Patna, Bihār, India. Author of* Bihar in Maps.
BIHĀR

P.De. Pierre Descargues. *Art historian and critic. Author of* Frans Hals; Jan Vermeer; *and other monographs.*
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VERMEER, JAN

P. de L. Pierre de Latil. *Scientific Editor,* Le Figaro, *Paris. Co-author of* Le Professeur Auguste Piccard; Man and the Underwater World; *and others.*
PICCARD FAMILY

P.Di. Porphyrios Dikaios (d. 1971). *Professor, Archaeological Institute, Rupert Charles University of Heidelberg. Director of Antiquities, Nicosia, Cyprus, 1960–63. Author of* A Guide to the Cyprus Museum *and others.*
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P.D.O. Peter D. Owen. *Painter and printmaker. Senior Lecturer, Croydon College of Design and Technology, England. Author of* Painting.
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PROBOSCIDEA

P.Er. Philippe Erlanger. *Plenipotentiary Minister. Former Director of Cultural Activities, Ministry of Foreign Affairs, Paris. Author of* Louis XIV *and others.*
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P.E.R. Peter Edward Russell. *King Alfonso XIII Professor of Spanish Studies, University of Oxford; Fellow of Exeter College, Oxford. Author of* The English Intervention in Spain and Portugal in the Time of Edward III and Richard II.
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Pe.S.G. Peter Spence Gilchrist, Jr. *President, Gilchem Corporation, Charlotte, North Carolina.*
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TIME PERCEPTION

P.F.B. Paul F. Borth. *Executive Director, Platemakers Educational and Research Institute, South Holland, Illinois. Author of numerous articles on engraving processes.*
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P.F.W. Paul F. Watson. *Associate Professor of the History of Art, University of Pennsylvania, Philadelphia. Co-author of* The Quest for Solomon and Sheba.
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LITERATURE, WESTERN: *French; 19th century*

P.G.P. Peter Georgiev Penčev. *Professor and Chairman, Department of Hydrology and Climatology, University of Sophia. Author of* Hydrologic Regionalization of Bulgaria; Basic Genetic Components of the River Flow in Bulgaria.
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P.Gr. Pier Groen. *Professor of Meteorology and Physical Oceanography, Free University,*

Amsterdam. Author of The Waters of the Sea.
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P.Gu. Pierre Gourou. *Honorary Professor, College of France, Paris. Emeritus Professor of Geography, Free University of Brussels. Author of* L'Asie.
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P.H. Paul Herget. *Director, Cincinnati Observatory, University of Cincinnati, Ohio. Author of* The Computation of Orbits.
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Ph.D. Philip Drew. *Professor of English Literature, University of Glasgow. Author of* The Poetry of Browning: A Critical Introduction; *editor of* Robert Browning: A Collection of Critical Essays.
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P.H.D. P.H. Davison. *Professor of English, St. David's University College, Lampeter, University of Wales. Editor,* The Library (*Journal of the Bibliographical Society*). *Author of* Songs of the British Music Hall; *"Contemporary Drama and Popular Dramatic Forms" in* Aspects of Drama.
POPULAR LITERATURE

P.He. Sir Philip Hendy. *Adviser to the Israel Museum, Jerusalem. Director, National Gallery, London, 1946–67. Author of* Giovanni Bellini; Piero della Francesca and the Early Renaissance.
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P.H.G. Peter Humphry Greenwood. *Senior Principal Scientific Officer (Curator of Fishes), Department of Zoology, British Museum (Natural History), London. Author of* The Fishes of Uganda; *co-author of the major modern classification of the bony fishes.*
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P.H.Ge. Paul Henry Gebhard. *Director, Institute for Sex Research; Professor of Anthropology, Indiana University, Bloomington. Co-author of* Pregnancy, Birth and Abortion; Sex Offenders.
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P.H.Gu. Pierre H. Guiguemde. *Representative for Central African Republic, Office of the United Nations High Commissioner for Refugees, Bangui.*
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Ph.H.J.H.t.C. Philo H.J. Houwink ten Cate. *Professor of Ancient Near Eastern History and Languages, University of Amsterdam. Author of* The Luwian Population Groups of Lycia and Cilicia Aspera during the Hellenistic Period; The Records of the Early Hittite Empire (c. 1450–1380 BC).
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P.Hi. Patrice Louis-René Higonnet. *Professor of History, Harvard University. Author of* Pont-de-Montvert.
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P.H.J.C. Peter Henry John Castle. *Reader in Zoology, Victoria University of Wellington, New Zealand. Author of numerous papers on eels.*
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P.H.K. Philip H. Kuenen (d. 1976). *Professor of Geology, State University of Groningen, The Netherlands, 1943–72. Authority on density currents and marine sedimentation. Author of* Marine Geology.
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P.Hu. Peter J. Huizing. *Professor of Canon Law and History of Canon Law, Catholic University of Nijmegen, The Netherlands. Author of* The Sacraments in Theology and Canon Law *and others.*
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P.I. Pavle Ivić. *Former Professor of Modern Serbo-Croatian Language, History, and Dialectology, University of Novi Sad, Yugoslavia. Author of* Die serbokroatischen Dialekte; *co-author of* Accent in Serbocroatian.
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P.J.F. Pasquale J. Federico. *Attorney and consultant in patent law. Professorial Lecturer in Law, George Washington University, Washington, D.C., 1950–73. Former Examiner in Chief, Board of Patent Appeals, Patent Office, U.S. Department of Commerce, Washington, D.C. Author of* Commentary on the New Patent Act *and others.*
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P.J.H. Peter John Hilton. *Fellow of Battelle Research Center, Seattle, Washington. Louis D. Beaumont Professor of Mathematics, Case Western Reserve University, Cleveland. Co-author of* Homology Theory; A Course in Homological Algebra; *and others.*
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P.U. Philip Soundy Unwin. *Free-lance editor. Former Senior Director, George Allen & Unwin Ltd., London. Author of* Book Publishing as a Career *and others.*
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P.V. Paul Veyret. *Professor of Mountain Geography, Institute of Alpine Geography, University of Grenoble I, France. Co-author of* Au coeur de l'Europe: Les Alpes *and others.*
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P.V.G. Pyotr Vatslavovich Gulyan. *Assistant Director, Institute of Economics, Latvian S.S.R. Academy of Sciences, Riga. Author of* Latvia in the System of the U.S.S.R. National Economy.
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P.W. Paul E. Walker. *Director, American Research Center in Egypt, Cairo.*
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P.Wa. Peggy (Margaret D.) Wagner. *Art Editor, Houghton Mifflin Company, Boston. Editorial Assistant, Arts,* Encyclopædia Britannica, *Chicago, 1971–73.*
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P.W.B. Percy Williams Bridgman (d. 1961). *Higgins University Professor, Harvard University, 1950–54; Hollis Professor of Mathematics and Natural Philosophy, 1926–50. Nobel Prize for Physics, 1946, for work in high-pressure physics. Author of* Dimensional Analysis; The Physics of High Pressure; *and others.*
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P.W.F. Peter W. Frank. *Professor of Biology, University of Oregon, Eugene.*
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P.W.J. Pascual W. Jordan. *Director, Institute of Theoretical Physics, University of Hamburg, 1963–71. Author of* Verdrängung und Komplementarität: Eine philosophische Untersuchung.
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P.W.K. Peter W. Kingsford. *Tutor, Extra Mural Department, University of London. Author of* Engineers, Inventors, and Workers; Victorian Railwaymen.
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P.W.P. P.W. Pestman. *Professor of Comparative History of Ancient Law, State University of Leiden, The Netherlands. Author of* Marriage and Matrimonial Property in Ancient Egypt.
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P.W.R. Paul Westmacott Richards. *Emeritus Professor of Botany, University College of North Wales, University of Wales, Bangor. Author of* The Life of the Jungle; The Tropical Rain Forest.
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P.Y.K. Pekka Yrjö Korkala. *Lecturer in Psychometrics, Institute of Psychology, University of Helsinki. Co-author of* Introduction to Psychometrics; *co-editor of* Contemporary Research in the Psychology of Perception.
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Q.-T.-T. Quách-Thanh-Tám. *Professor of Geography, University of Saigon.*
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NICARAGUA
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R.Al. Rex Alston. *Broadcaster and Journalist. Staff Sports Commentator and Reporter, British Broadcasting Corporation, 1942–61. Cricket Reporter,* Daily *and* Sunday Telegraph (*London*), *1961–78. Author of* Watching Cricket.
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R.A.McF. Ross Armstrong McFarland (d. 1976). *Guggenheim Professor of Aerospace Health and Safety, Harvard University School of Public Health, Boston, 1962–72. Author of* Human Factors in Air Transportation: Occupational Health and Safety.
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R.A.R.T. Ronald A.R. Tricker. *Staff Inspector for Science, Ministry of Education, U.K., 1946–62. Author of* Bores, Breakers, Waves and Wakes; The Contributions of Faraday and Maxwell to Electrical Science; *and others.*
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R.C.E. Robert C. Elliott. *Professor of English Literature, University of California, San Diego. Author of* The Power of Satire: Magic, Ritual, Art; The Shape of Utopia.
SATIRE

R.C.F. Richard Charles Froeschner. *Curator, Hemiptera Section, Department of Entomology, Smithsonian Institution, Washington, D.C.*
HETEROPTERA

R.C.H. Reginald Crawshaw Honeybone. *Professor and Head, School of Education, University of the South Pacific, Suva, Fiji. Co-author and editor of* World Geography.
FIJI

R.C.K. Roy Clement Knight. *Emeritus Professor of French, University College of Swansea, University of Wales. Author of* Racine et la Grèce *and others.*
RACINE, JEAN

R.C.L. Richard C. Latham. *Partner, Seay & Latham Investments, Dallas, Texas. Co-author of* United States Polo Association Annual.
POLO

R.C.N. Robert C. North. *Professor of Political Science, Stanford University, California. Author of* Moscow and Chinese Communists *and others.*
LIU SHAO-CH'I

R.Co. Robert Cornevin. *Permanent Secretary, Overseas Academy of Sciences, Paris. Head, Centre of Studies and Documentation on Africa and Overseas Departments. Author of* Histoire de l'Afrique.
GUADELOUPE
MARTINIQUE

R.Cog. Raymond Cogniat (d. 1977). *Principal Inspector of Fine Arts, 1943–67. Head of the arts section,* Le Figaro, *Paris, 1957–77. Author of* Renoir; *editor of* Renoir: Children: *and other works on 20th-century artists of the school of Paris.*
RENOIR, PIERRE-AUGUSTE

R.C.R. Reed C. Rollins. *Asa Gray Professor of Systematic Botany; Director, Gray Herbarium, Harvard University. Co-author of* Edible Wild Plants of Eastern North America.
PAPAVERALES

R.C.S. Reginald C. Sutcliffe. *Emeritus Professor of Meteorology, University of Reading, England. Author of* Weather and Climate.
WEATHER FORECASTING

R.C.Sm. Robert C. Smith (d. 1975). *Professor of the History of Art, University of Pennsylvania, Philadelphia, 1956–75. Author of* The Art of Portugal *and others.*
LACQUERWORK (*in part*)

R.C.Su. Robert Carl Suggs. *Chief, Fellowships and Overseas Projects Section, Division of International Education, Bureau of Higher and Continuing Education, Office of Education, U.S. Department of Health, Education, and Welfare, Washington, D.C. Author of* Island Civilizations of Polynesia *and others.*
POLYNESIAN CULTURES

R.C.V.C. Raoul Charles Van Caenegem. *Professor of Medieval History, State University of Ghent, Belgium. Author of* Guide to the Sources of Medieval History.
GHENT AND BRUGES, HISTORY OF

R.C.-W. Rupert Crawshay-Williams (d. 1977) *Author of* Russell Remembered; Methods and Criteria of Reasoning; *and others.*
RUSSELL, BERTRAND

R.C.Y. Richard Charles York. *Instructor of Ornamental Horticulture, McHenry County College, Crystal Lake, Illinois. Former Associate Editor, Biology,* Encyclopædia Britannica, *Chicago.*
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R.D. Robert Dorfman. *Professor of Economics, Harvard University. Author of* The Price System.
PRODUCTION, THEORY OF

R.Da. René David. *Professor of Comparative Law, University of Aix-Marseille III, Aix-en-Provence, France. Author of* Les Grands Systèmes de droit contemporains.
COMPARATIVE LAW, STUDY OF

R.D.D. Rodney Deane Davies. *Professor of Radio Astronomy, Nuffield Radio Astronomy Laboratories, Victoria University of Manchester, England. Co-author of* Radio Studies of the Universe.
RADIO SOURCES, ASTRONOMICAL

R.D.D.G. Robert Donald Davidson Gibson. *Professor of French, University of Kent at Canterbury, England. Author of* Modern French Poets on Poetry; The Quest of Alain-Fournier; *and others.*
VALÉRY, PAUL

R.d'E. Raul d'Eça. *Assistant Career Planning Officer, U.S. Information Agency, 1959–61. Branch Public Affairs Officer, Recife and Belo Horizonte, Brazil. Office of International Information and Cultural Affairs, 1947–58. Co-author of* Latin American History.
PERNAMBUCO (*in part*)

R.De. Robert Descloitres. *President and Director of Research, Centre of Applied Human Sciences, Aix-en-Provence, France. Co-author of* L'Algérie des bidonvilles.
MAGHRIB, CULTURES OF THE

R.D.Fo. Raymond D. Fogelson. *Professor of Anthropology, University of Chicago. Editor of* Handbook of North American Indians, *vol. 14,* Southeast.
SOUTHEAST AMERICAN INDIANS

R.D.H. Robert D. Herman. *Professor of Sociology, Pomona College, Claremont, California. Author of* Gamblers and Gambling.
GAMBLING
LOTTERY

R.D.L. R. Duncan Luce. *Professor of Psychology, Harvard University. Co-author of* Foundations of Measurement.
MEASUREMENT, THEORY OF (*in part*)

R.D.M. Robert Douthat Meade (d. 1974). *Professor of History, Randolph-Macon Woman's College, Lynchburg, Virginia, 1939–71. Author of* Patrick Henry, Patriot in the Making; Patrick Henry, Practical Revolutionary; *and others.*
HENRY, PATRICK

R.D.Mi. Robin David Middleton. *Librarian, Faculty of Architecture and History of Art, University of Cambridge. Head of General Studies, Architectural Association School of Architecture, London.*
VISUAL ARTS, WESTERN (*in part*)

R.Do. Ron Dorfman. *Former Articles Editor,* Chicago *magazine.*
CHICAGO (*in part*)

R.D.R. Richard D. Ross. *Vice President, Read-Ferry Company, Inc., Haddonfield, New Jersey. Editor of* Industrial Waste Disposal.
MATERIALS SALVAGE

R.Du. Raymond E. Durgnat. *Head, Department of Visual Arts, University of California, San Diego. Author of* Films and Feelings; Buñuel; Jean Renoir; *and others.*
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RESNAIS, ALAIN
TRUFFAUT, FRANÇOIS

R.Dum. René Dumesnil (d. 1967). *Literary and music critic. Member, Academy of Fine Arts, Institute of France, 1965–67. Author of* Gustave Flaubert, l'homme et l'oeuvre; Guy de Maupassant; *and others.*
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R.D.W. Robert Deryck Williams. *Professor of Classics, University of Reading, England. Author of* Virgil; *editor of* Aeneid.
VIRGIL

R.E.B. Roy E. Beal. *Manager, Welding Research, Illinois Institute of Technology Research Institute, Chicago.*
WELDING, BRAZING, AND SOLDERING

R.E.Be. Ronald E. Bedford. *Senior Research Officer, Division of Physics, National Research Council of Canada, Ottawa. Co-author of "Temperature Measurement" in* Tools and Techniques in Physical Metallurgy.
THERMOMETRY

R.E.C. Roy Eugene Cameron. *Director, Energy Resources Training and Development, Environmental Impact Studies Division, Argonne National Laboratory, Illinois.*
NORTH AMERICAN DESERT

R.E.Cr. Raymond E. Crist. *Research Professor Emeritus of Geography, University of Florida, Gainesville, Author of* The Cauca Valley, Colombia.
AMAZON RIVER
CUBA (*in part*)
HAVANA (*in part*)
VENEZUELA (*in part*)

R.E.D. Rev. Rupert E. Davies. *Warden, John Wesley's Chapel, Bristol, England. Author of* Methodism *and others.*
METHODISTS

R.E.Da. Robert E. Davies. *Benjamin Franklin Professor of Molecular Biology and University Professor; Chairman, Graduate Group on Molecular Biology; Chairman, Department of Animal Biology, University of Pennsylvania, Philadelphia.*
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R.E.E. Ronald Eric Emmerick. *Professor and Director, Department of Iranian Studies, University of Hamburg, West Germany. Author of* Saka Grammatical Studies; *editor and translator of several Khotanese works.*
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R.E.F. Ralph E. Fuhrman. *Assistant Director, National Water Commission, Arlington, Virginia. Editor of* Journal of the Water Pollution Control Federation.
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R.E.Fi. Raymond E. Fielding. *Professor of Communications, University of Houston, Texas. Editor of* A Technological History of Motion Pictures and Television.
DE FOREST, LEE

R.E.G. Ralph E. Grim. *Research Professor Emeritus of Geology, University of Illinois, Urbana. Scholar whose outstanding synthesis of clay mineralogy served as a guide for a generation of research scientists. Author of* Clay Mineralogy *and others.*
CLAY MINERALS

Re.H. Reinhold D. Hohl. *Art historian. Author of* Giacometti *and others.*
GIACOMETTI, ALBERTO

R.E.H. Richard E. Holttum. *Honorary Research Associate, Royal Botanic Gardens, Kew, England. Director, Botanic Gardens, Singapore, 1925–49. Professor of Botany, University of Malaya, Singapore, 1949–54. Author of* A Revised Flora of Malaya.
ZINGIBERALES

R.E.H.M. Roy E.H. Mellor. *Professor of Geography, University of Aberdeen, Scotland. Author of* Eastern Europe: A Geography of the Comecon Countries *and others.*
GERMAN DEMOCRATIC REPUBLIC (*in part*)
LEIPZIG (*in part*)

R.E.K. Rudolf E. Kalman. *Graduate Research Professor of Mathematics; Director, Center for Mathematical System Theory, University of Florida, Gainesville. Professor of Mathematical System Theory, Swiss Federal Institute of Technology, Zürich. Co-author of* Topics in Mathematical System Theory.
OPTIMIZATION, MATHEMATICAL THEORY OF (*in part*)

R.E.L.F. Robert E.L. Faris. *Emeritus Professor of Sociology, University of Washington, Seattle. Editor of* Handbook of Modern Sociology.
SOCIOLOGY

R.E.M. Roland E. Mousnier. *Former Professor of Modern History, University of Paris. Author of* Les XVI^{e} et XVII^{e} siècles: Le Progrès de la civilisation européenne et le déclin de l'Orient *and others.*
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R.E.O. Ronald E. Osborn. *Professor of American Church History, School of Theology at Claremont, California. Author of* The Spirit of American Christianity *and others.*
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R.E.Or. Richard Edmonds Orville. *Associate Professor of Atmospheric Science, State University of New York at Albany. Investigator of electrical phenomena in the atmosphere through photographs and their interpretation.*
LIGHTNING

Re.P. Rebecca Posner. *Professor of Romance Languages, University of Oxford. Author of* Consonantal Dissimilation in the Romance Languages; The Romance Languages: A Linguistic Introduction.
ROMANCE LANGUAGES

R.E.P. Rollie E. Poppino. *Professor of History, University of California, Davis. Author of* Brazil: The Land and People *and others.*
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PERNAMBUCO (*in part*)
VARGAS, GETÚLIO

R.E.Pa. Reinhard E. Paesler. *Academic Adviser, Institute for Economic Geography, Ludwig Maximilian University of Munich.*
BAYERN (*in part*)

R.E.Pi. Richard E. Pipes. *Frank B. Baird, Jr., Professor of History, Harvard University.*
NIKON

R.Es. Robert Escarpit. *Professor of Comparative Literature, University of Bordeaux III, France. Author of* L'Angleterre dans l'oeuvre de Madame de Staël; Sociologie de la littérature; *and others.*
STAËL, MADAME DE

R.E.S. Robert E. Stewart. *Distinguished Professor of Agricultural Engineering, Texas A & M University, College Station.*
AGRICULTURE, TECHNOLOGY OF

R.E.Y. R. Eric Young. *Consultant in Automation Instrumentation, Telemetry, Radar, Television and High Speed Data Transmission. Author of* Telemetry Engineering.
TELEMETRY

R.F. Robert L. Faherty. *Managing Editor, Congressional Budget Office, Washington, D.C. Staff editor, Religion,* Encyclopædia Britannica, *Chicago, 1969–72.*
BIBLICAL LITERATURE (*in part*)

R.F.B. Robert F. Byrnes. *Distinguished Professor of History, Indiana University, Bloomington. Author of* Pobedonostsev: His Life and Thought.
POBEDONOSTSEV, KONSTANTIN PETROVICH

R.F.D. Raymond F. Dasmann. *Professor of Environmental Studies, University of California, Santa Cruz. Author of* Environmental Conservation.
CONSERVATION OF NATURAL RESOURCES

R.F.F. Richard Foster Flint (d. 1976). *Henry Barnard Davis Professor of Geology, Yale University (1957–70). Author of* Glacial and Quaternary Geology.
PLEISTOCENE EPOCH

R.F.G.A. R.F.G. Alford. *Cassel Reader in Economics, London School of Economics and*

Political Science, University of London.
MONEY MARKET (*in part*)

R.F.H. Sir Roy Forbes Harrod (d. 1978). *Nuffield Reader in Economics, University of Oxford, 1952–67. Author of* International Economics *and others.*
EXCHANGE AND PAYMENTS, INTERNATIONAL (*in part*)

R.F.-He. Regina Flannery-Herzfeld. *Emeritus Professor and Senior Lecturer in Anthropology, Catholic University of America, Washington, D.C. Author of* The Gros Ventre of Montana, *Part I,* Social Life.
NORTH AMERICAN PLAINS INDIANS

R.F.Hi. Ronald Francis Hingley. *Fellow of St. Antony's College, Oxford; University Lecturer in Russian, University of Oxford. Author of* Chekhov: A Biographical and Critical Study; Russian Writers and Society; Nihilists; *and others; editor and translator of* The Oxford Chekhov.
CHEKHOV, ANTON
GORKY, MAKSIM
STALIN, JOSEPH

R.Fl. Ronald Fletcher. *Course Consultant for Open University, Walton Hall, England. Professor and Head, Department of Sociology, University of York, England, 1964–1968. Author of* Auguste Comte and the Making of Sociology *and others.*
COMTE, AUGUSTE

R.F.L. Robert Frederic Lawson. *Professor of Education and Dean, Faculty of Education, University of Calgary, Alberta. Co-author of Studies in Educational Change.*
EDUCATION, HISTORY OF (*in part*)

R.F.Li. René Felix Lissens. *Professor of Dutch and General Literature, St. Ignatius University Faculty, Antwerp. Member, Royal Flemish Academy of Language and Literature. Author of* De vlaamse letterkunde van 1780 tot heden.
LITERATURE, WESTERN: *Flemish; Renaissance, 19th, 20th century*

R.F.Lo. Richard F. Logan. *Professor of Geography, University of California, Los Angeles. Author of* Central Namib Desert.
NAMIB DESERT

R.-F.-M.A. Roger-François-Marie Aubert. *Professor of Church History, Catholic University of Louvain, Belgium. Author of* La Théologie catholique an milieu du XX^{e} siècle.
LEO XIII, POPE

R.F.P. Roland F. Pressat. *Head, Department of Statistics, National Institute for Demographic Studies, Paris. Author of* L'Analyse démographique.
DEMOGRAPHY

R.F.Pe. Ronald Francis Peel. *Emeritus Professor of Geography, University of Bristol, England. Former Chairman, Commission on Arid Lands, International Geographical Union. Author of* Physical Geography.
SAHARA (DESERT) (*in part*)

R.F.S. Robert F. Spencer. *Professor of Anthropology, University of Minnesota, Minneapolis. Author of* The North Alaskan Eskimo.
WESTERN ARCTIC CULTURES

R.F.T. René Frédéric Thom. *Mathematician, Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France. Author of* Stabilité structurelle et morphogénèse.
TOPOLOGICAL GROUPS AND DIFFERENTIAL TOPOLOGY (*in part*)

R.F.Th. Robert Folger Thorne. *Taxonomist and Curator, Rancho Santa Ana Botanic Garden, Claremont, California. Professor of Botany, Claremont Graduate School.*
SAPINDALES

R.F.Tr. Reginald Francis Treharne (d. 1967). *Professor of History, University College of Wales, Aberystwyth, University of Wales, 1930–67. Author of* The Baronial Plan of Reform, 1258–1263 *and others.*
EDWARD I OF ENGLAND
MONTFORT, SIMON DE

R.G. Roger Gibbins. *Assistant Professor of Political Science, University of Calgary, Alberta.*
ELECTORAL PROCESSES (*in part*)

R.Ga. Richard Gascon. *Professor of Local History, University of Lyon II. Author of* Grand Commerce et vie urbaine: Lyon et ses marchands au XVI^{e} siècle.
LYON

R.G.A. Raymond George Ayoub. *Professor and Head, Department of Mathematics, Pennsylvania State University, University Park. Author of* An Introduction to the Analytic Theory of Numbers.
NUMBER THEORY (*in part*)

R.G.F. Robert G. Fleagle. *Professor of Atmospheric Sciences, University of Washington, Seattle. Co-author of* An Introduction to Atmospheric Physics.
ATMOSPHERIC SCIENCES

R.G.G. Robert G. Gallager. *Professor of Electrical Engineering, Massachusetts Institute of Technology, Cambridge. Author of* Information Theory and Reliable Communication *and others.*
INFORMATION THEORY

R.Gh. Roman Ghirshman. *Archaeologist. Member, Académie des Inscriptions et Belles-Lettres, Institut de France, Paris. Emeritus Director General, French Archaeological Delegation to Iran.*
IRAN, HISTORY OF (*in part*)

R.G.H. Ralph G. Hopkinson. *Professor of Environmental Design and Engineering, University College, University of London. Author of* Lighting *and others.*
LIGHTING AND LIGHTING DEVICES

R.Gi. Robert W.V. Gittings. *Poet, biographer, and playwright. Author of* John Keats *and numerous other works on Keats.*
KEATS, JOHN

R.G.Li. R. Godfrey Lienhardt. *Reader in Social Anthropology, University of Oxford. Author of* Divinity and Experience: The Religion of the Dinka *and others.*
PRIMITIVE RELIGION

R.G.M. Robert Gwyn Macfarlane, M.D. *Emeritus Professor of Clinical Pathology, University of Oxford. Director, Medical Research Council Blood Coagulation Research Unit, Churchill Hospital, Oxford, 1959–67. Co-author of* Human Blood Coagulation and Its Disorders; *editor of* Functions of the Blood.
BLEEDING AND BLOOD CLOTTING

R.Gr. Ronald Grimsley. *Professor and Head, Department of French, University of Bristol, England. Author of* Jean d'Alembert.
ALEMBERT, JEAN LE ROND D'

R.G.R. Robert G. Richardson. *Consultant Medical Editor. Former Editor,* Abbottempo (*international medical journal*). *Author of* Surgery: Old and New Frontiers *and others.*
MEDICINE, HISTORY OF (*in part*)

R.G.S. Ralph G. Sanger (d. 1968). *Professor of Mathematics, Kansas State University, Manhattan, 1946–68. Author of* Synthetic Projective Geometry.
GEOMETRY, ANALYTIC AND TRIGONOMETRIC (*in part*)

R.G.T. Richard G. Tansey. *Professor of History of Art, San Jose State University, California. Co-author and co-editor of Helen Gardner's* Art Through the Ages (*5th and 6th ed.*).
VISUAL ARTS, WESTERN (*in part*)

R.H. Reuben Hersh. *Professor of Mathematics, University of New Mexico, Albuquerque. Author of papers on stochastic processes, differential equations, and others.*
BROWNIAN MOVEMENT

R.H.B. Roland H. Bainton. *Emeritus Professor of Church History, Yale University. Author of* The Reformation of the Sixteenth Century *and others.*
REFORMATION

R.H.Bi. R.H. Bing. *Professor of Mathematics, University of Texas at Austin. Author of* Elementary Point Set Topology.
TOPOLOGY, GENERAL

R.H.Br. Robert Harold Brown. *Professor of Geography, University of Wyoming, Laramie. Author of* Wyoming Occupance Atlas.
WYOMING

R.H.D. Robert H. Denison. *Associate, Museum of Comparative Zoology, Harvard University. Curator of Fossil Fishes, Field Museum of Natural History, Chicago, 1948–71.*
PLACODERMI

R.He. Richard Hellie. *Associate Professor of Russian History, University of Chicago. Author of* Enserfment and Military Change in Muscovy *and others.*
ALEXANDER NEVSKY
RUSSIAN SOVIET FEDERATED SOCIALIST REPUBLIC (*in part*)

R.H.E. Richard H. Eastman. *Professor of Chemistry, Stanford University, California. Author of* General Chemistry—Experiment and Theory.
ISOPRENOIDS

R.H.Fl. Richard Howell Fleming. *Professor and Chairman, Department of Oceanography, University of Washington, Seattle. Co-author of* The Oceans.
ATLANTIC OCEAN (*in part*)

R.H.Fr. Richard H. Freeborn. *Professor of Russian Literature, School of Slavonic and East European Studies, University of London. Author of* Turgenev, a Study *and others.*
TURGENEV, IVAN

R.H.Fu. Robert Henderson Fuson. *Professor and Chairman, Department of Geography, University of South Florida, Tampa. Author of* A Geography of Geography *and others.*
FLORIDA

R.H.G.L. Robert H.G. Lee. *Associate Professor of History; Chairman, Asian Studies Program, State University of New York at Stony Brook. Author of* The Manchurian Frontier in Ch'ing History.
MANCHURIA, HISTORY OF

R.H.H. Robert H. Hardie. *Professor of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee; Director, Dyer Observatory, 1961–72.*
PHOTOMETRY, ASTRONOMICAL
PLUTO

R.H.I. Ralph Hammond Innes. *Novelist and writer on history and travel. Author of* The Conquistadors *and many others.*
CORTÉS, HERNÁN

R.H.J. Richard H. Jahns. *Professor of Geology; Dean, School of Earth Sciences, Stanford University, California. Editor and co-author of* Geology of Southern California.
IGNEOUS ROCKS

R.H.M. Richard H. Manske (d. 1977). *Director of Research, Dominion Rubber Company Ltd., Guelph, Ontario, 1943–66. Editor of* The Alkaloids.
ALKALOIDS

R.H.O. Richard Horsley Osborne. *Professor of Geography, University of Nottingham, England. Author of* East-Central Europe: A Geographical Introduction to Seven Socialist States.
CZECHOSLOVAKIA (*in part*)
PRAGUE (*in part*)

R.H.P. Richard H. Popkin. *Professor of Philosophy, Washington University, St. Louis, Missouri. Author of* History of Scepticism from Erasmus to Descartes.
SKEPTICISM (*in part*)

R.H.Pa. Ralph Halstead Parker. *Emeritus Dean, School of Library and Information Science, University of Missouri, Columbia. Author of* Library Applications of Punched Cards.
LIBRARY SCIENCE

R.H.Po. René Henry Pomeau. *Professor of French Literature, University of Paris IV. Author of* La Religion de Voltaire *and others.*
VOLTAIRE

R.H.P.-W. Ralph H. Pinder-Wilson. *Deputy Keeper, Department of Oriental Antiquities, British Museum, London. Author of* Persian Painting in the Fifteenth Century.
CALLIGRAPHY (*in part*)

R.H.Ra. Robert H. Ralston. *Senior Research Chemist, Hercules Inc., Wilmington, Delaware.*
SALT AND SALT PRODUCTION (*in part*)

R.H.S. Roger Henry Simpson. *Historian and Lecturer.*
MITHRADATES VI EUPATOR

R.H.T. Ralph H. Turner. *Professor of Sociology and Anthropology, University of California, Los Angeles. Co-author of* Collective Behavior.
COLLECTIVE BEHAVIOUR

R.Hu. René Huyghe. *Professor of Art, College of France, Paris. President, Council of Museums, Paris. Author of* Cézanne; Delacroix ou le combat solitaire; *and others.*
CÉZANNE, PAUL
DELACROIX, EUGÈNE

R.H.W. Robert H. Whittaker. *Professor of Biology, Cornell University, Ithaca, New York. Author of* Communities and Ecosystems; Ordination and Classification of Communities.
COMMUNITY, BIOLOGICAL

Ri.G. Richard David Greenfield. *Senior Research Fellow, Institute of African Studies, University of Ghana, Accra. Author of* Ethiopia: A New Political History *and others.*
MENELIK II OF ETHIOPIA

Ri.H. Richard Hamilton Hobson. *Public Relations Officer, Zimco Services Ltd., London; formerly with Roan Selection Trust Management Services Ltd., Lusaka, Zambia.*
ZAMBIA

Ri.L. Richard Lane. *Research Associate, Honolulu Academy of Arts. Author of* Masters of the Japanese Print; *co-author of* Japanese Prints: From the Earliest Masters to the Modern.
HIROSHIGE
HOKUSAI

Ri.P. Richard Pittioni. *Emeritus Professor of Prehistory and Protohistory, University of Vienna. Author of* Ergebnisse und Probleme des urzeitlichen Metallhandels *and others.*
STONE AGE EUROPEAN PEOPLES, ARTS OF (*in part*)

R.I.Ro. Richard I. Rossbacher. *Head, Warfare Analysis Department, U.S. Naval Weapons Laboratory, Dahlgren, Virginia.*
BALLISTICS

Ri.W.S. Richard Walton Stephens. *Professor of Sociology, George Washington University, Washington, D.C. Co-author of* Power, Presidents, and Professors.
WASHINGTON, D.C.

R.J.A. Richard J. Andrew. *Professor of Animal Behaviour, University of Sussex, Brighton, England. Author of numerous papers on behaviour of birds and primates.*
AGGRESSIVE BEHAVIOUR
AVOIDANCE BEHAVIOUR

R.J.Al. Robert J. Alexander. *Professor of Economics and Political Science, Rutgers University, New Brunswick, New Jersey. Author of* Prophets of the Revolution: Profiles of Latin American Political Leaders.
CÁRDENAS, LÁZARO

R.J.B. Robert John Behnke. *Fisheries consultant. Part-time Associate Professor of Fishery Biology, Colorado State University, Fort Collins.*
SALMONIFORMES

R.J.C. Robert John Clements. *Chairman, Department of Comparative Literature, New York University, New York City. Author of* Michelangelo's Theory of Art; The Poetry of Michelangelo; *and others.*
MICHELANGELO

R.J.Ch. Robert Jesse Charleston. *Keeper, Department of Ceramics, Victoria and Albert Museum, London, 1963–76. Author of "Meissen and Other European Porcelain" in* Waddesdon Manor Catalogue: James A. De Rothschild Collection.
GLASS, HISTORY OF (*in part*)

R.J.F. Robert J. Fernier (d. 1977). *President, The Friends of Gustave Courbet, Paris. Author of* Gustave Courbet, peintre de l'art vivant.
COURBET, GUSTAVE

R.J.G. Richard Johnson Goss. *Professor of Biology, Brown University, Providence, Rhode Island. Author of* Principles of Regeneration.
REGENERATION, BIOLOGICAL

R.J.H. Robert J. Havighurst. *Emeritus Professor of Education and Human Development, University of Chicago. Specialist on the social pyschology of education and human development. Author of* Comparative Perspectives on Education *and others.*
TEACHING PROFESSION

R.J.Ha. Richard J. Harrison, M.D. *Professor of Anatomy, University of Cambridge. Author of* Reproduction and Man *and others.*
REPRODUCTIVE SYSTEM, HUMAN

R.J.H.-C. Ronald James Harrison-Church. *Emeritus Professor of Geography, London School of Economics and Political Science, University of London. Author of* West Africa.
DAKAR
SENEGAL RIVER

R.J.J. Roland John Jackson. *Professor of Music, Claremont Graduate School, California. Editor of* Neapolitan Keyboard Composers c. 1600.
COUNTERPOINT

R.J.K. Robert Jean Knecht. *Reader in French History, University of Birmingham, England. Author of* Francis I and Absolute Monarchy *and others.*
GUISE, HOUSE OF

R.J.M. Ronald James Morley. *Former Technical Director, Coal Products Division, National Coal Board, Harrow, England.*
COAL PROCESSING

R.J.M. De W. Roger J.M. De Wiest. *Former Professor and Chairman, Water Resources Program, Princeton University, New Jersey. Author of* Geohydrology *and others.*
GROUNDWATER

R.J.Me. Robert James Menzies. *Professor of Oceanography, Florida State University, Tallahassee. Panel Chairman in Marine Biology, Gulf University Research Corporation.*
CARIBBEAN SEA

R.J.N. Robert J. Nelson. *Professor of French and Comparative Literature, University of Illinois, Urbana. Author of* Corneille: His Heroes and Their Worlds *and others.*
CORNEILLE, PIERRE

R.J.Ne. R.J. Nelson. *Truman P. Handy Professor of Philosophy, Case Western Reserve University, Cleveland. Author of* Introduction to Automata.
AUTOMATA THEORY (*in part*)

R.J.R. Richard J. Russell (d. 1971). *Professor of Geography, Louisiana State University, Baton Rouge, 1930–71; Principal Investigator, Coastal Studies Institute, 1967–71. Author of* River Plains and Sea Coasts.
COASTAL FEATURES (*in part*)

R.J.S. Robert J. Stoller, M.D. *Professor of Psychiatry, University of California, Los Angeles. Author of* Sex and Gender: On the Development of Masculinity and Femininity.
SEXUAL DEVIATIONS

R.J.Sm. Ralph J. Smith. *Professor of Electrical Engineering, Stanford University, California. Author of* Engineering as a Career.
ENGINEERING

R.J.T. Roger John Tayler. *Professor of Astronomy; Dean, School of Mathematical and Physical Sciences, University of Sussex, Brighton, England. Author of* The Origin of the Chemical Elements *and others.*
CHEMICAL ELEMENTS, ORIGIN OF

R.J.Z. Roman J. Zorn. *Professor of History, University of Nevada, Las Vegas. Author of numerous articles on U.S. history and political science.*
NEVADA

R.J.Z.W. R.J. Zwi Werblowsky. *Professor of Comparative Religion, Hebrew University of Jerusalem. Author of* Joseph Karo, Lawyer and Mystic *and others; co-editor of* The Encyclopaedia of the Jewish Religion.
HERO WORSHIP
MESSIAH AND MESSIANIC MOVEMENTS
MIRACLE

R.K. Rudolf Kingslake. *Professor of Optics, University of Rochester. Director of Optical Design, Eastman Kodak Company, Rochester, New York, 1939–69. Author of* Lenses in Photography; *editor of* Applied Optics and Optical Engineering.
OPTICAL ENGINEERING
OPTICS, PRINCIPLES OF (*in part*)

R.K.A.G. Robert K.A. Gardiner. *Executive Secretary, United Nations Economic Commission for Africa, Addis Ababa, Ethiopia. Author of* A World of Peoples.
AFRICA (*in part*)

R.Ki. Ralph Kirkpatrick. *Harpsichordist. Emeritus Professor of Music, Yale University. Author of* Domenico Scarlatti *and others.*
SCARLATTI, DOMENICO

R.K.K. Russi Khurshedji Karanjia. *Editor in Chief, Blitz Publications Private Ltd., Bombay. Co-author of* Castro—Storm over Latin America *and others.*
CASTRO, FIDEL

R.K.L. Robert K. Lane. *Policy and Program Development Officer, Western and Northern Region, Environmental Management Service, Canadian Department of the Environment, Edmonton, Alberta. Head, Physical Limnology Section, Canada Centre for Inland Waters, Burlington, Ontario, 1967–72.*
LAKES AND LAKE SYSTEMS (*in part*)

R.K.M. Ronald K. Murton. *Senior Principal Scientific Officer, Institute of Terrestrial Ecology, Monks Wood Experimental Station, Huntingdon, England. Researcher on the*

population dynamics and behaviour of pigeons and doves. Author of The Woodpigeon.
COLUMBIFORMES

R.Kr. Richard Kroner (d. 1974). *Professor of the Philosophy of Religion, Union Theological Seminary, New York City, 1941–55. Author of* Von Kant bis Hegel.
FICHTE, JOHANN GOTTLIEB

R.K.U. Reuben Kenrick Udo. *Professor of Geography, University of Ibadan, Nigeria. Author of* Geographical Regions of Nigeria *and others.*
NIGERIA (*in part*)

R.L. Robert Lekachman. *Distinguished Professor of Economics, Herbert H. Lehman College, City University of New York. Author of* The Age of Keynes *and others.*
KEYNES, J.M.

R.La. Rex Lardner. *Free-lance writer. Author of "The Assault and Battery of Lacrosse" in* Holiday *and many books on sports.*
LACROSSE

R.L.A. Russell L. Ackoff. *Silberberg Professor of Systems Sciences, Wharton School, University of Pennsylvania, Philadelphia. Co-author of* Fundamentals of Operations Research.
OPERATIONS RESEARCH

R.Lay. Robert Layton. *Producer, Music Talks, British Broadcasting Corporation, London. Author of* Sibelius; The World of Sibelius.
SIBELIUS, JEAN

R.L.B. Rev. Robert L. Bireley, S.J. *Associate Professor of History, Loyola University, Chicago.*
XAVIER, SAINT FRANCIS

R.L.Bi. Raymond L. Bisplinghoff. *Deputy Director, National Science Foundation, Washington, D.C., 1970–74. Dean, College of Engineering, Massachusetts Institute of Technology, Cambridge, 1968–70; Professor and Head, Department of Aeronautics and Astronautics, 1966–68. Co-author of* Principles of Aeroelasticity.
AERONAUTICAL ENGINEERING

R.L.C. Robert L. Collison. *Emeritus Professor of Library Science and Information Studies, University of California, Los Angeles. Author of* Encyclopaedias: Their History Throughout the Ages *and others.*
ENCYCLOPAEDIA

R.L.C.F. Raymond-Louis-Charles Furon. *Professor of Geology, University of Paris. Author of* Géologie de l'Afrique *and others.*
AFRICA (*in part*)

R.L.Ch. Robert L. Christie. *Research Scientist, Geological Survey of Canada, Calgary, Alberta; Former Head, Arctic Islands Section. Author of numerous articles on the geology of Arctic islands.*
ARCTIC ISLANDS (*in part*)

R.L.D. R.L. Dwivedi. *Professor and Head, Department of Geography, University of Allāhābād, Uttar Pradesh, India.*
UTTAR PRADESH

R.Le. Robert Lebel. *Art expert and critic. Author of* On Marcel Duchamp *and others.*
DUCHAMP, MARCEL

R.L.F. Robert Louis Folk. *Professor of Geology, University of Texas at Austin. An authority on the classification and interpretation of sedimentary rocks. Author of* Petrology of Sedimentary Rocks.
SANDSTONES

R.L.Fr. Richard L(incoln) Frey. *Editor in Chief,* Official Encyclopedia of Bridge. *Associate Editor,* Bridge World *magazine; Emeritus Editor,* The Contract Bridge Bulletin; *Chief of Editorial Board, Charles H. Goren publications. President, International Bridge Press Association. Author of* According to Hoyle *and others.*
CRIBBAGE
RUMMY GAMES

R.L.G. Roger Lancelyn Green. *Author of* Lewis Carroll *and others; editor of* The Diaries of Lewis Carroll.
CARROLL, LEWIS

R.L.H. Richard Lawrence Hoffman. *Professor of Biology, Radford College, Virginia. Co-author of* Checklist of the Millipeds of North America.
MYRIAPOD

R.L.Ha. Rosemary Lois Harris. *Lecturer in Social Anthropology, University College, University of London. Author of* The Political Organization of the Mbembe of South-East Nigeria.
GUINEA COAST, CULTURES OF THE

R.L.He. Robert L. Heilbroner. *Professor and Chairman, Department of Economics, New School for Social Research, New York City. Author of* The Worldly Philosophers; An Inquiry into the Human Prospect; *and others.*
SMITH, ADAM

R.L.Hi. Richard Leslie Hill. *Professor of History, Abdullahi Bayero College, Ahmadu Bello University, Kano, Nigeria, 1968–69. Lecturer in Modern Near Eastern History, University of Durham, England, 1949–66. Author of* The Europeans in Sudan, 1834–78. *and others.*
MAHDĪ, AL-

R.L.J. Robert L. Johnson, M.D. *Colonel, U.S. Air Force (Medical Corps, retired); Cardiologist, Manned Spacecraft Center, National Aeronautics and Space Administration, Houston, Texas. Contributor of "Alterations in Atmospheric Pressure," in* Cecil-Loeb Textbook of Medicine *(12th–14th ed.).*
COMPRESSION AND DECOMPRESSION INJURIES

R.L.N.S. R.L.N. Sastri. *Research Officer, Telugu Academy, Hyderābād, India. Author of a series of studies of the Laurales.*
LAURALES

R.L.P. Robert Lewis Parkinson. *Chief Librarian and Historian, Circus World Museum, Baraboo, Wisconsin. Author of* The First 100 Years of the Greatest Show on Earth.
CIRCUS (*in part*)

R.L.S. Robert L. Scranton. *Emeritus Professor of Classical Art and Archaeology, University of Chicago. Author of* Aesthetic Aspects of Ancient Art; Corinth *(Vol. I, III, and XVI); and others.*
CORINTH
VISUAL ARTS, WESTERN (*in part*)

R.L.Sc. Robert L. Scheina. *Assistant Section Head, Research Section, Naval History Division, U.S. Department of the Navy, Washington, D.C. Co-author of* Capital Ships: A Handbook of American Battleships and Battle Cruisers, 1896–1969.
NAVAL SHIPS AND CRAFT (*in part*)

R.L.Se. Robert L. Seale. *Professor of Nuclear Engineering, University of Arizona, Tucson. Co-editor of* Water Production Using Nuclear Energy.
ENERGY

R.L.Sm. Robert Leo Smith. *Professor of Wildlife Biology and Ecology, West Virginia University, Morgantown. Author of* Ecology and Field Biology.
ECOLOGY

R.L.S.-R. Reginald Leslie Smith-Rose. *Secretary General, Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science. Director, Radio Research, Department of Scientific and Industrial Research, London, 1948–60.*
MARCONI, GUGLIELMO
POPOV, ALEKSANDR STEPANOVICH

R.L.Sw. Roland Lee Swink. *Director, Adult Evening Education Program, 10th Combat Support Group, United States Air Forces in Europe. Lecturer in Education, University of Maryland, Overseas Division. Author of* A Comparison of the Academic Achievement of English and American School Boys and Girls, Ages 12 and 17.
EDUCATION, HISTORY OF (*in part*)

R.L.Z. Richard L. Zusi. *Associate Curator, Division of Birds, National Museum of Natural History, Smithsonian Institution, Washington, D.C. Author of* Structural Adaptations of the Head and Neck in the Black Skimmer, Rhynchops Nigra Linnaeus.
CHARADRIIFORMES

R.L.Zi. Russel Leonard Zimmer. *Associate Professor of Biological Sciences, University of Southern California, Los Angeles.*
PHORONIDA

R.M. Roger Manvell. *Biographer and film historian. Professor of Film, Boston University. Director, British Film Academy, 1947–59. Author of* Ellen Terry; *co-author of* Hermann Göring; The Technique of Film Animation; *and many others.*
ANIMATION
GÖRING, HERMANN (*in part*)
TELEVISION AND RADIO, ARTS OF
TERRY, ELLEN

R.Ma. Roger Martinot. *Engineer in Chief, Rural Lands, Water, and Forests; Deputy Director, Ministry of Agriculture, Paris. Co-author of* La Stabulation libre des bovins Eyrolles.
FARM BUILDINGS

R.M.B. Ronald M. Berndt. *Foundation Professor and Head, Department of Anthropology, University of Western Australia, Nedlands. Co-author of* The World of the First Australians.
AUSTRALIAN ABORIGINAL CULTURES

R.McD. Raven I(oor) McDavid, Jr. *Professor of English and Linguistics, University of Chicago. Co-author of* The Pronunciation of English in the Atlantic States; *editor of H.L. Mencken's* The American Language.
SLANG; *Bibliography (in part)*
WEBSTER, NOAH

R.McK. Richard McKeon. *Charles F. Grey Distinguished Service Professor Emeritus of Philosophy and Greek, University of Chicago. Co-author of* The Freedom to Read.
CENSORSHIP

R.McK.MacI. Robert McKinlay MacIntosh. *Manager, Tin Research Institute, Inc., Columbus, Ohio. Author of numerous articles on tin, tin alloys, tin products, and tin processes.*
TIN PRODUCTS AND PRODUCTION

R.McMu. Roy Donald McMullen. *Art historian. Author of* Art, Affluence, and Alienation; The World of Marc Chagall; *and others.*
ARTS, STYLE IN THE
BRAQUE, GEORGES
CHAGALL, MARC
DAVID, JACQUES-LOUIS
KANDINSKY, WASSILY
LÉGER, FERNAND
MATISSE, HENRI
PRIMITIVE, FOLK, AND POPULAR ARTS
ROUAULT, GEORGES

R.M.D. Richard M. Dorson. *Director, Folklore Institute, and Editor,* Journal of Folklore Studies, *Distinguished Professor of History and Folklore, Indiana University,*

Bloomington. Author of American Folklore; Folklore and Fakelore; *and others; editor of the University of Chicago series,* Folktales of the World (*in progress*); *editor of* Journal of American Folklore.
FOLKLORE

R.Me. Reinhold Merkelbach. *Professor of Classics, University of Cologne, West Germany. Author of* Roman und Mysterium in der Antike *and others.*
MITHRAISM
MYSTERY RELIGIONS

R.M.G. Robert M. Grant. *Carl Darling Buck Professor of Humanities; Professor of Early Christian History, Divinity School, University of Chicago. Author of* Historical Introduction to the New Testament; Early Christianity and Society; *and others.*
BIBLICAL LITERATURE (*in part*)
GNOSTICISM

R.M.H. Ragnhild Marie Hatton. *Professor of International History, London School of Economics and Political Science, University of London. Author of* Charles XII of Sweden *and others.*
CHARLES XII OF SWEDEN

R.M.Ha. Ruth Mulvey Harmer. *Professor of English and Modern Languages, California State Polytechnic University, Pomona. Author of* The High Cost of Dying *and others.*
EMBALMING, BURIAL, AND CREMATION

R.M.He. Robert M. Henderson. *Chief, General Library and Museum of the Performing Arts, New York Public Library at Lincoln Center, New York City. Author of* D.W. Griffith, the Years at Biograph; D.W. Griffith, His Life and Times; *and others.*
GRIFFITH, D.W.

R.M.Hi. Richard M. Highsmith, Jr. *Professor and Chairman, Department of Geography, Oregon State University, Corvallis. Co-author of* Conservation in the United States.
OREGON

R.M.K. Robert M. Kingdon. *Professor of History; Director, Institute for Research in the Humanities, University of Wisconsin, Madison. Author of* Geneva and the Consolidation of the French Protestant Movement, 1564–1572 *and others.*
CALVIN, JOHN

R.M.L. R.M. Lockley. *Naturalist. Author of* Shearwaters; Puffins; *and others; co-author of* Sea Birds of the North Atlantic.
PROCELLARIIFORMES

R.M.Le. Richard M. Leighton. *Professor of National Security Affairs, National Defense University, U.S. Department of Defense, Washington, D.C. Co-author of* Global Logistics and Strategy 1940–45.
WARFARE, CONDUCT OF (*in part*)

R.M.Lu. R.M. Lumiansky. *President, American Council of Learned Societies. Professor of English, New York University, New York City. Author of* Of Sondry Folk: The Dramatic Principle in the Canterbury Tales *and others.*
CHAUCER, GEOFFREY

R.Mo. Rudolf Morsey. *Professor of Modern History, Postgraduate School for Administrative Sciences, Speyer, West Germany. Author of* Die deutsche Zentrumspartei, 1917–1923 *and others.*
STRESEMANN, GUSTAV

R.M.O. Richard Marian Ogorkiewicz. *Senior Lecturer in Mechanical Engineering, Imperial College of Science and Technology, University of London. Honorary life member of the U.S. Armour Association. Author of* Armoured Forces *and others.*
TANKS AND ARMOURED VEHICLES

R.M.Og. Robert Maxwell Ogilvie. *Professor of Humanity, University of St. Andrews, Fife, Scotland. Editor of* A Commentary on Livy, Books 1–5.
LIVY

R.M.P. Raghawendra Mukund Pai. *Professor of Botany, Marathwada University, Aurangabad, India.*
IRIDALES

R.M.S. Robert M. Saunders. *Professor of Electrical Engineering, University of California, Irvine. Co-author of* Analysis of Feedback Control Systems.
ELECTRIC MOTOR

R.M.Sa. Roger M. Savory. *Professor and Chairman, Department of Islāmic Studies, University of Toronto. Co-author of* Persia in Islamic Times: A Practical Bibliography of Its History, Culture and Language.
'ABBĀS I THE GREAT, OF PERSIA

R.My. Rollo H. Myers. *Writer on music. Author of* Modern French Music; Ravel: Life and Works; *and others.*
RAVEL, MAURICE

R.Na. Raghavan Narasimhan. *Professor of Mathematics, University of Chicago. Author of* Analysis on Real and Complex Manifolds; Several Complex Variables; *and others.*
ANALYSIS, COMPLEX (*in part*)

R.N.C. Richard N. Current. *University Distinguished Professor of History, University of North Carolina, Greensboro. Author of* Daniel Webster and the Rise of National Conservatism; The Lincoln Nobody Knows; *and others.*
LINCOLN, ABRAHAM
WEBSTER, DANIEL

R.N.DeJ. Russell N. DeJong, M.D. *Emeritus Professor of Neurology, University of Michigan Medical School, Ann Arbor. Author of* The Neurologic Examination, Incorporating the Fundamentals of Neuroanatomy and Neurophysiology.
CEREBROSPINAL FLUID

R.N.F. Richard N. Frye. *Aga Khan Professor of Iranian, Harvard University. President, Asia Institute, Pahlavi University, Shīrāz, Iran. Author of* The Heritage of Persia *and others.*
CYRUS II THE GREAT, OF PERSIA
KHOSROW I OF PERSIA

R.Ni. Romola Nijinsky (d. 1978). *Author of* Nijinsky; The Last Years of Nijinsky; *editor of* The Diary of Vaslav Nijinsky.
NIJINSKY, VASLAV

R.N.S. Rev. R. Norman Sharp. *Assistant Professor of Old Persian and Pahlavi, Pahlavi University, Shīrāz, Iran, 1962–67. Author of* The Inscriptions of the Achaemenian Emperors in Old Persian Cuneiform *and others.*
PERSEPOLIS

R.O. Ron Olver. *British correspondent,* The Ring. *Former Assistant Editor,* Boxing World *and* Boxing News. *Co-author of* Boxing.
BOXING

Ro.A. Roberto Almagià (d. 1962). *Professor of Geography, University of Rome, 1915–59. Author of* Il mondo attuale *and many others.*
VESPUCCI, AMERIGO

Ro.A.K. Roy A. Keller. *Professor of Chemistry, State University of New York, College at Fredonia. Editor,* Journal of Chromatographic Science; *co-editor of* Advances in Chromatography.
CHROMATOGRAPHY (*in part*)

Ro.Au. Robert Auty (d. 1978). *Professor of Comparative Slavonic Philology, University of Oxford, (1965–78); Fellow of Brasenose College, Oxford.*
LITERATURE, WESTERN: *Czech and Slovak*

R.O.C. Robert O. Collins. *Dean, Graduate Division; Professor of History, University of California, Santa Barbara. Author of* Land Beyond the Rivers: The Southern Sudan, 1898–1918 *and others.*
NILOTIC SUDAN, HISTORY OF THE

R.O.C.N. Richard O.C. Norman. *Professor of Chemistry, University of York, England. Author of* Principles of Organic Synthesis.
CHEMICAL SYNTHESIS, PRINCIPLES OF

R.O.F. Raymond Oliver Faulkner. *Fellow of University College, London; Lecturer in Ancient Egyptian, University College, University of London, 1955–67. Author of* Egypt; From the Inception of the Nineteenth Dynasty to the Death of Ramesses III *and others.*
RAMSES II THE GREAT

R.O.H. Raymond O. Harrison. *Director, Provincial Museum and Archives, Edmonton, Alberta.*
ALBERTA (*in part*)

Ro.H.R. Robert Henry Robins. *Professor of General Linguistics, University of London. Author of* General Linguistics: An Introductory Survey.
LANGUAGE

Ro.L. Robert Lechène. *Journalist and popular science writer. Author of* L'Imprimerie, de Gutenberg à l'électron *and others.*
PRINTING

Ro.M. Robert Merle. *Novelist. Author of* Ahmed Ben Bella *and others.*
BEN BELLA, AHMED

Ro.Ma. Robert L. Marshall. *Professor of Music, University of Chicago. Author of* The Compositional Process of J.S. Bach.
BACH, JOHANN SEBASTIAN (*in part*)

Ro.N. Robert Niklaus. *Emeritus Professor of French, University of Exeter, England. Author of* A Literary History of France: The Eighteenth Century; *editor of Diderot's* Pensées philosophiques; Lettre sur les aveugles.
DIDEROT, DENIS

Ro.P. Robert Parienté. *Editor in Chief,* L'Équipe (*daily sports newspaper*), *Paris. Author of* La Fabuleuse Histoire de l'athlétisme.
CYCLING

Ro.Pa. Roy Pascal. *Emeritus Professor of German, University of Birmingham, England. Author of* The German Novel *and others.*
MANN, THOMAS

Ro.Pe. Roger Pélissier (d. 1972). *Assistant Director, Centre for Far East Documentation, École Pratique des Hautes Études (Institute for Advanced Research), Paris. Author of* The Awakening of China, 1793–1949 *and others.*
CH'IEN-LUNG

Ro.Po. Roland Palmedo (d. 1977). *President, Amateur Ski Club of New York. Co-founder, National Ski Patrol. Author of* Ski New Horizons; *editor of* Skiing: The International Sport.
SKIING

Ro.R. Rollin C. Richmond. *Associate Professor of Biology, Indiana University, Bloomington.*
GENE (*in part*)

Ro.Ri. Roberto Ridolfi. *Member of Accademia Nazionale dei Lincei. Director of* La Bibliofilia. *Director of "National Editions of the Works of Savonarola." Author of* Life of Machiavelli *and others.*
MACHIAVELLI, NICCOLÒ
SAVONAROLA, GIROLAMO

Ro.S. Ronald Strahan. *Research Fellow, Australian Museum, Sydney. Director, Taronga*

Zoological Park, Sydney, Australia, 1967–74. Co-author of The Biology of Myxine.
AGNATHA

Ro.Si. Roy Sieber. *Rudy Professor of Fine Art, Indiana University, Bloomington. Author of* African Textiles and Decorative Arts.
METALWORK (*in part*)

Ro.W. Robert L. Wilken. *Professor of the History of Christianity, University of Notre Dame, Indiana. Author of* The Myth of Christian Beginnings *and others.*
TERTULLIAN

Ro.W.F. Robert W. Finley. *Professor and Chairman, Department of Geography and Geology, University of Wisconsin, Madison. Author of* Geography of Wisconsin: A Content Outline.
WISCONSIN

Ro.W.S. Robert Wooster Stallman. *Emeritus Professor of English, University of Connecticut, Storrs. Author of* Stephen Crane: A Biography; Stephen Crane: A Critical Bibliography; *and others.*
CRANE, STEPHEN

Ro.W.St. Robert Walter Steel. *Principal, University College of Swansea, University of Wales. John Rankin Professor of Geography, University of Liverpool, 1957–74. President, African Studies Association of the U.K., 1970–71.*
AFRICA (*in part*)

R.P. René Pélissier. *Authority on Portuguese- and Spanish-speaking Africa. Author of* Los territorios españoles de Africa; Études hispano-guinéennes; *co-author of* Angola.
EQUATORIAL GUINEA
PORTUGUESE GUINEA

R.Pa. Reginald Passmore. *Reader in Physiology, University of Edinburgh. Co-author of* Human Nutrition and Dietetics.
NUTRITION AND DIET, HUMAN

R.P.A. Richard Paul Aulie. *Former Lecturer in Natural Science, Loyola University, Chicago. Associate Editor,* Encyclopædia Britannica, *Chicago, 1971–72.*
EUDOXUS OF CNIDUS

R.Pal. Rodolfo Pallucchini. *Professor of the History of Art, University of Padua, Italy. Author of* Disegni di Giambattista Tiepolo; La giovinezza del Tintoretto; Veronese; *and others.*
TIEPOLO, GIOVANNI BATTISTA
TINTORETTO
VERONESE, PAOLO

R.P.An. Richard Paul Anschutz. *Emeritus Professor of Philosophy, University of Auckland, New Zealand. Author of* Philosophy of J.S. Mill.
MILL, JOHN STUART

R.P.B. Ronald Percy Bell. *Emeritus Professor of Chemistry, University of Stirling, Scotland. Honorary Research Professor of Physical Chemistry, University of Leeds, England. Author of* Acid-Base Catalysis *and others.*
ACID-BASE REACTIONS AND EQUILIBRIA

R.P.B.P. Robert P.B. Paine. *Professor of Anthropology, Memorial University of Newfoundland, St. John's. Author of* Coast Lapp Society.
EASTERN ARCTIC CULTURES

R.P.C.M. Reginald P.C. Mutter. *Reader in English Literature; Dean, School of English and American Studies, University of Sussex, Brighton, England. Editor of* The History of Tom Jones.
DEFOE, DANIEL
STEELE, SIR RICHARD
Reviewer: LITERATURE, WESTERN (*in part*)

R.Pe. Régine Pernoud. *Keeper, Joan of Arc Centre, Orléans, France. Author of* Aliénor d'Aquitaine; Héloïse and Abélard; Histoire de la bourgeoisie en France; *and others.*
ELEANOR OF AQUITAINE
VILLON, FRANÇOIS

R.P.H. Richard P. Hall (d. 1969). *Professor of Biology, New York University, New York City, 1938–68. Author of* Protozoology; Protozoa; Protozoan Nutrition.
PROTOZOA

R.P.He. Robert Proulx Heaney, M.D. *Vice President for Health Sciences, School of Medicine, Creighton University, Omaha, Nebraska. Co-author of* Skeletal Renewal and Metabolic Bone Diseases.
BONE (*in part*)

R.Pi. Robert Pick (d. 1978). *Free-lance writer and editor. Author of* Empress Maria Theresa.
MARIA THERESA, EMPRESS

R.P.M. Robert P. Multhauf. *Senior Researcher, Smithsonian Institution, Washington, D.C. Author of* The Origins of Chemistry *and others.*
ALCHEMY

R.Po. Raphael Powell (d. 1965). *Professor of Roman Law, University of London, 1955–64.*
ROMAN LAW (*in part*)

R.P.S. Robert P. Scharlemann. *Professor of Religion, University of Iowa, Iowa City. Author of* Reflection and Doubt in the Thought of Paul Tillich *and others.*
LUTHERAN CHURCHES
SCHLEIERMACHER, FRIEDRICH

R.P.Sp. Robert Phillip Sharp. *Professor of Geology, California Institute of Technology, Pasadena. Author of* Glaciers.
WIND ACTION

R.Q. Ricardo Quintana. *Emeritus Professor of English, University of Wisconsin, Madison. Author of* Mind and Art of Jonathan Swift; Oliver Goldsmith: A Georgian Study.
GOLDSMITH, OLIVER
SWIFT, JONATHAN

R.R. Romney Robinson. *Professor of Economics, University of Toronto, 1967–70. Associate Professor of Economics, Brandeis University, Waltham, Massachusetts, 1955–67.*
TRADE, INTERNATIONAL

R.R.B. Richard R. Beeman. *Associate Professor of History, University of Pennsylvania, Philadelphia. Author of* The Old Dominion and the New Nation, 1788–1801.
UNITED STATES, HISTORY OF THE (*in part*)

R.R.D. Ranjit Ramchandra Desai. *Agriculturist and writer. Author of* Śrīmāna Yogī: the Life of Śivajī in Marathi *and others.*
ŚIVAJĪ

R.Ri. Raymond Ritter (d. 1974). *Attorney. Editor in Chief of the review,* Pyrénées. *Author of* Henry IV lui-même; *editor of* Lettres du cardinal de Florence sur Henri IV et sur la France (1596–1598).
HENRY IV OF FRANCE

R.R.M. Raymond R. Myers. *University Professor of Chemistry, Kent State University, Ohio. Co-editor of* Treatise on Coatings.
PAINTS, VARNISHES, AND ALLIED PRODUCTS

R.Ro. Ralph Zvi Roskies. *Associate Professor of Physics, University of Pittsburgh.*
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

R.R.P. Robert R. Pennington. *Professor of Commercial Law, University of Birmingham, England. Special legal adviser to the Commission of European Communities. Author of* Company Law *and others.*
BUSINESS ASSOCIATIONS, LAW OF

R.R.Pr. Richard Riseley Proud (d. 1975). *Lieutenant Colonel, Indian Army.*
NEPAL (*in part*)

R.R.R. Richard R. Ring. *Former Assistant Professor of History, Ripon College, Ripon, Wisconsin.*
ROME (*in part*)

R.R.S. Robert R. Stoll. *Professor and Chairman, Department of Mathematics, Cleveland State University. Author of* Set Theory and Logic.
SET THEORY (*in part*)

R.R.Sc. Robert R. Schwanke. *Professor, Centre of Eastern Studies, Vienna. Contributor of Albania section in P. Horecky,* Southeastern Europe.
ALBANIA (*in part*)

R.S. Roger Sharrock. *Professor of English Language and Literature, King's College, University of London. Author of* John Bunyan *and others.*
BUNYAN, JOHN

R.S.B. Rupert Stevenson Bradley. *Former Reader in Inorganic and Structural Chemistry, University of Leeds, England. Co-author and editor of* High Pressure Physics and Chemistry.
BRIDGMAN, PERCY WILLIAMS

R.S.Be. R. Stephen Berry. *Professor, Department of Chemistry and James Franck Institute, University of Chicago. Author of numerous papers on the interactions of light and electrons with atoms and molecules.*
PHOTOCHEMICAL REACTIONS

R.Sc. R.A.M. Schmidt. *Consulting geologist. Chairman, Geology Department, Anchorage Community College, University of Alaska. Geologist, Geological Survey, U.S. Department of the Interior, 1943–56; District Geologist, Anchorage, Alaska, 1956–63.*
ALASKAN MOUNTAINS

R.S.C. Richard S. Cowan. *Senior Scientist, Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C.*
ROSALES

R.Sch. Reiner Schürmann. *Associate Professor of Philosophy; Chairman, Graduate Faculty, New School for Social Research, New York City. Author of* Meister Eckhart, Mystic and Philosopher.
ECKEHART, MEISTER

R.S.D. Robert Sinclair Dietz. *Professor of Geology, Arizona State University, Tempe. Co-author of* Seven Miles Down; The Story of the Bathyscaph Trieste.
OCEAN BASINS

R.S.De. Most Rev. Ralph Stanley Dean. *Theological Consultant, Christ Church, Greenville, South Carolina. Archbishop of Cariboo and Metropolitan of the Anglican Province of British Columbia, 1971–73. Author of* In the Light of the Cross.
ANGLICAN COMMUNION

R.S.Du. Richard S. Dunn. *Professor of History, University of Pennsylvania. Author of* Puritans and Yankees *and others.*
WINTHROP, JOHN

R.S.E. Robert S. Ellwood, Jr. *Bishop James W. Bashford Professor of Oriental Studies, University of Southern California, Los Angeles.*
CELIBACY

R.S.F.S. Richard S.F. Schilling. *Professor of Occupational Health, University of London; Director, TUC Centenary Institute of Occupational Health, London School of Hygiene and Tropical Medicine. Co-author and editor of* Occupational Health Practice.
INDUSTRIAL MEDICINE

R.Sh. Robert Shackleton. *Bodley's Librarian, University of Oxford; Fellow of Brasenose*

College, Oxford; Lecturer in French, 1949–65. Author of Montesquieu: A Critical Biography.
LITERATURE, WESTERN: *French; 18th century*
MONTESQUIEU

R.S.H. Richard S. Hartenberg. *Emeritus Professor of Mechanical Engineering, Northwestern University, Evanston, Illinois. Co-author of* Kinematic Synthesis of Linkages.
FULTON, ROBERT
HAND TOOLS

R.Si. Raymond Siever. *Professor and Chairman, Department of Geological Sciences, Harvard University. Co-author of* Sand and Sandstone; Earth.
SILICEOUS ROCKS

R.Sk. Robert A. Sklar. *Professor of Cinema and Chairman, Department of Cinema Studies, New York University, New York City. Author of* F. Scott Fitzgerald: The Last Laocoön; *editor of* The Plastic Age: 1917–1930.
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STAINED GLASS (*in part*)

R.Sp. Robert Spence (d. 1976). *Master of Keynes College; Professor of Applied Chemistry, University of Kent at Canterbury, England, 1968–73. Director, Atomic Energy Research Establishment, Harwell, England, 1964–68. Author of the obituary memoir on Otto Hahn for the Royal Society.*
HAHN, OTTO

R.S.Q. Robert S. Quimby. *Professor of Humanities, Michigan State University, East Lansing. Author of* The Background of Napoleonic Warfare.
VAUBAN, SÉBASTIEN LE PRESTRE DE

R.St. Ralph Stephenson. *Director, Paris Pullman Cinema, London. Author of* The Animated Film; *co-author of* The Cinema as Art.
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BA'AL SHEM ṬOV
LURIA, ISAAC BEN SOLOMON

R.S.V. René Santamaria Varela. *Director, R.V. y Asociados (management consultants), San Salvador, El Salvador.*
EL SALVADOR

R.S.W. Richard S. Westfall. *Professor of History of Science, Indiana University, Bloomington. Author of* The Construction of Modern Science; Force in Newton's Physics.
NEWTON, SIR ISAAC
RAY, JOHN

R.S.Y. Roland S. Young. *Consulting Chemical Engineer. Author of* Analytical Chemistry of Cobalt *and others; editor of* Cobalt: Its Chemistry, Metallurgy, Uses.
COBALT PRODUCTS AND PRODUCTION

R.T. Robert Traub. *Colonel, U.S. Army (Retired). Professor of Microbiology, University of Maryland, Baltimore. Author of numerous scientific papers, including several on fleas.*
SIPHONAPTERA (*in part*)

R.T.A. Robert T. Anderson. *Edward Hohfeld Professor of Anthropology, Mills College, Oakland, California. Author of* Traditional Europe: A Study in Anthropology and History.
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R.T.An. Roger T. Anstey. *Professor of Modern History, University of Kent at Canterbury, England. Author of* King Leopold's Legacy: The Congo Under Belgian Rule, 1908–1960 *and others.*
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R.T.C. Robert Thomas Coupland. *Professor and Head, Department of Plant Ecology, University of Saskatchewan, Saskatoon.*
GRASSLANDS

R.T.D. Ralph Thomas Daniel. *Professor of Music History; Director of Graduate Studies, School of Music, Indiana University, Bloomington. Co-author of* The Harvard Brief Dictionary of Music.
MUSIC, WESTERN

Rt.H. Robert Ho (d. 1972). *Senior Fellow, Department of Human Geography, Australian National University, Canberra. Author of* Farmers of Central Malaya; *editor of* Studies in the Geography of Southeast Asia.
SINGAPORE

R.Th. Romila Thapar. *Professor of Ancient Indian History, Jawaharlal Nehru University, New Delhi. Author of* A History of India (*Vol. I.*).
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

R.T.H. Robert Thomas Harms. *Professor of Linguistics, University of Texas at Austin. Author of* Estonian Grammar; Finnish Structural Sketch; *and many articles on the individual Uralic languages.*
URALIC LANGUAGES

R.T.L. Richard T. Lockhart. *President, Social Engineering Associates, Chicago; editor,* Illinois Political Reporter.
ILLINOIS (*in part*)

R.T.La. Robert Terence Lange. *Reader in Botany, University of Adelaide, Australia. Co-author of* Symbiosis.
AUSTRALIA (*in part*)

R.T.S. R. Thomas Sanderson. *Professor of Chemistry, Arizona State University, Tempe. Author of* Chemical Bonds and Bond Energy *and others.*
NITROGEN GROUP ELEMENTS AND THEIR COMPOUNDS

R.T.V. Richard T. Vann. *Professor of History and Letters, Wesleyan University, Middletown, Connecticut. Author of* The Social Development of English Quakerism, 1655–1755.
FRIENDS

R.T.We. Richard Tilghman Weidner. *Associate Dean, Rutgers College; Professor of Physics, Rutgers University. Co-author of* Elementary Modern Physics *and others.*
PHYSICS

Ru.M. Russell Meiggs. *Emeritus Fellow of Balliol College, Oxford; Lecturer in Ancient History, University of Oxford, 1939–70. Author of* Ostia; *editor of J.M. Bury's* History of Greece *and others.*
ALCIBIADES
CLEISTHENES OF ATHENS
GREEK CIVILIZATION, ANCIENT (*in part*)

Ru.S. Ruth Stephan (d. 1974). *Writer. Author of* The Flight; My Crown, My Love; *and others.*
CHRISTINA OF SWEDEN

Ru.V. Rudolf Vierhaus. *Professor and Director, Max Planck Institute for History, Göttingen, West Germany. Author of* Ranke und die soziale Welt *and others.*
RANKE, LEOPOLD VON

R.V. Randolph Vigne. *Director, Stillit Books Ltd., London. Author of* The Transkei: A South African Tragedy.
SOUTH AFRICA (*in part*)

R.Va. Richard Vaughan. *Professor of History, University of Hull, England. Author of* Philip the Good; John the Fearless.
JOHN THE FEARLESS, DUKE OF BURGUNDY
PHILIP THE GOOD, DUKE OF BURGUNDY

R.V.D. Robert V. Daniels. *Professor of History, University of Vermont, Burlington. Author of* Red October *and others.*
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R.V.F. Richard V. Fisher. *Professor of Geology, University of California, Santa Barbara.*
IGNEOUS ROCKS, PYROCLASTIC

R.Vi. Reino Virtanen. *Professor of Romance Languages, University of Nebraska, Lincoln. Author of* Claude Bernard and His Place in the History of Ideas.
BERNARD, CLAUDE

R.V.R. Robert Vincent Roosa. *Partner, Brown Brothers, Harriman and Company, New York City. Under Secretary for Monetary Affairs, U.S. Department of the Treasury, 1961–64. Vice President, Research Department, Federal Reserve Bank, New York City, 1956–60. Author of* Federal Reserve Operations in the Money and Government Securities Markets *and others.*
MONEY MARKET (*in part*)

R.V.R.C.R. R.V.R. Chandrasekhara Rao. *Reader and Head, Department of Politics and Public Administration, Andhra University, Waltair, India. Editor of* Indian Unity.
ANDHRA PRADESH
HYDERĀBĀD

R.W. Rex Wailes. *Consultant, U.K. Department of the Environment and National Trust on Industrial Monuments. Author of* The English Windmill *and others.*
WATERWHEEL
WINDMILL

R.W.A. R.W. Allard. *Professor of Genetics, University of California, Davis. Author of* Principles of Plant Breeding.
PLANT BREEDING

R.W.B. Roger William Benedict. *Managing Editor,* Petroleum Intelligence Weekly, *London.*
NORTHWEST PASSAGE
SAINT LAWRENCE SEAWAY

R.W.Bd. Raymond Walter Barnard (d. 1962). *Associate Professor of Mathematics, University of Chicago, 1932–62.*
GEOMETRY, ANALYTIC AND TRIGONOMETRIC (*in part*)

R.W.C. Robert W. Cahn. *Professor of Materials Science, University of Sussex, Brighton, England. Editor of* Physical Metallurgy.
AGRICOLA, GEORGIUS

R.W.Co. Richard W. Cottle. *Professor of Operations Research, Stanford University, California.*
OPTIMIZATION, MATHEMATICAL THEORY OF (*in part*)

R.W.D. Ronald Walter Douglas. *Emeritus Professor of Glass Technology, University of Sheffield, England. Editor of* Glass

Technology; Physics and Chemistry of Glasses.
GLASSY STATE

R.W.D.E. Robert Walter Dudley Edwards. *Professor of Modern Irish History, University College, Dublin, National University of Ireland. Author of* Church and State in Tudor Ireland *and others.*
BRITAIN AND IRELAND, HISTORY OF (*in part*)

R.W.Di. Robert William Ditchburn. *Emeritus Professor of Physics, University of Reading, England. Author of* Light.
LIGHT

R.We. Robert Werner. *Professor of Ancient History, Friedrich Alexander University of Erlangen-Nuremberg, West Germany. Author of* Der Beginn der römischen Republik.
PTOLEMY I SOTER

R.W.E. Richard W. Everett. *Vice President, Economic Research Division, Chase Manhattan Bank, New York City.*
ECONOMIC FORECASTING

R.W.F. Rhodes W. Fairbridge. *Professor of Geology, Columbia University. World authority on Quaternary history, events, and processes. Editor of* Encyclopedia of Geomorphology; Encyclopedia of World Regional Geology *and others.*
EARTH, PHYSIOGRAPHY OF
HOLOCENE EPOCH

R.W.Fi. Sir Raymond William Firth. *Emeritus Professor of Anthropology, University of London. Internationally known for his contributions in social anthropology. Author of* Man and Culture: An Evaluation of the Work of Bronislaw Malinowski.
MALINOWSKI, BRONISLAW

R.W.Fo. Roland Wynfield Force. *Director, Museum of the American Indian, New York City. Co-editor of* Polynesian Culture History.
OCEANIAN PEOPLES AND CULTURES

R.W.H. Russell W. Henke. *Consulting Engineer. Education Consultant, Institute for Fluid Power Education. Author of* Introduction to Fluid Mechanics *and others.*
HYDRAULICS, APPLICATIONS OF

R.W.Ha. Robert W. Hamilton, Jr. *Research Supervisor, Research and Development Laboratory, Ocean Systems, Inc., Tarrytown, New York, 1969–74.*
LIFE-SUPPORT SYSTEMS

R.W.He. Robert W. Henderson. *Librarian, Racquet and Tennis Club, New York City.*
JAI ALAI: *Bibliography*

R.Wk. Richard Weck. *Director General, Welding Institute, Cambridge, England.*
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

R.W.M. Robert W. Marks. *Lecturer, New School for Social Research, New York City. Author of* The Dymaxion World of Buckminster Fuller.
FULLER, R. BUCKMINSTER

R.W.Ma. Richard W. Macomber. *Professor of Physics, Brooklyn Center, Long Island University, Brooklyn, New York.*
LYELL, SIR CHARLES
SMITH, WILLIAM

R.W.P. Richard W. Pohl. *Distinguished Professor of Botany; Curator of the Herbarium, Iowa State University, Ames. Author of* How to Know the Grasses.
POALES

R.W.S. Reginald W. Sims. *Head, Annelida Section, Department of Zoology, British Museum (Natural History), London.*
ECHIURA
SIPUNCULA

R.W.St. Robert W. Storer. *Professor of Zoology; Curator of Birds, Museum of Zoology, University of Michigan, Ann Arbor.*
BIRD
PODICIPEDIFORMES

R.W.V. Robert W. Vance. *Consultant in Cryogenic Engineering. Member, National Research Council. Managing Director, Cryogenic Society of America. Editor of* Cryogenic Technology; *co-editor of* Applications of Cryogenic Technology.
CRYOGENICS, APPLICATIONS OF

R.W.Y. Ralph W. Yerger. *Professor of Biology, Florida State University, Tallahassee.*
OSTARIOPHYSI

R.Y.C. Roy Yorke Calne. *Professor of Surgery, University of Cambridge. Author of* Renal Transplantation *and others.*
TRANSPLANTS, ORGAN AND TISSUE

R.Y.T. Robert Young Thomson. *Senior Lecturer in Biochemistry, University of Glasgow.*
NUCLEIC ACID (*in part*)

S.A. Stanley W. Angrist. *Professor of Mechanical Engineering, Carnegie-Mellon University, Pittsburgh. Author of* Direct Energy Conversion.
PERPETUAL MOTION

S.A.G. Samuel A. Goudsmit. *Editor in Chief, American Physical Society, 1951–74. Senior Scientist, Brookhaven National Laboratory, Upton, New York, 1948–70. Co-author of* Atomic Energy States.
ATOMIC STRUCTURE (*in part*)

S.A.K. Samuel Alexander Kirk. *Professor of Special Education, University of Arizona, Tucson. Author of* Educating Exceptional Children *and others.*
EDUCATION OF THE EXCEPTIONAL

S.A.Kr. Stepan Andriyovich Kryzhanivsky. *Head, Department of the History of Ukrainian Soviet Literature, Institute of Literature, Ukrainian S.S.R. Academy of Sciences, Kiev. Co-author of* History of Ukrainian Literature, *vol. 8.*
LITERATURE, WESTERN: *Ukrainian (in part)*

S.A.M. Samuel A. Matz. *Vice President, Research and Development, Ovaltine Food Products, Villa Park, Illinois. Author of* Cookie and Cracker Technology.
BAKING AND BAKERY PRODUCTS

S.Ar. Silvano Arieti, M.D. *Clinical Professor of Psychiatry, New York Medical College, New York City. Author of* Interpretation of Schizophrenia *and others; editor of* American Handbook of Psychiatry.
PSYCHOSES

S.A.R. Sh. Abdur Rashid. *Adviser, Research Society of Pakistan, Lahore. Director, Historical Research Institute; Head, Department of History, University of the Punjab, Lahore, Pakistan, 1960–65. Author of* History of Muslims of India and Pakistan *and others.*
MUḤAMMAD IBN TUGHLUQ

S.Ara. Sinnappah Arasaratnam. *Professor of History, University of New England, Armidale, Australia. Author of* Ceylon *and others.*
CEYLON, HISTORY OF

S.A.Ri. Stefan Albrecht Riesenfeld. *Emmanuel S. Heller Professor Emeritus of Law, University of California, Berkeley. Author of* Cases and Materials on Creditors' Remedies and Debtors' Protection.
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S.A.S. Stanley A. Schumm. *Professor of Geology, Colorado State University, Fort Collins.*
SEDIMENT YIELD OF DRAINAGE SYSTEMS

S.A.V. Sergey Arsentyevich Vodovozov. *Head, Section of Economics of North Caucasus, Central Research Economic Institute of the R.S.F.S.R. Planning Committee.*
RUSSIAN SOVIET FEDERATED SOCIALIST REPUBLIC (*in part*)

S.A.W. Stephen A. Wurm. *Professor of Linguistics, School of Pacific Studies, Australian National University, Canberra. Author of* Languages of Australia and Tasmania; Papuan Languages of Oceania.
AUSTRALIAN ABORIGINAL LANGUAGES
PAPUAN LANGUAGES

S.A.Wo. Stanley A. Wolpert. *Professor of History, University of California, Los Angeles. Author of* Tilak and Gokhale; Morley and India; *and others.*
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

S.B. Suri Balakrishna. *Assistant Director, National Geophysical Research Institute, Council of Scientific and Industrial Research, Hyderābād, India. Author of* Earth.
BENGAL, BAY OF

S.B.Co. Saul Bernard Cohen. *Director, Graduate School of Geography, Clark University, Worcester, Massachusetts.*
DEAD SEA (*in part*)

S.Be. Staffan Bergsten. *Docent in Literary History, University of Uppsala, Sweden. Author of* Jaget och världen: Kosmiska analogier i svensk 1900–talslyrik.
LITERATURE, WESTERN: *Swedish (in part)*

S.B.F. Stuart Berg Flexner. *Former Vice President and Director of the Reference Book Division, Random House, Inc., New York City. Co-author and editor of* The Random House Dictionary of the American Language.
SLANG: *Bibliography (in part)*

S.Bh. Rev. Sebastian Bullough, O.P. (d. 1967). *Lecturer in Hebrew, University of Cambridge.*
DOMINIC, SAINT (*in part*)

S.Bl. Solomon Bluhm. *Professor of Education, Hunter College, City University of New York, 1930–59.*
FROEBEL, FRIEDRICH

S.B.L.N. Shyam Behari Lal Nigam. *Director, Indian Economic Service, Government of India. Chief, Jobs and Skills Programme for Africa, International Labour Organization, Addis Ababa, Ethiopia.*
ASSAM (*in part*)

S.B.O. Sherry B. Ortner. *Associate Professor of Anthropology, University of Michigan, Ann Arbor. Author of* Sherpas Through Their Rituals.
PURIFICATION RITES AND CUSTOMS

S.Br. Savile Bradbury. *University Lecturer in Human Anatomy, University of Oxford; Fellow of Pembroke College, Oxford. Author of* The Evolution of the Microscope.
MICROSCOPE

S.Bu. Salvino Busuttil. *Director, Division of Human Settlements and Socio-cultural Environments, United Nations Educational, Scientific, and Cultural Organization, Paris. Former Professor and Head, Department of Economics, Royal University of Malta, Msida. Author of* Fiscal Policy in Malta.
MALTA

S.C. Seymour Cain. *Senior Editor, Religion,* Encyclopædia Britannica, *Chicago, 1967–73. Author of* Gabriel Marcel.
BIBLICAL LITERATURE (*in part*)
MARCEL, GABRIEL

S.C.E. Søren Christian Egerod. *Professor of East Asian Languages; Director, Scandinavian Institute of Asian Studies, University of Copenhagen. Editor,* Acta Orientalia. *Author of* The Lungtu Dialect *and others.*
SINO-TIBETAN LANGUAGES

S.Ch. Sripati Chandrasekhar. *Vice-Chancellor and President, Annamalai University, India. Member, Rajya Sabha (upper house of the Indian Parliament), 1964–70. Director, Indian Institute for Population Studies, Gandhinagar, 1956–67. Author of* Asia's Population Problems *and others.*
ASIA (*in part*)

S.C.K. Stephen Cole Kleene. *Cyrus C. MacDuffee Professor of Mathematics and Computer Sciences, University of Wisconsin, Madison. Author of* Introduction to Metamathematics; Mathematical Logic.
MATHEMATICS, FOUNDATIONS OF (*in part*)

S.C.N. Rt. Rev. Stephen Charles Neill. *Professor of Philosophy and Religious Studies, University of Nairobi, Kenya, 1969–73. Author of* The Church and Christian Missions; Anglicanism; *and others.*
OLD CATHOLIC CHURCHES

S.C.O.C. Sten C.O. Carlsson. *Professor of History, University of Uppsala, Sweden. Author of* Svensk historia *and others.*
CHARLES XIV JOHN, OF SWEDEN AND NORWAY

S.C.P. Stephen C. Pepper (d. 1972). *Mills Professor of Philosophy, University of California, Berkeley, 1930–58. Author of* Basis of Criticism in the Arts.
AESTHETICS (*in part*)

S.D. Stanley Dufford. *Film and television make-up artist. Make-up and Wig Supervisor, Lyric Opera of Chicago.*
STAGING AND STAGE DESIGN (*in part*)

S.-d.C. Sen-dou Chang. *Professor of Geography, University of Hawaii, Honolulu. Author of "Peking: The Growing Metropolis of Communist China" in* Geographical Review.
PEKING

S. Der N. Sirarpie Der Nersessian. *Emeritus Professor of Byzantine Art, Dumbarton Oaks Research Library and Collection, Washington, D.C. Author of* L'Illustration des psautiers grecs du moyen-âge; L'Art arménien.
VISUAL ARTS, WESTERN (*in part*)

S.Di. Sven Dijkgraaf. *Professor and Head, Department of Comparative Physiology, Utrecht University, The Netherlands.*
MECHANORECEPTION

S.Dr. Seymour Drescher. *Professor of History, University of Pittsburgh. Author of* Tocqueville and England *and others.*
TOCQUEVILLE, ALEXIS DE

S.E. Samuel Eilon. *Professor and Head, Department of Management Science, Imperial College of Science and Technology, University of London. Author of* Elements of Production Planning and Control.
PRODUCTION MANAGEMENT

S.E.B. Susan Elizabeth Booth. *Former Assistant Keeper, Department of Western Art, Ashmolean Museum, University of Oxford.*
HOGARTH, WILLIAM
VISUAL ARTS, WESTERN (*in part*)

S.E.C. Sam E. Clagg. *Professor of Geography, Marshall University, Huntington, West Virginia. Author of* West Virginia Historical Almanac *and others.*
WEST VIRGINIA

Se.F. Seymour Feldman. *Professor and Chairman, Department of Philosophy, Rutgers College, Rutgers University, New Brunswick, New Jersey.*
JEWISH PHILOSOPHY: *Bibliography*

S.E.F. Samuel Edward Finer. *Professor of Government, Victoria University of Manchester. Author of* Anonymous Empire: A Study of the Lobby in Great Britain *and others.*
SPECIAL-INTEREST GROUPS

Se.M. Sengaku Mayeda. *Associate Professor of Indian Philosophy, University of Tokyo. Editor of Śaṅkara's* Upadeśasāhasrī.
ŚAṄKARA

S.E.McG. Samuel Emmett McGregor. *Collaborator and former Apiculturist, Bee Research Laboratory, U.S. Department of Agriculture, Tucson, Arizona. Co-author of* Beekeeping in the United States.
BEEKEEPING

S.Er. Sirri Erinc. *Professor of Geography, University of Istanbul. Author of* Geography of Eastern Anatolia.
TURKEY (*in part*)
VAN, LAKE

S.E.T. Stephen E. Toulmin. *Professor, Committee on Social Thought and Department of Philosophy, University of Chicago. Author of* Philosophy of Science.
SCIENCE, PHILOSOPHY OF

S.F.B. Stanley F. Bergstein. *Executive Vice President, Harness Tracks of America, Chicago. Vice President, Publicity—Public Relations, U.S. Trotting Association, and Executive Editor,* Hoof Beats *magazine, 1968–75.*
HORSE RACING (*in part*)

S.F.Be. Samuel Flagg Bemis (d. 1973). *Sterling Professor of Diplomatic History and Inter-American Relations, Yale University 1945–61. Author of* John Quincy Adams and the Foundations of American Foreign Policy *and others.*
ADAMS, JOHN QUINCY
MONROE, JAMES

S.Fe. Solomon Feferman. *Professor of Mathematics and Philosophy, Stanford University, California. Author of* The Number Systems: Foundations of Algebra and Analysis.
MATHEMATICS, FOUNDATIONS OF (*in part*)

S.F.W. S.F. Wise. *Professor of History; Director, Institute of Canadian Studies, Carleton University, Ottawa. Co-author of* Canada Views the United States: 19th Century Political Attitudes.
ONTARIO

S.G. Samy Gorgy. *Former Director General, Institute of Oceanography and Fisheries, Alexandria, Egypt. Author of numerous articles on oceanography.*
MEDITERRANEAN SEA (*in part*)

S.G.C. Sir Stanley George Clayton, M.D. *Emeritus Professor of Obstetrics and Gynecology, King's College Hospital Medical School, University of London.*
MENSTRUATION

S.G.F.B. Rev. Samuel G.F. Brandon (d. 1971). *Professor of Comparative Religion, Victoria University of Manchester, England, 1951–71. Author of* Man and His Destiny in the Great Religions; The Judgment of the Dead; *and others.*
DEATH RITES AND CUSTOMS
SALVATION

S.G.K. Samir G. Khalaf. *Associate Professor of Sociology; Chairman, Department of Sociology and Anthropology, American University of Beirut. Co-author of* Hamra of Beirut: A Case of Rapid Urbanization.
BEIRUT
LEBANON

S.Gl. Sidney Glazer. *Professor of History, Wayne State University, Detroit. Co-author of* Michigan: From Primitive Wilderness to Industrial Commonwealth.
MICHIGAN

S.G.P. Stanley G. Payne. *Professor of History, University of Wisconsin, Madison. Author of* Franco's Spain *and others.*
FRANCO, FRANCISCO

S.G.S. Stanwyn G(erald) Shetler. *Associate Curator of Phanerogams; Director of Flora North America Program, Department of Botany, Smithsonian Institution, Washington, D.C.*
NEPENTHALES
SARRACENIALES

S.G.W. Stephen Graham Wright. *Former Adviser at the National Library of Ethiopia and at Haile Selassie I University, Addis Ababa.*
LITERATURE, WESTERN: *Ethiopian*

S.H. Samuel Handel (d. 1972). *Member, Institution of Electrical Engineers. Author of* Dictionary of Electronics; The Electronic Revolution.
ELECTRONICS

S.Ha. Shirô Hattori. *Director, Tokyo Institute for Advanced Studies of Language. Emeritus Professor of Linguistics, University of Tokyo. Author of* Methods in Linguistics; Genealogy of Japanese; *and others.*
JAPANESE LANGUAGE

Sh.B. Sh. Batbayar. *Scientific Secretary, Institute of Economy, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

S.H.B. Samuel H. Baron. *Professor of History, University of North Carolina, Chapel Hill. Author of* Plekhanov: The Father of Russian Marxism *and others.*
PLEKHANOV, GEORGY VALENTINOVICH

S.H.Ba. S. Howard Bartley. *Distinguished Research Professor of Psychology, Memphis State University, Tennessee. Emeritus Professor of Psychology, Michigan State University, East Lansing; Director, Laboratory for the Study of Vision and Related Sensory Processes, 1966–71. Author of* Fatigue: Mechanism and Management; *co-author of* Fatigue and Impairment in Man.
FATIGUE

Sh.Bi. Sh. Bira. *Head of Section, Institute of History, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

S.H.Bl. Sheldon H. Blank. *Emeritus Professor of Bible, Hebrew Union College–Jewish Institute of Religion, Cincinnati, Ohio. Author of* Prophetic Faith in Isaiah *and others.*
ISAIAH

S.He. Stanislaw Herbst. (d. 1973). *Professor of Pre-18th Century Polish History, University of Warsaw. President, Polish Historic Society, Warsaw. Co-author of* A Thousand Years of Polish History.
KOSCIUSZKO, TADEUSZ

S.H.F.L. Seton H.F. Lloyd. *Emeritus Professor of Western Asiatic Archaeology, University of London. Author of* Art of the Ancient Near East; Early Highland Peoples of Anatolia; Twin Rivers; *and others.*
ANATOLIA, ANCIENT (*in part*)
TIGRIS-EUPHRATES RIVER SYSTEM
VISUAL ARTS, WESTERN (*in part*)

Sh.H. Shigeru Hayashi. *Professor, Institute of Social Science, University of Tokyo. Author of* The Pacific War.
KONOE FUMIMARO

S.H.J. Susan Heyner Joshi. *Professor of Biology, Philadelphia College of Pharmacy and Science.*
BIOLOGICAL SCIENCES (*in part*)

Sh.M. Shula E. Marks. *Reader in the History of Southern Africa, School of Oriental and African Studies and Institute of Commonwealth Studies, University of London. Author of* Reluctant Rebellion: The 1906–08 Disturbances in Natal *and others.*
SOUTHERN AFRICA, HISTORY OF

S.H.N. Seyyed Hossein Nasr. *Professor of Philosophy; Dean, Faculty of Letters and Humanities, University of Tehrān. Author of* Three Muslim Sages.
AVICENNA

Sh.Nj. Sh. Natsagdorj. *Director, Institute of History, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

S.H.O. Simeon Hongo Ominde. *Professor of Geography; Director, Population Studies and Research Institute, University of Nairobi, Kenya. Author of* Land and Population Movements in Kenya.
KENYA
NAIROBI

S.H.P. Stewart Henry Perowne. *Orientalist, historian, and lecturer. Author of* The Life and Times of Herod the Great; The End of the Roman World; The Political Background of the New Testament; *and others.*
CLEOPATRA
HEROD I THE GREAT
JERUSALEM (*in part*)
JULIAN THE APOSTATE

S.H.S. Solomon Halbert Snyder, M.D. *Distinguished Service Professor of Pharmacology and Psychiatry, School of Medicine, Johns Hopkins University, Baltimore.*
STIMULANT

S.H.St. S. Henry Steinbert (d. 1969). *Editor,* The Statesman's Year-Book, *1946–69. Author of* The Thirty Years' War and the Conflict for European Hegemony, 1600–1660 *and others.*
THIRTY YEARS' WAR
WALLENSTEIN, ALBRECHT WENZEL VON

Sh.Ts. Sh. Tsevegmid. *Director, Institute of Geography and Geocryology, Academy of Sciences of the Mongolian People's Republic, Ulaanbaatar.*
MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

S.H.W. Stanley H. Weitzman. *Curator of Fishes, Division of Fishes, National Museum of Natural History, Smithsonian Institutiton, Washington, D.C. Author of numerous articles on fishes.*
FISH
TELEOSTEI

S.-I.A. Syun-Ichi Akasofu. *Professor of Geophysics, Geophysical Institute, University of Alaska, Fairbanks. Author of* Polar and Magnetospheric Substorms *and others.*
AURORAS

S.I.B. Solomon Ilich Bruk. *Deputy Director, Institute of Ethnography, Academy of Sciences of the U.S.S.R., Moscow. Co-author and editor of* Ethnographic Maps of Asian Countries.
CAUCASUS MOUNTAINS (*in part*)
TIEN SHAN (MOUNTAINS) (*in part*)

Si.M. Sidney Marrat. *Journalist, literary critic, and theatre historian.*
AFRICAN PEOPLES, ARTS OF (*in part*)

Si.T. Sidney Thomas. *Professor of Fine Arts, Syracuse University, New York. Editor of* Images of Man; *co-editor of* The Nature of Art.
ARTS, PRACTICE AND PROFESSION OF THE

S.J.C. Selma Jeanne Cohen. *Editor,* Dance Perspectives. *Author of* Doris Humphrey: An Artist First; *editor of* The Modern Dance: Seven Statements of Belief.
MODERN DANCE

S.J.K.B. Samuel John Kenneth Baker. *Emeritus Professor of Geography, Makerere University, Kampala, Uganda. Honorary Lecturer in Geography, University of Leicester, England, 1968–74.*
EAST AFRICAN LAKES
EAST AFRICAN MOUNTAINS
VIRUNGA MOUNTAINS

S.J.S. Stanford Jay Shaw. *Professor of History, University of California, Los Angeles. Editor in Chief,* International Journal of Middle East Studies. *Author of* History of the Ottoman Empire and Modern Turkey *and others.*
OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE (*in part*)

S.J.W. Sam J. Wanous. *Emeritus Professor of Education, University of California, Los Angeles. Co-author of* Fundamentals of Data Processing.
OFFICE MACHINES

S.K. Shinzo Kiuchi. *Emeritus Professor of Geography, University of Tokyo. Professor of Economic Geography, Seijo University, Tokyo. Vice President, International Geographical Union. Co-editor of* Japanese Cities.
ŌSAKA-KŌBE METROPOLITAN AREA
TOKYO-YOKOHAMA METROPOLITAN AREA

S.K.G. Sisirkumar Ghose. *Professor of English, Visva-Bharati, Santiniketan, India. Author of* Mystics and Society *and others.*
MYSTICISM

S.Kh. Stella Kramrisch. *Curator, Indian and Himalayan Art, Philadelphia Museum of Art, Professor of Indian Art, Institute of Fine Arts, New York University, New York City. Author of* The Hindu Temple; Unknown India; The Art of Nepal; *and others.*
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

S.Kö. Stephan Körner. *Professor of Philosophy, University of Bristol, England, and Yale University. Author of* Conceptual Thinking; Categorial Frameworks; *and others.*
CLASSIFICATION THEORY

S.K.S. Sylvester K. Stevens (d. 1974). *Executive Director, Pennsylvania Historical and Museum Commission, Harrisburg, 1956–72. Author of* Pennsylvania: Birthplace of a Nation *and others.*
PHILADELPHIA

S.L. Steffen Linvald. *Director of Copenhagen City Museum. Author of several books on Copenhagen.*
COPENHAGEN

S.La. Sylvia Dorothy Lawler, M.D. *Senior Lecturer, Institute of Cancer Research; Honorary Consultant in Immunology and Cytogenetics, Royal Marsden Hospital, London. Co-author of* Human Blood Groups and Inheritance.
BLOOD GROUPS

S.L.D. S. Lawrence Dingman. *Associate Professor of Water Resources, University of New Hampshire, Durham.*
ICE IN RIVERS AND LAKES

S.Lr. Samuel Leiter. *Seminary Professor of Hebrew Literature, Jewish Theological Seminary of America, New York City. Editor of* Selected Stories of S.Y. Agnon.
LITERATURE, WESTERN: *Hebrew (Israeli)*

S.L.R. Stanley L. Robbins, M.D. *Professor and Chairman, Department of Pathology, School of Medicine, Boston University. Author of* Textbook of Pathology; Basic Pathology.
DISEASE, HUMAN (*in part*)

S.L.S. Shao L. Soo. *Professor of Mechanical Engineering, University of Illinois, Urbana. Author of* Fluid Dynamics of Multiphase Systems.
THERMIONIC DEVICES

S.L.Sm. Sigmund L. Smith. *Professor of Metallurgical Engineering, University of Arizona, Tucson. Author of* Ore Microscopy.
SILVER PRODUCTS AND PRODUCTION

S.M. Sonia Moore. *Founder and President, American Center for Stanislavski Theatre Art, Inc., New York City. Founder and Director, American Stanislavski Theatre. Author of* Training an Actor: The Stanislavski System in Class; The Stanislavski System.
STANISLAVSKY, KONSTANTIN

S.Ma. Sibyl Marcuse. *Curator, Yale University Collection of Musical Instruments, 1952–60. Author of* Musical Instruments: A Comprehensive Dictionary; A Survey of Musical Instruments.
PERCUSSION INSTRUMENTS

S.M.B. Surinder M. Bhardwaj. *Professor of Geography, Kent State University, Ohio.*
IRRAWADDY RIVER

S.McD. Sheila D. McDonough. *Professor of Religion, Sir George Williams University, Montreal. Author of* Muhammad Ali Jinnah, Maker of Modern Pakistan *and others.*
IQBĀL, MUḤAMMAD

S.M.Ci. Sima M. Cirković. *Professor of the Medieval History of Yugoslavia, University of Belgrade. Author of* Duke Stefan Vukčić Kosača and His Time; Istorija srednjovekovne bosanske države; *and others.*
STEFAN DUSAN

S.M.Co. Sonia M. Cole. *Associate of the British Museum (Natural History). Author of* The Prehistory of East Africa; Leakey's Luck; *and others.*
AFRICANS, PREHISTORIC

S.M.D. Stephanie Mary Dalley. *Independent researcher. Contributor to* Iraq (*journal*).
SARGON OF AKKAD

S.M.G. Stanley M. Garn. *Professor of Human Nutrition and of Anthropology; Fellow of the Center for Human Growth and Development, University of Michigan, Ann Arbor. Author of* Human Races.
RACES OF MANKIND

S.M.H. Sigismund M. Herschdoerfer. *Consultant and former Chief Chemist and Quality Controller, T. Wall & Sons Ltd. (ice cream), London. Editor of* Quality Control in the Food Industry.
FOOD, QUALITY CONTROL OF

S.Mi. Sandra Millikin. *Free-lance architectural historian. Lecturer in the History of Art, Open University, Walton, England, 1971–73.*
ADAM, ROBERT
VISUAL ARTS, WESTERN (*in part*)

S.M.I. S.M. Ikram. *Director, Institute of Islāmic Culture, Lahore, Pakistan. Author of* History of Muslim Civilisation in India and Pakistan *and others.*
AḤMAD KHAN, SIR SAYYID

S.M.M. Sidnie M. Manton. *Honorary Research Associate, British Museum (Natural History), London. Research Fellow, Queen Mary College, University of London; Reader in Zoology, King's College, 1949–60.*
SKELETAL SYSTEMS (*in part*)

S.Mo. Sitanshu Mookerjee. *President, Indian Institute of Geography. Principal, Morris College, Nāgpur University, India.*
MAHĀRĀSHTRA

S.M.R. Sidney Martin Robbins. *Chase Manhattan Professor of Financial Institutions, Columbia University. Author of* Investment Analysis and Securities Markets *and others.*
SECURITIES TRADING

S.M.S. Shekou M. Sesay. *Area Officer, Regional Bureau for Africa, United Nations Development Programme, New York City. Co-author of* Sierra Leone in Maps.
SIERRA LEONE (*in part*)

S.N.M. S.N. Mukerji. *Principal, Vidya Bhawan Govindram Seksaria Teachers' College; Dean, Faculty of Education, University of Udaipur, India. Author of* History of Education in India *and others.*
EDUCATION, HISTORY OF (*in part*)

S.N.R. Sergey Nikolayevich Ryazantsev. *Professor of Economic Geography, Moscow Pedagogical Institute. Author of* Kirgizskaya S.S.R. *and many others.*
KIRGIZ SOVIET SOCIALIST REPUBLIC (*in part*)

S.O.K. Suk Oh Kang. *Former Professor of Geography, Ewha Woman's University, Seoul. Author of* A New Geography of Korea *and others.*
YALU RIVER

So.T. Sol Tax. *Emeritus Professor of Anthropology, University of Chicago. Director, Center for the Study of Man, Smithsonian Institution, Washington, D.C. 1968–76. Editor,* Current Anthropology, *1957–74. Authority noted for his work in American Indian ethnology and in the theory of social anthropology.*
BOAS, FRANZ

S.P. Simeon Potter (d. 1976). *Bains Professor of English Language and Philology, University of Liverpool, 1945–65. Author of* Our Language; Changing English; *and others.*
ENGLISH LANGUAGE

S.Pa. S. Pandey. *Cartographer, National Bureau of Soil Survey and Land Use Planning, Indian Agricultural Research Institute, New Delhi.*
THAR DESERT (*in part*)

S.P.C. Shiba P. Chatterjee. *Emeritus Professor of Geography, University of Calcutta. Author of* Physiography of India *and others; editor of* Selected Papers of the 21st International Geographical Congress, *vol. 1–4.*
HIMALAYAN MOUNTAIN RANGES
TRIPURA (*in part*)

S.P.D. Stephen Porter Dunn. *Director of Research, Highgate Road Social Science Research Station, Inc., Berkeley, California. Co-author of* The Peasants of Central Russia.
SIBERIAN CULTURES (*in part*)

S.Pi. Shlomo Pines. *Professor of General and Jewish Philosophy, Hebrew University of Jerusalem. Author of* Scholasticism after Thomas Aquinas and the Teachings of Hasdai Crescas and his Predecessors; *translator of Maimonides'* Guide of the Perplexed.
JEWISH PHILOSOPHY (*in part*)

S.P.J. S. Paul Johnston. *Consultant, R. Dixon Speas, Inc., Manhasset, New York, Director, National Air and Space Museum, Smithsonian Institution, Washington, D.C., 1964–69. Author of* Horizons Unlimited *and others.*
AIRCRAFT
FLIGHT, HISTORY OF
SIKORSKY, IGOR

S.P.L. Stephen P. Ladas (d. 1976). *Attorney. Partner, Ladas, Parry, Von Gehr, Goldsmith & Deschamps, New York City. Author of* The International Protection of Industrial Property.
TRADEMARK LAW

S.P.V. Shanti Prasad Varma. *Visiting Fellow, Indian Institute of Advanced Study, Simla. Former Chairman, Department of Political Science; Former Director, South Asia Studies Centre, University of Rājasthān, Jaipur, India. Author of* A Study of Maratha Diplomacy: Anglo-Maratha Relations, 1772–1783.
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

S.R. Sydney Ross. *Professor of Colloid Science, Rensselaer Polytechnic Institute, Troy, New York. Co-author of* On Physical Adsorption; *editor of* The Chemistry and Physics of Interfaces.
PRIESTLEY, JOSEPH

S.Ra. Sheila Ralphs. *Senior Lecturer in Italian, Victoria University of Manchester, England.*
LITERATURE, WESTERN: *Italian; Medieval* (*in part*)

S.Rs. Sir Sydney (Castle) Roberts (d. 1966). *Vice Chancellor, University of Cambridge, 1949–51; Master of Pembroke College, Cambridge, 1948–58. A noted Johnson scholar. Author of* Doctor Johnson, and Others; *editor of* Samuel Johnson, Writer; *and many other works on Johnson.*
JOHNSON, SAMUEL (*in part*)

S.R.S. Stuart Reynolds Schram. *Professor of Politics, School of Oriental and African Studies, University of London. Author of* Mao Tse-tung; The Political Thought of Mao Tse-tung, *and others.*
MAO TSE-TUNG

S.R.T. Steven R. Tannenbaum. *Professor of Food Chemistry, Massachusetts Institute of Technology, Cambridge. Co-editor of* Single-Cell Protein *and others.*
FOOD, NEW SOURCES AND PRODUCTS

S.R.Ty. Spencer Rowe Titley. *Professor of Geology, School of Earth Sciences, University of Arizona, Tucson. Co-editor of* Geology of the Porphyry Copper Deposits: Southwestern North America.
SULFIDE MINERALS

S.S. Sheila Sherlock, M.D. *Professor of Medicine, Royal Free Hospital School of Medicine, University of London; Consultant Physician, Royal Free Hospital. Author of* Diseases of the Liver and Biliary System.
LIVER, HUMAN

S.S.A. Stanislas Spero Adotevi. *Director, Institute of Applied Research of Dahomey, Porto-Novo. Author of* Demain la veille.
DAHOMEY

S.S.C. S.S. Chern. *Professor of Mathematics, University of California, Berkeley. Author of* Complex Manifolds Without Potential Theory.
GEOMETRY, DIFFERENTIAL
PHYSICAL THEORIES, MATHEMATICAL ASPECTS OF (*in part*)

S.S.F. Sheppard Sunderland Frere. *Professor of the Archaeology of the Roman Empire, University of Oxford. Author of* Britannia: A History of Roman Britain *and others.*
BRITAIN, ANCIENT

S.S.G. Sergio Sepúlveda González. *Professor of Geography of Chile and Latin America, University of Chile, Santiago. Head, Department of Social Sciences, Centre of Experimental and Pedagogical Research. Author of* Regiones geográficas de Chile.
CHILE

S.S.H. Syed Sajjad Husain. *Former Vice Chancellor, University of Rājshāhi, Bangladesh. Author of* Descriptive Catalogue of Bengali Manuscripts.
BANGLADESH (*in part*)

S.Sk. Stephan Skalweit. *Professor of Modern History, Rhenish Friedrich University of Bonn. Author of* Frankreich und Friedrich der Grosse *and others.*
FREDERICK WILLIAM, THE GREAT ELECTOR

S.Sm. Stephen Smale. *Professor of Mathematics, University of California, Berkeley. Co-editor of* Global Analysis.
DIFFERENTIAL EQUATIONS (*in part*)

S.Sp. Rev. Sidney Spencer (deceased). *Minister, Bath and Trowbridge Unitarian Churches, England. Principal of Manchester College, University of Oxford, 1951–56. Author of* Mysticism in World Religion *and others.*
CHRISTIAN MYSTICISM

S.St. Sewell Stokes. *Author and dramatist. Author of* Isadora: An Intimate Portrait *and others.*
DUNCAN, ISADORA

S.T. Stith Thompson. *Distinguished Professor Emeritus of English and Folklore, Indiana University, Bloomington. Author of* Motif-Index of Folk-Literature, *6 vol;* The Folktale.
FOLK LITERATURE

S.Ta. Shin'Ichi Tani. *Professor of the History of Japanese Art, Kyōritsu Women's University, Tokyo. Author of* Muromachi-jidai bijutsushi-ron (*"A Study on Arts of the Muromachi Period"*); Bijutsushi (*"History of Japanese Art"*).
VISUAL ARTS, EAST ASIAN (*in part*)

S.To. Samuel Tolansky (d. 1973). *Professor of Physics, Royal Holloway College, University of London, 1947–73. Author of* Multiple-Beam Interferometry *and others.*
HOLOGRAPHY

S.v.d.S. Sybille van der Sprenkel. *Lecturer in Sociology, University of Leeds, England. Author of* Legal Institutions in Manchu China.
CHINESE LAW

S.V.G. Stephen Vincent Grancsay. *Emeritus Curator of Arms and Armor, Metropolitan Museum of Art, New York. Author of numerous classic studies on arms and metalwork.*
METALWORK (*in part*)

S.W.B. Salo Wittmayer Baron. *Emeritus Professor of Jewish History, Literature, and Institutions, Columbia University. Author of* A Social and Religious History of the Jews.
JUDAISM, HISTORY OF (*in part*)

S.We. Stanley Weintraub. *Research Professor of English; Director, Institute for the Arts and Humanistic Studies, Pennsylvania State University, University Park. Author of* Private Shaw and Public Shaw; A Dual Portrait of Lawrence of Arabia and G.B.S.; *editor of* Shaw: An Autobiography; *co-editor of* Evolution of a Revolt: Early Postwar Writings of T.E. Lawrence.
LAWRENCE, T.E.
SHAW, GEORGE BERNARD

S.W.F. Sidney W. Fox. *Director, Institute for Molecular and Cellular Evolution; Research Professor, University of Miami, Coral Gables, Florida. Co-author of* Molecular Evolution and the Origin of Life.
OPARIN, ALEKSANDR IVANOVICH

S.W.J. Stanley W. Jacob, M.D. *Associate Professor of Surgery, University of Oregon Health Sciences Center, Portland. Author of* Structure and Function in Man.
CARDIOVASCULAR SYSTEM, HUMAN

S.W.K.M. Stephen William Kenneth Morgan. *Former Director, Imperial Smelting Processes Limited, Avonmouth, England.*
ZINC GROUP ELEMENTS AND THEIR COMPOUNDS

S.W.M. S.W. Mikhail. *Professor of Electrical Technology, Ryerson Polytechnical Institute, Toronto.*
SEMICONDUCTOR DEVICES (*in part*)

S.W.R. Stephen Wentworth Roskill. *Captain, Royal Navy (retired). Fellow of Churchill College, University of Cambridge. Author of* The War at Sea, 1939–1945 (*4 vol.*) *and others.*
WARFARE, CONDUCT OF (*in part*)

S.Y.C. Shou Yi Chen. *Emeritus Professor of Chinese Culture, Pomona College, Claremont, California. Author of* Chinese Literature: A Historical Introduction.
LITERATURE, EAST ASIAN (*in part*)

S.-y.H. Shan-yüan Hsieh. *Assistant Professor of Philosophy, Haverford College, Pennsylvania.*
TSENG KUO-FAN

S.Z. Solly Zuckerman, Baron Zuckerman. *Sands Cox Professor Emeritus of Anatomy, University of Birmingham, England. President,*

Zoological Society of London. Author of Functional Affinities of Man, Monkeys and Apes.
ZOOLOGICAL GARDEN

S.Z.L. Sid Z. Leiman. *Dean, Bernard Revel Graduate School, Yeshiva University, New York City; Former Professor of Jewish History and Literature.*
BA'AL SHEM ṬOV (*in part*)
JEWISH RELIGIOUS YEAR
LURIA, ISAAC BEN SOLOMON (*in part*)

T.A.S. Thomas A. Schafer. *Professor of Church History, McCormick Theological Seminary, Chicago.*
EDWARDS, JONATHAN

T.B. Thomas Burnett. *Research Officer, Ottawa Research Station, Canada Department of Agriculture. Author of numerous papers on population dynamics of insect pests and their enemies.*
PEST CONTROL

T.B.B. Thomas B. Bottomore. *Professor of Sociology, University of Sussex, Brighton, England. Author of* Classes in Modern Society; Elites and Society.
SOCIAL CLASS AND MOBILITY
SOCIAL DIFFERENTIATION AND STRATIFICATION

T.B.H. Thomas B. Hinton (d. 1976). *Associate Professor of Anthropology, University of Arizona, Tucson. Author of* A Survey of Indian Assimilation in Eastern Sonora.
NORTH MEXICAN INDIAN CULTURES

T.B.T. Terence Barrington Thomas. *Director, Gladding International Ltd. Angling correspondent,* The Field *and others. Presenter of "Angling Today," Associated Television, Birmingham, England. Author of* Casting.
FISHING, SPORT (*in part*)

T.C. Theresa Clay. *Former Senior Principal Scientific Officer, Department of Entomology, British Museum (Natural History), London.*
PHTHIRAPTERA

T.C.M. Terence Croft Mitchell. *Deputy Keeper, Department of Western Asiatic Antiquities, British Museum, London.*
SIGILLOGRAPHY (*in part*)

T.C.O. Tobias Chant Owen. *Professor of Astronomy, State University of New York at Stony Brook. Co-editor of* Planetary Atmospheres (*IAU Symposium 40*).
JUPITER

T.C.P. Thomas C. Patterson. *Associate Professor of Anthropology, Temple University, Philadelphia. Author of* Pattern and Process in the Early Intermediate Period Pottery of the Central Coast of Peru.
ANDEAN CIVILIZATION, HISTORY OF (*in part*)

T.Cr. Rev. Theodore Crowley, O.F.M. *Professor of Scholastic Philosophy, Queen's University of Belfast, Northern Ireland. Author of* Roger Bacon: The Problem of the Soul in His Philosophical Commentaries.
BACON, ROGER

T.C.R. Thomas C. Reeves. *Professor of History, University of Wisconsin, Parkside. Author of* Freedom and the Foundation: The Fund for the Republic in the Era of McCarthyism *and others.*
EISENHOWER, DWIGHT D.

T.C.S. Thomas Clark Shedd. *Editor,* Modern Railroads, *Chicago.*
RAILROADS AND LOCOMOTIVES

T.C.Y., Jr. T. Cuyler Young, Jr. *Curator, West Asian Department, Royal Ontario Museum, Toronto. Professor of Near Eastern Studies, University of Toronto. Author of "A Comparative Ceramic Chronology for Western Iran, 1500–500 BC" in* Iran.
IRAN, HISTORY OF (*in part*)

T.D. Theodosius Dobzhansky (d. 1975). *Professor of Biology, Rockefeller University, New York City, 1962–71. Adjunct Professor of Genetics, University of California, Davis, 1971–75. Author of* Mankind Evolving; Genetics of the Evolutionary Process; *author of numerous papers on evolutionary genetics.*
GENE (*in part*)
HEREDITY

T.d.A. Rev. Tarsicio de Azcona. *Former Professor of Theology, University of Navarre, Pamplona, Spain. Author of* Isabel la Católica: Estudio crítico de su vida su reinado.
FERDINAND II THE CATHOLIC, OF ARAGON

T.-d.H. Rev. Tai-dong Han. *Dean, College of Theology and United Graduate School of Theology; Director, Christianity and Korean Culture Research Institute, Yonsei University, Seoul.*
KOREAN RELIGION

T.D.L. Thomas D. Luckey. *Professor of Biochemistry, University of Missouri, Columbia. Author of* Germfree Life and Gnotobiology; *co-editor of* Advances in Germfree Research and Gnotobiology.
GERMFREE LIFE

T.E.A. Thomas Edward Allibone. *External Professor of Electrical Engineering, University of Leeds, England. Visiting Professor of Physics, City University, London. Director, Research Laboratory, Associated Electrical Industries, Aldermaston, England, 1946–63. Author of* The Release and Use of Nuclear Energy.
RUTHERFORD, LORD

T.E.G. T.E. Gudava. *Professor of Linguistics, Tbilisi State University, Georgian S.S.R.*
CAUCASIAN LANGUAGES (*in part*)

T.E.Je. Thomas Edmund Jessop. *Emeritus Professor of Philosophy, University of Hull, England. Editor of* Bibliography of David Hume and of Scottish Philosophy.
HUME, DAVID

Te.K. Terrence Kaufman. *Associate Professor of Anthropology, University of Pittsburgh. Author of* Tzeltal Phonology and Morphology.
MESO-AMERICAN INDIAN LANGUAGES

T.E.K. Thomas Edward Keys. *Emeritus Professor of the History of Medicine, Mayo Graduate School of Medicine, University of Minnesota, Rochester. Emeritus Librarian, Mayo Foundation. Author of* The History of Surgical Anesthesia.
MAYO FAMILY

T.E.O'T. Thomas E. O'Toole. *Associate Professor of History, Western Carolina University, Cullowhee, North Carolina.*
GUINEA

T.F.B. Thomas F. Budinger, M.D. *Professor of Research Medicine, Donner Laboratory, Lawrence Berkeley Laboratory; Professor of Bioinstrumentation, University of California, Berkeley. Operations Officer, International Ice Patrol, 1959–60.*
ICEBERGS AND PACK ICE

T.F.McG. Thomas F. McGann. *Professor of History, University of Texas at Austin. Author of* Argentina, the Divided Land; Argentina, the United States, and the Inter-American System, 1880–1914.
PERÓN, JUAN (*in part*)

T.F.R. Theodore F. Rich. *Associate Editor, Medicine,* Encyclopædia Britannica, *Chicago, 1968–73.*
MEDICAL EDUCATION (*in part*)

T.F.T. Thomas Frederick Tout (d. 1929). *President, Royal Historical Society, 1925–28. Honorary Professor and Professor of History, Victoria University of Manchester, England, 1890–1925. Author of* Edward the First; The Place of the Reign of Edward II in English History; *and others.*
EDWARD III OF ENGLAND (*in part*)

T.F.W.B. T.F.W. Barth (d. 1971). *Professor of Geochemistry, University of Oslo, 1936–46, 1949–71. Internationally known for his work on igneous petrology and geysers. Author of* Theoretical Petrology.
GEYSERS AND FUMAROLES

T.G. Sir Tyrone Guthrie (d. 1971). *Theatrical director. Chancellor, Queen's University of Belfast, Northern Ireland, 1963–70. Author of* A Life in the Theatre; New Theatre; *and others.*
THEATRE, ART OF

T.G.B. Thomas G. Benedek, M.D. *Chief, Outpatient Department and Rheumatology Section, Veterans Administration Hospital, Pittsburgh. Associated Professor of Medicine, University of Pittsburgh.*
CONNECTIVE TISSUE DISEASES (*in part*)

T.G.H.J. Thomas Garnet Henry James. *Keeper, Department of Egyptian Antiquities, British Museum, London. Editor of* The Hekanakhte Papers, and Other Middle Kingdom Documents *and others.*
EGYPT, HISTORY OF (*in part*)

T.G.McG. Terence Gary McGee. *Senior Fellow, Department of Human Geography, Research School of Pacific Studies, Australian National University, Canberra. Author of* The Southeast Asian City.
HANOI

T.G.O. Thomas G. Overmire. *Head, Office of Project Management, Kuwait Institute for Scientific Research. Author of* Homeostatic Regulation.
HOMEOSTASIS

T.G.P.S. T.G. Percival Spear. *Fellow of Selwyn College, Cambridge; Lecturer in History, University of Cambridge, 1963–69. Author of* India: A Modern History *and others; co-author and editor of* Oxford History of India (*3rd ed.*).
AURANGZEB
BĀBUR
CLIVE, ROBERT
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

T.Gr. Theodore C. Grame. *President, Study Center of American Musical Pluralism, Tarpon Springs, Florida. Author of* Folk Music.
STRINGED INSTRUMENTS

T.H.B. Thornton Howard Bridgewater. *Chief Engineer, Television, British Broadcasting Corporation, 1962–68.*
TELEVISION (*in part*)

T.H.C. Theodore Hsi-en Chen. *Professor of Education and Asian Studies, University of Southern California, Los Angeles. Author of* Thought Reform of Chinese Intellectuals.
EDUCATION, HISTORY OF (*in part*)

T.H.D. Tulio Halperin Donghi. *Professor of History, University of California, Berkeley. Author of* Historia contemporánea de América Latina *and others.*
ARGENTINA, HISTORY OF

T.H.E. Thomas H. Everett. *Senior Horticulture Specialist, New York Botanical Garden, Bronx. Author of* Living Trees of the World.
TREE (*in part*)

T.H.G. Theodor H. Gaster. *Professor of Religion, Barnard College, Columbia University. Author of* Myth, Legend, and Custom in the Old Testament; Thespis: Ritual, Myth, and Drama in the Ancient Near East.
JEWISH MYTH AND LEGEND

Th.H. Thor Heyerdahl. *Member, Norwegian Academy of Science and Letters, Oslo. Organized and led Norwegian Archaeological Expedition to Easter Island and the East Pacific, 1955–56, and many other expeditions. Author of* Aku-Aku: The Secret of Easter Island; The Kin-Tiki Expedition; *and others.*
EASTER ISLAND

Th.Ho. Thomas Howarth. *Professor of Architecture, University of Toronto.*
TORONTO

Th.M. Thomas Munro (d. 1974) *Curator of Education, Cleveland Museum of Art, 1931–67. Professor of Art, Case Western Reserve University, Cleveland. Author of* The Arts and Their Interrelations *and others.*
AESTHETICS (*in part*)
ARTS, CLASSIFICATION OF THE

T.Ho. Thomas Hodgkin. *Writer. Emeritus Fellow of Balliol College, Oxford; Lecturer in the Government of New States, University of Oxford, 1965–70. Author of* Nationalism in Colonial Africa *and others.*
USMAN DAN FODIO

T.Hor. Theodore Hornberger (d. 1975). *John Welsh Centennial Professor of History and English Literature, University of Pennsylvania, Philadelphia, 1968–75. Author of* Benjamin Franklin.
FRANKLIN, BENJAMIN

Th.V.G. Thomas V. Gamkrelidze. *Director, Oriental Institute, Academy of Sciences of the Georgian S.S.R., Tbilisi. Author of* Sibilant Correspondences and Some Questions of the Ancient Structure of the Kartvelian Languages; *co-author of* The System of Sonants and Ablaut in the Kartvelian Languages.
CAUCASIAN LANGUAGES (*in part*)

T.I. Toshihiko Izutsu. *Professor of Islāmic Studies, McGill University, Montreal. Author of* A comparative Study of the Key Philosophical Concepts in Sufism and Taoism.
IBN AL-'ARABĪ

T.Ic. Takashi Ichiye. *Professor of Oceanography, Texas A & M University, College Station.*
EKMAN, VAGN WALFRID

T.Io. Teiji Ichiko. *Director General, National Institute of Japanese Literature, Tokyo. Author of* History of Japanese Literature *and others.*
FABLE, PARABLE, AND ALLEGORY (*in part*)

T.I.S. Trevor Ian Shaw (d. 1972). *Professor of Zoology, Queen Mary College, University of London.*
NERVE IMPULSE

T.J. Thorkild Jacobsen. *Emeritus Professor of Assyriology, Harvard University. Author of* The Sumerian Kinglist; *"Mesopotamia" in* The Intellectual History of Ancient Man; *and others.*
MESOPOTAMIAN RELIGIONS
MESOPOTAMIAN RELIGIOUS LITERATURE AND MYTHOLOGY

T.J.B. Trent J. Bertrand. *Professor of Economics, State University of New York at Binghamton. Author of several articles on the theory of international trade.*
TARIFFS (*in part*)

T.J.Br. T. Julian Brown. *Professor of Palaeography, University of London. Co-author of* Codex Lindisfarnensis.
CALLIGRAPHY (*in part*)
PUNCTUATION

T.J.C. Theodore John Cadoux. *Senior Lecturer in Ancient History, University of Edinburgh.*
CIMON
SOLON

T.Jo. Thomas Jones (d. 1972). *Professor of Welsh Language and Literature, University College of Wales, Aberystwyth, University of Wales, 1952–70. Editor of* Brut y Tywysogion; *co-translator of* The Mabinogion.
LITERATURE, WESTERN: *Welsh*

T.J.W. Theodore J. Williams. *Professor of Engineering; Director, Purdue Laboratory for Applied Industrial Control, Purdue University, Lafayette, Indiana. Co-editor of* Progress in Direct Digital Control *and others.*
CONTROL SYSTEMS

T.K. Teiichi Kobayashi. *Emeritus Professor of Geology, University of Tokyo. Author of* Geology of Japan.
PALEOZOIC ERA, LOWER

T.Ka. Thomas Kamanzi. *Research Assistant, National Institute of Scientific Research; Lecturer, National University of Rwanda, Butare. Co-author of* Récits historiques Rwanda.
RWANDA

T.K.B. T. Keilor Bentley. *Director, Owens Art Gallery, Mount Allison University, Sackville, New Brunswick. Superintendent, Alexander Graham Bell Museum, Baddeck, Nova Scotia, 1959–64.*
BELL, ALEXANDER GRAHAM

T.Ke. Tom Kemp. *Reader in Economic History, University of Hull, England. Author of* Theories of Imperialism *and others.*
ECONOMIC HISTORY SINCE 1500 (*in part*)

T.K.F. Thea K. Flaum. *Producer, WTTW (public television), Chicago. Former Editor, Urban Research Corporation, Chicago.*
UNITED STATES OF AMERICA (*in part*)

T.Kh. Tarif Khalidi. *Associate Professor of History and Archaeology, American University of Beirut.*
'ABD AL-MALIK IBN MARWĀN
'ABD AR-RAḤMAN III AN-NĀṢIR

T.Kl. Tibor Klaniczay. *Assistant Director, Institute for the History of Literature, Hungarian Academy of Sciences, Budapest.*
LITERATURE, WESTERN: *Hungarian* (*in part*)

T.Ku. Tadachika Kuwata. *Professor of Japanese History, Kokugakuin University, Tokyo. Author of* Toyotomi Hideyoshi *and others.*
TOYOTOMI HIDEYOSHI

T.Ky. Thin Kyi. *Emeritus Professor of Geography, Arts and Science University, Rangoon. Author of* Geography of Burma; Rangoon.
RANGOON

T.K.Z. Tatyana Konstantinovna Zakharova. *Senior Science Editor,* Sovetskaya entsiklopediya (*publishing house*).
PAMIR MOUNTAIN AREA

T.L.H. Sir Thomas Little Heath (d. 1940). *Controller General, National Debt Office, London, 1919–26. Author of* Archimedes *and others.*
ARCHIMEDES (*in part*)

T.L.K. Thomas L(indas) Karnes. *Professor of History, Arizona State University, Tempe. Author of* Failure of Union: Central America, 1824–1960; *"Origins of Costa Rican Federalism" in* The Americas.
CENTRAL AMERICAN STATES, HISTORY OF (*in part*)

T.L.L. Thomas L. Lentz, M.D. *Associate Professor of Cytology, School of Medicine, Yale University. Author of* Primitive Nervous Systems.
NERVES AND NERVOUS SYSTEMS

T.L.P. Thornton Leigh Page. *Research Astrophysicist, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration, Houston, Texas. Professor of Astronomy, Wesleyan University, Middletown, Connecticut, 1958–68. Co-editor of* UFO's: A Scientific Debate.
UNIDENTIFIED FLYING OBJECTS

T.L.Pe. Troy L. Péwé. *Professor of Geology, Arizona State University, Tempe. Chairman, Permafrost Committee, National Academy of Sciences. An authority on the geomorphology of Arctic regions. Editor of* The Periglacial Environment: Past and Present.
PERMAFROST

T.L.S. T(homas) Lynn Smith (d. 1976). *Graduate Research Professor of Sociology, University of Florida, Gainesville, 1959–74. Author of* Brazil: People and Institutions; Latin American Population Studies; *and others.*
BRAZIL (*in part*)
URUGUAY (*in part*)

T.M. Tatsuro Matsumoto. *Professor of Geology (Stratigraphy), Kyūshū University, Fukuoka, Japan. Authority on the Mesozoic history of Asia. Co-author and editor of* Historical Geology.
CRETACEOUS PERIOD

T.M.K. Sir T. Malcolm Knox. *Principal of the University of St. Andrews, Scotland, 1953–66. Translator of Hegel's* Political Writings, Early Theological Writings, *and* Aesthetics.
HEGEL, GEORG WILHELM FRIEDRICH

T.Mo. Therald Moeller. *Professor of Chemistry, Arizona State University, Tempe. Author of* Inorganic Chemistry.
CARBON GROUP ELEMENTS AND THEIR COMPOUNDS

T.M.P. Rev. Thomas Maynard Parker. *Emeritus Fellow of University College, Oxford; Lecturer in Theology, University of Oxford, 1950–73. Author of* Christianity and the State in the Light of History.
CHURCH AND STATE

T.N. Tenzing Norgay. *Field Director of Training, Himalayan Mountaineering Institute, Darjeeling, India. The first man (with Edmund Hillary) to reach the summit of Mount Everest. Author of* Man of Everest.
EVEREST, MOUNT

T.Na. Takesi Nagata. *Professor of Geomagnetism and Upper Atmosphere Physics, Geophysical Institute, University of Tokyo. Author of* Rock Magnetism.
EARTH, MAGNETIC FIELD OF

T.N.B. Thomas N. Bisson. *Professor of History, University of California, Berkeley. Author of* Assemblies and Representation in Languedoc in the Thirteenth Century.
FRANCE, HISTORY OF (*in part*)

T.O. Takeo Oda. *Professor of Geography, Kyōto University. Author of* Kodai chirigakushi no kenkyū.
KYŌTO

T.O.M. Thomas Ollive Mabbott (d. 1968). *Professor of English, Hunter College, City University of New York, 1946–66. Editor of* Complete Works of Poe.
POE, EDGAR ALLAN (*in part*)

T.O'R. Tarlach O'Raifeartaigh. *Chairman, Cultural Relations Committee, Dublin. Editor of* Genealogical Tracts I.
PATRICK, SAINT

T.O.S. Thomas O. Sloane. *Professor of Rhetoric, University of California, Berkeley. Author of* The Oral Study of Literature *and of numerous articles on rhetoric; co-editor* The Rhetoric of Renaissance Poetry.
RHETORIC (*in part*)

To.Ya. Tasaburo Yamada. *Counsellor, Japan Atomic Industrial Forum, Inc., Tokyo. Author of* Nuclear Power Generation.
ELECTRIC POWER

T.P. Tatiana Proskouriakoff. *Honorary Curator of Maya Art, Peabody Museum, Harvard University. Former staff member, Carnegie Institution of Washington, D.C. Author of* An Album of Maya Architecture.
CALENDAR (*in part*)

T.P.M. Terence Patrick Morris. *Professor of Sociology (with special reference to Criminology), London School of Economics and Political Science, University of London. Author of* The Criminal Area: A Study in Social Ecology *and others.*
PUNISHMENT

T.Po. Tom Pocock. *Travel Editor,* Evening Standard, *London. Author of* Nelson and His World; Remember Nelson; *and others.*
NELSON, LORD

T.P.v.B. Theodorus P. van Baaren. *Professor of Science of Religions, State University of Groningen, The Netherlands. Author of* Menschen wie wir *and others.*
MONOTHEISM
PROVIDENCE, RELIGIOUS DOCTRINES AND MYTHS OF

T.R.H. Theodore R. Higgins. *Consultant, American Institute of Steel Construction, New York City; Director of Engineering and Research, 1943–69. Editor of* AISC Standard Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
STEEL CONSTRUCTION

T.R.T. Thomas R. Tregear. *Warden, Woodbrooke College, Selly Oak, Birmingham, England, 1959–63. Lecturer in Geography, University of Hong Kong, 1951–59. Author of* A Geography of China; Economic Geography of China; *and others.*
ANHWEI
HONAN
HUNAN
HUPEH

T.S. Tadao Sato. *Writer. Chairman, Japan Film P.E.N. Club. Author of* Kurosawa Akira no sekai *and others.*
KUROSAWA AKIRA

T.Sa. Taro Sakamoto. *Historian. Emeritus Professor, University of Tokyo. Author of* History of Japan *and others.*
JAPAN, HISTORY OF (*in part*)

T.S.B. Truesdell S. Brown. *Emeritus Professor of History, University of California, Los Angeles. Author of* Ancient Greece *and others.*
HERODOTUS

T.S.Bu. Thomas S. Buechner. *President, Corning Museum of Glass, Corning, New York; Director, 1951–60. President, Corning Glass Works Foundation. President, Steuben Glass, Inc. Author of* Guide to the Collections of the Corning Museum of Glass *and others.*
GLASS, HISTORY OF (*in part*)

T.S.D. T.S. Danowski, M.D. *Clinical Professor of Medicine, University of Pittsburgh. Director, Department of Medicine, Shadyside Hospital, Pittsburgh. Author of* Outline of Endocrine Gland Syndromes *and others.*
ENDOCRINE SYSTEM DISEASES AND DISORDERS

T.S.H. Theodore S. Hamerow. *Professor of History, University of Wisconsin, Madison. Author of* Restoration, Revolution, Reaction: Economics and Politics in Germany, 1815–1871 *and others.*
GERMANY, HISTORY OF (*in part*)

T.S.McL. Thomas S. McLeod. *Technical Manager, Automation and Transmission Divisions, Plessey Company Ltd., Poole, England. Author of* Management of Research Development and Design in Industry.
RESEARCH AND DEVELOPMENT, INDUSTRIAL

T.Sp. Terence John Bew Spencer (d. 1978). *Professor of English Language and Literature, 1958–78; Director, Shakespeare Institute, 1961–78, University of Birmingham, England. General Editor, The New Penguin Shakespeare and the Penguin Shakespeare Library, 1964–78. Author of* The Tyranny of Shakespeare; Shakespeare: The Roman Plays; *and others.*
SHAKESPEARE, WILLIAM (*in part*)

T.T. Takeshi Toyoda. *Historian. Professor, Tohoku University, Sendai, Japan. Author of* Nihon no hōken toshi (*"Feudal Cities in Japan"*) *and others.*
JAPAN, HISTORY OF (*in part*)

T.-t.C. Tse-tsung Chow. *Professor of East Asian Languages, Literature, and History, University of Wisconsin, Madison. Author of* The May Fourth Movement: Intellectual Revolution in Modern China *and others.*
CH'EN TU-HSIU

T.T.M. T.T. Macan. *Former Naturalist, Freshwater Biological Association, Windermere Laboratory, Ambleside, England. Author of* Freshwater Ecology.
RIVERS AND RIVER SYSTEMS (*in part*)

T.T.R. Tamara Talbot Rice. *Author of* Ancient Arts of Central Asia; The Scythians; Russian Art; *and others.*
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)
SARMATIANS
SCYTHIANS

T.V.W. Turrell V. Wylie. *Professor of Tibetan Studies, University of Washington, Seattle. Author of* The Geography of Tibet According to the 'Dzam-gling-rgyas-bshad.
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)
TIBET (*in part*)

T.W. Thomas M. Woodard. *Writer and researcher. Instructor in Classics, Princeton University, 1962–64. Editor of* Sophocles: A Collection of Critical Essays.
SOPHOCLES

T.W.D.S. Tsepon W.D. Shakabpa. *Historian. Author of* Tibet: A Political History.
LHASA
TIBET (*in part*)

T.W.J.G. Theodorus W.J. Gadella. *Lecturer in Systematic Botany, Utrecht University, The Netherlands. Author of* Cytotaxonomic Studies in the Genus Campanula.
CAMPANULALES

T.W.W. Thomas W. Whitaker. *Collaborator, U.S. Department of Agriculture, La Jolla, California; Research Geneticist and Investigations Leader, Plant Science Research Division, Agricultural Research Service, 1961–73. Co-author of* The Cucurbits: Botany, Cultivation and Utilization.
CUCURBITALES

T.Y. Takeo Yamane. *Professor of Food Manufacture, Showa Women's University, Tokyo. Author of* Cane Sugar Handbook.
SUGAR PRODUCTION

T.-y.L. Tien-yi Li. *Mershon Professor of Chinese Literature and History, Ohio State University, Columbus. Editor of* Selected Readings in Chinese Communist Literature; Chinese Historical Literature.
LITERATURE, EAST ASIAN (*in part*)

T.Y.S. Tatyana Yosifovna Supranovich. *Senior Scientist and Head, Division of Sea Dynamics, Far Eastern Hydrometeorological Research Institute, Vladivostok, U.S.S.R.*
OKHOTSK, SEA OF

U.A.U. Urho A. Uotila. *Professor and Chairman, Department of Geodetic Science, Ohio State University, Columbus. A world authority on geodesy.*
EARTH, FIGURE OF

U.B. Ugo Bianchi. *Professor of the History of Religions, University of Rome. Author of* Il dualismo religioso; *editor of* The Origins of Gnosticism.
DUALISM, RELIGIOUS

U.Ba. Umberto Baldini. *Art Historian. Superintendent Director, Opificio delle Pietre Dure (museum and laboratory), Florence. Author of* Il Rinascimento nell' Italia centrale; La scultura di Michelangiolo; *and others.*
MASACCIO

U.Be. Ulli Beier. *Free-lance writer. Former Research Professor and Director, Institute of African Studies, University of Ife, Ile-Ife, Nigeria. Founder of* Black Orpheus. *Author of* African Poetry *and others; editor of* Introduction to African Literature.
AFRICAN PEOPLES, ARTS OF (*in part*)

U.B.M. Ursula B. Marvin. *Geologist, Smithsonian Astrophysical Observatory, Cambridge, Massachusetts. Lecturer in Geology, Harvard University.*
CONTINENTAL DRIFT

U.Bo. Umberto Bosco. *Emeritus Professor of Italian Language and Literature, University of Rome. Director,* Enciclopedia italiana. *Editor of Boccaccio's* Decameron *and others.*
BOCCACCIO, GIOVANNI

U.M. Umberto Marcelli. *Lecturer in History, University of Bologna, Italy. Author of* Cavour diplomatico *and others.*
CAVOUR, COUNT

U.Ma. Ulrich W. Mammey. *Research Associate, Federal Institute for Population Research, Wiesbaden, West Germany. Associate of the Geographical Institute, Johann Wolfgang Goethe University of Frankfurt.*
FRANKFURT AM MAIN

U.M.D. Ulrich M. Drobnig. *Academic Member, Max-Planck Institute for Foreign Private and Private International Law, Hamburg, West Germany. Author of* American-German Private International Law.
COMMERCIAL TRANSACTIONS, LAW OF

U.P.B. Ulick Peter Burke. *Reader in Intellectual History, School of European Studies, University of Sussex, Brighton, England. Author of* The Renaissance Sense of the Past *and others.*
VALLA, LORENZO

U.P.S. Umakant Premanand Shah. *Former Deputy Director, Oriental Institute, Maharaja Sayajirao University of Baroda, India. Author of* Studies in Jaina Art: Akota Bronzes; *and others.*
JAINISM
MAHĀVIRA

V.A. Vernon Ahmadjian. *Professor of Botany, Clark University, Worcester, Massachusetts. Author of* The Lichen Symbiosis; *co-editor of* The Lichens.
LICHEN

V.A.B. Vladimir Alekseyevich Blagoobrazov. *Senior Science Editor, Soviet Encyclopaedia Publishing House, Moscow.*
ISSYK-KUL, LAKE

Va.K. Valdimar Kristinsson. *Editor,* Fjarmalatidindi (*Financial Times*), *Central Bank of Iceland, Reykjavík.*
ICELAND

V.Al. Victor Alba. *Associate Professor of Political Science, Kent State University, Ohio. Author of* The Mexicans *and others.*
ZAPATA, EMILIANO

V.A.U. Victor Andrade U. *Former Minister of Foreign Affairs of Bolivia. Former Ambassador of Bolivia to the U.S., 1944–46; 1952–58. Author of* Problemas sociales de Bolivia *and others.*
BOLIVIA (*in part*)

V.B. Victor Barna (d. 1972). *World table tennis champion, men's singles, 1930, 1932–35; men's doubles, 1929–35; mixed doubles, 1932,*

1935. Author of Table Tennis Today.
TABLE TENNIS

V.Ba. Vladimir Bakarić. *Member, Council of the Federation, Socialist Federal Republic of Yugoslavia. Member, Yugoslav Academy of Sciences and Art. Prime Minister of the Socialist Republic of Croatia, 1953–63. Author of* Aktuelní problemi sadašnje etape revolucije.
YUGOSLAVIA (*in part*)

V.Be. V.V. Beloussov. *Head, Department of Geodynamics, Institute of Physics of the Earth, Academy of Sciences of the U.S.S.R., Moscow. An internationally known authority on the physics of the Earth's crust and mantle. Author of* Basic Problems in Geotectonics.
CONTINENTS, DEVELOPMENT OF

V.Bi. Victor J.P. Biel. *Attorney at Law, Luxembourg. Author of numerous articles on law.*
LUXEMBOURG (*in part*)

V.B.M. V(ictor) B(en) Meen (d. 1971). *Chief Mineralogist, Royal Ontario Museum, Toronto, 1964–71. Co-author of* Crown Jewels of Iran.
GEMSTONES

V.Br. Vincent Brome. *Biographer, novelist, playwright, and essayist. Author of* Freud and His Early Circle *and others.*
FREUD, SIGMUND

V.B.W. Sir Vincent Brian Wigglesworth. *Emeritus Professor of Biology, University of Cambridge; Director, Agricultural Research Council Unit of Insect Physiology, 1943–67. Author of* The Principles of Insect Physiology; The Life of Insects.
INSECTA

V.B.Z. Viktor Borisovich Zhmuida. *Head, Central Asian Section, Council for Research on Productive Forces, U.S.S.R. Planning Commission, Moscow. Author of numerous publications on Turkmen S.S.R.*
TURKMEN SOVIET SOCIALIST REPUBLIC (*in part*)

V.C. Vincent Cronin. *Free-lance writer. Author of* The Flowering of the Renaissance *and others.*
SARPI, PAOLO

V.D. Vilmos Diószegi (d. 1971). *Research Fellow, Hungarian Academy of Sciences, Budapest. Author of* Tracing Shamans in Siberia; *editor of* Popular Beliefs and Folklore Tradition in Siberia.
SHAMANISM

V.D.B. Vasili Dmitrievitch Bykov. *Professor of Geography, Moscow M.V. Lomonosov State University. Author of* Hydrology *and others.*
WATER RESOURCES (*in part*)

V.E.I. Verity Elizabeth Irvine. *Writer and researcher.*
SYRIA AND PALESTINE, HISTORY OF (*in part*)

V.E.McK. Vincent E. McKelvey. *Director, Geological Survey, U.S. Department of the Interior, Reston, Virginia. An authority on mineral deposits and energy needs of the United States.*
PHOSPHORITES

V.F.K. Viktor Filipovich Kanayev. *Senior Scientist, Moscow M.V. Lomonosov State University. Co-author of* Principal Features of the Structure of the Bottom of the Northeastern Part of the Indian Ocean.
INDIAN OCEAN (*in part*)

V.F.Ko. Vladimir Fyodorovich Kosov. *Head, Kazakhstan Section, Scientific Council on the Location of U.S.S.R. Productive Forces, Academy of Sciences of the U.S.S.R., Moscow; Candidate of Sciences (Geography). Co-author of* Development of National Economy of the U.S.S.R. Eastern Regions.
KAZAKH SOVIET SOCIALIST REPUBLIC (*in part*)

V.G. Viktor Gutmann. *Professor of Inorganic Chemistry, Technical University of Vienna. Author of* Halogen Chemistry *and others.*
HALOGEN ELEMENTS AND THEIR COMPOUNDS

V.G.N. Viktor Grigoryevich Neyman. *Senior Scientist, Institute of Oceanology, Academy of Sciences of the U.S.S.R., Moscow; Candidate of Sciences (Geography). Author of several articles on oceanology.*
INDIAN OCEAN (*in part*)

V.G.S. Victor G. Szebehely. *Professor of Aerospace Engineering, University of Texas at Austin. Co-editor of* Methods in Astrodynamics and Celestial Mechanics.
MECHANICS, CELESTIAL

V.I.S. Victor Ilyich Seroff. *Writer. Author of* Rachmaninoff *and others.*
RACHMANINOFF, SERGEY

V.I.Sl. Vladimir Ilich Slavin. *Professor, Moscow M.V. Lomonosov State University.*
SALT RANGE (*in part*)

V.J.C. Valentine J. Chapman. *Professor of Botany, University of Auckland, New Zealand. Author of* The Algae; Seaweeds and Their Uses; *and others.*
ALGAE

V.J.M. Vytautas J. Mažiulis. *Professor of Lithuanian Language, Vilnius V. Kapsukas State University, Lithuanian S.S.R. Author of* Baltu ir kitu indoeuropiečiu kalbu santykiai.
BALTIC LANGUAGES

V.J.P. V.J. Parry (d. 1974). *Reader in the History of the Near and Middle East, School of Oriental and African Studies, University of London. Contributor to* The New Cambridge Modern History; Encyclopaedia of Islam; *and other works.*
BAYEZID II
SÜLEYMAN I THE MAGNIFICENT

V.J.T. Vello Julius Tarmisto. *Head of Section, Institute of Economics, Estonian S.S.R. Academy of Sciences, Tallin. Co-author of* Estonian S.S.R.
ESTONIAN SOVIET SOCIALIST REPUBLIC (*in part*)

V.K. Viola Klein (d. 1973). *Reader in Sociology, University of Reading, England, 1971–73. Co-author of* Women's Two Roles: At Home and Work *and others.*
WOMEN, STATUS OF

V.Ka. Vytautas Kavolis. *Charles A. Dana Professor of Comparative Civilizations and Professor of Sociology, Dickinson College, Carlisle, Pennsylvania. Author of* Artistic Expression: A Sociological Analysis; History on Art's Side: Social Dynamics in Artistic Efflorescences.
ARTS, SOCIAL AND ECONOMIC ASPECTS OF THE

V.Lo. Victor Lowe. *Emeritus Professor of Philosophy, Johns Hopkins University, Baltimore. Author of* Understanding Whitehead.
WHITEHEAD, ALFRED NORTH

V.L.S. Victor L. Streeter. *Emeritus Professor of Civil Engineering, University of Michigan, Ann Arbor. Author of* Fluid Mechanics.
MECHANICS, FLUID

V.L.S.P.R. Vaddiparti Lova Surya Prakasa Rao. *Senior Fellow in Human Geography and Ecology, Institute for Social and Economic Change, Bangalore, India.*
DELHI (*in part*)

V.L.T. Victor-Lucien Tapie (d. 1974). *Member, Academy of Moral and Political Sciences, Institute of France, Paris, 1963–74. Professor of Modern History, University of Paris-IV, 1949–70. Author of* La France de Louis XIII et de Richelieu *and others.*
COLBERT, JEAN-BAPTISTE

V.M. Valerio Mariani. *Professor of the History of Art, University of Naples. Author of* Pittori protagonisti della crisi del quattrocento; Giotto; *and others.*
LIPPI, FRA FILIPPO

V.Mi. Vasile Malinschi. *Governor, National Bank of the Socialist Republic of Romania. Chairman, Section of Economics and Sociological Research, Academy of the Socialist Republic of Romania, Bucharest.*
BUCHAREST (*in part*)

V.M.S. Vasily Mikhaylovich Sinitsyn. *Head, Laboratory of Paleography; Dean, Department of Geology, Leningrad A.A. Zhdanov State University.*
KUNLUN MOUNTAINS

V.M.St. Valery Mikhailovich Strygin. *Head of Section, Geographical Books, Mysl Publishing House, Moscow. Author of numerous papers on the geography of the Soviet Union.*
SOVIET UNION (*in part*)

V.M.W. Vera Muriel White. *Extramural Lecturer, University of Cambridge.*
PITT, WILLIAM, THE ELDER

V.N.D. Vladimir Nikolaevich Dunaev. *Correspondent, Novosti Press Agency, Moscow. Author of numerous papers on the administrative and social conditions of the Soviet Union.*
SOVIET UNION (*in part*)

V.N.K. Victor Nikolaevich Kondratiev. *Assistant Director, Institute of Chemical Physics; Member, Academy of Sciences of the U.S.S.R., Moscow. Author of* Chemical Kinetics of Gas Reactions.
COMBUSTION AND FLAME

V.P.G. Vladimir Petrovich Goncharov. *Head, Geology of the Southern Seas Laboratory, Southern Division, Institute of Oceanography, Academy of Sciences of the U.S.S.R., Gelendzhik. Co-author of* Geomorphology of the Bottom and Tectonic Problems in the Black Sea.
BLACK SEA (*in part*)

V.P.U. Vernon Philip Underwood. *Professor of French, University College, University of London. Author of* Verlaine et l'Angleterre; *editor of Verlaine's* Carnet personnel *and others.*
VERLAINE, PAUL

V.P.Z. Vsevolod Pavlovich Zenkovich. *Head of Shore Department, Institute of Oceanology, Academy of Sciences of the U.S.S.R., Moscow. An authority on near-shore oceanography and attendant physical processes.*
BEACHES
GULFS AND BAYS

V.R.F. Vernon R. Fryburger, Jr. *Professor of Advertising and Marketing; Chairman, Department of Advertising, Northwestern University, Evanston, Illinois. Co-author of* Advertising Theory and Practice.
ADVERTISING

V.R.L. Val R. Lorwin. *Professor of History, University of Oregon, Eugene.*
UNITED NATIONS (*in part*)

V.R.P. V.R. Pillai. *Member of Pay Commission, Government of India, New Delhi. Co-author of* Land Reclamation in Kerala.
KERALA

V.S. Vera Sanford (deceased). *Professor of Mathematics, State University of New York College at Oneonta, 1943–59.*
MATHEMATICS, HISTORY OF (*in part*)

V.S.C. Vasile S. Cucu. *Professor of Geography; Pro-rector, University of Bucharest. Author of* Geografia României.
ROMANIA (*in part*)

V.S.M. V. Standish Mallory. *Professor of Geological Sciences; Curator of Invertebrate*

Paleontology and Chairman, Geology and Paleontology Division, Burke Washington State Museum, University of Washington, Seattle.
STRATIGRAPHIC BOUNDARIES

V.T.C. Ven Te Chow. *Professor of Civil and Hydrosystems Engineering, University of Illinois, Urbana. Editor in Chief and contributor to* Handbook of Applied Hydrology.
HYDROLOGIC CYCLE
HYDROLOGIC SCIENCES

V.T.P. Vladimir T. Pashuto. *Corresponding member, Academy of Sciences of the U.S.S.R., Moscow. Author of* Vneshnyaya politika drevney Rusi *and others.*
ALGIRDAS

V.U. Valev Uibopuu. *Novelist. Editor, Estonian Writers' Co-operative, Lund, Sweden. Author of* Keegi ei kuule meid.
LITERATURE, WESTERN: *Estonian*

V.V.I. Vyacheslav Vesvolodovich Ivanov. *Head, Department of Structural Typology, Institute of Slavonic and Balkan Studies, Academy of Sciences of the U.S.S.R., Moscow.*
SLAVIC LANGUAGES

V.V.K. Vera V. Khvostova (d. 1977). *Chief, Laboratory of Cytogenetics, Institute of Cytology and Genetics, Siberian Department, Academy of Sciences of the U.S.S.R., Novosibirsk. Author of* Genetics for Animal Breeders; *editor of* Cytogenetics of Wheat and Its Hybrids.
DOMESTICATION, PLANT AND ANIMAL (*in part*)

V.V.P. Vladimir V. Pokhshishevsky. *Staff member, Institute of Ethnography, Academy of Sciences of the U.S.S.R., Moscow.*
SOVIET UNION (*in part*)

V.V.Z. Vladimir Viktorovich Zhdanov. *Literary critic. Assistant to the Chief Editor,* Kratkaya Literaturnaya Entsiklopediya, *Moscow. Author of* M. Yu. Lermontov *and other works on Russian writers.*
LERMONTOV, MIKHAIL

V.W.v.H. Victor Wolfgang von Hagen. *Director, Roman Road Expeditions. Director, Inca High Expedition. Author of* Realm of the Incas *and others; editor of* The Incas.
INCA RELIGION

V.Y.L. Vasily Yosifovich Lymarev. *Professor of Geography, Kuban State University, Krasnodar, U.S.S.R. Author of* Berega Aralskogo Morya-vnutrennego vodoyema aridnoy zony.
ARAL SEA

V.Z. Vice Zaninović. *Professor of Serbian Literature, University of Zagreb, Yugoslavia. Author of* August Cesarec, Life and Work.
LITERATURE, WESTERN: *Serbian*

W.A. Warren Andrew, M.D. *Professor of Anatomy, School of Medicine, Indiana University, Indianapolis. Author of* Textbook of Comparative Histology.
SKELETAL SYSTEM, HUMAN

Wa.B. Walter Blair. *Emeritus Professor of English, University of Chicago. Author of* Mark Twain and "Huck Finn"; *co-author of* America's Humor: Poor Richard to Doonesbury.
LITERATURE, WESTERN (*in part*)

W.A.B. Warren A. Beck. *Professor of History, California State University, Fullerton. Author of* New Mexico: A History of Four Centuries.
NEW MEXICO

W.A.D.A. W.A.D. Anderson, M.D. *Emeritus Professor of Pathology, School of Medicine, University of Miami. Author of* Synopsis of Pathology; *editor of* Pathology.
ATROPHY

Wa.E.M. Wayne E. Manning. *Emeritus Professor of Botany, Bucknell University, Lewisburg, Pennsylvania. Author of numerous articles on the walnut family.*
JUGLANDALES

W.A.H. Walter A. Harrison. *Professor of Applied Physics, Stanford University, California. Author of* Pseudopotentials in the Theory of Metals.
METALS, THEORY OF

W.A.Ha. Willard A. Hanna. *Senior Associate, American Universities Field Staff, Hanover, New Hampshire. Author of* Bung Karno's Indonesia *and others.*
SUKARNO

Wa.K. Walter Kolneder. *Professor of Music, University of Karlsruhe, West Germany. Author of* Antonio Vivaldi *and others.*
VIVALDI, ANTONIO

W.Am. Winslow Ames. *Associate Professor of Art, University of Rhode Island, Kingston, 1966–75. Curator, Gallery of Modern Art, New York City, 1957–61. Author of* Great Drawings of All Time, *vol. 1,* Italian Drawings *and others.*
CARICATURE, CARTOON, AND COMIC STRIP (*in part*)

W.A.N. William Anderson Newman. *Professor of Biological Oceanography, Scripps Institution of Oceanography, University of California, San Diego. Co-author of "Cirripedia" in* Treatise on Invertebrate Paleontology; Antarctic Cirripedia.
CIRRIPEDIA

W.A.P. Rev. William Arthur Purdy. *Secretary for Anglican and Methodist Relations, Secretariat for Promoting Christian Unity, Vatican. Author of* The Church on the Move: The Characters and Policies of Pius XII and John XXIII.
PIUS XII, POPE

Wa.R. Walpola Rāhula. *Supervisor, University of Oxford. Vice Chancellor, Vidyodaya University of Ceylon, 1966–69. Author of* What the Buddha Taught *and others.*
BUDDHA

W.A.R. William Alexander Robson. *Emeritus Professor of Public Administration, University of London; Honorary Fellow and Lecturer, London School of Economics and Political Science. Vice President, Royal Institute of Public Administration. Author of* Justice and Administrative Law; *co-editor of* Great Cities of the World: Their Government, Politics and Planning.
ADMINISTRATIVE LAW
CITY GOVERNMENT

W.A.Ri. William Andrew Ringler, Jr. *Professor of English, University of Chicago. Editor of* The Poems of Sir Philip Sidney.
SIDNEY, SIR PHILIP

W.A.S. W.A. Swanberg. *Free-lance writer. Author of* Dreiser *and others.*
DREISER, THEODORE

W.A.W. Warid A. Warid. *Professor of Agriculture, University of Libya, Tripoli. Co-author of* Vegetable Production.
VEGETABLES AND VEGETABLE FARMING

W.B. Willem Burger. *Senior Lecturer in Maritime Studies, University of Wales Institute of Science and Technology, Cardiff. Co-author of* Marine Gyro-Compasses and Automatic Pilots.
GYROSCOPE (*in part*)

W.B.B. William B. Bean, M.D. *Director, Institute of Medical Humanities, University of Texas Medical Branch at Galveston. Editor in Chief, Archives of Internal Medicine, 1962–67. Author of* Rare Diseases and Lesions: Their Contributions to Clinical Medicine.
DIAGNOSIS

W.B.F. W. Beall Fowler. *Professor of Physics, Lehigh University, Bethlehem, Pennsylvania.*
IONIC CRYSTALS

W.B.Fi. William B. Fisher. *Principal, The Graduate Society; Head, Department of Geography, University of Durham, England. Author of* The Middle East; *editor of* Cambridge History of Iran, *vol. 1.*
IRAQ (*in part*)
SUEZ CANAL

W.B.F.R. William B.F. Ryan. *Research Associate, Lamont-Doherty Geological Observatory, Columbia University.*
RED SEA (*in part*)

W.B.H. Wilfred Brooks Heginbotham. *Cripps Professor and Head, Department of Production Engineering and Production Management, University of Nottingham, England. Editor,* The Industrial Robot. *Chairman of the Council, British Robot Association.*
ROBOT DEVICES

W.Bi. Walter Biemel. *Professor of Philosophy, State Academy of Art of Düsseldorf, West Germany.*
PHENOMENOLOGY (*in part*)

W.B.K. W. Barclay Kamb. *Professor of Geology and Geophysics, California Institute of Technology, Pasadena. A leading authority on the properties of Earth materials, including ice.*
ROCKS, PHYSICAL PROPERTIES OF

W.Bl. Warren Blanding. *Chief Operating Executive, Marketing Publications Inc., Washington, D.C. Author of* Profit Opportunities in Physical Distribution *and others.*
STORAGE AND WAREHOUSING

W.B.McM. William B. McMahon. *Program Manager in Law Enforcement, Office of Telecommunications Policy, Executive Office of the President, Washington, D.C. Editor of* Law Enforcement Science and Technology III.
POLICE TECHNOLOGY

W.B.N.B. William B.N. Berry. *Professor of Paleontology, University of California, Berkeley. Author of* Growth of a Prehistoric Time Scale.
HUTTON, JAMES

W.Br. Werner Braunbek (d. 1977). *Professor of Theoretical Physics, University of Tübingen, West Germany.*
PLANCK, MAX

W.Bu. William Burrows. *Emeritus Professor of Microbiology, University of Chicago. Author of* Textbook of Microbiology.
DISEASE

W.B.W. Wilse B. Webb. *Graduate Research Professor of Psychology, University of Florida, Gainesville. Author of* Sleep: An Experimental Analysis.
DREAMS

W.C. Warren Cowgill. *Professor of Linguistics, Yale University. Author of several articles on Indo-European languages.*
INDO-EUROPEAN LANGUAGES

W.C.A. William C. Atkinson. *Professor of Hispanic Studies, University of Glasgow, 1932–72; Director, Institute of Latin-American Studies, 1966–72. Author of* A History of Spain and Portugal; *translator of Camões'* The Lusiads.
CERVANTES, MIGUEL DE
LITERATURE, WESTERN: *Spanish* and *Portuguese* (*in part*)

W.C.B. William Charles Brice. *Reader in Geography, Victoria University of Manchester.*
TUNISIA (*in part*)

W.C.Da. William C. Davis, Jr. *Firearms consultant. Former Chief, Small-Caliber-Ammunition Engineering Laboratory, U.S.*

Army, Frankford Arsenal, Philadelphia.
AMMUNITION

W.C.Di. William C. Dilger. *Associate Professor of Ethology, Cornell University, Ithaca, New York. Author of* Psychobiology; 39 Steps to Biology; *and others.*
BEHAVIOUR, ANIMAL

W.C.F. Warren Curtis Freihofer. *Associate Curator, Department of Ichthyology, California Academy of Sciences, San Francisco. Author of research papers on the anatomy and systematics of fishes.*
PERCIFORMES (*in part*)

W.C.H. Walther C. Hubatsch. *Professor of Medieval and Modern History, Rhenish Friedrich Wilhelm University of Bonn. Author of* Die Ära Tirpitz *and others.*
TIRPITZ, ALFRED VON

W.C.McC. William Cheyne McCallum. *Senior Research Fellow in Neuropsychology, Burden Neurological Institute and University of Bristol, England. Co-editor of* The Responsive Brain.
ATTENTION (*in part*)

W.Cr. William Cruse. *Technical Consultant, Uris Theatre Complex, New York City and New Orleans Cultural Center. Former Supervisor of Scenic Services, American Broadcasting Company, New York City. Former Technical Director, Ahmandson Theatre, Los Angeles.*
STAGING AND STAGE DESIGN (*in part*)

W.C.S. William Cofield Summers, M.D. *Professor of Radiobiology, Molecular Biophysics, Biochemistry, and Human Genetics, Yale University.*
VIRUS

W.C.Se. William C. Seitz (d. 1974). *George R. Kenan, Jr., Professor of the History of Art, University of Virginia, Charlottesville, 1971–74. Author of* Claude Monet.
MONET, CLAUDE

W.C.St. William Campbell Steere. *Professor of Botany, Columbia University. Emeritus President, New York Botanical Garden, Bronx. Editor of* Fifty Years of Botany.
BOTANY

W.Cu. William Culican. *Reader in History, University of Melbourne. Author of* The Medes and Persians *and others.*
HANNIBAL
KHOSROW II OF PERSIA
STONE AGE EUROPEAN PEOPLES, ARTS OF (*in part*)

W.D. Wilma Dykeman. *Free-lance writer. Author of* Seeds of Southern Change; *co-author of* The Border States *and others.*
APPALACHIAN MOUNTAINS
KENTUCKY

W.De. Wilfrid Desan. *Professor of Philosophy, Georgetown University, Washington, D.C. Author of* The Tragic Finale; The Marxism of Jean-Paul Sartre.
SARTRE, JEAN-PAUL

W.D.N. Wilbert D. Newgold. *Director, Colony Arts Center, Woodstock, New York, and Newgold Archives, Stamford, Connecticut. Author of* Newgold's Guide to Modern Hobbies, Arts, and Crafts.
HOBBIES

W.D.P. W. Douglas Piercey, M.D. (d. 1972). *Associate Professor of Hospital Administration, University of Toronto, 1954–65. Executive Director, Canadian Hospital Association, Toronto; Editor,* The Canadian Hospital Journal, 1954–65.
HOSPITAL

W.D.R. Wayne D. Rasmussen. *Historian, Agricultural History Branch, Economics, Statistics and Cooperatives Service, U.S. Department of Agriculture, Washington, D.C. Editor of* Agriculture in the United States: A Documentary History.
AGRICULTURE, HISTORY OF (*in part*)

W.E. William Epstein. *Professor of Psychology, University of Wisconsin, Madison. Author of* Varieties of Perceptual Learning.
LEARNING, PERCEPTUAL

W.E.A. Walter E. Allen. *Professor of English Studies, New University of Ulster, Coleraine, Northern Ireland, 1968–73. Author of* The English Novel *and others.*
CONRAD, JOSEPH
FIELDING, HENRY
SMOLLETT, TOBIAS

W.E.D. William E. Duellman. *Curator, Division of Herpetology, Museum of Natural History; Professor of Systematics and Ecology, University of Kansas, Lawrence. Researcher on the biology and systematics of frogs, with particular emphasis on the New World tropics. Author of* The Hylid Frogs of Middle America.
ANURA

W.E.K. Walter Emil Kaegi, Jr. *Professor of Byzantine and Roman History, University of Chicago. Author of* Byzantium and the Decline of Rome *and others.*
LEO III THE ISAURIAN

W.Em. Walter Emery (d. 1974). *Director, Novello and Company Ltd., London. Specialist on the work of Bach. Author of* Bach's Ornaments.
BACH, JOHANN SEBASTIAN (*in part*)

W.E.M. William Edward May. *Commander, Royal Navy. Deputy Director, National Maritime Museum, Greenwich, England, 1951–68. Naval Assistant to the Director, Compass Department, Admiralty, 1929–51. Author of* Compass Adjustment.
COMPASS (*in part*)

W.E.Mo. W.E. Mosse. *Professor of European History, University of East Anglia, Norwich, England. Author of* Alexander II and the Modernization of Russia *and others.*
ALEXANDER II OF RUSSIA

W.E.Mü. Wilhelm Emil Mühlmann. *Emeritus Professor of Sociology and Anthropology, Rupert Charles University of Heidelberg. Author of* Homo Creator; *editor and co-author of* Chiliasmus und Nativismus.
PACIFISM AND NONVIOLENT MOVEMENTS

W.E.P. Warren E. Preece. *Vice Chairman, Board of Editors,* Encyclopædia Britannica, *Chicago; The Editor, 1964–75. Co-author of* The Technological Order.
TYPOGRAPHY (*in part*)

W.Er. Walter Erben. *Professor of Art Education, College of Education of the Ruhr, Dortmund, West Germany. Author of* Joan Miró; Chagall, *and others.*
MIRÓ, JOAN

W.E.S. William Edward Stubbs. *Assistant Judge Advocate General, Office of the Judge Advocate General of the British Forces in Germany, London.*
MILITARY LAW

W.E.St. W. Earl Stewart. *Chief Engineer and Vice President of Manufacturing Facilities, Standard Register Company, Dayton, Ohio, 1956–70. Director of Engineering, Maico Company, Minneapolis, Minnesota, 1953–56. Manager, Broadcast Audio Engineering, Radio Corporation of America, Camden, New Jersey, 1948–53. Author of* Magnetic Recording Techniques.
SOUND RECORDING AND REPRODUCING (*in part*)

W.E.T. William E. Thomson. *Composer. Kulas Professor of Music, Case Western Reserve University, Cleveland. Author of* Materials and Structure of Music; Introduction to Music as Structure.
SOUND, MUSICAL

W.E.V. W. Edgar Vinacke. *Professor of Psychology, State University of New York at Buffalo. Author of* The Psychology of Thinking.
THOUGHT PROCESSES, TYPES OF

W.F. Wallace Fowlie. *James B. Duke Professor of French Literature, Duke University, Durham, North Carolina. Author of* Jean Cocteau; Stendhal; Mallarmé; Rimbaud; A Guide to Contemporary French Literature; Age of Surrealism.
COCTEAU, JEAN
STENDHAL

W.F.A. William Foxwell Albright (d. 1971). *Professor of Semitic Languages, Johns Hopkins University, Baltimore, Maryland, 1929–58. Author of* Archæology of Palestine; From the Stone Age to Christianity.
NEAR EAST, ANCIENT

W.F.B. William Francis Brown. *Editor,* American Field, *Chicago. Author of* How to Train Hunting Dogs; Retriever Gun Dogs; *and others.*
HUNTING, SPORT (*in part*)

W.F.F. William F. Fratcher. *R.B. Price Distinguished Professor of Law, University of Missouri, Columbia. Author of* Perpetuities and Other Restraints.
MORTGAGES, LAW OF

W.F.G. William F. Ganong, M.D. *Professor and Chairman, Department of Physiology, University of California, San Francisco. Author of* Review of Medical Physiology; *co-editor of* Neuroendocrinology.
ENDOCRINE SYSTEM, HUMAN

W.F.J. Wilhelmina Feemster Jashemski. *Professor of Ancient History, University of Maryland, College Park. Author of* Letters from Pompeii *and numerous other works based on her excavations at Pompeii.*
POMPEII AND HERCULANEUM

W.F.K. William F. Kieffer. *Professor of Chemistry, Wooster College, Ohio. Author of* The Mole Concept in Chemistry.
CHEMICAL COMPOUNDS, CLASSIFICATIONS OF

W.F.Kn. Wilfrid F. Knapp. *Fellow and Tutor in Politics, St. Catherine's College, University of Oxford. Author of* A History of War and Peace, 1939–65.
HITLER, ADOLF (*in part*)

W.F.O. Waldir Freitas Oliveira. *Co-ordinator Professor of the Course of History, Federal University of Bahia, Salvador, Brazil.*
PARAGUAY RIVER

W.F.P. Walter Fernando Piazza. *Professor of History, Federal University of Santa Catarina, Florianópolis, Brazil. Author of* Atlas Histórico de Santa Catarina *and others.*
SANTA CATARINA

W.F.V. Walter F. Vella. *Professor of History, University of Hawaii, Honolulu. Author of* Siam under Rama III, 1824–1851; A History of Modern Thailand; *and others.*
SIAM AND THAILAND, HISTORY OF

W.F.W. Warren F. Walker, Jr. *Professor of Biology, Oberlin College, Ohio. Author of* Vertebrate Dissection.
MUSCLE SYSTEMS

W.F.Wh. William Foote Whyte. *Professor of Industrial and Labour Relations, Cornell University, Ithaca, New York. Author of* Organizational Behavior: Theory and Application *and others.*
INDUSTRIAL AND ORGANIZATIONAL RELATIONS

W.G. Werner Gatz. *Director, Bremen Society for Economic Research, West Germany.*
NIEDERSACHSEN (*in part*)

W.Ga. William Gaunt. *Art historian. Special correspondent on art subjects,* The Times,

London. Author of The Pre-Raphaelite Tragedy; The Aesthetic Adventure.
ROSSETTI FAMILY

W.G.A. W. Geoffrey Arnott. *Professor of Greek Language and Literature, University of Leeds, England.*
TERENCE

W.G.B. Walter G. Bergmann. *Former Editor, Schott and Co. Ltd., Music Publishers, London. Author of several articles on Telemann; editor of many of his works.*
TELEMANN, GEORG PHILIPP

W.G.C. William G. Constable (d. 1976). *Curator of Paintings, Boston Museum of Fine Arts, 1938–57. Author of* Canaletto: Giovanni Antonio Canal, 1697–1768.
CANALETTO

W.G.E. W. Gordon East. *Emeritus Professor of Geography, Birkbeck College, University of London. Author of* An Historical Geography of Europe *and others.*
EUROPE

W.G.I. W. Grant Inglis. *Director General of Education for South Australia, Adelaide. Author of "Patterns of Evolution in Parasitic Nematodes" in* Evolution of Parasites.
ASCHELMINTHES

W.G.Ib. William G. Ibberson. *Chairman, George Ibberson and Company Ltd.; Sheffield Testing Works Ltd.; and Cutlery Research Council, Sheffield, England.*
CUTLERY AND TABLEWARE

W.G.M. William George Mokray. *Editor and Publisher,* Basketball's Best. *Writer for* Converse Basketball Yearbook. *U.S. correspondent on basketball for European publications. Elected to the Basketball Hall of Fame, 1965.*
BASKETBALL

W.G.Mo. Will G. Moore (d. 1978). *Reader in French Literature, University of Oxford. Author of* La Rochefoucauld: His Mind and Art *and others.*
LA ROCHEFOUCAULD
LITERATURE, WESTERN: *French; 17th century*
MOLIÈRE

W.Go. Walter Otto Julius Görlitz. *Journalist; Editorial Staff,* Die Welt, *Hamburg. Author of* History of the German General Staff, 1657–1945 *and others.*
LUDENDORFF, ERICH
ROMMEL, ERWIN

W.G.O. Willard Gurdon Oxtoby. *Professor of Religious Studies; Director, Centre for Religious Studies, University of Toronto. Author of* Some Inscriptions of the Safaitic Bedouin.
ARABIAN RELIGIONS

W.G.P. William G. Pfann. *Consultant and former Department Head, Materials Research Laboratory, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey. Author of* Zone Melting.
ZONE MELTING

W.G.Pr. W.G. Prout. *Consultant Surgeon, Portsmouth Group Hospitals, England.*
SHOCK, PHYSIOLOGICAL

W.Gr. Werner Gross. *Professor, Gustav Embden Centre of Biological Chemistry, Johann Wolfgang Goethe University of Frankfurt, West Germany. Author of* Transport Through Biological Membranes.
MEMBRANE BIOLOGICAL (*in part*)

W.G.S. Walter Graham Spector. *Professor of Pathology, St. Bartholomew's Hospital Medical College, University of London. Co-author of* The Pharmacology of Inflammation.
INFLAMMATION

W.G.St. William Glenn Steiner. *Professor of Psychology. Bradley University, Peoria, Illinois.*
DRUG PROBLEMS

W.G.U. William G. Urry. *Reader in Medieval Western Paleography, University of Oxford; Fellow of St. Edmund Hall, Oxford.*
PALEOGRAPHY

W.G.W. William Grey Walter (d. 1977). *Head of Research, Burden Neurological Institute, Bristol, England. Author of* The Living Brain.
ATTENTION (*in part*)

W.H. Wolfgang Helck. *Professor of Egyptology, University of Hamburg. Author of* Manetho und die ägyptischen Königslisten *and others.*
CHRONOLOGY (*in part*)

W.Ha. Walter Harrelson. *Distinguished Professor of Old Testament, Vanderbilt University, Nashville, Tennessee. Author of* From Fertility Cult to Worship *and others.*
WORSHIP

W.H.B. William H. Baumer. *Major General, U.S. Army Reserve (retired). President, International General Industries, Inc., Washington, D.C., 1963–72. Co-author of* The Little Wars of the United States.
FORTIFICATIONS (*in part*)

W.H.C. Walter Houston Clark. *Professor of the Psychology of Religion, Andover Newton Theological School, Newton Centre, Massachusetts, 1962–67. Author of* Chemical Ecstasy: Psychedelic Drugs and Religion.
PHARMACOLOGICAL CULTS

W.H.C.F. William Hugh Clifford Frend. *Professor of Ecclesiastical History, University of Glasgow. Author of* Martyrdom and Persecution in the Early Church *and others.*
CYPRIAN, SAINT

W.H.D. William Henry Dawbin. *Reader in Biology, University of Sydney, Australia. Author of papers on tuataras.*
RHYNCHOCEPHALIA

W.He. Walter Heinemeyer. *Professor of Medieval History, Philipps University of Marburg, West Germany. Co-editor of* Politisches Archiv des Landgrafen Philipps.
PHILIPP THE MAGNANIMOUS, LANDGRAVE OF HESSE

W.H.G. W. Horsley Gantt, M.D. *Associate Professor Emeritus of Psychiatry; Consultant and Emeritus Director, Pavlovian Laboratory, School of Medicine, Johns Hopkins University, Baltimore. Senior Scientist, Pavlovian Laboratory, Veterans Administration Hospital, Perry Point, Maryland.*
PAVLOV, IVAN PETROVICH

W.H.G.A. Walter Harry Green Armytage. *Professor of Education, University of Sheffield, England. Author of* A Social History of Engineering.
EADS, JAMES BUCHANAN
EVANS, OLIVER

W.H.M. William H. Miller, M.D. *Professor of Ophthalmology and Visual Science, School of Medicine, Yale University.*
PHOTORECEPTION

W.H.McC. William Hunter McCrea. *Emeritus Professor of Astronomy, University of Sussex, Brighton, England. Author of* Physics of the Sun and Stars.
UNIVERSE, STRUCTURE AND PROPERTIES OF

W.H.McL. William Hewat McLeod. *Professor of History, University of Otago, Dunedin, New Zealand. Author of* Gurū Nānak and the Sikh Religion.
NĀNAK

W.H.McN. William H. McNeill. *Robert A. Milliken Distinguished Service Professor of History, University of Chicago. Author of* The Rise of the West *and others.*
BALKANS, HISTORY OF THE (*in part*)

W.Hn. Walter B.O. Hansen. *University Professor Emeritus of Oceanography, University of Hamburg.*
TIDES (*in part*)

W.H.O. William Hosking Oliver. *Professor and Head, Department of History, Massey University, Palmerston North, New Zealand. Author of* The Story of New Zealand *and others.*
NEW ZEALAND, HISTORY OF

W.H.P.R. William H.P. Robertson. *Editor-Publisher,* The Thoroughbred Record; *Chairman, Record Publishing Company, Inc., Lexington, Kentucky. Author of* History of Thoroughbred Racing in America.
HORSE RACING (*in part*)

W.H.T. William Homan Thorpe. *Emeritus Professor of Animal Ethology, University of Cambridge. Author of* Learning and Instinct in Animals.
INSTINCT
LEARNING, ANIMAL

W.H.Th. William Harford Thomas. *Journalist. Former Deputy Editor,* The Guardian, *London. Author of* Crisis in the British Press.
ENGLAND

W.H.v.A. Wilhelm H. von Aulock. *Head, Bell Telephone Laboratories, Inc., Whippany, New Jersey. Co-author of* Linear Ferrite Devices for Microwave Applications; *editor of* Handbook of Microwave Ferrite Materials.
FERRITES

W.H.W. William Henry Walsh. *Professor of Logic and Metaphysics, University of Edinburgh. Fellow of the British Academy. Author of* Reason and Experience; Metaphysics; *and others.*
METAPHYSICS (*in part*)

W.H.Wa. Warren H(erbert) Wagner, Jr. *Professor of Botany; Curator of Pteridophytes, University Herbarium, University of Michigan, Ann Arbor. Author of* The Fern Genus Diellia.
FERN

Wi.B. William Back. *Research Hydrologist, Water Resources Division, Geological Survey, U.S. Department of the Interior, Reston, Virginia. An authority on the geochemistry of freshwaters.*
GEOCHEMICAL EQUILIBRIA AT LOW TEMPERATURES AND PRESSURES (*in part*)

Wi.G.M. William G. Moulton. *Professor of Linguistics, Princeton University. Professor of Germanic Linguistics, Cornell University, Ithaca, New York, 1949–60. Author of* The Sounds of English and German.
GERMANIC LANGUAGES (*in part*)

Wi.M. Wilhelm Matull. *Senior Civil Servant, National Centres for Political Education, Hannover, Bonn, and Düsseldorf, West Germany, 1954–68. Author of* Ferdinand Lassalle *and others.*
LASSALLE, FERDINAND

Wi.S. Wilson Stephens. *Editor,* The Field, *London. Co-editor of* In Praise of Hunting.
HUNTING, SPORT (*in part*)

W.J. Walter John. *Research Specialist, Air and Industrial Hygiene Laboratory, California Department of Health, Berkeley.*
WAVE MOTION

W.J.B. William J. Baumol. *Professor of Economics, Princeton University, and New York University, New York City. Author of* Business Behavior, Value and Growth.
UTILITY AND VALUE, ECONOMIC

W.J.Bo. William J. Bouwsma. *Sather Professor of History, University of California, Berkeley. Author of* Venice and the Defense of Republican Liberty *and others.*
ITALY AND SICILY, HISTORY OF (*in part*)

W.J.Bu. Rev. Walter John Burghardt, S.J. *Professor of Historical Theology, Woodstock College, New York City. Editor,* Theological Studies. *Author of* Saints and Sanctity.
JEROME, SAINT

W.J.E. W.J. Eccles. *Professor of History, University of Toronto. Author of* The Canadian Frontier, 1534–1760; Frontenac; *and others.*
CARTIER, JACQUES
FRONTENAC, COMTE DE

W.J.F. W.J. Frank. *Senior Staff, Lawrence Livermore Laboratory, University of California, Livermore.*
NUCLEAR WEAPONS

W.J.G. Willis John Gertsch. *Emeritus Curator, Arachnida, Department of Entomology, American Museum of Natural History, New York City. Author of* American Spiders.
SCORPIONIDA

W.J.Gr. William J. Griffith. *Emeritus Professor of History; Director, Center of Latin American Studies, University of Kansas, Lawrence. Author of* Empires in the Wilderness: Foreign Colonization and Development in Guatemala, 1834–1844 *and others.*
CENTRAL AMERICAN STATES, HISTORY OF (*in part*)

W.J.H. William James Hamilton, M.D. (d. 1975). *Professor of Anatomy, Charing Cross Hospital Medical School, University of London, 1947–70. Editor of* Textbook of Human Anatomy.
SKELETAL SYSTEMS (*in part*)

W.J.H.W. Wolfgang J.H. Wickler. *Director, Max Planck Institute for Behavioural Physiology, Seewiesen, West Germany. Professor of Zoology, Ludwig Maximilian University of Munich. Author of* Mimicry in Plants and Animals.
MIMICRY

W.J.LeV. William Judson LeVeque. *Executive Director, American Mathematical Society, Providence, Rhode Island. Professor of Mathematics, Claremont Graduate School, California, 1970–77. Author of* Topics in Number Theory; Elementary Theory of Numbers; *and others.*
ARITHMETIC (*in part*)
MATHEMATICS, HISTORY OF (*in part*)

W.J.McC. Willard J. McCarthy. *Associate Professor of Industrial Technology, Illinois State University, Normal. Co-author of* Machine Tool Technology.
MACHINE TOOLS

W.J.McG. William J. McGuire. *Professor of Psychology, Yale University. Co-author of* Attitude Organization and Change.
ATTITUDES
PERSUASION

W.J.Mi. William James Mills, Jr., M.D. *Orthopedic Surgeon. Medical Director, Emergency Medical Services, State of Alaska. Rear Admiral, Medical Corps, U.S. Naval Reserve. Consultant on Cold Injury to the Surgeons General of the U.S. Army and Navy. Author of many articles and papers on frostbite.*
FROSTBITE

W.J.S. W. John Smith. *Associate Professor of Biology and Psychology, University of Pennsylvania, Philadelphia. Author of* The Behavior of Communicating *and others.*
COMMUNICATION, ANIMAL

W.J.St. W.J. Stankiewicz. *Professor of Political Science, University of British Columbia, Vancouver. Editor of* In Defense of Sovereignty
SOVEREIGNTY

W.J.T. William John Talbot. *Emeritus Professor of Geography, University of Cape Town. Co-author of* Atlas of the Union of South Africa.
CAPE OF GOOD HOPE

W.J.Tu. William Julian Tuttle. *Head of Make-Up Department, Metro-Goldwyn-Mayer Studio, Culver City, California. Winner of a special Academy Award, 1965.*
DRESS (*in part*)

W.Jw. Wadie Jwaideh. *Professor of History and Arabic; Chairman, Department of Near Eastern Languages and Literatures, Indiana University, Bloomington. Translator of* The Introductory Chapters of Yāqūt's Mu'jam al-Buldān.
IDRISĪ, AL-

W.J.W. Willem Johan Waworoentoe. *Senior Lecturer in Regional and City Planning, Center for Planning Studies, Bandung Institute of Technology, Java, Indonesia. Author of* Recent Urban Growth in Indonesia and Its Regional Development Implications.
DJAKARTA

W.J.Wh. William J. Whalen. *Associate Professor of Communication, Purdue University, West Lafayette, Indiana; Director of Publications and University Editor; Director, Purdue University Press. Author of* Minority Religions in America *and others.*
JEHOVAH'S WITNESSES

W.K. Walter Kranz. *Director, Press and Information Office of the Liechtenstein Government. Editor of* The Principality of Liechtenstein *and others.*
LIECHTENSTEIN

W.Ka. Walter Kaufmann. *Professor of Philosophy, Princeton University. Author of Nietzsche: Philosopher, Psychologist, Antichrist; translator of many of Nietzsche's works.*
NIETZSCHE, FRIEDRICH

W.K.C. Wilbert K. Carter. *Associate Professor of Anthropology; Co-chairman, Department of Sociology and Anthropology, Tufts University, Medford, Massachusetts.*
ARCTIC PEOPLES AND CULTURES

W.K.D.D. Wayne K.D. Davies. *Associate Professor of Geography, University of Calgary, Alberta. Author of* The Conceptual Revolution in Geography: Selected Essays.
GEOGRAPHY (*in part*)
LIVERPOOL

W.Ki. William Kirk. *Professor and Head, Department of Geography, Queen's University of Belfast, Northern Ireland. Author of various articles on historical and political geography of southern Asia.*
JAMMU AND KASHMIR

W.Ko. Walter Korn. *Author of* The Brilliant Touch in Chess; Modern Chess Openings; *and others.*
CHESS

W.K.R.M. William K.R. Musgrave. *Professor of Organic Chemistry; Head, Department of Chemistry, University of Durham, England. Author of numerous articles on halogen-containing organic compounds.*
ORGANIC HALOGEN COMPOUNDS

W.L.J. William Lee Jolly. *Professor of Chemistry, University of California, Berkeley. Author of* The Synthesis and Characterization of Inorganic Compounds.
HYDROGEN AND ITS COMPOUNDS
SODIUM AND POTASSIUM PRODUCTS AND PRODUCTION (*in part*)

W.L.M. William Lewis Morton. *Vanier Professor Emeritus of Canadian History, Trent University, Peterborough, Ontario. Author of* The Kingdom of Canada *and others.*
CANADA, HISTORY OF

W.L.Re. William L. Reese. *Professor of Philosophy, State University of New York at Albany. Author of* Dictionary of Philosophy and Religion: Eastern and Western Thought.
PANTHEISM AND PANENTHEISM

W.L.S. William L. Schaaf. *Emeritus Professor of Mathematical Education, Brooklyn College, City University of New York. Author of* Bibliography of Recreational Mathematics.
NUMBER GAMES AND OTHER MATHEMATICAL RECREATIONS

W.L.Sc. Waldo L. Schmitt (d. 1977). *Head Curator of Zoology, U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C., 1947–57. Author of* The Marine Decapod Crustacea of California *and many papers on marine invertebrates*
CRUSTACEA (*in part*)

W.L.St. William Louis Stern. *Professor of Botany, University of Maryland, College Park. Co-author of* Humanistic Botany.
SAXIFRAGALES

W.L.W. Walter L. Weeks. *Professor of Electrical Engineering, Purdue University, West Lafayette, Indiana. Author of* Antenna Engineering *and others.*
ANTENNAS AND WAVE GUIDES

W.M. William Montagna. *Director, Oregon Regional Primate Research Center, Beaverton. Professor of Dermatology, University of Oregon Health Sciences Center, Portland. Editor,* Advances in Biology of Skin (*annual*). *Author of* The Structure and Function of Skin.
SKIN, HUMAN

W.Ma. William Markowitz. *Adjunct Professor of Physics, Nova University, Dania, Florida. Professor of Physics, Marquette University, Milwaukee, 1966–72. Editor of* Continental Drift, Secular Motion of the Pole, and Rotation of the Earth.
TIME (*in part*)

W.Man. William Manchester. *Writer-in-Residence, Wesleyan University, Middletown, Connecticut. Author of* The Death of a President; The Arms of Krupp; *and others.*
KENNEDY FAMILY
KRUPP FAMILY

Wm.A.R.T. William Archibald Robson Thomson, M.D. *Editor,* The Practitioner, 1944–72. *Author of* The Searching Mind in Medicine *and others; co-editor of* Black's Medical Dictionary.
MEDICINE, HISTORY OF (*in part*)

W.M.B. W. Mary Bannerman. *Co-author of* The Birds of the Atlantic Islands (*4 vol.*) *and others.*
CAPE VERDE ISLANDS

W.M.C. W. Mercer Cook. *Emeritus Professor of Romance Languages, Howard University, Washington, D.C. Author of* Five French Negro Authors; *translator of Senghor's* On African Socialism.
SENGHOR, LÉOPOLD

W.M.Cl. Wayne M. Clegern. *Professor of History, Colorado State University, Fort Collins. Author of* British Honduras: Colonial Dead End, 1859–1900.
CENTRAL AMERICAN STATES, HISTORY OF (*in part*)

W.Me. William Richard Merrifield. *International Coordinator for Anthropology and Community Development, Summer Institute of Linguistics, Inc., Dallas, Texas. Author of* Palantla Chinantec Grammar.
MESO-AMERICAN INDIAN CULTURES

W.M.E. Walter M. Elsasser. *Research Professor, Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park.*
EARTH AS A PLANET

W.M.-F. Wolfram Müller-Freienfels. *Professor of International Civil Law; Director, Institute of Foreign and International Civil Law, Albert Ludwig University of Freiburg, Freiburg im Breisgau, West Germany. Author of* Die Vertretung beim Rechtsgeschäft.
AGENCY, LAW OF

W.Mi. Wesley Milgate. *Emeritus Professor of English, Australian National University, Canberra. Editor of* John Donne: The Satires, Epigrams and Verse Letters; John Donne: A Life.
DONNE, JOHN

W.M.K. William M. Kaula. *Professor of Geophysics, University of California, Los Angeles. Author of* Theory of Satellite Geodesy.
EARTH, GRAVITATIONAL FIELD OF

W.M.S. William Merritt Sale, Jr. *Goldwin Smith Professor Emeritus of English, Cornell University, Ithaca, New York. Author of* Samuel Richardson: A Biographical Record; Samuel Richardson: Master Printer.
RICHARDSON, SAMUEL

W.M.W. William Montgomery Watt. *Professor of Arabic and Islāmic Studies, University of Edinburgh. Author of* Muhammad: Prophet and Statesman; Muslim Intellectual: A Study of al-Ghazālī; *general editor of* Islāmic Surveys.
GHAZĀLĪ, AL-
HĀRŪN AR-RASHĪD
MUḤAMMAD

W.M.Wa. Willard M. Wallace. *Professor of History, Wesleyan University, Middletown, Connecticut. Author of* Appeal to Arms: A Military History of the American Revolution *and others.*
WAR OF INDEPENDENCE, U.S.

W.M.Wh. Walter Muir Whitehill (d. 1978). *Director and Librarian, Boston Athenaeum, 1946–73. Author of* Boston: A Topographical History *and others.*
BOSTON

W.M.Y. William Munro Yool. *Air Vice Marshal, Royal Air Force (retired). Military writer. Former assistant editor,* Brassey's Annual.
WARFARE, CONDUCT OF (*in part*)

W.N. Werner Neugebauer. *Former Director, Office for Prehistory and Early History, Office of the Mayor of Lübeck, West Germany.*
LÜBECK

W.N.D. William N. Dember. *Professor of Psychology, University of Cincinnati, Ohio. Author of* The Psychology of Perception.
PERCEPTION

W.N.H. Wilmot Norton Hess. *Director, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Boulder, Colorado. Author of* The Radiation Belt and Magnetosphere.
VAN ALLEN RADIATION BELTS (*in part*)

W.O. Wilfred Owen. *Former Senior Fellow, Brookings Institution, Washington, D.C. Author of* The Accessible City *and others.*
UNITED STATES OF AMERICA (*in part*)

W.O.B. William O(liver) Bright. *Professor of Linguistics and Anthropology, University of California, Los Angeles. Editor,* Language (*journal*). *Author of* The Karok Language; *editor of* Studies in Californian Linguistics.
NORTH AMERICAN INDIAN LANGUAGES

W.O.C. W. Owen Chadwick. *Regius Professor of Modern History, University of Cambridge. Author of* The Reformation *and others.*
GREGORY OF TOURS, SAINT
NEWMAN, JOHN HENRY
PROTESTANTISM, HISTORY OF

W.P. Wilhelm Pauck. *Emeritus Professor of Church History, Union Theological Seminary, New York City. Author of* Harnack and Troeltsch: Two Historical Theologians *and others.*
HARNACK, ADOLF VON

W.Pa. Władysław Parczewski. *Professor of Physics of the Atmosphere, Technical University of Warsaw. Director, National Institute for Hydrology and Meterology, Warsaw, 1966–69; Vice Director, 1952–65.*
ODER RIVER (*in part*)
VISTULA RIVER (*in part*)

W.P.D. W. Phillips Davison. *Professor of Sociology and Journalism, Columbia University. Author of* International Political Communication.
PUBLIC OPINION

W.P.G. Wesley Patterson Garrigus. *Emeritus Professor of Animal Husbandry, University of Kentucky, Lexington. Author of* Introductory Animal Science.
LIVESTOCK AND POULTRY FARMING

W.Ph.C. W. Ph. Coolhaas. *Emeritus Professor of Colonial History, Utrecht University, The Netherlands. Co-author of* Jan Pieterszoon Coen *and others.*
COEN, JAN PIETERSZOON

W.P.M. William P. Malm. *Professor of Music, University of Michigan, Ann Arbor. Author of* Japanese Music and Musical Instruments; Music Cultures of the Pacific, The Near East, and Asia.
MUSIC, EAST ASIAN

W.P.McG. William Paul McGreevey. *Director, Population and Development Policy Program, Battelle Memorial Institute, Washington, D.C. Author of* An Economic History of Colombia, 1845–1930.
COLOMBIA, HISTORY OF

W.P.Mn. Warren Perry Mason. *Senior Research Associate, Henry Krumb School of Mines, Columbia University. Head of Mechanics Research, Bell Telephone Laboratories, Inc., 1948–65. Author of* Piezoelectric Crystals and Their Application to Ultrasonics *and others.*
PIEZOELECTRIC DEVICES

W.R. Willi Reich. *Music critic. Author of* The Life and Work of Alban Berg *and many others.*
BERG, ALBAN

W.Ra. William Ravenhill. *Reardon Smith Professor and Head, Department of Geography, University of Exeter, England. Author of* Ben Donn's Map of Devon, 1765; *co-author of* South-West England.
UNITED KINGDOM (*in part*)

W.R.J. Wilbur R. Jacobs. *Professor of History, University of California, Santa Barbara. Editor of* The Letters of Francis Parkman.
PARKMAN, FRANCIS
PRESCOTT, WILLIAM HICKLING

W.R.L. W.R. Lee, M.D. *Professor of Occupational Health, Victoria University of Manchester, England.*
SHOCK, ELECTRICAL

W.R.P. William Roe Polk. *Historian. Professor of Middle Eastern History, University of Chicago, 1965–75. Author of* The United States and the Arab World.
SYRIA AND PALESTINE, HISTORY OF (*in part*)

W.R.S. Walter R. Sharp (d. 1977). *Professor of International Relations, Yale University, 1951–64. Author of* Field Administration in the United Nations System *and others.*
UNITED NATIONS (*in part*)

W.R.T. William R. Thompson. *Professor of Psychology, Queen's University at Kingston, Ontario. Co-author of* Foundations of Behavior Genetics.
HUMAN BEHAVIOUR, INNATE FACTORS IN

W.Sc. Walter Schulz. *Professor of Philosophy, Eberhard Karl University of Tübingen, West Germany. Member of the F.W.J. Schelling Commission of the Bavarian Academy of Sciences. Author of* Schelling.
SCHELLING, FRIEDRICH

W.S.-cg. Wu Shih-ch'ang. *Former Senior Lecturer in Chinese, University of Oxford.*
CHRONOLOGY (*in part*)

W.S.F. William S. Fyfe. *Professor and Chairman, Department of Geology, University of Western Ontario, London. Co-author of* The Earth.
METAMORPHIC ROCKS

W.S.H. Winthrop S. Hudson. *Distinguished Seminary Professor, Colgate Rochester Divinity School, Rochester, New York; James B. Colgate Professor of the History of Christianity, 1948–77. Author of* Baptist Convictions *and others.*
BAPTISTS

W.S.MacK. William Scott MacKenzie. *Professor of Petrology, Victoria University of Manchester, England.*
FELDSPARS

W.S.MacNu. W. Stewart MacNutt (d. 1976). *Professor of History, University of New Brunswick, Fredericton. Author of* New Brunswick: A History, 1784–1867.
NEW BRUNSWICK

W.S.N. William S. Newman. *Pianist. Alumni Distinguished Professor Emeritus of Music, University of North Carolina at Chapel Hill. Author of* The Sonata in the Baroque Era *and others.*
CONCERTO

W.Sp. William Spector. *Senior Editor, Human Life,* Encyclopædia Britannica, *Chicago, 1967–72. Editor of* Handbook of Biological Data *and others.*
HEALTH, HUMAN

W.S.S. William S. Sahakian. *Professor of Psychology and Philosophy, Suffolk University, Boston. Author of* History and Systems of Psychology.
PSYCHOLOGY, HISTORY OF

W.S.Sh. Wendy Stedman Sheard. *Assistant Professor of the History of Art, Mount Holyoke College, South Hadley, Massachusetts. Co-editor of* Collaboration in Italian Renaissance Art.
MANTEGNA, ANDREA

W.St. Wayne A. Stein. *Associate Professor of Physics, University of California, San Diego, and University of Minnesota, Minneapolis.*
INFRARED SOURCES, ASTRONOMICAL

W.T. Walter Terry. *Contributing Editor,* Saturday Review *magazine. Dance Critic and Editor,* New York Herald Tribune, *1939–42, 1945–66. Author of* The Dance in America *and others.*
GRAHAM, MARTHA

W.Ta. William Taylor. *Director, Institute of Education, University of London. Author of* Society and the Education of Teachers *and others.*
TEACHER EDUCATION

W.-t.C. Wing-tsit Chan. *Anna R.D. Gillespie Professor of Philosophy, Chatham College, Pittsburgh, Pennsylvania. Emeritus Professor of Chinese Philosophy and Culture, Dartmouth College, Hanover, New Hampshire. Author of* A Source Book in Chinese Philosophy; Religious Trends in Modern China; *and others.*
CHINESE PHILOSOPHY

CONFUCIAN TEXTS, CLASSICAL
OU-YANG HSIU
WANG YANG-MING

W.T.Ca. William Thomas Calman (d. 1952). *Lecturer in Zoology, University of St. Andrews, Scotland, 1940–46. Keeper, Department of Zoology, British Museum, London, 1927–36. Author of* The Life of Crustacea.
CRUSTACEA (*in part*)

W.T.G. Wassil Todorov Gjuzelev. *Assistant Professor of Bulgarian Medieval History, University of Sofia. Author of* Knjaz Boris Parvi *and others.*
BORIS I OF BULGARIA

W.T.I. William T. Ingram. *Consulting engineer. Adjunct Professor of Civil and Environmental Engineering, Polytechnic Institute of New York, New York City. Author of "Sanitary Engineering" in* Standard Handbook for Civil Engineers.
PLUMBING

W.T.K. Werner Th. Kuhn (d. 1973). *Professor of Geography, Staedtisches Gymnasium, Bern. Lecturer, State College, Bern. Chairman, Geographical Society of Bern.*
JURA MOUNTAINS

W.T.Ke. William T. Keeton. *Liberty Hyde Bailey Professor of Biology, Cornell University, Ithaca, New York. Author of* Biological Science; Elements of Biological Science.
DIGESTION AND DIGESTIVE SYSTEMS

W.T.S. William T. Stearn. *Senior Principal Scientific Officer, Department of Botany, British Museum (Natural History), London, 1952–76. Author of an introduction to Robert Brown's* Prodromus florae Novae Hollandiae et insulae Van Diemen.
BROWN, ROBERT

W.T.Sa. William T. Sanders. *Professor of Anthropology, Pennsylvania State University, University Park. Co-author of* Mesoamerica: The Evolution of a Civilization *and others.*
MESO-AMERICAN CIVILIZATION, HISTORY OF (*in part*)

W.T.v.S. Wolfram Th. von Soden. *Emeritus Professor of Ancient Semitic Philology and Ancient Oriental History, University of Münster, West Germany.*
MESOPOTAMIA AND IRAQ, HISTORY OF (*in part*)

W.U. Walter Ullmann. *Professor of Medieval History, University of Cambridge; Fellow of Trinity College, Cambridge. Author of* The Growth of Papal Government in the Middle Ages *and others.*
LEO IX, SAINT AND POPE

W.V.D.'A. William Vincent D'Antonio. *Professor and Chairman, Department of Sociology, University of Connecticut, Storrs, 1971–76. Co-author of* Influentials in Two Border Cities.
INDIANA

W.V.E. Wolf Von Eckardt. *Architecture Critic,* The Washington Post. *Author of* A Place to Live: The Crisis of the Cities.
MIES VAN DER ROHE, LUDWIG

W.v.K. Wilhelm von Kürten. *Professor of Geography, University of Wuppertal, West Germany. Author of* Nordrhein-Westfalen.
NORDRHEIN-WESTFALEN

W.V.M. William Vernon Mayer. *Professor of Biology, University of Colorado, Boulder. Director, Biological Sciences Curriculum Study. Author of* Hibernation.
DORMANCY

W.V.P. William V. Porter. *Associate Professor of Music History and Literature, Northwestern University, Evanston, Illinois.*
VOCAL MUSIC

W.V.S. Walter V. Scholes (d. 1975). *Professor of History, University of Missouri, Columbia, 1954–75. Author of* Mexican Politics During the Juárez Regime, 1855–1872 *and others.*
JUÁREZ, BENITO

W.W. William Watson. *Professor of Chinese Art and Archaeology; Head, Percival David Foundation of Chinese Art, School of Oriental and African Studies, University of London. Author of* China Before the Han Dynasty *and others.*
CH'ANG-AN
LO-YANG
SIGILLOGRAPHY (*in part*)

W.W.B. William W. Brickman. *Professor of Educational History and Comparative Education, University of Pennsylvania, Philadelphia. Dean, Touro College, New York City. Author of* Educational Systems in the United States *and others.*
EDUCATION, SYSTEMS OF (*in part*)

W.W.C. W. Walker Chambers. *William Jacks Professor of German, University of Glasgow. Co-author of* A Short History of the German Language.
LITERATURE, WESTERN: *German; Medieval*

W.W.H. Warren W. Hassler, Jr. *Professor of American History, Pennsylvania State University, University Park. Author of* Commanders of the Army of the Potomac *and others.*
CIVIL WAR, U.S.

W.Wi. William Witte. *Emeritus Professor of German, University of Aberdeen, Scotland. Author of* Schiller; *editor of several of Schiller's works.*
HÖLDERLIN, FRIEDRICH
SCHILLER, FRIEDRICH

W.W.R. William Wallace Robson. *Masson Professor of English Literature, University of Edinburgh. Author of* Critical Essays; Modern English Literature.
LAWRENCE, D.H.
TENNYSON, ALFRED, LORD

W.W.W. William Walter Watts (d. 1948). *Keeper, Department of Metal Work, Victoria and Albert Museum, London, 1879–1923. Author of* Old English Silver *and others.*
METALWORK (*in part*)

W.-Y.K. Won-Yong Kim. *Professor of Archaeology, Seoul National University, Korea. Author of* Treasures of Korean Art; History of Korean Art.
CALLIGRAPHY (*in part*)
VISUAL ARTS, EAST ASIAN (*in part*)

W.Y.W. William Young Willetts. *Curator, Museum of Asian Art, University of Malaya, Kuala Lumpur. Author of* Chinese Art.
METALWORK (*in part*)

W.Z. Warren Zeiller. *Vice President and General Manager, Miami Seaquarium, Miami, Florida. Author of* Tropical Marine Fishes of South Florida and the Bahamas.
GASTEROSTEIFORMES

W.Ze. Wilbur Zelinsky. *Professor of Geography, Pennsylvania State University, University Park. Author of* Prologue to Population Geography.
UNITED STATES OF AMERICA (*in part*)

Y.A.C. Yehudi A. Cohen. *Professor of Anthropology, Rutgers University, New Brunswick, New Jersey. Editor of* Man in Adaptation.
DIETARY LAWS AND FOOD CUSTOMS

Y.B. Yvon Belaval. *Professor of Philosophy, University of Paris I. Vice President, Leibniz Society, Hanover, West Germany. President, Society of Eighteenth Century Studies, Paris. Author of* Leibniz: Initiation à sa philosophie *and many others.*
LEIBNIZ, GOTTFRIED WILHELM

Y.-c.K. Yu-chin Kang. *Professor of Atmospheric Sciences, National Taiwan University, Taipei.*
TAIWAN

Y.C.W. Yi Chu Wang. *Professor of History, Queens College, City University of New York. Author of* Chinese Intellectuals and the West.
CHANG CHIH-TUNG
SUN YAT-SEN

Y.-G.G.H. Yueh-Gin Gung Hu. *Researcher in Chinese studies. Assistant Librarian, University of Chicago, 1938–43.*
SZECHWAN (*in part*)

Y.G.N. Yevgeny Gurevich Nikiforov. *Senior Scientist, Arctic and Antarctic Scientific Research Institute, Leningrad.*
KARA SEA (*in part*)
LAPTEV SEA (*in part*)

Y.H. Yasuji Honda. *Former Professor of Drama, Waseda University, Tokyo. Member, Japanese Society for Theatre Research. Author of* Nō oyobi Kyōgen kō; Kagura.
NŌ THEATRE

Y.Ha. Yata Haneda. *Curator, Yokosuka City Museum, Japan. Co-editor of* Bioluminescence in Progress.
BIOLUMINESCENCE (*in part*)

Y.J. Yette Jeandet. *Reader, Editions Albin Michel, Maison Casterman, and Librairie Hatier publishing companies, Paris. Editor,* Literary News, *Bayard-Presse, Paris. Author of* Blanche de Castille, reine de l'unité française *and others.*
BLANCHE OF CASTILE

Y.K.Y. Yury Konstantinovich Yefremov. *Senior Scientist, Geographical Museum, Moscow M.V. Lomonosov State University.*
ASIA (*in part*)

Y.L. Yvonne Lanhers. *Curator, National Archives, Paris. Co-editor of* La Réhabilitation de Jeanne la Pucelle.
CHARLES VII OF FRANCE
JOAN OF ARC, SAINT

Y.M. Yasuo Masai. *Professor of Geography, University of Tsukuba, Japan. Co-editor of* Japanese Geography 1966.
JAPAN (*in part*)

Y.M.A. Yuri M. Ado. *Chief of the Accelerator Division, Institute for High Energy Physics, State Committee for Utilization of Atomic Energy of the U.S.S.R., Serpukhov. Co-author of "Coherent Radiation from the Electrons in a Synchrotron" in* Atomnaya energiya.
ACCELERATORS, PARTICLE

Y.M.D. Yelena Matveyevna Doroshinskaya. *Journalist. Co-author of* Leningrad.
LENINGRAD (*in part*)

Y.-m.Y. Yue-man Yeung. *Senior Program Officer, International Development Research Centre, Singapore.*
KWANGTUNG (*in part*)

Y.N. Yelavarthy Nayudamma. *Distinguished Scientist, Central Leather Research Institute, Madras, India. Author of* Wet Blue Leather for Export.
LEATHER AND HIDES

Y.P.M. Yi Pao Mei. *Henry Luce Professor of Humanities, Tunghai University, T'ai-chung, 1973–77. Professor of Oriental Studies, University of Iowa, Iowa City, 1955–70. Author of* Motse: The Neglected Rival of Confucius.
CONFUCIANSIM
MENCIUS
MO-TZU

Y.T. Yoshinori Takeuchi. *Emeritus Professor of Philosophy of Religion, Kyōto University, Japan. Author of* Philosophy of Shinran.
NISHIDA KITARŌ

Y.T.T. Youssef T. Toni. *Professor of Geography, Kuwait University.*
YEMEN (SAN'Ā')

Y.V.Y. Yevgeny Venyaminovich Yastrebov. *Assistant Professor of Geography, Moscow Regional Pedagogical Institute.*
URAL MOUNTAINS

Y.Y.R. Yelizaveta Yakovlevna Rantsman. *Senior Scientist, Institute of Geography, Academy of Sciences of the U.S.S.R., Moscow Candidate of Sciences (Geography). Author of numerous articles on geography.*
TIEN SHAN (mountains) (*in part*)

Z.A. Zoltán Antal. *Professor of Geography, Eötvös Loránd University, Budapest, Hungary. Author of* Industrial Geography of Hungary.
BUDAPEST (*in part*)

Z.A.K. Zafar Ahmad Khan. *Professor of Geography, Government College, Rāwalpindi, Pakistan. Author of* Karachi: An Urban Profile.
KARĀCHI

Z.D.K. Zimani David Kadzamira. *Senior Lecturer in History, Chancellor College, University of Malawi, Zomba. Contributor to* Malawi Past and Present.
MALAWI

Z.I.A. Zafar Ishaq Ansari. *Professor of History, University of Petroleum and Minerals, Dhahran, Saudi Arabia.*
ABŪ ḤANĪFAH

Z.O. Zoé Oldenbourg-Idalie. *Novelist and free-lance writer. Author of* Catherine the Great *and others.*
CATHERINE II THE GREAT, OF RUSSIA

Z.R. Zain ol-Abedin Rahnema. *Secretary General of the P.E.N. Club of Iran, Teherān. Former Member of the Parliament of Iran. Author of* Messenger *and others.*
TEHRĀN

Z.V. Zeno Vendler. *Professor of Philosophy, University of California, San Diego, at La Jolla. Author of* Linguistics in Philosophy; Adjectives and Nominalizations.
SEMANTICS

Names of Contributors and Consultants to the Macropædia

volumes 1–19

Listed below, with initials that identify them in volumes 1–19, are the names of persons who have written articles or sections of articles in the *Macropædia* or have served as consultants on specific articles. For brief summaries of their positions and the titles of all articles contributed, see under authors' initials in the list on pages 7–104.

Aaron, Richard I. R.Aa.
Abbagnano, Nicola. N.Ab.
Abbe, Ernst C. E.C.A.
Abdo, Ass'ad Sulaiman. A.S.A.
Abel-Smith, Brian. B.A.-S.
Aberdare, Morys George Lyndhurst Bruce, 4th Baron. A.
Abragam, Anatole. A.A.
Abraham, Gerald E.H. G.E.H.A.
Abrahams, Harold Maurice. H.M.A.
Abrahams, John R. J.R.A.
Abrahart, Edward Noah. E.N.A.
Abu Jaber, Kamel S. K.S.A.J.
Abu-Lughod, Ibrahim A. I.A.A.-L.
Abu-Lughod, Janet L. J.L.A.-L.
Accordi, Bruno. B.A.
Ackerman, James S. J.S.Ac.
Ackoff, Russell L. R.L.A.
Acton, Harry Burrows. H.B.A.
Adamovich, Anthony. A.Ad.
Adams, Charles Joseph. C.J.A.
Adams, Don. D.A.
Adams, Preston. P.Ad.
Adejuwon, James Oladipo. J.O.A.
Adhémar, Jean. J.Ad.
Adkins, Dorothy C. D.C.A.
Adler, John H. J.H.A.
Ado, Yuri M. Y.M.A.
Adotevi, Stanislas Spero. S.S.A.
Adrov, Mikhail Mikhaylovich. M.M.A.
Agostino, Guido d'. G.d'A.
Aguirre, Margarita. M.Ag.
Aherne, Sister Consuelo Maria. C.M.A.
Ahlström, Gösta W. G.W.A.
Ahmad, Kazi Saied-Uddin. K.S.-U.A.
Ahmad, Nafis. N.A.
Ahmadjian, Vernon. V.A.
Ahnlund, Henrik S. H.S.A.
Ahrweiler, Hélène. H.Ah.
Aiyappan, Ayinipalli. A.Ai.
Ajaegbu, Hyacinth Iheanyichuku. H.I.A.
Akasofu, Syun-Ichi. S.-I.A.
Akdağ, Mustafa. M.Ak.
Akita, George. G.Ak.
Alavi, Hamza A. H.A.A.
Alba, Victor. V.Al.
Albrecht-Carrié, René. R.A.-C.
Albright, William Foxwell. W.F.A.
Albritton, Claude C. C.C.A.
Albury, E. Paul. E.P.A.
Alden, John Richard. J.R.Al.
Aleem, Anwar Abdel. An.A.A.
Aleksandrovskaya, Natalia Vitalyevna. N.V.A.
Alexander, Frederick. F.A.
Alexander, Lewis M. L.M.A.
Alexander, Robert J. R.J.Al.
Alexopoulos, Constantine John. C.J.Al.
Alford, Alfred E. A.E.A.
Alford, R.F.G. R.F.G.A.
Ali, Mohammad. M.Al.
Alip, Eufronio M. Eu.M.A.
Allais, Maurice. Ma.A.
Allard, Rev. Michel Adrien. M.A.Al.
Allard, R.W. R.W.A.
Allchin, Frank Raymond. F.R.Al.
Allen, Francis A. F.A.A.
Allen, Garland Edward. G.E.Al.
Allen, Geoffrey Freeman. G.F.A.
Allen, Walter E. W.E.A.
Aller, Lawrence Hugh. L.H.A.
Allibone, Thomas Edward. T.E.A.
Allworth, Edward. E.Al.
Almagià, Roberto. Ro.A.
Alpert, Barbara Anne. B.A.A.
Al-Shahi, Ahmed S. A.Al-Sh.
Alston, Rex. R.Al.
Alvariño, Angeles. A.Al.
Amadio, Anselm H. A.H.Ao.
Amaral, Ilídio Melo Peres do. I.M.P. do A.
Amber, John Thomas. J.T.A.
Amengual, Barthélemy. B.Am.
Amerine, Maynard A. .M.A.A.
Ames, Winslow. W.Am.
Anastaplo, George. G.An.
Anderson, Donald M. D.An.
Anderson, Douglas M.W. D.M.W.A.
Anderson, Edward W. E.W.A.
Anderson, Franklin K. F.K.A.
Anderson, Franz E. F.E.A.
Anderson, Joseph Chapman. J.C.An.
Anderson, Robert T. R.T.A.
Anderson, W.A.D. W.A.D.A.
Andrade, Edward Neville da Costa. E.N. da C.A.
Andrade U., Victor. V.A.U.
Andresen, Jack. J.A.
Andrew, Richard J. R.J.A.
Andrew, Warren. W.A.
Andrews, Gould Arthur. G.A.A.
Andreyev, Nikolay. N.An.
Andrups, J.A. J.A.A.
Angel, Pierre Robert. P.R.A.
Angelo, Frank. Fr.A.
Angrist, Alfred Alvin. A.A.A.
Angrist, Stanley W. S.A.
Ansari, Zafar Ishaq. Z.I.A.
Anschutz, Richard Paul. R.P.An.
Anstey, Roger T. R.T.An.
Antal, Zoltán. Z.A.
Anthony, Jean Daniel. J.D.A.
Anweiler, Oskar. O.A.
Aquilecchia, Giovanni. G.A.
Arasaratnam, Sinnappah. S.Ara.
Archibald, Raymond Clare. R.C.A.
Aretin, Karl Otmar, Baron von. K.O.v.A.
Arey, Leslie B. L.B.A.
Arfa, Maj. Gen. Hassan. H.Ar.
Argov, Daniel. D.Ar.
Arguello, Rosendo. R.A.
Argyle, Michael. M.Ar.
Arieti, Silvano. S.Ar.
Arkhurst, Frederick S. F.S.A.
Arlazorov, Mikhail S. M.S.A.
Armitage, John. J.Ar.
Armstrong, A. Hilary. A.H.A.
Armstrong, Annette Elizabeth. A.E.Ar.
Armstrong, David. M. D.M.A.
Armstrong, Lloyd Van Horn. L.V.A.
Armytage, Walter Harry Green. W.H.G.A.
Arnason, H. Harvard. H.H.A.
Arnold, Denis Midgley. D.M.Ar.
Arnold, Godfrey Edward. G.E.A.
Arnott, W. Geoffrey. W.G.A.
Arpigny, Claude. C.A.
Arrington, Leonard James. L.J.A.
Årsenyeva, Nina Yakovlevna. N.Y.A.
Artsimovitch, Lev. L.A.
Arvon, Henri. H.A.
Asanachinta, Col. Phoon Phon. P.P.A.
Ashley, Maurice. M.As.
Ashmole, N. Philip. N.P.As.
Asimov, Isaac. I.A.
Aspinall, Arthur C.V.D. A.As.
Asprey, Larned B. L.B.As.
Asprey, Robert Brown. R.B.A.
Atherden, Lewis Malcolm. L.M.At.
Atherton, James Stephen. J.S.A.
Atiyah, Michael Francis. M.F.A.
Atkinson, Bruce W. B.W.A.
Atkinson, William C. W.C.A.
Attwater, Donald. D.At.
Atwater, Gordon I. G.I.A.
Aubert, Roger-François-Marie. R.-F.-M.A.
Auboyer, Jeannine. J.Au.
Auclair, Marcelle. M.A.
Auerbach, Charlotte. C.Au.
Aulie, Richard Paul. R.P.A.
Aulock, Wilhelm H. von. W.H.v.A.
Aumann, Francis R. F.R.A.
Aurenhammer, Hans. Ha.A.
Austerlitz, Robert. R.Au.
Austin, Oliver L., Jr. O.L.A.
Auty, Robert. Ro.Au.
Avery, George Sherman. G.S.A.
Avery, Peter William. P.W.A.
Avila, Héctor Fernando. H.F.A.
Avrich, Paul. P.A.
Axelson, Eric. E.A.
Aymans, G.H.P. G.H.P.A.
Ayoub, Raymond George. R.G.A.
Ayres, John C. J.C.A.
Ayyar, Nagarajan Panchapagesan. N.P.A.
Azcona, Rev. Tarsicio de. T.d.A.

Baaren, Theodorus P. van. T.P.v.B.
Back, William. Wi.B.
Bacon, Frederick E. F.E.B.
Badash, Lawrence. L.Ba.
Badian, E. E.Ba.
Badt, Kurt. K.Ba.
Baigent, Margaret J. M.J.B.
Bailey, John A. J.A.Ba.
Bain, Joe S. J.S.B.
Bainton, Roland H. R.H.B.
Baird, A. Craig. A.C.B.
Bakarić, Vladimir. V.Ba.
Baker, Carl G. C.G.B.
Baker, Philip S. P.S.B.
Baker, Samuel John Kenneth. S.J.K.B.
Baker of Windrush, John Fleetwood Baker, Baron. J.F.Br.
Balakrishna, Suri. S.B.
Balassa, Bela. B.B.
Baldini, Umberto. U.Ba.
Baldwin, A. Richard. A.R.B.
Baldwin, Marshall W. M.W.B.
Balfet, Hélène J. He.Ba.
Balfour, Michael Graham. M.G.B.
Balinsky, Boris Ivan. B.I.B.
Ballesteros Gaibrois, Manuel. M.B.G.
Ballhatchet, Kenneth A. K.A.B.
Ballinger, Ronald B. R.B.Ba.
Baloch, N.A. N.A.B.
Balon, Eugene Kornel. E.K.B.
Balsdon, John P.V. Dacre. J.P.V.D.B.
Bannerman, W. Mary. W.M.B.
Bannister, Lawrence Howard. L.H.Ba.
Banton, Michael Parker. M.P.B.
Banzragch, D. D.Ba.
Barblan, Guglielmo. Gu.B.
Barbour, Nevill. N.B.
Barbour, Ruth. R.Ba.
Barclay, Brig. Cyril Nelson. C.N.B.
Bargebuhr, Frederick P. F.P.B.
Barghoorn, Frederick C. F.C.B.
Barker, B. Devereux, III. B.D.B.
Barker, Daniel Stephen. D.S.B.
Barker, John Walton, Jr. J.W.Ba.
Barlow, Frank. F.Ba.
Barlow, Jon Charles. J.C.B.
Barna, Victor. V.B.
Barnard, Raymond Walter. R.W.Bd.
Barnes, Clifford A. C.A.B.
Barnes, Ivan. I.B.
Barnes, John Arundel. Jo.A.B.
Barnett, Henry Lewis. H.L.B.
Barnett, M. Robert M.R.B.
Baron, Salo Wittmayer. S.W.B.
Baron, Samuel H. S.H.B.

Barrère, Jean-Bertrand. J.-B.Ba.
Barrington, Ernest J.W. E.J.W.B.
Barrow, Geoffrey Wallis Steuart. G.W.S.B.
Barth, T.F.W. T.F.W.B.
Barthakur, Minodhar. M.B.
Bartley, S. Howard. S.H.Ba.
Barton, Sir Derek Harold Richard. D.H.R.B.
Bar-Zohar, Michael. M.Ba.
Barzun, Jacques. J.Ba.
Basham, Arthur Llewellyn. A.L.B.
Bass, Howard. H.Ba.
Bassham, James Alan. J.A.B.
Batbayar, Sh. Sh.B.
Bates, David V. D.V.B.
Battan, Louis J. L.J.B.
Bauer, Göran C.H. G.C.H.B.
Baumer, Maj. Gen. William H. W.H.B.
Baumol, William J. W.J.B.
Bawden, Charles R. C.R.B.
Baxter, Alexander D. A.D.B.
Baxter, Douglas C. D.C.B.
Baxter, Glen W. G.W.Ba.
Baxter, Ian F.G. I.F.G.B.
Bay, Howard. Ho.B.
Bayley, Charles Calvert. C.C.B.
Bazin, Germain René Michel. G.R.M.B.
Beal, Roy E. R.E.B.
Beale, Geoffrey H. G.H.B.
Beams, Jesse W. J.W.B.
Bean, Lowell John. Lo.J.B.
Bean, William B. W.B.B.
Beaufort, Lieven Ferdinand de. L.F. de B.
Beaufre, Gen. André. A.Be.
Beaujeu-Garnier, Jacqueline. J.B.-G.
Beaumont, Charles-Louis de. C.-L. de B.
Béchervaise, John Mayston. J.M.B.
Beck, Alfred C. A.C.Bk.
Beck, Curt W. F.E.Be.
Beck, Forrest E. F.E.Be.
Beck, Hans-Georg. H.-G.B.
Beck, Kevin Charles. K.C.B.
Beck, Leslie John. L.J.Be.
Beck, Warren A. W.A.B.
Becker, Alfons. Al.Be.
Beckerman, Bernard. B.Be.
Beckingsale, Bernard Winslow. B.W.B.
Beckson, Karl. K.Be.
Bedford, Ronald E. R.E.Be.
Beegle, Dewey M. D.M.Be.
Beeman, Richard R. R.R.B.
Beer, John Bernard. J.B.B.
Beeton, Alfred M. A.M.B.
Behnke, Robert John. R.J.B.
Beier, Ulli. U.Be.
Belaval, Yvon. Y.B.
Bell, Eric Temple. E.T.B.
Bell, Robert Charles. R.C.Be.
Bell, Ronald Percy. R.P.B.
Beloussov, V.V. V.Be.
Belshaw, Cyril S. C.S.B.
Belton, Michael J.S. M.J.S.B.
Belyaev, Dmitri Konstantinovich. D.K.B.
Bemis, Samuel Flagg. S.F.Be.
Benedek, Thomas G. T.G.B.
Benedict, Roger William. R.W.B.
Benedikz, Benedikt Sigurdur. B.S.B.
Bengtson, Hermann. He.B.
Ben-Gurion, David. D.B.-G.
Benítez, Fernando. F.Be.
Benneh, George. G.Be.
Bennett, John C. J.C.Be.
Ben-Sasson, Haim Hillel. H.H.B.-S.
Bensing, Manfred. M.Be.
Benson, D. Mary. D.M.B.
Benson, Fred J. J.F.B.
Benson, Lyman (David). L.Be.
Bent, Ian D. I.Be.
Bentley, John Beresford. Jo.Be.
Bentley, T. Keilor. T.K.B.
Benz, Ernst Wilhelm. E.W.B.
Berengo, Marino. Ma.B.
Berenson, Louis Stanley. L.S.B.
Berghe, Pierre Louis van den. P.L.v.d.B.
Bergmann, Peter G(abriel). P.G.Be.
Bergmann, Walter G. W.G.B.
Bergsland, Knut. K.B.
Bergstein, Stanley F. S.F.B.
Bergsten, Staffan. S.Be.
Berlyne, D.E. D.E.B.
Bernard, François. F.B.
Berndt, Ronald M. R.M.B.
Bernstein, Jeremy. J.Be.
Berrall, Julia S. Ju.S.B.
Berrill, N.J. N.J.B.
Berry, André. A.By.
Berry, R. Stephen. R.S.Be.
Berry, William B.N. W.B.N.B.
Bertram, C.K. C.K.B.
Bertram, G.C.L. G.C.L.B.
Bertrand, Trent J. T.J.B.
Bessac, Frank Bagnall. F.B.B.
Bessarabov, Georgy Dmitriyevich. G.D.B.
Beuve-Méry, Hubert. H.B.-M.
Beynon, John Herbert. J.H.Be.
Bharati, Agehananda. A.Bh.
Bhardwaj, Surinder M. S.M.B.
Bianchi, Ugo. U.B.
Bibby, Cyril. C.Bi.
Bickerman, E.J. E.J.Bi.
Bieber, Margarete. M.Bi.
Biel, Victor J.P. V.Bi.
Bielenstein, Hans H.A. H.H.A.B.
Bieler, Ludwig G.J. L.G.J.B.
Biemel, Walter. W.Bi.
Bietenholz, Peter G. P.G.B.
Biezais, Haralds. H.Bi.
Bigalke, R.C. R.C.Bi.
Billings, Henry H. H.H.B.
Billingsley, Patrick Paul. P.P.B.
Binder, Raymond C. R.C.B.
Bing, R.H. R.H.Bi.
Bira, Sh. Sh.Bi.
Bird, Otto Allen. O.A.B.
Bird, R. Byron. R.B.Bi.
Bireley, Rev. Robert L. R.L.B.
Birkhoff, Garrett. G.Bi.
Birnbaum, Howard Kent. H.K.B.
Birnholz, Alan Curtis. A.C.Bi.
Bisplinghoff, Raymond L. R.L.Bi.
Bissell, Harold J. H.J.Bi.
Bisson, Thomas N. T.N.B.
Bivar, Adrian David Hugh. A.D.H.B.
Black, Clinton V. C.V.B.
Black, Sir Douglas A.K. D.A.K.B.
Blackwell, Donald Eustace. D.E.Bl.
Blagoobrazov, Vladimir Alekseyevich. V.A.B.
Blagoy, Dimitry Dimitriyevich. D.D.B.
Blair, Claude. C.Bl.
Blair, Walter. Wa.B.
Blake, Robert Norman William Blake, Baron. B.
Blanding, Warren. W.Bl.
Blank, Sheldon H. S.H.Bl.
Blanksten, George I. G.I.B.
Blanshard, Brand. B.Bl.
Blaug, Mark. M.Bg.
Blažek, Miroslav. M.Bl.
Bleaney, Brebis. B.Ble.
Blendinger, Friedrich. F.Br.
Bliss, Lawrence C. L.C.B.
Bliss, Milton E. M.E.Bl.
Bloch, Raymond. R.Bl.
Blok, Anton. A.Bl.
Blond, Georges. G.Bl.
Bluhm, Solomon. S.Bl.
Boalt, Gunnar. G.Bo.
Boardman, John. Jo.Bo.
Boateng, Ernest Amano. E.A.B.
Bobek, Hans. H.B.
Bockris, John O'M. J.O'M.B.
Bode, Carl. Ca.B.
Bode, Hendrik W. H.W.B.
Bodin, D. Joseph. D.J.B.
Boerma, Addeke Hendrik. A.H.B.
Boesch, Hans H. H.H.Bh.
Bogoslovsky, Boris Borisovich. B.B.Bo.
Boissevain, Jeremy. Je.Bo.
Bokser, Rabbi Ben Zion. B.Z.B.
Boland, Frederick Henry. F.H.B.
Bold, Harold C. H.C.B.
Bolle, Kees W. K.W.Bo.
Bollema, Jan. Ja.B.
Bollnow, Otto Friedrich. O.F.B.
Bond, Donald F. D.F.B.
Bonelli Rubio, Juan M. J.B.Ro.
Bonfante, Larissa. L.B.W.
Bonham-Carter, Graeme F. G.B.-C.
Bonilla, José. Jo.B.
Bonilla, Luis. L.Bo.
Bonin, Gerhardt von. G.v.B.
Bonner, Charles Edmond Bradlaugh. C.E.B.B.
Bonner, Gerald. Ge.B.
Bonner, John Tyler. J.T.Bo.
Boocock, Colin. C.B.
Booth, Susan Elizabeth. S.E.B.
Borgatta, Edgar F. E.F.B.
Borgstrom, Georg A. G.A.B.
Borko, Harold. H.Bo.
Bornecque, Jacques-Henry. J.-H.B.
Bornkamm, Günther. G.Bor.
Borth, Paul F. P.F.B.
Boscaglia, Clara. C.Bo.
Bosco, Umberto. U.Bo.
Bose, Raj C. R.C.Bo.
Bosellini, Alfonso. A.Bo.
Bosisio, Alfredo. Al.B.
Bosworth, Clifford Edmund. C.E.B.
Bottomore, Thomas B. T.B.B.
Boucot, Arthur James. A.J.Bo.
Boulding, Kenneth E. K.E.Bo.
Bouloiseau, Marc. M.Bo.
Bouvier, Jean. Je.B.
Bouwsma, William J. W.J.Bo.
Bowersock, G.W. G.W.Bo.
Bowle, John Edward. J.E.B.
Bowman, John S. J.S.Bo.
Bowness, Alan. Al.Bo.
Boxer, Baruch. B.Bo.
Boyd, John. J.B.
Boyden, Edward Allen. E.A.Bo.
Boyer, Carl B(enjamin). C.B.B.
Boyer, Marjorie Nice. M.N.B.
Boyle, John Andrew. J.A.Bo.
Brace, Keith. K.Br.
Bradbury, Savile. S.Br.
Bradford, Ernle. E.Br.
Bradley, Harold Whitman. H.W.Br.
Bradley, Rupert Stevenson. R.S.B.
Brady, Rev. Ignatius Charles. I.C.B.
Bramson, Leon. L.Br.
Brand, Donald Dilworth. D.D.Br.
Brandon, James R. J.R.B.
Brandon, Rev. Samuel G.F. S.G.F.B.
Brandt, Andres R.F.T. von. A.v.B.
Brant, Irving. I.Bt.
Brasted, Robert C. R.C.Br.
Brathwaite, Edward. E.Be.
Braun, Armin C. A.C.Br.
Braunbek, Werner. W.Br.
Brawer, Moshe. M.Br.
Bready, James H. Ja.H.B.
Bredsdorff, Elias Lunn. E.L.B.
Brembeck, Cole S. Co.S.B.
Bresson, Henri. H.Bre.
Brett, Martin. Ma.Br.
Brice, William Charles. W.C.B.
Brickman, William W. W.W.B.
Bridges, Edward Bridges, 1st Baron. E.B.
Bridgewater, Thornton Howard. T.H.B.
Bridgman, Percy Williams. P.W.B.
Briggs, Asa Briggs, Baron. As.B.
Bright, John. Jo.Br.
Bright, William O(liver). W.O.B.
Brill, Reginald. R.Br.
Brincourt, André. An.Br.
Brisby, Liliana. L.B.
Briskey, Ernest J. E.J.B.
Britt, Kenneth W. K.W.Br.
Britter, Eric V.B. E.V.B.B.
Brock, John Fleming. J.F.B.
Brodie, Fawn McKay. F.M.B.
Brome, Vincent. V.Br.
Bromiley, Geoffrey W. G.W.B.
Bromke, Adam. A.Br.
Brommelle, Norman Spencer. N.S.B.
Bronowski, J(acob). J.Br.
Brown, Arthur Joseph. A.J.B.
Brown, David C. D.C.Br.
Brown, Elizabeth A.R. E.A.R.B.

Brown, Frank A., Jr. F.A.B.
Brown, G. Malcolm. G.M.B.
Brown, J.A.C. J.A.C.B.
Brown, J. Guthrie. J.G.B.
Brown, John Russell. J.R.Br.
Brown, Laurie M. L.M.B.
Brown, Leslie Hilton. L.H.B.
Brown, Maurice J.E. M.J.E.B.
Brown, Peter R.L. P.R.L.B.
Brown, Robert Harold. R.H.Br.
Brown, T. Julian. T.J.Br.
Brown, Truesdell S. T.S.B.
Brown, William Francis. W.F.B.
Browning, Robert. R.B.
Bruce, Frederick Fyvie. F.F.B.
Bruce, Michael I. M.I.B.
Brugière, Jean-Marie. Je.-M.B.
Bruhat, Jean. J.Bru.
Bruk, Solomon Ilich. S.I.B.
Brunner, Hellmut. H.Br.
Brunnschweiler, Dieter. Di.B.
Bruschi, Arnaldo. Ar.B.
Brusher, Rev. Joseph Stanislaus. J.S.Br.
Bry, Doris. D.Br.
Bryant, Sir Arthur. Ar.Br.
Bryant, John H. J.H.Br.
Bucarelli, Palma. P.Bu.
Buchan, The Hon. Alastair Francis. A.F.B.
Buchanan, Robert Angus. R.A.Bu.
Budden, Julian Medforth. J.M.Bu.
Budenholzer, Roland A. R.A.B.
Budinger, Thomas F. T.F.B.
Buechner, Thomas S. T.S.Bu.
Buettner-Janusch, John. J.B.-J.
Buitenen, J.A.B. van. J.A.B.v.B.
Bullock, Alan Bullock, Baron. A.B.
Bullough, Rev. Sebastian. S.Bh.
Burbidge, E. Margaret. E.M.B.
Burbidge, Geoffrey. G.B.
Burdeau, Michel. Mi.B.
Burdon-Jones, C. C.B.-J.
Burger, Willem. W.B.
Burgess, Anthony. An.B.
Burghardt, Rev. Walter John. W.J.Bu.
Burke, Ulick Peter. U.P.B.
Burn, Andrew Robert. A.R.Bu.
Burnaby, Rev. John. Jo.Bu.
Burnett, Thomas. T.B.
Burrows, William. W.Bu.
Burrus, John N. J.N.B.
Burt, Alexander Dean. A.D.Bu.
Burton, Ivor F. I.F.B.
Burton, Milton. M.Bu.
Buru, Mukhtar Mustafa. Mu.B.
Busby, Douglas E. D.E.Bu.
Busch, Daryle H. D.H.B.
Bush, Douglas. D.B.
Bush-Brown, Albert. A.B.-B.
Bushman, Donald O. D.O.B.
Bushnell, Geoffrey H.S. G.H.S.B.
Busuttil, Salvino. S.Bu.
Butcher, H. John. H.J.B.
Butler, Joseph T. J.T.B.
Butler of Saffron Walden, Richard Austen Butler, Baron. Bu.
Butlin, Martin. Ma.Bu.
Butt, John Everett. J.E.Bu.
Butterfield, Lyman H. L.H.Bu.
Buttersack, Felix. F.Bu.
Buttinger, Joseph. J.Bu.
Butts, Allison. A.Bu.
Butzer, Karl W. K.W.B.
Byers, Horace R. H.R.B.
Bykov, Vasili Dmitrievitch. V.D.B.
Byrnes, Robert F. R.F.B.

Cadbury, Henry J. H.J.C.
Cadoux, Theodore John. T.J.C.
Cahen, Claude. C.C.
Cahill, James F. J.F.C.
Cahn, Robert W. R.W.C.
Cain, A.J. A.J.Ca.
Cain, Seymour. S.C.
Caird, Rev. George B. G.Cai.
Calian, Rev. Carnegie Samuel. C.S.Ca.
Calkins, Philip B. P.B.Ca.
Callimahos, Lambros Demetrios. L.D.C.
Calman, William Thomas. W.T.Ca.
Calmon, Pedro. P.Ca.
Calnan, Charles D. C.D.C.
Calne, Roy Yorke. R.Y.C.
Calogero, Guido. G.C.
Calpe Ibarz, José Maria. J.M.C.I.
Camacho, Jorge A. J.A.Ca.
Camara, Camille. Ca.C.
Cameron, Kenneth Walter. K.W.C.
Cameron, Roy Eugene. R.E.C.
Campana, Pier Paolo del. P.P. del C.
Campbell, Alan K. A.K.Ca.
Campbell, Eila M.J. E.M.J.C.
Cannon-Brookes, Peter. P.C.-B.
Canright, James Edward. J.E.Ca.
Cansdale, George S. Ge.C.
Capers, Gerald M. G.M.C.
Caponigri, A. Robert. A.R.C.
Capper, Comdr. Douglas Parodé. D.P.C.
Cardascia, Guillaume. G.Ca.
Cardona, George. Ge.Ca.
Cardoze, Nydia María. N.M.C.
Cardozo, Efraim. E.C.
Carey, Margret A. Ma.A.C.
Carli, Enzo. E.Ca.
Carlsson, Sten C.O. S.C.O.C.
Carluccio, Luigi. L.Ca.
Carmagnani, Marcello A. M.A.Ca.
Carpenter, Malcolm Breckenridge. M.B.C.
Carr, Bruce Alan. B.A.C.
Carr, Edward H. E.H.C.
Carr, Raymond. R.Ca.
Carriazo, Juan de M. J. de M.C.
Carrington, Dorothy V. D.V.C.
Carrion, Francisco Machado. F.M.C.
Carruthers, John E. J.E.C.
Carsaniga, Giovanni. G.Car.
Carson, David. D.Ca.
Carson, Hampton L. H.L.C.
Carson, Michael Anthony. M.A.C.
Carter, Francis William. F.W.C.
Carter, Wilbert K. W.K.C.
Cartwright, Frederick F. F.F.C.
Cartwright, Janet M. J.M.Ca.
Carvalho, José Candido de Melo. J.C.M.C.
Cary, Max. M.Car.
Cash, Arthur H. A.H.Ca.
Casolani, Lieut. Col. Charles Edward. C.E.C.
Castañeda, Concepción E. C.E.Ca.
Castex, Pierre-Georges. P.-G.Ca.
Castle, Peter Henry John. P.H.J.C.
Caswell, John Edwards. Jo.E.C.
Catalano, Eduardo F. E.F.C.
Caudle, Ben H. B.H.C.
Caughey, John W. J.W.C.
Caussou, Jean-Louis. J.-L.Ca.
Cawkwell, George Law. G.L.Ca.
Cazelles, Raymond. Ra.C.
Cestre, Charles. C.Ce.
Chadwick, Charles. C.Ch.
Chadwick, Very Rev. Henry. H.Cha.
Chadwick, W. Owen. W.O.C.
Chaix-Ruy, Jules-Marie. J.C.-R.
Chambers, W. Walker. W.W.C.
Chambre, Rev. Henri. H.C.
Chamot, Mary. M.Ch.
Champernowne, David Gawen. D.G.C.
Chan, David B. D.B.C.
Chan, Wing-tsit. W.-t.C.
Chanderli, Abdel Kader. A.K.Ch.
Chandra, Pramod. P.Ch.
Chandrasekhar, Sripati. S.Ch.
Chang, Chen-tung. C.-t.C.
Chang, Sen-dou. S.-d.C.
Chao Lin. Ch.L.
Chapanis, Alphonse. Al.C.
Chapman, Brian. B.Ch.
Chapman, Floyd Barton. F.B.C.
Chapman, Frank. F.Ch.
Chapman, Valentine J. V.J.C.
Charles, Jean-Léon. J.-L.Ch.
Charleston, Robert Jesse. R.J.Ch.
Charlton, Donald Geoffrey. D.G.Ch.
Chastenet de Castaing, Jacques. J.C. de C.
Chatterjee, Shiba P. S.P.C.
Chavez, Carlos M. C.M.C.
Chen, Cheng-Siang. C.-S.Ch.
Ch'en, Jerome. Je.Ch.
Chen, Kenneth K.S. K.K.S.C.
Chen, Shou Yi. S.Y.C.
Chen, Theodore Hsi-en. T.H.C.
Cheng, Bin. Bi.C.
Cheng, Chu-yuan. C.-y.C.
Chenu, Rev. Marie-Dominique. M.-D.Ch.
Chern, S.S. S.S.C.
Cherry, John. J.Ch.
Chevallier, Jean-Jacques. J.-J.C.
Chiang Yee. C.Y.
Chiappini, Luciano. L.Ch.
Childers, Norman F. N.F.C.
Chilver, Guy Edward Farquhar. G.E.F.C.
Chisholm, Lawrence James. L.J.C.
Chissell, Joan. Jo.Ch.
Choay, Françoise. F.C.
Chong, Byong-Wuk. B.-W.C.
Chow, Tse-tsung. T.-t.C.
Chow, Ven Te. V.T.C.
Christensen, Dieter. Di.C.
Christensen, Jan. Ja.C.
Christie, Andrew Barnett. A.B.C.
Christie, Ian R. I.R.C.
Christie, Robert L. R.L.Ch.
Chuang Shang-yen. C.S.-y.
Ćirković, Sima M. S.M.Ci.
Clagg, Sam E. S.E.C.
Clark, Andrew Christopher. A.C.Cl.
Clark, Cecily. C.Ck.
Clark, Eugene. E.Cl.
Clark, George B. G.B.Cl.
Clark, John Grahame Douglas. J.G.D.C.
Clark, Walter Houston. W.H.C.
Clarke, Martin Lowther. M.L.C.
Clarke, Mary. M.Cl.
Clarkson, James D. J.D.Cl.
Clarkson, Jesse Dunsmore. J.D.C.
Classen, Peter. P.Cla.
Clauser, Henry R. H.R.C.
Clay, Theresa. T.C.
Clayton, Raymond Brazenor. R.B.C.
Clayton, Sir Stanley George. S.G.C.
Clegern, Wayne M. W.M.Cl.
Clemence, Gerald M. G.M.Ce.
Clements, Robert John. R.J.C.
Clench, Mary Heimerdinger. M.H.C.
Clifford, Derek Plint. D.P.Cl.
Clifford, James Lowry. J.L.Cl.
Clifford, Paul R. P.R.Cd.
Cline, Barbara Lovett. B.L.C.
Cline, C.L. C.L.Cl.
Cline, Howard F. H.F.C.
Clingan, Ian C. I.C.C.
Closs, Gerhard L. G.L.C.
Cloud, Preston. P.C.
Cloudsley-Thompson, John Leonard. J.L.C.-T.
Cluff, Leighton E. L.E.C.
Clutton, Cecil. C.Cl.
Coates, J.E. J.E.Co.
Cochrane, Rev. Arthur C. A.C.C.
Cockshut, A.O.J. A.O.J.C.
Coe, Michael Douglas. M.D.C.
Cofer, Charles N. C.N.C.
Coffin, David R. D.R.C.
Coffin, Ivor Cecil. I.C.Cn.
Coggeshall, Ivan Stoddard. I.S.C.
Cogley, John. Jo.C.
Cogniat, Raymond. R.Cog.
Cohen, Arthur L. A.L.C.
Cohen, Gerson D. G.D.C.
Cohen, Jerome B. J.B.Co.
Cohen, Jozef. J.C.
Cohen, Saul Bernard. S.B.Co.
Cohen, Selma Jeanne. S.J.C.
Cohen, Yehudi A. Y.A.C.
Cohn, Paul M. P.M.C.
Cole, Dame Margaret I. M.I.C.
Cole, Sonia M. S.M.Co.
Coleman, James Malcolm. J.M.C.
Collins, George R. G.R.Co.
Collins, Peter. Pe.C.
Collins, Philip. Ph.C.
Collins, Robert O. R.O.C.
Collison, Robert L. R.L.C.

Comarmond, Charles Gustave de. C.G. de C.
Comhaire, Jean L. L.Co.
Compton, Paul Alwyn. P.A.C.
Condliffe, J(ohn) B. J.B.C.
Condon, Edward U. E.U.C.
Cone, Carl B. C.B.Co.
Cone, James H. J.H.C.
Conley, C. Lockard. C.L.C.
Conn, J.F.C. J.F.C.C.
Connor, Ralph A. R.A.Co.
Conor, Bernard Earl. B.E.C.
Conrad, Barnaby. B.C.
Constable, William G. W.G.C.
Contreras R., Jose Daniel. J.D.C.R.
Conversi, Leonard W. L.C.
Conybeare, Charles E.B. C.E.B.C.
Cook, Arthur Herbert. A.H.C.
Cook, James Gordon. J.G.Co.
Cook, L. Russell. L.R.C.
Cook, W. Mercer. W.M.C.
Cooke, Deryck V. D.V.Co.
Coolhaas, W.Ph. W.Ph.C.
Coomaraswamy, Ananda K. A.K.Co.
Coon, Carleton Stevens. C.S.C.
Cooper, Douglas. D.C.
Cooper, G(ustav) Arthur. G.A.C.
Cooper, Martin Du Pré. M. Du P.C.
Copp, J. Terry. J.T.C.
Corbet, André George. A.G.C.
Corbet, Philip S. P.S.C.
Cornelius, Charles E. C.E.Co.
Cornevin, Robert. R.Co.
Cornwall, John L. J.L.C.
Coser, Lewis A. L.A.C.
Coste, René. R.C.
Cotter, Charles Henry. C.H.C.
Cottle, Richard W. R.W.Co.
Cotton, F. Albert. F.A.C.
Coulson, Noel James. N.J.C.
Coupland, Robert Thomas. R.T.C.
Court, Nathan Altshiller. N.A.Ct.
Courthion, Pierre. P.Co.
Cousin, Jean. Je.C.
Couzens, Edward Gordon. E.G.C.
Cowan, Richard S. R.S.C.
Cowgill, Warren. W.C.
Cowie, Alexander. A.Co.
Cowley, Malcolm. Ma.C.
Cox, Francis E.G. F.E.G.C.
Cox, Hiden T. H.T.C.
Coxe, Antony Dacres Hippisley. A.D.H.C.
Coxeter, H.S. MacDonald. H.S.MacD.C.
Crabb, David W. D.W.C.
Crafts, Alden S. A.S.C.
Cragg, Rt. Rev. Albert Kenneth. A.K.C.
Cranston, Maurice. M.C.
Cratty, Bryant J. B.J.C.
Crawford, Carl B. C.B.C.
Crawshay-Williams, Rupert. R.C.-W.
Creevey, Peter Raymond. P.R.C.
Cremin, Lawrence A. L.A.Cr.
Crews, Eli Rush. E.R.C.
Crews, Frederick C. F.C.C.
Crist, Raymond E. R.E.Cr.
Croizier, Ralph C. R.C.C.
Croll, Gerhard. G.Cr.
Cromer, George C. G.C.C.
Cromer, Orville C. O.C.C.
Crone, Gerald Roe. G.R.C.
Cronin, Vincent. V.C.
Cronquist, Arthur (J.). A.Cr.
Crook, John Anthony. J.A.Cr.
Crook, Keith A.W. K.A.W.C.
Crossley-Holland, Peter. P.C.-H.
Crowell, Edward P. E.P.C.
Crowley, Daniel J. D.J.C.
Crowley, Rev. Theodore. T.Cr.
Crowther, Bosley. B.Cr.
Crowther, J.G. J.G.Cr.
Cruickshank, John. J.Cr.
Cruse, William. W.Cr.
Cucu, Vasile S. V.S.C.
Culican, William. W.Cu.
Cullen, James. J.Cul.
Cunha, Décio Neves da. D.N. da C.
Cunill, Pedro. P.Cl.
Cuninghame, John Garry. J.G.C.
Current, Richard N. R.N.C.
Curtin, Nancy A. N.A.C.
Curtis, Alan S. A.S.Cu.
Cuttler, Charles D. C.D.Cu.

Daiches, David. D.Da.
Dallas, Daniel B. D.B.D.
Dalley, Stephanie Mary. S.M.D.
Dalstrom, Harl Adams. H.A.D.
Daniel, Glyn Edmund. G.E.D.
Daniel, Ralph Thomas. R.T.D.
Daniels, Robert V. R.V.D.
Danowski, T.S. T.S.D.
Dansette, Adrien. A.Da.
D'Antonio, William Vincent. W.V.D'A.
Dantzig, George B. G.B.D.
Danzig, Allison. A.D.
Das, Hariprasanna. H.D.
Das, Manmath Nath. M.N.D.
Dashjamts, D. D.Ds.
Dashtseren, D. D.Dn.
Dasmann, Raymond F. R.F.D.
Dauer, A.M. A.M.D.
David, Henry P. H.P.D.
David, René. R.Da.
Davidsohn, A.S. A.S.D.
Davidson, Eugene A. E.A.D.
Davidson, James Norman. J.N.D.
Davidson, Robert Bruce. R.B.D.
Davies, Ernest Albert John. E.A.J.D.
Davies, Horton Marlais. H.M.D.
Davies, Rev. J. Gordon. J.G.D.
Davies, Robert E. R.E.Da.
Davies, Rodney Deane. R.D.D.
Davies, Rev. Rupert E. R.E.D.
Davies, Wayne K.D. W.K.D.D.
Davis, Charles C. C.C.D.
Davis, Gwenda Louise. G.L.D.
Davis, Harry. Ha.D.
Davis, H. Grady. H.G.D.
Davis, M. Edward. M.E.D.
Davis, Norman. N.Ds.
Davis, William C., Jr. W.C.Da.
Davison, P.H. P.H.D.
Davison, W. Phillips. W.P.D.
Davson, Hugh. H.Da.
Dawbin, William Henry. W.H.D.
Dawson, Andrew Hutchinson. A.H.D.
Dawson, Mary R. M.R.D.
Day, Michael H. M.H.D.
Dayal, P. P.D.
Dean, Most Rev. Ralph Stanley. R.S.De.
DeBakey, Michael E. M.E.DeB.
de Beer, Sir Gavin. G. de B.
de Blij, Harm J. H.J. de B.
d'Eça, Raul. R.d'E.
de Carle, Donald. D. de C.
De Conde, Alexander. A. De C.
Dédéyan, Charles. C.De.
de Graft-Johnson, John Coleman. J.C. de G.-J.
Deissmann, Gerhard. G.Dn.
DeJong, Russell N. R.N.DeJ.
Dekker, George G. G.De.
de la Croix, Horst M.A. H. de la C.
de la Mare, Peter B.D. P.B.D. de la M.
Delane, Mary. M.De.
Delebecque, Edouard. E.D.
DeLong, Dwight Moore. D.M.DeL.
Delporte, Henri J. H.J.De.
DeMaggio, Augustus E. A.E.D.
Dember, William N. W.N.D.
Demoz, Abraham. A.Dem.
Denecke, Ludwig. L.De.
Denison, Robert H. R.H.D.
Dennis, Nigel T.M. N.T.M.D.
Deraniyagala, Paul E. Pieris. P.E.P.D.
Der Nersessian, Sirarpie. S. Der N.
Desai, Ranjit Ramchandra. R.R.D.
Desan, Wilfrid. W.De.
de Santana, Pedro Neiva. P.N. de S.
de Santillana, Giorgio D. G. de S.
Descargues, Pierre. P.De.
Deschamps, Hubert Jules. H.J.D.
Descloitres, Robert. R.De.
Descola, Jean. J.De.
Despić, Aleksandar R. A.De.
Desrosier, Norman Wilfred. N.W.D.
Dethan, Georges. G.Det.
de Varine-Bohan, Hugues. H. de V.-B.
de Vleeschauwer, Herman Jean. H.J. de V.
De Vries, Johan G.W. J.G.W. de V.
Dewdney, John C. J.C.D.
De Wiest, Roger J.M. R.J.M. De W.
Diakonoff, Igor Mikhailovich. I.M.D.
Diano, Carlo. C.D.
Dias, Caio Benjamin. C.B.D.
Dibner, Bern. B.Di.
Dickie, James. J.Di.
Dickinson, Harry T. H.T.D.
Dickson, Kwamina Busumafi. K.B.D.
Dickson, Lovat. L.D.
Dienst, Heide. H.Di.
Diethrich, Edward Bronson. E.B.D.
Dietz, Robert Sinclair. R.S.D.
Diffloth, Gérard. G.Di.
Dijkgraaf, Sven. S.Di.
Dikaios, Porphyrios. P.Di.
Dilger, William C. W.C.Di.
Dillon, Myles. M.D.
Dimitrovsky, Haim Zalman. H.Z.D.
Dimock, Edward C., Jr. E.C.D.
Dimroth, Erich. E.Di.
Dingman, S. Lawrence. S.L.D.
Diószegi, Vilmos. V.D.
Diringer, David. D.D.
Ditchburn, Robert William. R.W.Di.
Djibladze, Mikhail Leonidovich. M.L.D.
Djordjevic, Dimitrije V. D.V.D.
Dobzhansky, Theodosius. T.D.
Dockstader, Frederick J. F.J.D.
Dodd, J. Robert. J.R.D.
Dodson, Calaway H. C.H.D.
Dodson, Edward O. E.O.D.
Dölger, Franz. F.Dr.
Dollfus, Charles. Ch.Do.
Domanitsky, Anatoly Petrovich. A.P.D.
Domingues, Mário José. M.J.D.
Domke, Martin. M.Do.
Donald, David Herbert. D.H.D.
Donini, Filippo. F.Do.
Donnellan, Keith S. K.S.D.
Donoghue, Denis. D.Do.
Donovan, Bernard Thomas. B.T.D.
Donovan, Desmond Thomas. D.T.D.
Donovan, Michael Hugh. Mi.Do.
Doorn, Jacques van. J.v.D.
Doresse, Jean P. J.P.Do.
Dorfman, Robert. R.D.
Dorfman, Ron. R.Do.
Doroshinskaya, Yelena Matveyevna. Y.M.D.
Dorpalen, Andreas. A.Do.
Dorson, Richard M. R.M.D.
Dorst, Jean P. J.P.D.
Doucy, Arthur J.M. Ar.D.
Douglas, A. Vibert. A.V.D.
Douglas, Ronald Walter. R.W.D.
Dowd, Douglas F. D.F.Do.
Dowdey, Clifford. C.Do.
Dowling, Herndon G. H.G.Do.
Downey, Glanville. G.D.
Dowsett, Charles James Frank. C.J.F.D.
Draper, Ellinor Elizabeth Nancy. E.E.N.D.
Dresch, Jean. Je.D.
Drescher, Seymour. S.Dr.
Dresden, Mark J. M.J.Dr.
Drew, Philip. Ph.D.
Driscoll, John S. J.S.D.
Drobnig, Ulrich M. U.M.D.
Drower, Margaret Stefana. M.S.D.
Drucker, Philip. P.Dr.
Drummond, Boyce A., Jr. B.A.D.
Dubé, Raymond. Ra.D.
Dubois, Carlos Pablo. C.P.D.
Dubpernell, George. G.Du.
Du Brul, E. Lloyd. E.L. Du B.
Duchesne-Guillemin, Jacques. J.D.-G.
Duckett, Eleanor Shipley. E.S.D.
Dudderidge, John W. J.W.D.
Dudley, Donald Reynolds. D.R.D.
Dudley, Elizabeth Corning. E.C.Du.
Due, John F. J.F.D.

Duellman, William E. W.E.D.
Dufford, Stanley. S.D.
Dufour, Pierre. P.Du.
Dugdale, Donald Stephen. D.S.D.
Dull, Jack L. J.L.D.
Dulles, Rev. Avery. A.Du.
Dumesnil, René. R.Dum.
Dummett, Michael A.E. Mi.D.
Dunaev, Vladimir Nikolaevich. V.N.D.
Dunn, Ethel Deikman. E.D.D.
Dunn, L.C. L.C.D.
Dunn, Richard S. R.S.Du.
Dunn, Stephen Porter. S.P.D.
Dupree, Louis. L.Du.
Durant, Frederick C., III. F.C.D.III.
Durgnat, Raymond E. R.Du.
Durham, J. Wyatt. J.W.Du.
Durko, Janusz. Ja.D.
Durnbaugh, Donald F. D.F.D.
Dury, George Harry. G.H.D.
Dussel, Enrique. E.Du.
Du Val, Patrick. P. Du V.
Duveen, Denis Ian. D.I.D.
Duverger, Maurice. M.Du.
Dwivedi, R.L. R.L.D.
Dwyer, Denis John. D.J.D.
Dyck, Cornelius J. C.J.D.
Dyer, Denys G. D.G.D.
Dykeman, Wilma. W.D.
Dykhuizen, George. G.Dy.

Eardley, Armand J. A.J.E.
Earl, David Magarey. D.M.Ea.
Easby, Dudley Tate, Jr. D.T.E.
East, Robert A. R.A.E.
East, W. Gordon. W.G.E.
Eastman, Richard H. R.H.E.
Easton, Archie H. A.H.E.
Ebisawa, Arimichi. A.Eb.
Eccles, W.J. W.J.E.
Eckbo, Garrett. G.Ec.
Eckert, Ernst R.G. E.R.G.E.
Ede, David A. D.E.
Edel, Leon. L.Ed.
Edelmann, Chester Monroe, Jr. C.M.E.
Edlin, Herbert Leeson. H.L.E.
Edwards, Clive Arthur. C.A.E.
Edwards, Robert Walter Dudley. R.W.D.E.
Edzard, Dietz O. D.O.E.
Egerod, Søren Christian. S.C.E.
Eggen, Olin Jeuck. O.J.E.
Egli, Emil. E.Eg.
Egli, Ernst Arnold. E.A.E.
Ehrlich, Blake. B.E.
Eibl-Eibesfeldt, Irenäus. I.E.-E.
Eicher, Don L. D.L.E.
Eilon, Samuel. S.E.
Einstein, Albert. A.Ei.
Elath, Eliahu. E.E.
Elazar, Daniel Judah. D.J.E.
Eldermans, H.W. H.W.E.
Elekes, Lajos. L.El.
Elftman, Herbert. H.El.
El-Hamamsy, Laila Shukry. L.S.El H.
Elisséeff, Nikita. N.E.
El-Kammash, Magdi M. M.M.El-K.
Eller, Ernest McNeill. E.McN.E.
Ellicott, Dorothy M. D.M.E.
Elliott, Geoffrey Kenyon. G.K.E.
Elliott, Sir Ivo D'Oyly. I.D'O.E.
Elliott, John F. J.F.E.
Elliott, Robert C. R.C.E.
Ellis, E. Earle. E.E.E.
Ellis, Peter. P.E.
Ellwood, Robert S., Jr. R.S.E.
Elsasser, Walter M. W.M.E.
Elton, Geoffrey R. G.R.E.
Elwyn, Alexander J. A.J.El.
Emerit, Marcel. M.E.
Emerson, Kendall, Jr. K.E.
Emery, Walter. W.Em.
Emmerick, Ronald Eric. R.E.E.
Emrich, Linn. L.E.
Enander, Henrik. H.En.
Endress, Peter K. P.K.E.
Engberg, Jens. J.E.
Englekirk, John E. J.E.E.
Enrico, Eugene J. E.J.E.
Enters, Angna. A.E.
Entrambasaguas, Joaquín de. J. de E.
Epperson, Gordon. G.E.
Epstein, Joseph. J.Ep.
Epstein, William. W.E.
Erb, Donald James. D.Er.
Erb, Hubert Joseph. H.J.Er.
Erben, Walter. W.Er.
Erdens, Antonia Déa. A.D.E.
Ericson, David Barnard. D.B.E.
Erinc, Sirri. S.Er.
Erlanger, Philippe. P.Er.
Erpelding, Jean-Pierre. J.-P.E.
Escarpit, Robert. R.Es.
Escholier, Marc Marie. M.M.E
Eskenazi, Gerald. G.Es.
Ess, Josef van. J.v.E.
Essien-Udom, E.U. E.U.E.-U.
Esslin, Martin J. M.J.E.
Eulau, Heinz. H.E.
Euler, Heinrich Gustav. H.G.E.
Evans, Graham. G.Ev.
Evans, Joan. J.Ev.
Evans, Luther Harris. L.H.E.
Evans, M. Albert. M.A.E.
Everard, Cyril Ernest. C.E.E.
Everett, Richard W. R.W.E.
Everett, Thomas H. T.H.E.
Every, Brother George. Ge.E.
Ewald, Paul P. P.P.E.
Eyring, Henry. H.Ey.
Eysenck, Hans Jurgen. H.J.E.
Ezell, John S(amuel). J.S.E.

Fabro, Cornelio. C.F.
Fadiman, Clifton. C.Fa.
Fage, John Donnelly. J.D.F.
Fages, Jean. J.Fa.
Fagg, John E. J.E.F.
Faherty, Robert L. R.F.
Fainsod, Merle. M.F.
Fairbridge, Rhodes W. R.W.F.
Faller, James E. Ja.F.
Faller, Larry D. L.D.F.
Fand, David I. D.I.F.
Farhang, Mohamed Sediq. M.S.F.
Faris, Robert E.L. R.E.L.F.
Faron, Louis C. L.C.F.
Faulkner, Raymond Oliver. R.O.F.
Fawcett, Don W. D.W.F.
Fecher, Hans. H.Fec.
Federico, Pasquale J. P.J.F.
Fedorovich, Boris Aleksandrovich. B.A.F.
Feferman, Solomon. S.Fe.
Fefferman, Charles L. C.L.F.
Feigl, Herbert. H.Fe.
Feigon, Lee Nathan. L.N.F.
Feldman, Louis H. L.H.F.
Feldman, Seymour Se.F.
Fellman, David. D.Fe.
Fellner, Fritz. F.Fe.
Felteau, Cyrille. C.Fe.
Fennell, John Lister Illingworth. J.L.I.F.
Ferdinandy, Michael de. M. de F.
Ferguson, Ian Keith. I.K.F.
Ferguson, John. J.Fe.
Fermín Gómez, Mercedes. Me.F.G.
Fernald, John Bailey. J.B.F.
Fernandes Pimenta, João Epitácio. J.E.F.P.
Fernier, Robert J. R.J.F.
Ferracuti, Franco. F.F.
Ferreira, Milton Gonçalves. M.G.F.
Feuer, Lewis S. L.S.F.
Fieandt, Kai V.J. von. K.V.J.v.F.
Fiegenbaum, J.W. J.W.F.
Field, Andrew. A.Fi.
Fielder, Gilbert. G.Fi.
Fielding, Raymond E. R.E.Fi.
Figueiredo, José Carlos de. J.C.de F.
Filho, José da Silva Ribeiro. J. da S.R.F.
Filip, Jan. J.F.
Filliozat, Jean L.A. J.L.A.F.
Findenegg, Ingo. I.F.
Findley, James Smith. J.Fi.
Finer, Samuel Edward. S.E.F.
Fink, Donald G. D.G.F.
Finkbeiner, Daniel T., II. D.T.F.
Finley, Robert W. Ro.W.F.
Finn, Bernard S. B.S.F.
Firth, Sir Raymond William. R.W.Fi.
Fischer, John L. J.L.Fi.
Fisher, Richard V. R.V.F.
Fisher, William B. W.B.Fi.
FitzGerald, Charles Patrick. C.P.F.
FitzGibbon, Constantine. C.Fi.
Flannery-Herzfeld, Regina. R.F.-He.
Flaum, Thea K. T.K.F.
Fleagle, Robert G. R.G.F.
Fleming, George Thomas. G.T.F.
Fleming, Richard Howell. R.H.Fl.
Fletcher, Angus Stewart. A.S.F.
Fletcher, Basil Alais. B.F.
Fletcher, Ian. I.Fl.
Fletcher, Joseph O. J.O.Fl.
Fletcher, Ronald. R.Fl.
Flew, Antony Garrard Newton. A.G.N.F.
Flexner, Stuart Berg. S.B.F.
Flint, Richard Foster. R.F.F.
Flood, Merrill M. M.M.F.
Florinsky, Michael T. M.T.F.
Florkin, Marcel. M.Fl.
Flusser, David. D.Fl.
Fogelson, Raymond D. R.D.Fo.
Folk, Robert Louis. R.L.F.
Folkerts, Martin Otto Walter. M.O.W.F.
Fomin, Luch Mikhaylovich. L.M.F.
Foner, Anne. A.F.
Foner, Philip S. P.S.F.
Foot, Michael Richard Daniell. M.R.D.F.
Force, Roland Wynfield. R.W.Fo.
Ford, Arthur B. A.B.Fo.
Ford, Lester R. L.R.F.
Forde, Enid R.A. E.R.A.F.
Forder, Henry George. H.G.F.
Fordham, Frieda. F.Fo.
Fordham, Michael S.M. M.S.M.F.
Formo, Marvin W. M.W.F.
Forsdyke, Sir Edgar John. E.J.F.
Foss, Lukas. L.Fo.
Foster, Henry Hubbard, Jr. H.H.F.
Foulkes, David. D.F.
Fourastié, Jean. J.Fo.
Fournier, Gabriel. G.Fo.
Fowler, Catherine S. C.S.F.
Fowler, Don D. D.D.F.
Fowler, E. Bert. E.B.F.
Fowler, Murray. M.Fo.
Fowler, W. Beall. W.B.F.
Fowlie, Wallace. W.F.
Fox, Denis Llewellyn. D.L.F.
Fox, Sidney W. S.W.F.
Foxon, G.E.H. G.E.H.F.
Fraenkel, Heinrich. H.Fra.
Fraisse, Paul. P.F.
Frame, Donald M. D.M.F.
Francis, Sir Frank C. F.C.F.
Frank, Peter W. P.W.F.
Frank, W.J. W.J.F.
Franke, Herbert. H.Fr.
Frankel, Joseph. J.Fr.
Frankel, Marvin. Ma.F.
Franzius, Enno. E.F.
Fraser, Lady Antonia. A.Fr.
Fratcher, William F. W.F.F.
Fredericksen, Linwood. L.F.
Freeborn, Richard H. R.H.Fr.
Freeman-Grenville, Greville Stewart Parker. G.S.P.F.-G.
Freidel, Frank. F.Fr.
Freihofer, Warren Curtis. W.C.F.
French, Richard Antony. R.A.F.
Frend, William Hugh Clifford. W.H.C.F.
Frere, Sheppard Sunderland. S.S.F.
Freund, Michael. M.Fre.
Frey, Frederick Ward. F.W.F.
Frey, Richard L(incoln). R.L.Fr.
Friedlander, Rabbi Albert H. A.H.F.
Friedman, Albert B. A.B.F.
Friedman, Herbert. H.Fn.
Friedman, Milton. M.Fr.
Friedmann, Arnold A. A.A.F.
Friedmann, Herbert. He.F.
Friedmann, Marion Valerie. M.V.F.

Friedrich, Carl J. C.J.F.
Friedrich, Hermann. H.F.
Friermood, Harold T. H.T.F.
Frings, Hubert William. H.W.F.
Fritz, Kurt von. K.v.Fr.
Froehlich, Claudio Gilberto. C.G.F.
Froelich, Jean Claude. J.C.F.
Froeschner, Richard Charles. R.C.F.
Frost, David B.J. D.B.J.F.
Fryburger, Vernon R., Jr. V.R.F.
Fryde, Edmund B. E.B.Fr.
Frye, Richard N. R.N.F.
Fuechsel, Charles F. C.F.F.
Fuhrman, Ralph E. R.E.F.
Fujimura Michio. Fu.M.
Fu-Kiau kia Bunseki-L., André. A.Fu.
Fuller, David. D.Fu.
Fuller, Edmund. E.Fu.
Furon, Raymond-Louis-Charles. R.L.C.F.
Fuson, Robert Henderson. R.H.Fu.
Fussell, George Edwin. G.E.F.
Fyfe, William S. W.S.F.

Gadella, Theodorus W.J. T.W.J.G.
Gaines, Alan M. A.M.G.
Galazy, Grigory Ivanovich. G.I.G.
Gallager, Robert G. R.G.G.
Gallaher, John G. J.G.G.
Gam, Mikael. M.Ga.
Gamble, David P. D.P.Ga.
Gamkrelidze, Thomas V. Th.V.G.
Ganong, William F. W.F.H.
Gantt, W. Horsley. W.H.G.
Garavito, Clemente. C.Ga.
García y Bellido, Antonio. A.G. y B.
Gard, Elizabeth. E.G.My.
Garden, Edward J.C. E.J.C.G.
Gardiner, Patrick Lancaster. P.L.G.
Gardiner, Robert K.A. R.K.A.G.
Gardner, Ernest Dean. E.D.G.
Gargi, Balwant. B.Ga.
Garigue, Philippe. P.Ga.
Garn, Stanley M. S.M.G.
Garrad, Kenneth. K.Ga.
Garrett, Alfred B. A.B.Ga.
Garrigus, Wesley Patterson. W.P.G.
Gascon, Richard. R.Ga.
Gash, Norman. N.G.
Gasking, Elizabeth Belmont. E.B.G.
Gasparini, Evel. E.G.
Gaster, Theodor H. T.H.G.
Gates, David M. D.M.G.
Gatz, Werner. W.G.
Gaunt, William. W.Ga.
Gavrilov, Aleksandr Mikhaylovich. A.M.Ga.
Gayfer, Alan H. A.H.G.
Geanakoplos, Deno John. D.Ge.
Gebhard, Paul Henry. P.H.Ge.
Geerlings, Gerald K. G.K.Ge.
Geiringer, Karl. K.G.
Gelb, Arthur. A.Ge.
Gelb, Barbara. B.Ge.
Gelb, Ignace. J. I.J.G.
Gelpi, Ettore. E.Ge.
Gentilli, Joseph. J.G.
Gentry, Alan William. A.W.G.
Gerardin, Lucien Albert. L.A.G.
Gerasimov, Innokentii Petrovich. I.P.G.
Gerig, O. Benjamin. O.B.G.
Germani, Gino. G.Ge.
Gerow, Edwin. Ed.G.
Gershoy, Leo. L.Ge.
Gerstenmaier, Eugen. Eu.G.
Gertsch, Willis John. W.J.G.
Gewirth, Alan. Al.Ge.
Geyer, Richard A. R.A.G.
Ghirshman, Roman. R.Gh.
Ghori, G.K. G.K.G.
Ghose, Sisirkumar. S.K.G.
Ghul, Mahmud Ali. M.A.G.
Gibbins, Roger. R.G.
Gibbs, Frederick William. F.W.G.
Gibbs, Gerald V. G.V.G.
Gibbs, Norman H. N.H.G.
Gibbs-Smith, Charles Harvard. C.H.G-S.
Gibney, Frank B. F.B.G.
Gibson, Robert Donald Davidson. R.D.D.G.
Giddings, J. Calvin. J.C.Gi.
Gies, Frances Carney. F.C.Gi.
Gifford, Ernest M., Jr. E.M.G.
Gil Arantegui, Malaquias. M.G.A.
Gilbert, Douglas Stuart. D.Gi.
Gilbert, M. Charles. M.C.G.
Gilchrist, Peter Spence, Jr. Pe.S.G.
Giles, Charles Hugh. C.H.Gi.
Gill, Rev. Joseph. J.Gi.
Gillies, Alexander. A.Gi.
Gimbutas, Marija. M.G.
Gimm, Martin. M.Gi.
Gingerich, Owen. O.G.
Gingras, Marcel. Ma.G.
Ginns, Harry Norwood. H.N.G.
Ginsberg, Donald M. D.M.Gi.
Ginsburg, Norton S. N.S.G.
Gintel, Oliver. O.Gi.
Giorgetti, Giovanni Pietro. G.P.Gi.
Girvetz, Harry K. H.K.G.
Gittings, Robert W.V. R.Gi.
Giunta, Francesco. F.Gi.
Gjuzelev, Wassil Todorov. W.T.G.
Glaessner, Martin F. M.F.G.
Glasz, Christiaan. C.G.
Glatzer, Nahum N. N.N.G.
Glazer, Sidney. S.Gl.
Gleeson, Geoffrey R. G.R.G.
Gleeson, Leo John. L.J.G.
Glubb, Sir John Bagot. J.B.Gl.
Gnedenko, Boris Vladimirovich. B.V.G.
Godechot, Jacques. J.Go.
Goethals, Peter R. P.R.Go.
Goetz, Hermann. H.Go.
Gogolák, Ludwig von. L.v.G.
Goin, Coleman Jett. C.J.G.
Goldammer, Kurt Moritz Artur. K.M.A.G.
Goldbeck, Frederick. F.Go.
Goldin, Judah. J.Gol.
Goldscheider, Ludwig. L.Go.
Gollin, Gillian Lindt. G.L.Go.
Gomillion, Charles Goode. C.G.G.
Gomme, Arnold Wycombe. A.W.Ge.
Goncharov, Vladimir Petrovich. V.P.G.
Gongor, D. D.Go.
González, Nancie L. N.L.G.
González Casanova, Pablo. P.G.C.
González Díaz, Emilio Fernando. E.F.G.D.
Gooberman, George L. G.L.G.
Goodall, David W. D.W.G.
Goodbody, Ivan M. I.M.G.
Goode, Richard B. R.B.G.
Goodman, George J. G.J.G.
Goodman, Morris F. M.F.Go.
Goodnight, Clarence James. C.J.Go.
Goodnight, Marie Louise. M.L.Go.
Goodrich, L. Carrington. L.C.G.
Goodrich, Leland Matthew. L.M.G.
Goodwin, Albert. Al.G.
Goodwin, (Trevor) Noël. N.Go.
Gorbman, Aubrey. Au.G.
Gordon, Arnold L. A.L.G.
Gordon, Cyrus H. C.H.G.
Gordon, George N. G.N.G.
Gordon, Isabella. I.G.
Gordon, Maxwell. M.Go.
Gordon-Walker, Patrick Chrestien Gordon Walker, Baron. P.G.W.
Goren, Charles H. C.H.Go.
Gorgy, Samy. S.G.
Görlitz, Walter Otto Julius. W.Go.
Gorman, George C. G.C.G.
Goss, Richard Johnson R.J.G.
Goth, Andres. A.Go.
Goudsmit, Samuel A. S.A.G.
Goult, Herman W. H.W.G.
Gourou, Pierre. P.Gu.
Gowans, Alan. Al.Go.
Gowing, Lawrence. La.G.
Grabar, Oleg. O.Gr.
Graf, Alfred Byrd. A.B.Gr.
Graham, Lois, L.Gr.
Grame, Theodore C. T.Gr.
Grancsay, Stephen Vincent. S.V.G.
Grant, Michael. M.Gr.
Grant, Peter R. P.R.G.
Grant, Robert M. R.M.G.
Grastyán, Endre. E.Gr.
Graue, Jerald C. J.C.Gr.
Gray, Alic William. A.W.Gr.
Gray, Eric William. E.W.G.
Gray, Jack. J.Gra.
Gray, Jane. J.Gr.
Gray, Peter. Pe.G.
Graybiel, Ashton. A.G.
Green, Benny. B.Gr.
Green, Edna R. E.R.G.
Green, Estill I. E.I.G.
Green, J. J.Gre.
Green, Peter S. P.S.G.
Green, Roger Lancelyn. R.L.G.
Greenaway, Frank. F.Gre.
Greenberg, Moshe. Mo.Gr.
Greene David. D.Gr.
Greene, Edward F. E.F.G.
Greene, Mark Richard. M.R.G.
Greenfield, Richard David. Ri.G.
Greenspan, Morris. M.Gre.
Greenwood, Peter Humphry. P.H.G.
Greer, Henry Kirk. H.K.Gr.
Gregg, Alan. Al.Gr.
Gregorietti, Guido. G.Gr.
Gregory, Derek Peter. D.P.G.
Greisen, Kenneth I. K.Gr.
Grenville, John A.S. J.A.S.G.
Gressitt, Judson Linsley. J.L.G.
Griffith, Guy Thompson. G.T.G.
Griffith, William J. W.J.Gr.
Grim, Ralph E. R.E.G.
Grimsley, Ronald. R.Gr.
Groen, Pier. P.Gr.
Gross, Harvey S. Ha.G.
Gross, Leo, L.G.
Gross, M. Grant. M.G.G.
Gross, Werner. W.Gr.
Grossmann, F. F.G.
Gruijters, Johannes P.A. J.P.A.G.
Grünbaum, Branko. B.G.
Gspan, Alfonz. A.Gn.
Gudava, T.E. T.E.G.
Gudzii, Nikolai Kallinikovich. N.K.G.
Guenther, Herbert V. H.G.
Guerello, Rev. Franco. F.Gu.
Guest, Ann Hutchinson. A.H.Gt.
Guiart, Jean. J.Gt.
Guichonnet, Paul. P.G.
Guiguemde, Pierre H. P.H.Gu.
Guillemin, Henri. He.Gu.
Guimarães, Alberto Passos. A.P.G.
Guitton, Henri. H.Gu.
Gulick, John. J.Gu.
Gulliver, P.H. P.H.Gul.
Gulyan, Pyotr Vatslavovich. P.V.G.
Gundermann, Karl-Dietrich. K.-D.G.
Gungaadash, B. B.Gu.
Gunji, Masakatsu. M.Gu.
Gunstone, Frank Denby. F.D.G.
Gunther, Erna. E.Gu.
Gurney, Ashley B. A.B.G.
Gurney, Oliver Robert. O.R.G.
Gusdorf, Georges Paul. G.P.G.
Gustafson, Neil C. N.C.G.
Güterbock, Hans G. H.G.G.
Gutherz, Elmer J. E.J.G.
Guthke, Karl S. K.S.G.
Guthrie, Douglas James. D.J.G.
Guthrie, Sir Tyrone. T.G.
Gutmann, Viktor. V.G.
Gutsche, C. David. C.D.G.
Gvozdetsky, Nikolay Andreyevich. N.A.G.
Gwynn, Denis Rolleston. D.R.G.
Gyftopoulos, Elias Panayiotis. E.P.G.
Gyllensvärd, Bo Vilhelm. B.V.Gy.

Haaf, Ernst ten. E.t.H.
Haar, Dirk ter. D.t.H.
Hacker, Andrew. A.Ha.
Hackett, John. Jo.Hac.
Hackworth, Green H. G.H.H.
Haedeke, Hanns-Ulrich. H.-U.H.
Haekel, Josef. Jo.H.
Hagely, John R. J.R.Ha.

Hagen, Victor Wolfgang von. V.W.v.H.
Haggerty, James J. J.Ha.
Hagiwara Takahiro. H.To.
Hahn, Bae-ho. B.-h.H.
Haight, Gordon S. G.S.Ha.
Hainsworth, F. Reed. F.R.H.
Haley, K.H.D. K.H.D.H.
Hall, Marshall, Jr. Ma.H.
Hall, Richard P. R.P.H.
Hall, Robert A., Jr. R.A.H.
Hallam, Anthony. A.H.
Halldal, Per H.H. P.H.H.H.
Halm, George N. G.N.H.
Halperin Donghi, Tulio. T.H.-D.
Halpern, Jack. J.Ha.
Halstead, Bruce W. B.W.H.
Hambly, Gavin R.G. G.R.G.H.
Hamelin, Louis-Edmond. L.-E.H.
Hamerow, Theodore S. T.S.H.
Hamidé, Abdul-Rahman. A.-R.H.
Hamilton, Bernice Margaret. B.M.H.
Hamilton, Robert W., Jr. R.W.Ha.
Hamilton, William James. W.J.H.
Hamm, Charles E. C.E.H.
Hamman, Rev. Adalbert G. A.G.Ha.
Hammen, Oscar J. O.J.H.
Hammer, A. Gordon. A.G.H.
Hammond, Mason. M.Ha.
Hammond, Nicholas G.L. N.G.L.H.
Hammond Innes, Ralph. R.H.I.
Hamp, Eric P. E.P.H.
Han, Rev. Tai-dong. T.-d.H.
Hanahan, Donald J. D.J.H.
Hancock, Keith J. K.J.H.
Hand, Cadet H., Jr. C.H.Ha.
Handel, Samuel. S.H.
Haneda, Yata. Y.Ha.
Hanna, Willard A. W.A.Ha.
Hansen, Arlen J. A.J.H.
Hansen, Walter B.O. W.Hn.
Hanshaw, Bruce B. B.B.H.
Hanson, A.H. A.H.H.
Hanson, Carl. C.Ha.
Hanson, Earl Dorchester. E.D.H.
Hanson, Earl Parker. E.P.Ha.
Harbaugh, John W. J.W.Ha.
Harbison, Craig S. C.S.Ha.
Hardie, Robert H. R.H.H.
Hardy, Sir Alister C. A.C.Ha.
Hardy, Edward R. E.R.Ha.
Hardy, James Daniel. J.D.H.
Hardy, Jerry F. J.F.H.
Hare, F. Kenneth. F.K.H.
Hargrave, John G. J.G.H.
Harler, Campbell Ronald. C.R.H.
Harmel, Claude. C.H.
Harmer, Ruth Mulvey. R.M.Ha.
Harmon, Mamie. Ma.Ha.
Harms, Robert Thomas. R.T.H.
Harrelson, Walter. W.Ha.
Harris, David. Da.H.
Harris, Enriqueta. E.Ha.
Harris, James T. J.T.H.
Harris, Leslie. L.H.
Harris, Louis Selig. L.S.H.
Harris, Rosemary Lois. R.L.Ha.
Harrison, Anna J. A.J.Ha.
Harrison, Donald F.N. D.F.N.H.
Harrison, Edward R. E.R.H.
Harrison, John A. J.A.Ha.
Harrison, Raymond O. R.O.H.
Harrison, Richard J. R.J.Ha.
Harrison, Walter A. W.A.H.
Harrison-Church, Ronald James. R.J.H.-C.
Harriss, C(lement) Lowell. C.L.Ha.
Harrod, Sir Roy Forbes. R.F.H.
Harroy, Jean-Paul. Je.-P.H.
Hart, Harold. H.Ha.
Hart, Herbert Lionel Adolphus. H.L.A.H.
Hartenberg, Richard S. R.S.H.
Hashisaki, Joseph. Jo.Ha.
Haskell, Arnold Lionel. A.L.H.
Hasselt, Maria van. M.v.H.
Hassler, Warren W., Jr. W.W.H.
Hastings, Margaret. M.Has.
Hatsopoulos, George N. G.N.Ha.
Hatt, Jean-Jacques. J.-J.H.
Hatton, Ragnhild Marie. R.M.H.
Hattori, Shirô. S.Ha.
Hatzikakidis, Athan(assios) D. A.D.H.
Haugen, Einar. Ei.H.
Haurowitz, Felix. F.Ha.
Häuser, Karl H. K.Hä.
Hauser, Philip M. P.M.H.
Havard, C. William H. C.W.H.H.
Havard, John David Jayne. J.D.J.H.
Havelock, Eric Alfred. E.A.Ha.
Haverschmidt, François. F.H.
Havighurst, Alfred F. A.F.H.
Havighurst, Robert J. R.J.H.
Hawes, Donald. D.Ha.
Hawkins, Gerald S. G.S.H.
Hawkins, Joseph E., Jr. J.E.H.
Hawting, G.R. G.R.H.
Hayashi, Shigeru. Sh.H.
Hayford, Charles W. C.W.H.
Hayward, Charles Harold. C.H.H.
Hayward, John F. J.F.Ha.
Haywood, H. Carl. H.C.H.
Haywood, John A. J.A.H.
Hazai, Georg. G.Ha.
Hazard, John N. J.N.H.
Healy, Nicholas Joseph. N.J.H.
Heaney, Robert Proulx. R.P.He.
Heath, Dwight B. D.B.H.
Heath, Sir Thomas Little. T.L.H.
Heaton, Pauline. Pa.H.
Hecht, Charles E. C.E.He.
Hecht, Melvin E. M.E.H.
Heelan, Patrick Aidan. P.A.H.
Heerden, Ernst van. E.v.H.
Heezen, Bruce C. B.C.H.
Heginbotham, Wilfred Brooks. W.B.H.
Heiber, Helmut. H.Hei.
Heilbroner, Robert L. R.L.He.
Heinemeyer, Walter. W.He.
Heinen, Heinz. He.H.
Heinz, Erich. E.H.
Heirtzler, J.R. J.R.H.
Heiser, Charles B., Jr. C.B.He.
Helck, Wolfgang. W.H.
Held, Julius S. Ju.H.
Heldrich, Andreas F.A. A.F.A.H.
Heller, Peter. Pe.H.
Hellie, Richard. R.He.
Hempel, Carl G. C.G.H.
Hempel, Kenneth F.B. K.F.B.H.
Henderson, Philip Prichard. P.P.H.
Henderson, Robert M. R.M.He.
Henderson, Robert W. R.W.He.
Hendricks, George. G.He.
Hendrickson, James B. J.B.He.
Hendy, Sir Philip. P.He.
Heneghan, Maureen. M.H.
Henfrey, Norman V. N.V.He.
Henke, Russell W. R.W.H.
Hensel, Herbert. H.He.
Henson, Ronald A. R.A.He.
Herbert, H.W. H.W.H.
Herbst, Stanislaw. S.He.
Herde, Peter. Pe.He.
Herget, Paul. P.H.
Herivel, John. J.He.
Herklots, Geoffrey A.C. G.A.C.H.
Herman, Robert D. R.D.H.
Herschdoerfer, Sigismund M. S.M.H.
Hersh, Reuben. R.H.
Hertzberg, Rabbi Arthur. Ar.H.
Herzfeld, Hans. Ha.He.
Herzog, Marvin Irving. M.I.H.
Herzog, Peter E. P.E.H.
Heslop, D. Alan. D.A.He.
Heslop-Harrison, John. J.H.-H.
Hess, Eckhard H. E.H.H.
Hess, Wilmot Norton. W.N.H.
Heston, Most Rev. Edward Louis. E.L.H.
Hewish, Antony. A.He.
Hey, Max H. M.H.H.
Heydenreich, Ludwig Heinrich. L.H.H.
Heyerdahl, Thor. Th.H.
Heywood, John B. J.B.H.
Hibbard, Howard. H.Hi.
Hibbert, Christopher. C.Hi.
Hickey, Gerald C. G.C.H.
Hieatt, A. Kent. A.K.H.
Higgins, David J.M. D.J.M.H.
Higgins, Reynold Alleyne. R.A.Hi.
Higgins, Theodore R. T.R.H.
Higgs, Eric S. E.S.H.
Highet, Gilbert. G.Hi.
Highfield, J.R.L. J.R.L.H.
Highsmith, Richard M., Jr. R.M.Hi.
Hightower, Nicholas Carr. N.C.H.
Higonnet, Patrice Louis-René. P.Hi.
Hilger, Marie-Elisabeth. M.-E.V.
Hill, Dorothy. D.Hi.
Hill, J.E. Christopher. J.E.C.H.
Hill, John Hugh. J.H.Hi.
Hill, Laurita L. L.L.H.
Hill, Richard Leslie. R.L.Hi.
Hiller, Lejaren. L.Hi.
Hillers, Delbert R. D.R.H.
Hills, John M. J.M.Hi.
Hilton, Peter John. P.J.H.
Himmelfarb, David. D.H.
Hines, Colin O. C.O.H.
Hines, Neal O. N.O.H.
Hingley, Ronald Francis. R.F.Hi.
Hintikka, K. Jaakko J. K.J.Hi.
Hinton, Thomas B. T.B.H.
Hirai, Naofusa. N.H.
Hirschberg, H.Z. H.Z.H.
Hitchins, Keith Arnold. K.A.H.
Hjelmqvist, Hakon. H.Hj.
Ho, Robert. Rt.H.
Hoaglin, David C. D.C.H.
Hobbs, F.D. F.D.H.
Hobson, Richard Hamilton. Ri.H.
Hodge, Harold C(arpenter). H.C.Ho.
Hodges, James A. J.A.Ho.
Hodgkin, Thomas. T.Ho.
Hoebel, E. Adamson. E.A.H.
Hofer, Kenneth E., Jr. K.E.H.
Hoffer, Abram. A.Ho.
Hoffman, Richard Lawrence. R.L.H.
Hofmann, Michel-Rotislva. M.-R.Ho.
Hogetsu, Keigo. K.Ho.
Hogg, Helen Sawyer. H.S.H.
Hohl, Reinhold D. Re.H.
Hölder, Helmut. H.H.
Holland, Frederick Anthony. F.A.H.
Hollister, C. Warren. C.W.Ho.
Holloway, John. J.Hy.
Holm, Donald August. D.A.H.
Holmes, Arthur F. A.F.Ho.
Holmes, Ralph. Ra.Ho.
Holt, Edgar Crawshaw. E.C.H.
Holt, J.C. J.C.H.
Holt, Peter M. P.M.Ho.
Holthusen, Hans Egon. H.E.H.
Holttum, Richard E. R.E.H.
Holtzman, Jerome. Je.Ho.
Honda, Yasuji. Y.H.
Honeybone, Reginald Crawshaw. R.C.H.
Honigmann, John J. J.J.Ho.
Honko, Lauri O. L.O.H.
Hood, M. Sinclair F. M.S.F.H.
Hoogstraten, Jan S.F. van. J.v.H.
Hookham, Hilda H. H.H.H.
Hopkinson, Ralph G. R.G.H.
Horan, Ellen M. E.M.Ho.
Hori, Ichiro. I.H.
Hornberger, Theodore. T.Hor.
Horne, R.A. R.A.Ho.
Hoskin, Michael Anthony. M.A.H.
Hospers, John. Jo.Ho.
Hough, Jack Luin. J.L.Ho.
Hourani, Albert Habib. A.H.Ho.
House, Michael R. M.R.H.
Houston, James. J.Ho.
Houtgast, Jakob. J.H.
Houtte, Baron Jean M.J. van. J.M.J.v.H.
Houwink ten Cate, Philo H.J. Ph.H.J.H.t.C.
Howard, Ian P. I.P.H.
Howard, John Lawrance. J.L.H.
Howard, Perry H. P.H.H.
Howarth, Thomas. Th.Ho.
Howell, F. Clark. F.C.H.
Howie, Alan Crawford. A.C.H.
Hoy, Cyrus Henry. C.H.Ho.
Hoyt, Joseph Bixby. J.B.Ho.

Hrbek, Ivan. I.Hr.
Hsia, David Yi-Yung. D.Y.-Y.H.
Hsiao, Kung-chuan. K.-c.H.
Hsieh, Chiao-Min. C.-M.H.
Hsieh, Shan-yüan. S.-y.H.
Hsu, Cho-yun. C.-y.H.
Hsueh, Chun-tu. C.-t.H.
Htin Aung, Maung. M.H.Au.
Hu, Charles Y. C.Hu.
Hu, Yueh-Gin Gung. Y.-G.G.H.
Hubatsch, Walther C. W.C.H.
Hübscher, Arthur. Ar.Hü.
Hucker, Charles O(scar). C.O.Hu.
Hudson, Winthrop S. W.S.H.
Huffman, John W. J.W.Hu.
Hughes, David C. D.C.Hu.
Hughes, Rev. G.E. G.E.H.
Hughes, Graham McK. G.McK.H.
Huizing, Peter J. P.Hu.
Hultkrantz, Åke Gunnar Birger. Å.G.B.H.
Hulugalle, Herbert A.J. H.A.J.H.
Humphrey, John H. J.H.Hy.
Hung, Frederick Fu. F.Hu.
Hunt, Charles B(utler). C.B.H.
Hunt, Earl B. E.B.H.
Hunt, Herbert James. H.J.H.
Hunt, Inez Whitaker. I.W.H.
Hunten, Donald M. D.M.H.
Hunwick, J.O. J.O.H.
Huot, Jean-Louis. J.-L.Hu.
Huq, Muhammad Shamsul. M.S.H.
Hurlbut, Cornelius Searle. C.S.H.
Husain, Mahmud. M.Hu.
Husain, Syed Sajjad. S.S.H.
Hussey, Dyneley. D.Hus.
Hussey, Joan Mervyn. J.M.H.
Hutchinson, Edward M. E.M.H.
Hutter, Heribert R. H.R.H.
Huxley, Herbert Henry. H.H.Hu.
Huygens, Gerard Willem. G.W.H.
Huyghe, René. R.Hu.
Hyatt, J. Philip. J.P.Hy.
Hyde, Earl K. E.K.H.
Hyman, Isabelle. I.Hy.

Iakovos, Archbishop (James A. Coucouzes). I.
Ibberson, William G. W.G.Ib.
Ichiko, Teiji. T.Io.
Ichiye, Takashi. I.Ic.
Ihde, Aaron J. A.J.I.
IJsewijn, Jozef A.M.K. J.A.M.K.I.
Ike, Nobutaka. N.I.
Ikram, S.M. S.M.I.
Illick, Joseph E. J.E.I.
Imbo, Giuseppe. G.I.
Imshenetsky, Aleksandr Ilyich. A.I.I.
Inalcik, Halil. H.I.
Inden, Ronald B. R.B.I.
Inglis, David Rittenhouse. D.R.I.
Inglis, W. Grant. W.G.I.
Ingram, William T. W.T.I.
Insall, Donald W. D.W.I.
Ipfling, Heinz-Jürgen. H.-J.I.
Irmscher, Hans Dietrich. H.D.I.
Irvine, Keith. K.I.
Irvine, Verity Elizabeth. V.E.I.
Irving, John H.B. J.H.B.I.
Irving, Laurence. L.I.
Irwin, David. D.I.
Irwin, John B. J.B.I.
İsnard, Hildebert. H.Is.
Issawi, Charles. C.I.
Itzkowitz, Norman. N.It.
Ivanov, Artemy V. A.V.I.
Ivanov, Vyacheslav Vsevolodovich. V.V.I.
Ivić, Pavel. P.I.
Iwasawa, Kenkichi, K.Iw.
İz, Fahir. F.İ.
Izenour, George C. G.C.I.
Izutsu, Toshihiko. T.I.

Jackson, Carl T. C.T.J.
Jackson, Christopher Stewart. C.S.J.
Jackson, Joy Juanita. J.J.J.
Jackson, Roland John. R.J.J.
Jacob, K.K. K.K.J.
Jacob, Stanley W. S.W.J.
Jacobs, Wilbur R. W.R.J.
Jacobsen, Erik S.A. E.S.A.J.
Jacobsen, Thorkild. T.J.
Jacobson, Bernard. B.Ja.
Jacoby, Oswald. O.J.
Jaffe, Bernard. Be.J.
Jaffé, Hans L.C. H.L.C.J.
Jaffé, Michael. Ml.J.
Jahns, Richard H. R.H.J.
Jairazbhoy, Nazir Ali. N.A.J.
James, A. Walter. A.W.J.
James, C.L.R. C.L.R.J.
James, D. Clayton. D.C.J.
James, Rev. Edwin Oliver. E.O.J.
James, Preston E(verett). P.E.J.
James, Thomas Garnet Henry. T.G.H.J.
Jamieson, John Calhoun. J.C.J.
Janick, Jules. J.J.
Jansen, Marius B. M.B.J.
Janson, H.W. H.W.J.
Jarry, Madeleine. M.J.
Järvinen, E. Jaakko. E.J.J.
Jashemski, Wilhelmina Feemster. W.F.J.
Jeandet, Yette. Y.J.
Jeffares, Alexander Norman. A.N.J.
Jefferson, Alan R. A.R.J.
Jelavich, Barbara. B.Je.
Jelavich, Charles. C.J.
Jellett, John Holmes. J.H.J.
Jenkins, Brian Michael. B.M.J.
Jenkins, Rev. Daniel T. D.T.J.
Jenkins, Elizabeth. E.Je.
Jenks, C. Wilfred. C.W.J.
Jennings, Burgess H. B.H.J.
Jerphagnon, Lucien. L.J.
Jescheck, Hans-Heinrich. H.-H.J.
Jessop, Thomas Edmund. T.E.Je.
Jessup, Philip C. P.C.J.
Johansson, Ivar K. I.J.
John, Walter. W.J.
Johnson, D. Gale. D.G.J.
Johnson, Donald D. D.D.J.
Johnson, Dorothy M. D.M.J.
Johnson, Norman Gardner. N.G.J.
Johnson, Col. Robert L. R.L.J.
Johnston, Benjamin Burwell, Jr. B.B.J.
Johnston, Marshall C. M.C.J.
Johnston, S. Paul. S.P.J.
Jolly, William Lee. W.L.J.
Jolowicz, Herbert Felix. H.F.J.
Jones, Abeodu Bowen. A.B.J.
Jones, Rev. A.M. A.M.J.
Jones, Benjamin A., Jr. B.A.J.
Jones, Emrys. E.J.
Jones, Frederick L. F.L.J.
Jones, Gareth H. G.H.J.
Jones, J. Knox, Jr. J.K.J.
Jones, Marsden. Ma.J.
Jones, Mary Eileen. M.E.J.
Jones, Meirion T. M.T.J.
Jones, Thomas. T.Jo.
Jongkees, Adriaan G. A.G.J.
Jonsson, Inge. I.Jo.
Jonsson, Ingrid Margareta. I.M.P.
Jordan, David Starr. D.S.J.
Jordan, Karl H.E. K.J.
Jordan, Pascual W. P.W.J.
Josephson, Matthew. M.Jo.
Joshi, Susan Heyner. S.H.J.
Jourcin, Albert. A.Jn.
Joy, Bernard. B.Jo.
Judson, Jay Richard. J.R.J.
Jwaideh, Wadie. W.Jw.

Kadzamira, Zimani David. Z.D.K.
Kaegi, Walter Emil, Jr. W.E.K.
Kaeppler, Adrienne L. A.Ka.
Kafoglis, Milton Z. M.Z.K.
Kagan, Jerome. J.K.
Kalinin, Gennadi Pavlovitch. G.P.Ka.
Kallen, Horace M. H.M.K.
Kalman, Rudolf E. R.E.K.
Kalmbach, Olin. O.K.
Kaltenmark, Max. Ma.K.
Kalven, Harry, Jr. H.Ka.
Kamanzi, Thomas. T.Ka.
Kamb, W. Barclay. W.B.K.
Kanai, Madoka. Ma.Ka.
Kanayev, Viktor Filipovich. V.F.K.
Kanda, Nobuo. N.Ka.
Kandler, Otto. O.Ka.
Kang, Suk Oh. S.O.K.
Kang, Yu-chin. Y.-c.K.
Kann, Robert A. R.A.K.
Kanya-Forstner, Alexander Sydney. A.S.K.-F.
Kapelrud, Arvid S. A.S.K.
Kaplan, James L. J.L.K.
Kaplan, Lawrence. L.K.
Kaplansky, Irving. I.K.
Karan, P.P. P.P.K.
Karanjia, Russi Khurshedji. R.K.K.
Karasek, Francis W. F.W.K.
Karger, Barry L. B.L.K.
Karlen, Delmar. D.K.
Karnes, Thomas L(indas). T.L.K.
Katritzky, Alan Roy. A.R.K.
Kaufman, Hyman. Hy.K.
Kaufman, Terrence. Te.K.
Kaufmann, Edgar, Jr. E.K.
Kaufmann, Walter. W.Ka.
Kaula, William M. W.M.K.
Kavolis, Vytautas. V.Ka.
Kay, Marshall. M.K.
Kazemzadeh, Firuz. F.Ka.
Kazimour, Jan. Ja.K.
Keating, Frank E. F.E.K.
Kedourie, Elie. E.Ke.
Keen, Benjamin. B.K.
Keenan, Edward Louis. E.L.K.
Kennan, Joseph Henry. J.H.K.
Keene, Donald. D.Ke.
Keep, John L.H. J.L.H.K.
Keerna, Arno Artur. A.A.Ke.
Keeton, George Williams. G.W.K.
Keeton, William T. W.T.Ke.
Keith, E. Gordon. E.G.K.
Keith, G. Stuart. G.S.Ke.
Kell, John Robert. J.R.K.
Keller, Mark. M.Ke.
Keller, Roy A. Ro.A.K.
Kelley, Fenton Crosland. F.C.Ke.
Kellner, Charlotte L. C.L.K.
Kellogg, Edward Washburn. E.W.Ke.
Kelly, Rev. John N.D. J.N.D.K.
Kelly-Gadol, Joan. J.Ga.
Kelman, Arthur. Ar.Kn.
Kemp, Betty. B.Ke.
Kemp, Rev. John Arthur. J.A.Ke.
Kemp, Martin J. M.J.Ke.
Kemp, Tom. T.Ke.
Kendall, Paul Murray. P.M.K.
Kendler, Howard H. H.H.K.
Kennedy, Kenneth A.R. K.A.R.K.
Kenney, Edward John. E.J.Ke.
Kenny, Michael. M.Ky.
Kent, George C., Jr. G.C.K.
Kent-Jones, Douglas W. D.W.K.-J.
Kenyon, Cecelia M. C.M.K.
Kenyon, John P. J.P.K.
Kenyon, Dame Kathleen Mary. K.M.K.
Kerensky, Oleg. O.Ke.
Kerferd, George Briscoe. G.B.K.
Kerney, James, Jr. J.Ke.
Kerr, Malcolm H. M.H.K.
Kessler, Herbert Leon. H.L.Ke.
Keuffel, A.W. A.W.Ke.
Keynes, Sir Geoffrey Langdon. G.L.K.
Keys, Thomas Edward. T.E.K.
Khadduri, Majid. M.Kh.
Khalaf, Samir G. S.G.K.
Khalidi, Tarif. T.Kh.
Khan, Zafar Ahmad. Z.A.K.
Khvostova, Vera V. V.V.K.
Kieffer, William F. W.F.K.
Kiefner, Hans. H.Kie.
Kieft, C. van de. C.v.d.K.
Kiesinger, Carol D. C.D.S.
Killheffer, John V. J.V.K.
Killian, Lewis M. L.M.K.
Kilson, Martin. M.Ki.
Kim, Won-Yong. W.-Y.K.
Kimble, George H.T. G.H.T.K.

Kimble, Gregory A. G.A.K.
Kindermann, Heinz. H.Ki.
King, Cuchlaine Audrey Muriel. C.A.M.K.
King, John Louis, Jr. J.L.Ki.
King, Lester S. L.S.K.
King, Peter K. P.K.K.
Kingdon, Robert M. R.M.K.
Kingsford, Peter W. P.W.K.
Kingslake, Rudolf. R.K.
Kinsbruner, Jay. J.Ki.
Kiralfy, Albert Roland. A.R.Ki.
Kirby, Anthony John. A.J.K.
Kirby, F.E. F.E.Ki.
Kirby, George Hall. G.H.K.
Kirk, Geoffrey S. G.S.K.
Kirk, Samuel Alexander. S.A.K.
Kirk, William. W.Ki.
Kirkpatrick, Ralph. R.Ki.
Kissam, Philip. P.K.
Kitagawa, Joseph M. J.M.K.
Kitajima Masamoto. K.Ma.
Kitson, Michael William Lely. M.W.L.K.
Kitto, H.D.F. H.D.F.K.
Kiuchi, Shinzo. S.K.
Kiwanuka, Matia Semakula Mulumba. M.S.Ki.
Klaniczay, Tibor. T.Kl.
Kleene, Stephen Cole. S.C.K.
Klein, Herbert S. H.S.K.
Klein, Lawrence R. L.R.K.
Klein, Martin J(esse). M.J.K.
Klein, Viola. V.K.
Klindt-Jensen, Ole. O.K.-J.
Klopsteg, Paul E. P.E.K.
Klots, Alexander B. A.B.K.
Klyukanova, Anna Alekseyevna. A.A.K.
Knapp, Wilfrid F. W.F.Kn.
Knappert, Jan. Ja.Kn.
Knecht, Robert Jean. R.J.K.
Knechtel, Herbert B. H.B.K.
Kneller, George Frederick. G.F.K.
Knight, Arthur. A.Kn.
Knight, David Marcus. D.M.K.
Knight, Franklin W. F.W.Kn.
Knight, George Angus Fulton. G.A.F.K.
Knight, Roy Clement. R.C.K.
Knowelden, John. J.Kn.
Knowles, Hugh S. H.S.Kn.
Knowles, Rev. Michael David. M.D.K.
Knox, Sir T. Malcolm. T.M.K.
Kobayashi, Teiichi. T.K.
Kochan, Lionel. L.Ko.
Koegler, Horst. H.Ko.
Koenigsberger, Helmut Georg. H.G.K.
Koeper, H.F. H.F.K.
Koestler, Arthur. A.Ko.
Kohl, Margaret. Ma.Ko.
Köhler, Oswin R.A. O.R.A.K.
Kohn, Hans. H.K.
Kolb, Frank P. F.P.K.
Kolinski, Mieczyslaw. M.Ko.
Kolneder, Walter. Wa.K.
Kondracki, Jerzy A. J.A.K.
Kondratiev, Victor Nikolaevich. V.N.K.
König, Most Rev. Franz Cardinal. F.K.
Kopanev, German Viktorovich. G.V.K.
Kopytoff, Igor. I.K.
Korab, Harry Edward. H.E.K.
Korkala, Pekka Yrjö. P.Y.K.
Korn, Walter. W.Ko.
Kornberg, Hans L. H.L.K.
Körner, Stephan. S.Kö.
Kosarev, Aleksey Nilovich. A.N.K.
Koshland, Daniel E., Jr. D.E.K.
Kosov, Vladimir Fyodorovich. V.F.Ko.
Kossev, Dimiter Konstantinov. D.Ko.
Kossmann, E.H. E.H.K.
Kozlov, Innokenty Varfolomeevich. I.V.Ko.
Kracke, E.A., Jr. E.A.K.
Krader, Lawrence. L.Kr.
Kramer, Leonie Judith. L.J.K.
Kramm, Hans-Joachim. H.-J.K.
Kramrisch, Stella. S.Kh.
Kranbuhl, Kathryn Weichert. K.W.K.
Kranbuhl, Michael Scott. M.S.K.
Krantz, John C., Jr. J.C.K.
Kranz, Walter. W.K.
Kranzberg, Melvin. M.Kr.
Kravis, Irving B. I.B.K.
Kresse, Hermann. He.K.
Krevelen, D.W. van. D.W.v.K.
Krishna, Kumar. K.K.
Kristinsson, Valdimar. Va.K.
Kroner, Richard. R.Kr.
Kronick, David A. D.A.K.
Kropotkin, Pyotr Nikolayevich. P.N.K.
Krueger, John Richard. J.R.Kr.
Kruger, Daniel Wilhelmus. D.W.K.
Kryzhanivsky, Stepan Andriyovich. S.A.Kr.
Krzyzanowski, Julian. J.Kr.
Kubik, Gerhard. G.K.
Kuenen, Philip H. P.H.K.
Kuhn, Harold W. H.W.K.
Kuhn, Werner Th. W.T.K.
Kühner, Hans. H.Kü.
Kuijt, Job. J.Ku.
Kularatnam, Karthigesapillai. K.Ku.
Kummel, Bernhard. B.Ku.
Kunene, Daniel P. D.P.K.
Kunzle, David M. D.M.Ke.
Kuo, Ping-chia. P.-c.K.
Kurath, Gertrude Prokosch. G.P.K.
Kürten, Wilhelm von. W.v.K.
Kurtz, Harold. Ha.K.
Kuwata, Tadachika. T.Ku.
Kuzin, Pavel Sergeyevich. P.S.K.
Kuznetsov, Nikolay Timofeyevich. N.T.K.
Kyrou, Ado. A.Ky.

Labanauskas, Arthur Lon. A.L.La.
Lacey, Brigadier Joseph Harold Spence. J.H.S.L.
Lack, David L. D.L.L.
Lacouture, Jean. J.La.
Ladas, Stephen P. S.P.L.
Ladefoged, Peter N. P.N.L.
Ladner, Gerhart B. G.B.L.
Laessoe, Jorgen. Jo.La.
Laffargue, Gen. Charles-André. C.-A.La.
LaFond, Eugene C. E.C.LaF.
Lafont, Pierre-Bernard. P.-B.L.
Lagowski, J.J. J.J.L.
Laitinen, Kai L.K. K.L.K.L.
Lamb, Hubert Horace. H.H.L.
Lamb, Norman Jones. N.J.L.
Lamott, Kenneth. K.La.
Landau, Jacob M. J.M.L.
Landes, David S. D.S.La.
Landgrebe, Ludwig M. L.M.L.
Landon, H.C. Robbins. H.C.R.L.
Lane, George S. G.S.L.
Lane, Kenneth S. K.S.L.
Lane, Richard. Ri.L.
Lane, Robert K. R.K.L.
Lang, George. G.L.
Lange, Arthur L. A.L.L.
Lange, Robert Terence. R.T.La.
Langevin, Luce-Andrée. L.-A.L.
Lanhers, Yvonne. Y.L.
La Orden Miracle, Ernesto. E.L.O.M.
Laoust, Henri. H.L.
Laporte, Léo F. L.F.L.
Lardner, Rex. R.La.
Laroui, Abdallah. A.La.
Lakser, Gabriel W(ard). G.W.L.
Lasko, Peter Erik. P.E.L.
Lassen, Erik. Er.L.
Lasserre, François. F.La.
Latham, Agnes M.C. A.M.C.L.
Latham, Earl. Ea.L.
Latham, Richard C. R.C.L.
Latil, Pierre de. P. de L.
Lattimer, John Kingsley. J.K.La.
Lattimore, Owen. O.La.
Lattin, Gerald W. G.W.La.
Lattin, Harriet Pratt. H.P.La.
Laudise, Robert A. R.A.L.
Laue, Gilbert P. G.P.L.
Laughlin, H.P. H.P.L.
Launay, Michel C. M.C.L.
Lauwerys, Joseph Albert. J.A.L.
Laver, James. Ja.L.
Lavondès, Henri. H.La.
Lavrin, Janko. Ja.La.
Lawler, Sylvia Dorothy. S.La.
Lawrence, Carl Adam. C.A.L.
Lawrence, Joseph Collins. J.C.L.
Lawson, Joan. Jo.L.
Lawson, Robert Frederic. R.F.L.
Laya, Diuldé. Di.L.
Layton, Robert. R.Lay.
Lea, David A.M. D.A.M.L.
Lea, Sir Frederick M. F.M.L.
Lea, Kathleen Marguerite. K.M.L.
Leary, Lewis. L.Le.
Lebel, Robert. R.Le.
Lecco, Alberto. A.L.
Lechène, Robert. Ro.L.
Lechevalier, Hubert Arthur. H.A.L.
Lee, Chan. C.Le.
Lee, James A. J.A.Le.
Lee, Ki-baik. K.-b.L.
Lee, Kwang-rin. K.-r.L.
Lee, Robert H.G. R.H.G.L.
Lee, W.R. W.R.L.
Leech, Clifford. Cl.L.
Lee-Franzini, Juliet. J.L.-F.
Leeming, Frank Andrew. F.A.L.
Legge, (Mary) Dominica. D.Le.
Legge, John David. J.D.L.
Legum, Colin. Co.L.
Legum, Margaret Jean. M.J.L.
Lehman, Mildred K. M.K.L.
Lehman, Milton. M.Ln.
Lehmann, Andrew George. A.G.L.
Lehmann-Haupt, Hellmut E. H.E.L.-H.
Leicester, Henry M. H.M.L.
Leichter, Otto. O.L.
Leighton, Richard M. R.M.Le.
Leiman, Sid Z. S.Z.L.
Leite, Aureliano. A.Le.
Leite, Celso de Paiva. C. de P.L.
Leiter, Samuel. S.Lr.
Lejeune, Michel. M.Le.
Lejewski, Czeslaw. Cz.L.
Lekachman, Robert. R.L.
Lenti, Libero. Li.L.
Lentz, Thomas L. T.L.L.
Leonard, Justin W. J.W.L.
Leone, Lucile P. L.P.Le.
Leontyev, Oleg Konstantinovich. O.K.L.
Leprohon, Pierre. P.Le.
Lerner, Irwin Solomon. I.S.L.
Lernet-Holenia, Alexander Marie Norbert. A.L.-Ho.
Lessing, Lawrence P. L.P.L.
Leung, Chi-Keung. C.-K.L.
Le Vay, David. D. Le V.
Levene, Howard. H.Le.
LeVeque, William Judson. W.J.LeV.
Levi, Albert William. A.W.L.
Levi, Herbert W. H.W.L.
Levi, Lorna R. L.R.L.
Levie, Col. Howard S. H.S.L.
Levron, Jacques. J.Le.
Lewis, Bernard. B.Le.
Lewis, David L. D.L.Le.
Lewis, David Malcolm. D.M.L.
Lewis, Hywel David. H.D.L.
Lewis, I.M. I.M.L.
Lewis, John Wilson. J.W.Le.
Lewis, Peirce F. P.F.L.
Ley, Dorothy C.H. D.C.H.L.
Leyser, K.J. K.J.L.
Li, Fang Kuei. F.K.L.
Li, Tien-yi. T.-y.L.
Libin, Laurence Elliot. La.L.
Li Chi. L.Ci.
Lieberich, Heinz. H.Li.
Lien, Chan. C.Li.
Lienhardt, R. Godfrey. R.G.Li.
Liess, Otto. O.Li.
Lieuwen, Edwin. E.Li.
Lifson, David S. D.S.L.
Liley, Bruce Sween. B.S.L.
Lima, José Lourenço de. J.L. de L.
Lima, Miguel Alves de. M.A. de L.
Lin, Maung Wai. M.W.L.
Lindauer, Martin. M.Li.
Lindbeck, Assar. A.Li.
Lindbeck, George Arthur. G.A.L.

Lindsay, R. Bruce. R.B.L.
Lindström, Maurits. M.L.
Link, Arthur Stanley. A.S.L.
Linvald, Steffen. S.L.
Lippold, Adolf. A.Lip.
Lisitsin, Aleksandr Petrovich. A.P.L.
Lissens, René Felix. R.F.Li.
Little, Donald P. D.P.L.
Liu, James T.C. J.T.C.L.
Livermore, Harold V. H.V.L.
Livi-Bacci, Massimo. M.L.-B.
Livingstone, Daniel A. D.A.L.
Llwellyn, Karl Nickerson. K.N.L.
Lloyd, Albert Lancaster. A.L.Ll.
Lloyd, Seton H.F. S.H.F.L.
Lloyd-Jones, David Mathias. D.M.L.-J.
Lo, Jung-pang. J.-p.L.
Lockhart, Laurence. L.L.
Lockhart, Richard T. R.T.L.
Lockley, R.M. R.M.L.
Lockspeiser, Edward. E.L.
Loeffler, M. John. M.J.Lo.
Loehr, Max. Ma.L.
Loewe, Fritz P. F.P.L.
Logan, Richard F. R.F.Lo.
Lomax, Alan. A.Lo.
Lombardo, Antonino. An.L.
Long, Charles H. C.H.Lo.
Longford, Elizabeth Pakenham, Countess of. E.Lo.
Longhurst, Alan R. A.R.L.
Longworth, Philip. P.L.
Lonsdale, Dame Kathleen. K.Lo.
Loomis, Charles P. C.P.L.
Loon, Maurits N. van. M.N.v.L.
Loosli, John K. J.K.L.
Lopez, Robert Sabatino. R.S.L.
Lorig, Clarence H. C.H.L.
Lortz, Joseph. J.L.
Lorwin, Val R. V.R.L.
Losey, George S. G.S.Lo.
Low, D. Anthony. D.A.Lo.
Low, David Morrice. D.M.Lo.
Lowe, Victor. V.Lo.
Lowenthal, Constance. C.Lo.
Lozinsky, Mikhail Grigoriyevich. M.G.L.
Lucas, Donald William. D.W.L.
Luce, R. Duncan. R.D.L.
Luck, Georg Hans. G.Lu.
Lucker, Joseph M. J.M.Lu.
Luckey, Thomas D. T.D.L.
Lukoff, Fred. F.L.
Lüling, Karl Heinz. K.H.L.
Lumiansky, R.M. R.M.Lu.
Luscombe, David Edward. D.E.L.
Lustig, Lawrence K. L.K.L.
Lutfi al-Sayyid Marsot, Afaf. A.L.al-S.M.
Luttrell, Anthony Thornton. A.T.L.
Lyman, John. J.Ly.
Lymarev, Vasily Yosifovich. V.Y.L.
Lynch, John. Jo.Ly.
Lynch, Kevin. K.L.
Lyne, A. Gordon. A.G.Ly.
Lyons, John. J.Lyo.

Mabbott, Thomas Ollive. T.O.M.
Mabbutt, J.A. J.A.M.
Mabee, Carleton. C.Ma.
Mabogunje, Akinlawon Ladipo. A.L.M.
Macan, T.T. T.T.M.
Macartney, Carlile Aylmer. C.A.M.
McBirney, Alexander R. A.R.McB.
McBride, George McCutchen. G.McC.McB.
McCallum, William Cheyne. W.C.McC.
McCarthy, Willard J. W.J.McC.
McChesney, Malcolm. M.McC.
Macchia, Giovanni. Gi.M.
McClelland, Charles A. C.A.McC.
McClintock, Elizabeth. E.McC.
MacConaill, Michael A. M.A.MacC.
McConnaughey, Bayard H. B.H.McC.
McCrea, William Hunter. W.H.McC.
McDavid, Raven I(oor), Jr. R.McD.
McDivitt, James F. J.F.McD.
McDonald, Alexander Hugh. A.H.McD.
MacDonald, Charles B. C.B.MacD.
McDonald, Forrest. F.McD.
McDonough, Sheila D. S.McD.
MacDuffee, C.C. C.C.MacD.
Maceda, José. Jé.Ma.
McElroy, Frank E. F.E.McE.
McEwen, Rev. James Stevenson. J.S.McE.
McFarland, Ross Armstrong. R.A.McF.
McFarlane, James Walter. J.W.McF.
Macfarlane, Robert Gwyn. R.G.M.
McGann, Thomas F. T.F.McG.
McGee, Terence Gary. T.G.McG.
McGrath, Joseph E. J.E.McG.
McGreevey, William Paul. W.P.McG.
McGregor, Samuel Emmett. S.E.McG.
McGuire, William J. W.J.McG.
Machlis, Joseph. J.Ma.
McHugh, Christine. C.McH.
MacIntosh, Robert McKinlay. R.Mck.MacI.
McIntyre, Donald. D.McI.
McKelvey, Vincent E. V.E.McK.
Mackenzie, Fred T. F.T.M.
McKenzie, Rev. John L. J.L.Mc.K.
MacKenzie, William Scott. W.S.MacK.
McKeon, Richard. R.McK.
Mack Smith, Denis. De.M.S.
McLaughlin, John. J.McL.
MacLeod, Murdo J. M.J.MacL.
McLeod, Thomas S. T.S.McL.
McLeod, William Hewat. W.H.McL.
McLintock, Peter. P.McL.
McMahon, William B. W.B.McM.
McMullen, Roy Donald. R.McMu.
McMurtrey, James Edward, Jr. J.E.McM.
McNeill, William H. W.H.McN.
MacNutt, W. Stewart. W.S.MacNu.
Macomber, Richard W. R.W.Ma.
McQuown, Norman Anthony. N.A.McQ.
MacRae, Donald Gunn. D.G.MacR.
Maeno, Naoaki. Na.Mo.
Magarshack, David. Da.Ma.
Magdoff, Harry. Ha.Ma.
Magoun, Horace Winchell. H.W.M.
Mahdi, Muhsin S. M.S.M.
Majeska, George P. G.P.M.
Makdisi, George. G.M.
Malcolm, Norman A. N.A.M.
Malia, Martin E. M.E.Ma.
Malik, Liliya Konstantinovna. L.K.M.
Malina, Frank J(oseph). F.J.Ma.
Malinschi, Vasile. V.Mi.
Mallett, Michael Edward. Mi.Ma.
Mallory, V. Standish. V.S.M.
Mallowan, Sir Max. M.Mn.
Malm, William P. W.P.M.
Maloney, Francis J. Terence. Fr.J.M.
Mammey, Ulrich W. U.Ma.
Manchester, William. W.Man.
Mann, Golo. G.Ma.
Mannheim, Hermann. H.M.
Mannheim, L. Andrew. L.A.Ma.
Manning, Raymond B. R.B.M.
Manning, Wayne E. Wa.E.M.
Manschreck, Clyde L. C.L.Ma.
Manske, Richard H. R.H.M.
Mantell, Charles L. C.L.M.
Mantilla Pineda, Benigno. B.M.P.
Manton, Sidnie M. S.M.M.
Manuel, Frank Edward. F.E.M.
Manvell, Roger. R.M.
Maraini, Fosco. F.M.
Marcelli, Umberto. U.M.
March, Benjamin. B.Ma.
Marc'hadour, Rev. Germain P. G.P.Ma.
Marchand, Leslie A. L.A.M.
Marcus, Leonard M. L.M.M.
Marcuse, Sibyl. S.Ma.
Marden, Luis. Lu.M.
Margenau, Henry. H.Ma.
Margolis, Joseph. J.Ms.
Mariani, Valerio. V.M.
Marinich, Aleksandr Mefodyevich. A.M.M.
Mark, Herman F. H.F.M.
Markovitz, Hershel. He.M.
Markowitz, William. W.Ma.
Marks, Robert W. R.W.M.
Marks, Shula E. Sh.M.
Marlowe, John. Jo.Ma.
Marquard, Leopold. L.Ma.
Marqués, Nemesio. N.Ma.
Marrast, J. J.Mar.
Marrat, Sidney. Si.M.
Marriott, McKim. Mc.M.
Marrou, Henri-Irénée. H.-I.M.
Marsh, Christopher Marriage. C.M.
Marshall, Joe T. J.T.M.
Marshall, John S. J.S.Ma.
Marshall, P.J. P.J.M.
Marshall, Robert L. Ro.Ma.
Martin, Boyd A. B.A.M.
Martin, Gene E. G.E.Ma.
Martin, Laurence Woodward. L.W.M.
Martindale, Andrew Henry Robert. A.Ma.
Martini, Giuseppe. Gi.Ma.
Martinot, Roger. R.Ma.
Martins, Luciano. L.Ms.
Marton, Ladislaus L. L.L.M.
Marts, M.E. M.E.Ms.
Marty, Martin E. M.E.M.
Marvin, Ursula B. U.B.M.
Marwick, Maxwell Gay. M.G.Ma.
Masai, Yasuo. Y.M.
Mascarenhas, Adolfo C. A.C.M.
Mason, Basil John. B.J.M.
Mason, Brian H. B.H.M.
Mason, Charles T., Jr. C.T.M., Jr.
Mason, Ian Lauder. I.L.M.
Mason, Leonard E. L.E.M.
Mason, Philip. P.Ma.
Mason, Warren Perry. M.P.Mn.
Massevitch, Alla Genrikhovna. AG.Ma.
Massey, Alan Gibbs. A.G.M.
Mast, Gerald. Ge.M.
Masur, Gerhard Strassmann. G.S.M.
Masutani Fumio. Ma.Fu.
Mathew, Most Rev. David. D.Ma.
Mathis, John S. J.S.M.
Matloff, Maurice. Ma.M.
Matsui Taketoshi. M.Ti.
Matsumoto, Nobuhiro. N.M.
Matsumoto, Tatsuro. T.M.
Matthews, Geoffrey Vernon Townsend. G.V.T.M.
Matthews, J.F. J.F.Ma.
Matthias, Erich. E.Ma.
Matthiasson, Björn. B.M.
Mattuck, Arthur Paul. A.P.Ma.
Matull, Wilhelm. Wi.M.
Matz, Samuel A. S.A.M.
Maurer, Rev. Armand. A.A.Ma.
Maurer, D.W. D.W.M.
Mawby, John E. Jo.E.M.
Max, Abraham M. A.M.Ma.
Maxwell, D.E.S. D.E.S.M.
May, Comdr. William Edward. W.E.M.
Mayeda, Sengaku. Se.M.
Mayer, Harold M. H.M.M.
Mayer, Joseph E. J.E.Ma.
Mayer, William Vernon. W.V.M.
Mays, John Barron. J.B.M.
Mažiulis, Vytautas J. V.J.M.
Mazzoni, Francesco. F.Ma.
Meade, Robert Douthat. R.D.M.
Medina, José Ramón. J.R.Me.
Medina, Manuel. M.Me.
Mee, John F. J.F.Me.
Meen, V(ictor) B(en). V.B.M.
Meerheaghe, M.A. van. M.A.v.M.
Meeuse, Bastiaan J.D. B.J.D.M.
Mehren, Arthur Taylor von. A.T.v.M.
Mei, Yi Pao. Y.P.M.
Meier, Mark F. M.F.M.
Meiggs, Russell. Ru.M.
Meischner, Dieter. D.M.
Meland, Bernard E. B.E.M.
Mellor, Roy E.H. R.E.H.M.
Melsen, Andrew G.M. van. A.G.M.v.M.
Meltzer, Julian Louis. J.L.Me.
Melville, Kenneth I. K.I.M.
Mendeloff, Albert I. A.I.M.
Mendenhall, George Emery. G.E.Me.
Mendoza, Eric. E.M.
Mensching, Gustav. G.Me.
Menzies, Robert James. R.J.Me.
Mercier, Paul. Pa.M.

Merdinger, Capt. Charles John. C.J.M.
Merkelbach, Reinhold. R.Me.
Merle, Robert. Ro.M.
Mernagh, Laurence Reginald (Bob). L.R.M.
Mero, John Lawrence. J.L.M.
Merrifield, William Richard. W.Me.
Merritt, H. Houston. H.H.M.
Merskey, Harold. H.Me.
Mertz, Barbara G. B.G.M.
Mertz, Pierre. P.Me.
Meskauskas, Kazimiers Antano. K.A.M.
Messenger, P.S. P.S.M.
Metford, John Callan James. J.C.J.M.
Meyendorff, Rev. John. J.M.
Meyer, Adolphe Erich. A.E.M.
Meyer, C. Beat. C.B.M.
Meyer, John Richard. J.R.M.
Meyer, Karl W. K.W.M.
Meyer, Peter. P.M.
Michael, Franz H. F.H.M.
Michael, Karl B. K.B.M.
Michaelsen, Robert Slocumb. R.S.M.
Michałowski, Kazimierz. K.Mi.
Michel, Michel. M.Ml.
Michelena, Luis. L.M.
Michelmore, Peter. P.Mi.
Middlehurst, Barbara Mary. B.M.M.
Middlemiss, J. Howard. J.H.M.
Middleton, Dorothy. D.Mi.
Middleton, Gerard V. G.V.M.
Middleton, John F.M. J.F.M.
Middleton, Robin David. R.D.Mi.
Miège, Jacques. J.Mi.
Miers, Earl Schenck. E.S.Mi.
Mikhail, S.W. S.W.M.
Mikhaylov, Nikolay Ivanovich. N.I.M.
Mikoletzky, Hanns Leo. H.L.M.
Milgate, Wesley. W.Mi.
Milkov, Fyodor Nikolayevich. F.N.M.
Miller, George Leslie. G.L.M.
Miller, John Donald Bruce. J.D.B.M.
Miller, Mark D.H. M.D.H.M.
Miller, Maynard Malcolm. M.M.M.
Miller, William H. W.H.M.
Millikin, Sandra. S.Mi.
Millman, Peter Mackenzie. P.M.M.
Millner, Maurice Alfred. M.A.M.
Millon, Henry A. H.A.M.
Millot, Jacques. Ja.M.
Mills, William James, Jr. W.J.Mi.
Minarcik, Elbert John. E.J.M.
Minifie, Bernard W. B.W.M.
Minio-Paluello, Lorenzo. L.M.-P.
Mints, Aleksey Aleksandrovich. A.A.M.
Mirreh, Hassan Ali. H.A.Mi.
Mirsky, Jeannette. J.Mir.
Mitchell, Andrew Ronald. A.R.Mi.
Mitchell, G.A.G. G.A.G.M.
Mitchell, Jean Brown. J.B.Mi.
Mitchell, Mairin. M.Mi.
Mitchell, Terence Croft. T.C.M.
Mitford, Nancy. Na.M.
Mitry, Jean. Je.M.
Mittelberger, Hermann. He.Mi.
Mitzman, Arthur. Ar.M.
Mizener, Arthur. A.Mi.
Moeller, Therald. T.Mo.
Moen, Arve Sverre. A.S.M.
Mohanty, Jitendra N. J.N.M.
Mohr, P.A. P.A.M.
Mokray, William George. W.G.M.
Moldenhauer, Hans. Ha.M.
Mollat, Michel J. M.J.Mo.
Moltmann, Jürgen D. J.D.M.
Momigliano, Arnaldo Dante. A.D.Mo.
Momo, Hiroyuki. Hi.Mo.
Moncada R., J. Roberto. J.R.M.R.
Mondrain, P. P.Mon.
Monet, Rev. Jacques. J.Mo.
Mongan, Agnes. Ag.M.
Mongrédien, Georges. G.Mn.
Monick, John A. J.A.Mo.
Monk, C.B., Jr. C.B.Mo.
Monnerville, Gaston. G.Mo.
Monroy, Alberto. A.Mo.
Montagna, William. W.M.
Montross, Lynn. L.Mo.
Moog, Florence. Fl.M.
Mookerjee, Sitanshu. S.Mo.
Moore, Gerald. Ge.Mo.
Moore, Gordon E. G.E.Mo.
Moore, Harold E., Jr. H.E.Mo.
Moore, John Preston. J.P.M.
Moore, Patrick. P.Mo.
Moore, Sonia. S.M.
Moore, Will G. W.G.Mo.
Moraes, Frank R. F.R.M.
Morales-Carrión, Arturo. A.M.-C.
Moran, Francis (Frank). F.Mo.
Morehouse, Laurence E. L.E.Mo.
Moreira, Amélia A. Nogueira. A.A.N.M.
Morgan, Edwin George. E.G.M.
Morgan, Neil. N.Mo.
Morgan, Stephen William Kenneth. S.W.K.M.
Morison, John Edgar. J.E.M.
Morley, Cyril John. C.J.Mo.
Morley, Ronald James. R.J.M.
Morrey, Charles B., Jr. C.B.My.
Morris, Donald R. D.R.M.
Morris, H.S. H.S.M.
Morris, Terence Patrick. T.P.M.
Morrish, Allan H. A.H.M.
Morrison, Hugh Sinclair. Hu.M.
Morrissey, Charles Thomas. C.T.Mo.
Morsey, Rudolf. R.Mo.
Mortensen, Brita Maud Ellen. B.Mo.
Morton, John Edward. J.E.Mo.
Morton, William Lewis. W.L.M.
Moseley, Maynard F., Jr. M.F.Mo.
Mosher, Frederick C. F.C.M.
Mosley, Leonard. Le.M.
Mosse, W.E. W.E.Mo.
Mosteller, Frederick. Fr.M.
Mostofi, Khosrow. Kh.Mo.
Mostow, George Daniel. G.D.M.
Moulton, Matthew James. Ma.J.M.
Moulton, William G. Wi.G.M.
Moumouni, Abdou. A.M.
Mousnier, Roland E. R.E.M.
Mouzelis, Nicos Panayiotou. N.P.M.
Mowry, George E. G.E.M.
Moylan, Michael James. M.J.M.
Mozumder, Asokendu. A.Moz.
Mueller, David Livingstone. D.L.M.
Mühlmann, Wilhelm Emil. W.E.Mü.
Mukerji, S.N. S.N.M.
Mulholland, J. Derral. J.D.Mu.
Müller, Claudius Cornelius. C.C.M.
Müller, Edith A. E.A.M.
Müller, Joachim. J.Mu.
Müller-Brockmann, Josef. J.M.-Br.
Müller-Freienfels, Wolfram. W.M.-F.
Multhauf, Robert P. R.P.M.
Munn-Rankin, J.M. J.M.M.-R.
Munro, Thomas. Th.M.
Munroe, John A. J.A.Mu.
Munson, J. Ronald. J.R.Mn.
Munsterberg, Hugo. H.Mu.
Munz, Peter. P.Mu.
Muranov, Aleksandr Pavlovich. A.P.M.
Muromtsev, Aleksey Mikhaylovich. A.M.Mu.
Murphy, Arthur D. A.D.M.
Murphy, Rev. Francis Xavier. F.X.M.
Murphy, James J. J.J.M.
Murra, John V. J.V.M.
Murray, Anne Wood. A.W.M.
Murray, Francis J. F.J.M.
Murray, Peter J. P.J.Mu.
Murton, Ronald K. R.K.M.
Musgrave, William K.R. W.K.R.M.
Muskie, Edmund S. E.S.M.
Mutter, Reginald P.C. R.P.C.M.
Mutton, Alice F.A. A.F.A.M.
Myachin, Ivan Kirillovich. I.K.M.
Myers, Alexander Reginald. A.R.M.
Myers, Raymond R. R.R.M.
Myers, Rollo H. R.My.
Myint, Hla. H.My.

Nachod, Frederick C. F.C.N.
Nadeau, Maurice. M.Na.
Naess, Arne D. A.D.N.
Nagahara, Keiji. K.N.
Nagata, Takesi. T.Na.
Nagel, Heinrich. H.N.
Nagler, Alois M. A.M.N.
Naim, C.M. C.M.N.
Nair, Kusum. K.Na.
Nair, N. Chandrasekharan. N.C.N.
Naisbitt, John. Jo.N.
Naka, Arata. A.Na.
Nakamura, Hajime. H.Na.
Nakosteen, Mehdi K. M.K.N.
Namias, Jerome. J.Na.
Nanda, B.R. B.R.N.
Nangeroni, Giuseppe. G.Na.
Napier, B. Davie. B.D.N.
Napier, J.R. J.R.N.
Narain, A.K. A.K.N.
Narasimhan, Chakravarthi V. C.V.N.
Narasimhan, Raghavan. R.Na.
Narayana, H.S. H.S.N.
Narkiss, Bezalel. B.Ns.
Narr, Karl J. K.J.N.
Nash, Manning. Ma.N.
Nash, Paul. Pa.N.
Nash, Ray. Ra.N.
Nasr, Seyyed Hossein. S.H.N.
Natsagdorj, Sh. Sh.Nj.
Nayudamma, Yelavarthy. Y.N.
Neal, Maj. James T. J.T.Ne.
Neill, Rt. Rev. Stephen Charles. S.C.N.
Neisser, Philip B. P.B.N.
Nel, Andries. A.Ne.
Nelson, Bert. B.Ne.
Nelson, E. Clifford. E.C.N.
Nelson, Gareth Jon. G.J.N.
Nelson, Gerald C. G.C.N.
Nelson, James D. J.D.N.
Nelson, R.J. R.J.Ne.
Nelson, Robert J. R.J.N.
Nemerov, Howard. H.Ne.
Nestyev, Israel Vladimirovich. I.V.N.
Netter, Francis. F.Ne.
Nettl, Bruno. B.N.
Neugebauer, Werner. W.N.
Neumann, Gerhard. G.N.
Neumann, Jehuda. J.N.
Neumark, Fritz. F.N.
Nevins, Allan. Al.N.
Newcombe, Curtis L. C.N.
Newgold, Wilbert D. W.D.N.
Newhall, Beaumont. Be.N.
Newlin, Dika. D.N.
Newman, Graeme R. G.Ne.
Newman, Robert Bradford. R.B.N.
Newman, William Anderson. W.A.N.
Newman, William S. W.S.N.
Newton, Brian E. B.E.N.
Neyman, Viktor Grigoryevich. V.G.N.
Nichol, John Thomas. J.T.N.
Nicholas, Herbert G. H.G.N.
Nicholson, Norman L. N.L.N.
Nickel, Helmut A. H.Ni.
Nicol, Davidson S.H.W. D.S.H.W.N.
Nicol, Donald MacGillivray. D.M.N.
Nicolet, Marcel. M.N.
Nicolle, Jacques-M.-R. J.-M.-R.N.
Niederer, Arnold. A.Ni.
Nigam, Shyam Behari Lal. S.B.L.N.
Nijim, Basheer K. B.K.N.
Nijinsky, Romola. R.Ni.
Nikiforov, Leonid Alekseyevich. L.A.N.
Nikiforov, Yevgeny Gurevich. Y.G.N.
Niklaus, Robert. Ro.N.
Nisbet, Robert A. R.A.N.
Noback, Charles R. C.R.N.
Noble, Clyde Everett. C.E.N.
Noble, J. Jeremy. J.J.No.
Noble, Joseph Veach. J.V.N.
Noda, Kazuo. K.No.
Noller, Carl R. C.R.No.
Norbeck, Edward. E.N.
Norbye, Jan P. J.P.N.
Nordhagen, Per Jonas. P.J.N.
Nordtvedt, Kenneth L., Jr. K.L.N.
Nörlund, Niels Erik. N.E.N.
Norman, A.V.B. A.V.B.N.
Norman, Lennart T. L.T.N.

Norman, Richard O.C. R.O.C.N.
Norris, Kenneth Stafford. K.S.N.
North, Robert C. R.C.N.
Norwich, John Julius Cooper, 2nd Viscount. J.J.Cr.
Noss, John B(oyer). J.B.N.
Nove, Alexander. A.No.
Novick, Alvin. A.N.
Nowell, Charles E. C.E.No.
Nuwinkware, Pierre-Claver. P.-C.N.

Oakley, Francis Christopher. F.C.O.
Oates, E.E. David M. E.E.D.M.O.
Oberg, Kalervo. K.Ob.
Obichere, Boniface Ihewunwa. B.I.O.
O'Brien, Conor Cruise. C.C.O'B.
O'Brien, Gerald D. G.D.O'B.
O'Callaghan, Joseph F. J.F.O'C.
Occhialino, Mario E. Ma.E.O.
O'Connell, Daniel Patrick. D.P.O'C.
O'Connor, Rev. Daniel William. D.W.O'C.
O'Connor, Francis Valentine. F.V.O'C.
Oda, Takeo. T.O.
Oddone, Juan A. J.A.O.
Odlozilik, Otakar. O.O.
Odum, Eugene P. E.P.O.
Ogden, Horace Russell. H.R.O.
Ogilvie, Robert Maxwell. R.M.Og.
Ogorkiewicz, Richard Marian. R.M.O.
O'Gorman, James Francis. J.F.O'G.
O'Grady, Brendan Anthony. B.O'G.
O'Keefe, John A. J.A.O'K.
O'Kelly, Bernard. B.O'K.
Olah, George A. G.A.O.
Oldenbourg-Idalie, Zoé. Z.O.
Oldroyd, Harold. H.O.
Oliveira, Waldir Freitas. W.F.O.
Oliver, Jack E. J.E.O.
Oliver, William Hosking. W.H.O.
Olivier, Daria. D.Ol.
Ollier, Clifford David. C.D.O.
Olson, Edwin A. E.A.O.
Olson, Everett C. E.C.O.
Olson, Harry F. H.F.O.
Olson, Jerry S. J.S.O.
Olson, Maynard V. M.V.O.
Olver, Ron. R.O.
Oman, Carola (Lady Lenanton). C.O.
Omar, Farouk. F.Om.
Ominde, Simeon Hongo. S.H.O.
Ommanney, Francis D. F.D.O.
O'Neill, Denis. D.O'N.
Ooi Jin Bee. O.J.B.
Opie, Iona. I.O.
Opie, Peter. P.O.
Oppenheimer, Jane M. J.M.O.
O'Raifeartaigh, Tarlach. T.O'R.
Orcibal, Jean. J.Or.
Ordish, George. G.O.
Ore, Oystein. O.Or.
Ornati, Oscar A. O.A.O.
Orne, Martin T. M.T.O.
Ortner, Sherry B. S.B.O.
Orville, Richard Edmonds. R.E.Or.
Osborn, Frederick Henry. F.H.O.
Osborn, Ronald E. R.E.O.
Osborne, John W. J.W.O.
Osborne, Keith Langford. K.L.O.
Osborne, Milton Edgeworth. M.E.O.
Osborne, Richard Horsley. R.H.O.
Osler, Margaret J. M.J.O.
Ostenso, Grace L. G.L.O.
Ostenso, Ned Allen. N.A.O.
Oteiza, David. D.O.
O'Toole, Thomas E. T.E.O'T.
Otto, Christian F. C.F.O.
Otto, Eberhard. E.O.
Outler, Albert Cook. A.C.O.
Overbeek, Jan Theodoor Gerard. J.T.G.O.
Overmire, Thomas G. T.G.O.
Overton, Leonard C. L.C.O.
Owen, Peter D. P.D.O.
Owen, Tobias Chant. T.C.O.
Owen, Wilfred. W.O.
Owens, Rev. Joseph. J.O.
Oxtoby, Willard Gurdon. W.G.O.

Pacaut, Marcel. M.Pa.
Padelford, Norman J. N.J.P.
Padoa Schioppa, Antonio. A.P.S.
Paesler, Reinhard E. R.E.Pa.
Page, Thornton Leigh. T.L.P.
Pagel, Bernard E.J. B.E.J.P.
Pai, Raghawendra Mukund. R.M.P.
Paine, Frank A. F.A.P.
Paine, Robert P.B. R.P.B.P.
Painter, George Duncan. G.D.P.
Pal, Indra. I.P.
Pallucchini, Rodolfo. R.Pal.
Palmedo, Roland. Ro.Po.
Palmer, Allison R. A.R.P.
Pálsson, Hermann. He.P.
Pandey, S. S.Pa.
Pannain, Guido. G.Pan.
Paoletti, John T. J.T.Pa.
Papadakis, Juan. J.Pa.
Papike, J.J. J.J.Pa.
Papp, A. A.P.
Paproth, Eva. E.P.
Parczewski, Władysław. W.Pa.
Parienté, Robert. Ro.P.
Park, George Kerlin. G.K.P.
Parke, Herbert William. H.W.P.
Parker, Alexander A. A.A.P.
Parker, Franklin D. F.D.P.
Parker, Ralph Halstead. R.H.Pa.
Parker, Rev. Thomas Maynard. T.M.P.
Parkes, Kenneth C. K.C.P.
Parkin, Charles William. C.W.Pa.
Parkinson, Robert Lewis. R.L.P.
Parr, Peter J. P.J.Pa.
Parrot, André. A.Pa.
Parry, John W. J.W.P.
Parry, V.J. V.J.P.
Parsons, James Bayard. J.B.Pa.
Pascal, Roy. Ro.Pa.
Pashuto, Vladimir T. V.T.P.
Passavant, Günter. G.Pa.
Passmore, Reginald. R.Pa.
Pastor, José M.F. J.M.F.P.
Pathak, Devavrat Nanubhai. D.N.P.
Patrick, Hugh T. H.T.P.
Patterson, Colin. C.P.
Patterson, Thomas C. T.C.P.
Patze, Hans. H.Pa.
Patzig, Günther. Gü.P.
Pauck, Wilhelm. W.P.
Paul, George M. G.M.P.
Pauling, Linus C. L.C.P.
Pavelić, Ante S. A.S.Pa.
Pawley, Andrew K. A.K.Pa.
Pawson, David Leo. D.L.P.
Payanzo, Ntsomo. N.Pa.
Payne, Stanley G. S.G.P.
Pearcy, G. Etzel. G.E.P.
Pearson, Charles G. C.G.P.
Pearson, H.F. H.F.P.
Pécsi, Márton. Má.P.
Pedanou, Macaire K. M.K.P.
Peel, Edwin A. E.A.P.
Peel, Ronald Francis. R.F.Pe.
Peiser, H. Steffen. H.S.P.
Pelczar, Michael J., Jr. M.J.P.
Pelikan, Jaroslav Jan. J.J.Pe.
Pélissier, René. R.P.
Pélissier, Roger. Ro.Pe.
Pellat, Charles L.P. C.L.P.P.
Pelletier, Michel B. M.B.P.
Pen, Jan. J.P.
Penčev, Peter Georgiev. P.G.P.
Pendle, George. G.Pe.
Penner, Hans H. Ha.P.
Pennington, D.H. D.H.P.
Pennington, Robert R. R.R.P.
Pepper, Stephen C. S.C.P.
Perelman, Chaim. C.Pe.
Perham, Dame Margery. M.Pm.
Perkins, Edward S. E.S.P.
Pernoud, Régine. R.Pe.
Perowne, Stewart Henry. S.H.P.
Perrin, Norman. N.P.
Perry, Harry. H.Pe.
Peruta, Franco della. F.d.Pe.
Pessen, Edward. E.Pe.
Pestman, P.W. P.W.P.
Peterdi, Gabor F. G.F.P.
Peters, James A. J.A.P.
Peterson, James T. J.T.P.
Petit, Paul. P.P.
Petrov, Mikhail Platonovich. M.P.Pe.
Pettitt, George A. G.A.P.
Péwé, Troy L. T.L.Pe.
Peyre, Henri M. H.M.P.
Pfaffmann, Carl. C.Pf.
Pfann, William G. W.G.P.
Phelps Brown, Ernest Henry. E.H.P.B.
Phillips, Charles Franklin, Jr. C.F.P.
Phillips, Courtenay Stanley Goss. G.S.G.P.
Phillips, Joseph D. J.D.P.
Phillips, Melba. M.Ph.
Piazza, Walter Fernando. W.F.P.
Pichon, Jean-Charles. J.-C.P.
Pick, Robert. R.Pi.
Pickering, Sir George (White). G.Pi.
Pickersgill, John Whitney. Jo.W.P.
Pickles, Dorothy M. D.M.P.
Pieper, Josef. Jf.Pi.
Pierce, A. Keith. A.K.P.
Pierce, Francis S. F.S.P.
Pierce, John R. J.R.P.
Piercey, W. Douglas. W.D.P.
Piercy, Josephine Ketcham. J.K.P.
Pilikian, Hovhanness Israel. Ho.I.P.
Pillai, V.R. V.R.P.
Pincus, Alexis G. A.G.P.
Pincus, John. J.Pi.
Pinder-Wilson, Ralph H. R.H.P.-W.
Pine, Leslie Gilbert. L.G.P.
Pines, Shlomo. S.Pi.
Pingree, David E. D.E.P.
Pipes, Richard E. R.E.Pi.
Pirsig, Maynard E. M.E.P.
Pittioni, Richard. Ri.P.
Piveteau, Jean. J.Piv.
Plamenatz, John P. J.P.Pl.
Platnauer, Maurice. M.Pl.
Playfair, Giles William. G.W.P.
Pleasants, Henry. H.Pl.
Pluckhahn, J. Bruce. J.B.P.
Plum, Fred. F.P.
Plumb, J.H. J.H.P.
Pocock, Tom. T.Po.
Podhajsky, Alois Wilhelm. A.W.P.
Podlecki, Anthony J. A.J.P.
Poelhekke, Jan J. J.J.P.
Pogue, Forrest C. F.C.P.
Pohl, Frederik. F.Po.
Pohl, Richard W. R.W.P.
Pokhshishevsky, Vladimir V. V.V.P.
Polk, William Roe. W.R.P.
Pollack, Peter J. P.J.P.
Pollard, John Richard Thornhill. J.R.T.P.
Polmar, Norman C. N.C.P.
Polunin, Nicholas. N.Po.
Pomeau, René Henry. R.H.Po.
Pontecorvo, Guido. G.Po.
Pontieri, Ernesto. E.Po.
Poole, Gary William. Ga.P.
Poole, Gray Johnson. G.J.P.
Poole, Kenyon Edwards. K.E.P.
Poonawala, Ismail K. I.K.P.
Pope, Clifford Hillhouse. C.H.P.
Pope-Hennessy, Sir John Wyndham. J.W.P.-H.
Popkin, Richard H. R.H.P.
Popov, Igor Vladimirovich. I.V.P.
Poppino, Rollie E. R.E.P.
Porter, William V. W.V.P.
Posner, Rebecca. Re.P.
Potter, George Richard. G.R.P.
Potter, Simeon. S.P.
Potthoff, Heinrich. H.P.
Pottier, Jean D. J.D.Po.
Pottle, Frederick A(lbert). F.A.Po.
Pounder, Cuthbert Coulson. C.C.P.
Pournaras, Dimitris. D.P.
Powell, James M(atthew). J.M.Po.
Powell, Raphael. R.Po.
Powers, Philip N. P.N.P.
Pozo Vélez, Homero. H.P.V.
Pradhan, Keshab C. K.C.Pr.

Prakasa Rao, Vaddiparti Lova Surya. V.L.S.P.R.
Prausnitz, John M. J.M.P.
Preece, Warren E. W.E.P.
Preidel, Helmut. H.Pr.
Prescott, J.R.V. J.R.V.P.
Pressat, Roland F. R.F.P.
Preuschen, Gerhardt. G.P.
Prevost, Jean. J.Pr.
Price, Arnold H. A.H.P.
Price, Cecil John Layton. C.J.L.P.
Priestley, Charles Henry Brian. C.H.B.P.
Prieto, Justo Pastor. J.P.P.
Pringle, John Douglas. J.D.Pr.
Proskouriakoff, Tatiana. T.P.
Proud, Lieut. Col. Richard Riseley. R.R.Pr.
Proudlove, James Alan. J.Pro.
Prout, W.G. W.G.Pr.
Prown, Jules David. J.D.Pro.
Pruchnicki, Jerzy. Je.P.
Prudhoe, John Edgar. Jo.P.
Puech, Henri-Charles. H.-C.P.
Puhvel, Jaan. J.Pl.
Pulgar-Vidal, Javier. J.P.-V.
Pulleyblank, Edwin G. E.G.P.
Purdy, Ken W. K.W.P.
Purdy, Rev. William Arthur. W.A.P.
Puri, Baij Nath. B.N.P.
Purrington, Philip F. P.F.P.
Pursell, Carroll W. C.W.Pu.
Pye, E. Michael. M.Py.

Quimby, Robert S. R.S.Q.
Quinn, John Francis. J.F.Q.
Quintana, Ricardo. R.Q.
Quinton, Anthony M. A.M.Q.
Quittmeyer, Charles Loreaux. C.L.Q.

Rabie, Hassanein Muhammad. H.Ra.
Rabin, Chaim. Ch.R.
Rabinowicz, Ernest. E.R.
Rae, John Bell. J.B.Ra.
Raeff, Marc. M.Ra.
Raghavan, Chakravarthi. C.Ra.
Rahman, Fazlur. F.R.
Rahnema, Zain ol-Abedin. Z.R.
Rāhula, Walpola. Wa.R.
Ralphs, Sheila. S.Ra.
Ralston, Robert H. R.H.Ra.
Ramanujan, A.K. A.K.R.
Ramberg, Hans. Ha.R.
Ramsay, James Arthur. J.A.R.
Ramsey, Rt. Rev. Ian Thomas. I.T.R.
Rand, Austin L. Au.L.R.
Rankin, Bayard. B.R.
Ransom, Harry Howe. H.H.R.
Rantsman, Yelizaveta Yakovlevna. Y.Y.R.
Rao, R.V.R. Chandrasekhara. R.V.R.C.R.
Raphael, D.D. D.D.R.
Rashid, Sh. Abdur. S.A.R.
Rasmussen, John O., Jr. J.O.R.
Rasmussen, Wayne D. W.D.R.
Ravenhill, William. W.Ra.
Ravetz, Jerome R. J.R.R.
Rawlinson, John Lang. J.L.Ra.
Rawson, Philip S. P.S.R.
Rea, Donald G. D.G.R.
Rea, Kenneth John. K.J.R.
Read, Allen Walker. A.W.Re.
Read, Donald. D.Re.
Rechnitzer, Andreas B. A.B.R.
Reddick, DeWitt C. DeW.C.R.
Redl, Helen B. H.B.R.
Reed, Alan. A.Re.
Reese, William L. W.L.Re.
Reeves, Marjorie E. M.E.R.
Reeves, Thomas C. T.C.R.
Reich, Willi. W.R.
Reichardt, Hans. H.Re.
Reid, John Cowie. J.C.Rd.
Reilly, John C., Jr. J.C.Re.
Reindel, Kurt. Ku.R.
Reinhard, Marcel. M.Re.
Reish, Donald J. D.J.R.
Reiss, Hans Siegbert. H.S.R.
Reiter, Elmar Rudolf. E.R.R.
Renger, Johannes M. J.M.R.
Rentz, George S. G.Re.
Rescher, Nicholas. N.R.
Resis, Albert. Al.Re.
Rexroth, Kenneth. K.Re.
Reynolds, Charles Edward. C.E.R.
Reynolds, Frank E. F.E.R.
Reynolds, Graham. G.R.
Rheinstein, Max Y. M.Y.R.
Rhoads, Edward J.M. E.J.M.R.
Rhode, Gotthold K.S. G.K.S.R.
Riasanovsky, Nicholas V. N.V.R.
Rich, Alan. A.Ri.
Rich, Theodore F. T.F.R.
Richard, Jean B. J.B.R.
Richards, Alan Westcott. A.W.R.
Richards, Paul Westmacott. P.W.R.
Richardson, Hugh E. H.E.R.
Richardson, Margaret Ann. M.A.R.
Richardson, Robert G. R.G.R.
Riché, Pierre. P.R.
Richmond, Rollin C. Ro.R.
Richter, Charles F. C.F.R.
Richter, Maurice N. M.N.R.
Ridolfi, Roberto. Ro.Ri.
Riesenfeld, Stefan Albrecht. S.A.Ri.
Riley, Matilda White. M.W.R.
Ring, Klaus. K.R.
Ring, Richard R. R.R.R.
Ringer, Alexander L. A.L.R.
Ringer, Barbara A. B.A.R.
Ringgren, Helmer. H.R.
Ringler, William Andrew, Jr. W.A.Ri.
Ringwood, Alfred Edward. A.E.R.
Ripin, Edwin M. E.M.R.
Ritchie, C.T. C.T.R.
Ritter, Raymond. R.Ri.
Ritterbush, Philip C. P.C.R.
Riva, Alfredo. Al.R.
Rivlin, Helen Anne B. H.A.B.R.
Rizley, John H. J.H.R.
Roach, Jack L. J.R.
Roach, Janet K. J.K.R.
Robb, Nesca A. N.A.R.
Robbins, Jonathan H. J.H.Ro.
Robbins, Sidney Martin. S.M.R.
Robbins, Stanley L. S.L.R.
Roberts, Michael. M.Ro.
Roberts, Sir Sydney (Castle). S.Rs.
Robertson, Bruce Carlisle. B.C.R.
Robertson, H. Rocke. H.R.R.
Robertson, William H.P. W.H.P.R.
Robineau, Claude. C.R.
Robins, Robert Henry. Ro.H.R.
Robinson, Arthur Napoleon Raymond. A.N.R.R.
Robinson, Daniel Sommer. D.S.R.
Robinson, Edgar Eugene. E.E.R.
Robinson, Elwyn B. E.B.R.
Robinson, Frank Neville H. F.N.H.R.
Robinson, George Clarence. G.C.R.
Robinson, Gloria. G.Ro.
Robinson, J. Lewis. J.L.Ro.
Robinson, Joan Violet. J.Ro.
Robinson, John Talbot. J.T.R.
Robinson, Romney. R.R.
Robson, Charles Alan. C.A.Rn.
Robson, James Scott. J.S.Ro.
Robson, William Alexander. W.A.R.
Robson, William Wallace. W.W.R.
Roche, Jerome Laurence Alexander. J.L.A.R.
Rockwell, Anne F. A.F.R.
Rödevand, Öivind. Öi.R.
Rodgers, Harry Brian. H.B.Ro.
Rodnan, Gerald P. G.P.R.
Rodolfo, Kelvin S. K.S.R.
Rodriguez-Monegal, Emir. E.R.-M.
Roe, (Owen) Michael. Ml.R.
Roey, Jan L.R. Van. J.V.R.
Rogers, C. Ambrose. C.A.Ro.
Rogers, Jack D. J.D.Ro.
Rogers, Leonard R. L.R.R.
Rogg, Lionel A. L.A.R.
Rogge, Helmuth. He.R.
Rohan-Csermak, G. de. G. de R.-C.
Rohde, Peter P. P.P.R.
Rollins, Reed C. R.C.R.
Rolt, L.T.C. L.T.C.R.
Romas, Nicholas A. N.A.Ro.
Romer, Alfred S. A.S.R.
Romero, Emilio. Em.R.
Ronan, Colin Alistair. C.A.R.
Rood, Arnold. A.Ro.
Roos, Hans. Ha.Ro.
Roosa, Robert Vincent. R.V.R.
Rose, Leo E. L.E.R.
Rosemont, Henry, Jr. He.Ro.
Rosen, Edward. Ed.R.
Rosenberg, Pierre M. P.M.R.
Rosenfeld, Arthur H. A.H.Ro.
Rosenthal, Erwin I.J. E.I.J.R.
Roseveare, Henry Godfrey. H.G.R.
Roskies, Ralph Zvi. R.Ro.
Roskill, Capt. Stephen Wentworth. S.W.R.
Ross, Angus. A.Rs.
Ross, C.D. C.D.R.
Ross, Elisabeth Kübler-. E.K.-R.
Ross, Marvin Chauncey. M.C.R.
Ross, Peter McGregor. P.McG.R.
Ross, Richard D. R.D.R.
Ross, Sydney. S.R.
Rossbacher, Richard I. R.I.Ro.
Rossi, Mario. M.R.
Rostovtsev, Mikhail Ivanovich. M.I.R.
Rothschild, Miriam Louisa. M.L.R.
Rouch, Jean Pierre. J.P.R.
Rouzé, Michel. Mi.Ro.
Rowe, James Wilmot. J.W.R.
Rowe, John A. Jo.R.
Rowe, Margaret Ann. M.A.Ro.
Rowen, Herbert H. H.Ro.
Rowlatt, Mary. Ma.R.
Rowlinson, John Shipley. Jo.S.R.
Rowton, Michael B. M.B.R.
Roy, B.B. B.B.R.
Royde-Smith, John Graham. J.R.-S.
Roys, Henry E. H.E.Ro.
Rubinstein, Nicolai. N.Ru.
Ruckgaber, Erich. Er.R.
Rudwick, Elliott. El.R.
Ruggles, Eleanor. E.Ru.
Ruhen, Olaf. O.R.
Ruhmer, Eberhard. Eb.R.
Ruiter, Leendert de. L. de R.
Rumney, George Richard. G.R.R.
Rupp, Rev. Ernest Gordon. E.G.R.
Ruppert, Karl. K.Ru.
Rushbrook-Williams, Laurence Frederic. L.F.R.-W.
Russell, Charles R. C.R.R.
Russell, Don. D.R.
Russell, Norman H. N.H.R.
Russell, Peter Edward. P.E.R.
Russell, Richard J. R.J.R.
Russon, Allien R. A.R.R.
Ryalls, Alan. A.R.
Ryan, Rev. Edward A. E.A.R.
Ryan, William B.F. W.B.F.R.
Ryazantsev, Sergey Nikolayevich. S.N.R.
Ryder, John D. J.D.R.
Rylaarsdam, J. Coert. J.C.Ry.
Ryland, John S. J.S.R.

Sabr, Mohy el Din. M.e.D.S.
Sacher, George A. G.A.Sa.
Sadek, Dawlat Ahmed. D.A.Sa.
Sadler, John E. J.E.Sa.
Sáez, Emilio. E.Sa.
Sagan, Carl (Edward). C.Sn.
Saggs, Henry W.F. H.W.F.S.
Sahakian, William S. W.S.S.
St. John, Robert. R.St.J.
Sakamoto, Taro. T.Sa.
Salah, Mostafa Moh. M.M.Sa.
Sale, William Merritt, Jr. W.M.S.
Salibi, Kamal Suleiman. K.S.S.
Salisbury, Sir Edward James. E.J.S.
Salisbury, Neil E. N.E.S.
Salita, Domingo C. D.C.S.
Salmi, Mario. M.Sal.
Salmon, Edward Togo. E.T.S.
Sammons, Jeffrey L. J.L.Sa.
Samuel, Alan Edouard. A.E.S.
Samuel, Pierre. P.S.

Sandeen, Ernest R. E.R.S.
Sandelin, Carl Fredrik. C.F.S.
Sander, Emilie T. E.T.Sa.
Sanders, William T. W.T.Sa.
Sanderson, R. Thomas. R.T.S.
Sandvik, Gudmund. G.Sa.
Saner, Hans. Ha.S.
Sanford, Vera. V.S.
Sanger, Clyde William. C.W.S.
Sanger, Jonathan. J.Sa.
Sanger, Ralph G. R.G.S.
Sanlaville, Paul Jean. P.Sa.
Sarà, Michele. M.Sà.
Sarason, Irwin G. I.G.S.
Sarna, Nahum M. N.M.Sa.
Sartori, Claudio. C.Sa.
Sasaki, Genjun H. G.H.S.
Sastri, R.L.N. R.L.N.S.
Sato, Tadao. T.S.
Satter, Heinrich. H.Sa.
Saunders, Bernard G. B.G.Sa.
Saunders, Jason Lewis. Ja.L.S.
Saunders, Robert M. R.M.S.
Sautter, Gilles François. G.F.S.
Savage, George. Ge.S.
Savile, Douglas B.O. D.B.O.S.
Saville, James Patrick. J.P.S.
Savory, Roger M. R.M.Sa.
Sawer, Geoffrey. G.S.
Sawyer, John Stanley. J.S.S.
Sayenga, Donald. D.S.
Scanlon, David G. D.G.S.
Scarfe, Francis. F.Se.
Scarne, John. J.S.
Schaaf, William L. W.L.S.
Schaden, Egon. Eg.S.
Schaeffer, Bobb. B.Sc.
Schaeffer, Claude Frédéric Armand. C.F.A.S.
Schafer, Thomas A. T.A.S.
Schaper, Eva. Ev.S.
Schapiro, Leonard Bertram. L.B.S.
Scharf, Aaron. A.Sc.
Scharlemann, Robert P. R.P.S.
Schattenhofer, Michael. Mi.Sc.
Schatz-Uffenheimer, Rivka. R.S.-U.
Schawlow, Arthur L. Ar.L.S.
Schechtman, Joseph B. J.B.Sc.
Scheepers, Johannes Nicolaas. J.N.S.
Scheer, Bradley Titus. B.T.S.
Scheina, Robert L. R.L.Sc.
Schell, Herbert S. H.S.Sc.
Schiffers, Heinrich. H.Sc.
Schilling, Richard S.F. R.S.F.S.
Schimmel, Annemarie. An.Sc.
Schirmann, Jefim H. J.Sc.
Schirokauer, Conrad M. C.M.S.
Schlechten, Albert Wilbur. A.W.S.
Schmale, Franz-Josef. F.-J.Se.
Schmidt, Carl Frederic. C.F.Sc.
Schmidt, John D. J.D.Sc.
Schmidt, Karl Patterson. K.P.S.
Schmidt, R.A.M. R.Sc.
Schmitt, Waldo L. W.L.Sc.
Schmundt, Maria. M.Sc.
Schofield, Vice Adm. Brian Betham. B.B.S.
Scholes, Walter V. W.V.S.
Schram, Stuart Reynolds. S.R.S.
Schreiber, B. Charlotte. B.C.S.
Schreyvogl, Friedrich. F.Sc.
Schubert, Bernice Giduz. B.G.S.
Schudson, Michael S. Mi.S.
Schultz, Alarich R. A.R.S.
Schulz, Walter. W.Sc.
Schumach, Murray. Mu.S.
Schumacher, Alvin J. A.J.Sc.
Schumm, Stanley A. S.A.S.
Schürmann, Reiner. R.Sch.
Schwanke, Robert R. R.R.Sc.
Schwartz, Jacob T. J.T.Sc.
Schwartz, Mischa. M.Sch.
Schwartz, Paul A. P.A.S.
Schwarzenberger, Georg. G.Sc.
Schwelb, Egon. E.S.
Scott, Alfred Eric. A.E.Sc.
Scott, Rev. Guthrie Michael. G.M.S.
Scott, James Henderson. J.H.S.
Scott, Joseph Frederick. J.F.S.
Scott, Peter. P.Sc.
Scranton, Robert L. R.L.S.
Screech, M.A. M.A.S.
Scullard, Howard Hayes. H.H.S.
Seaborg, Glenn T. G.T.S.
Seabury, Paul. P.Se.
Seale, Robert L. R.L.Se.
Sealey, B. Raphael. B.R.S.
Searle, Humphrey. H.Se.
Sedov, L.I. L.I.S.
Seeman, Melvin. M.S.
Šega, Drago. D.Še.
Seibert, Jakob. J.Se.
Seidel, Anna K. A.K.Se.
Seitz, William C. W.C.Se.
Selz, Jean. Je.S.
Selzer, Arthur. Ar.S.
Sen, Amulya Chandra. A.Se.
Sen, D.M. D.M.S.
Sena, Jorge de. J. de S.
Sendut, Hamzah. Ha.Se.
Sepúlveda González, Sergio. S.S.G.
Sequera de Segnini, Isbelia M. I.S. de S.
Serjeant, Robert Bertram. R.B.Se.
Seroff, Victor Ilyich. V.I.S.
Serventy, D.L. D.L.Se.
Service, Elman R. E.R.Se.
Sesay, Shekou M. S.M.S.
Seton-Watson, Hugh. H.S.-W.
Severin, Giles Timothy. G.T.Se.
Sewall, Richard B. R.B.S.
Seymour, Charles. C.Se.
Seznec, Jean J. J.J.Se.
Shackleton, Robert. R.Sh.
Shadbolt, Maurice Francis Richard. M.F.R.S.
Shaffer, Jerome A. J.A.Sh.
Shagdarsuren, O. O.Sh.
Shah, Umakant Premanand. U.P.S.
Shakabpa, Tsepon W.D. T.W.D.S.
Shambaugh, George E., Jr. G.E.S.
Sharaf, Abd el Aziz Torayah. A. el A.T.S.
Sharlin, Harold I. H.I.S.
Sharp, Aaron J. A.J.Sh.
Sharp, Rev. R. Norman. R.N.S.
Sharp, Robert Phillip. R.P.Sp.
Sharp, Walter R. W.R.S.
Sharrock, Roger. R.S.
Shata, Abdou Aly. Ab.A.S.
Shaw, Ivan Peter. I.P.S.
Shaw, Stanford Jay. S.J.S.
Shaw, Trevor Ian. T.I.S.
Sheard, Wendy Stedman. W.S.Sh.
Shearman, John K.G. J.K.Sh.
Shedd, Thomas Clark. T.C.S.
Shelton, John E. J.E.S.
Shennan, J.H. J.H.Sh.
Shepard, Francis P. F.P.S.
Shepherd, Rev. Massey H., Jr. M.H.S.
Sheppard, Richard A. R.A.S.
Shepperson, George Albert. G.A.S.
Shercliff, Jose. J.Sh.
Sheridan, Lionel Astor. L.A.S.
Sherlock, Sheila. S.S.
Sherman, Franklin. F.S.
Sherrington, Sir Charles Scott. C.S.S.
Sherwin-White, Adrian N. A.Sh.-W.
Shetler, Stanwyn G(erald). S.G.S.
Shiel, James. J.Shi.
Shih, Rev. Joseph Hsing-san. J.H.-s.S.
Shillinglaw, Gordon. G.Sh.
Shiloah, Amnon. A.Sh.
Shiloh, Ailon. An.S.
Shimahara, Nobuo. N.S.
Shinoda, Minoru. M.Sh.
Shipley, Joseph T. J.T.S.
Shipman, Frank M. F.M.S.
Shirendev, B. B.Sv.
Shirley-Smith, Sir Hubert. H.S.-Sm.
Shnitnikov, Arseny Vladimirovich. A.V.S.
Shock, Nathan Wetherill. N.W.S.
Shore, Arthur Frank. A.F.Sh.
Short, Rev. Harry Lismer. H.L.S.
Short, Lester L. L.L.S.
Short, Nicholas M. N.M.S.
Shpaykher, Alfred Osipovich. A.O.S.
Shurtleff, Malcolm C. M.C.S.
Sibley, David C.G. D.C.G.S.
Sick, Helmut. H.S.
Siebens, Arthur A. A.A.S.
Sieber, Roy. Ro.Si.
Siever, Raymond. R.Si.
Siker, Ephraim S. E.S.S.
Silaev, Evgeny Dmitrievich. E.D.S.
Silber, Kate. K.Si.
Silberbauer, George Bertrand. G.Si.
Silberman, Lou Hackett. L.H.S.
Silverstein, Josef. J.Si.
Simmons, Ernest J. E.J.Si.
Simmons, Pauline. Pa.S.
Simon, Akiba Ernst. A.E.Si.
Simon, Edith. E.Si.
Simon, John Y. J.Y.S.
Simons, Eric Norman. E.N.S.
Simpson, Dale R. D.R.S.
Simpson, John M. J.M.S.
Simpson, Roger Henry. R.H.S.
Sims, Reginald W. R.W.S.
Sinclair, Andrew Annandale. A.A.Si.
Singer, Isaac Bashevis. I.B.S.
Singh, H.K. Manmohan. H.K.M.S.
Singh, Khushwant. K.S.
Singh, Madan Mohan. M.M.S.
Singleton, Frederick Bernard. F.B.S.
Sinha, N.K. N.K.S.
Sinitsyn, Vasily Mikhaylovich. V.M.S.
Sinor, Denis. D.Si.
Sippl, Charles J. C.J.S.
Siragusa, Alfredo. A.Si.
Sivaramamurti, Calambur. C.S.
Skalweit, Stephan. S.Sk.
Sklar, Robert A. R.Sk.
Slack, Keith Vollmer. K.V.S.
Slavin, Vladimir Ilich. V.I.Sl.
Sloane, Thomas O. T.O.S.
Slobin, Mark S. M.S.S.
Sløk, Axel Mose. A.M.Sl.
Slonimsky, Nicolas. N.Sl.
Sloss, L.L. L.L.Sl.
Smailes, Arthur Eltringham. A.E.Sm.
Smale, Stephen. S.Sm.
Smart, John Jamieson Carswell. J.J.C.S.
Smart, Ninian. N.Sm.
Smith, Anna Hester. A.H.S.
Smith, Bruce Lannes. B.L.S.
Smith, Charles Gordon. C.G.S.
Smith, Dale M. D.M.Sm.
Smith, David Eugene. D.E.S.
Smith, Donald Arnold. D.A.S.
Smith, George Alan. G.A.Sm.
Smith, Harlan James. H.Sm.
Smith, Jack. J.Sm.
Smith, J(enkyn) Beverley. J.B.Sm.
Smith, John Edwin. J.E.Sm.
Smith, Jonathan Zittell. J.Z.S.
Smith, Joseph V. J.V.S.
Smith, Lacey Baldwin. La.B.S.
Smith, L.P. L.P.S.
Smith, Lyman B. L.B.Sm.
Smith, Neal Griffith. N.G.S.
Smith, Norman Obed. N.O.S.
Smith, Peter A.S. P.A.S.S.
Smith, Ralph J. R.J.Sm.
Smith, Robert C. R.C.Sm.
Smith, Robert Leo. R.L.Sm.
Smith, Sigmund L. S.L.Sm.
Smith, T(homas) Lynn. T.L.S.
Smith, W. John. W.J.S.
Smith-Rose, Reginald Leslie. R.L.S.-R.
Smogorzewski, Kazimierz Maciej. K.M.S.
Smykay, Edward W. E.W.S.
Smylie, Rev. James Hutchinson. J.H.Sm.
Smyth, James Desmond. J.D.Sm.
Sneddon, Ian Naismith. I.N.S.
Snell, Esmond E. E.E.Sn.
Snellgrove, David Llewelyn. D.L.S.
Snyder, James E. J.E.Sn.
Snyder, Solomon Halbert. S.H.S.
Soboul, Albert M. Al.S.
Soden, Wolfram Th. von. W.T.v.S.
Sokoloff, Leon. L.S.
Sokolov, Aleksey Aleksandrovich. A.A.So.
Solem, G. Alan. G.A.So.

Solinger, Jacob. J.So.
Solmi, Angelo. A.So.
Solmsen, Friedrich. F.So.
Solomon, Arthur K. A.K.S.
Solt, Leo F. L.F.S.
Somers, Harold M. H.M.S.
Soo, Shao L. S.L.S.
Sorley Walker, Kathrine. K.S.W.
Sourdel, Dominique. D.So.
Soustelle, Jacques. Ja.S.
Southall, Aidan William. Ai.S.
Southam, Brian C. B.C.So.
Southgate, Donald. Do.S.
Southward, Alan James. A.J.So.
Sowers, Robert W. R.So.
Spalding, David A.E. D.A.E.S.
Spalding, Fred L. F.L.S.
Spalding, James C. J.C.S.
Speaight, George. G.St.
Spear, T.G. Percival. T.G.P.S.
Spears, Monroe K. M.K.Sp.
Spector, Walter Graham. W.G.S.
Spector, William. W.Sp.
Spedding, Frank Harold. F.H.S.
Spence, Robert. R.Sp.
Spencer, J. Brookes. J.B.Sp.
Spencer, John R. J.R.Sp.
Spencer, Joseph E. Jo.E.S.
Spencer, Robert F. R.F.S.
Spencer, Rev. Sidney. S.Sp.
Spencer, Terence John Bew. T.Sp.
Spengler, Joseph J. J.J.Sp.
Spicer, Edward H. E.H.S.
Spiegel, Henry William. H.W.S.
Spiegelberg, Herbert. H.Sp.
Spilhaus, Athelstan. A.Sp.
Spinka, Matthew. M.Sp.
Spiro, Herbert John. H.J.Sp.
Sprenkel, Sybille van der. S.v.d.S.
Spring, David. D.Sp.
Spurling, Maj. Gen. John M.K. J.M.K.S.
Squires, James Duane. J.D.S.
Srivastava, A.L. A.L.S.
Stacey, Rev. John. Jo.S.
Stafford-Clark, David. D.S.-C.
Stains, Howard James. H.J.S.
Stallman, Robert Wooster. Ro.W.S.
Stamp, Sir Laurence Dudley. L.D.S.
Štampar, Emil. Em.Š.
Standen, Anthony. A.St.
Stankiewicz, W.J. W.J.St.
Stannard, Jerry. Je.St.
Stannard, Lewis Judson, Jr. L.J.S.
Stant, Margaret Yvonne. M.Y.S.
Stark, John E. J.E.St.
Starke, Helmut Dietmar. H.D.S.
Starkey, Lawrence H. L.H.St.
Starkie, Enid. En.S.
Starr, Chester G. C.G.St.
State, Oscar. O.S.
Stearn, William T. W.T.S.
Steel, Robert Walter. Ro.W.St.
Steere, William Campbell. W.C.St.
Stehkämper, Hugo. H.Sr.
Stein, Jane J. J.J.St.
Stein, Peter G. P.G.S.
Stein, Wayne A. W.St.
Steinberg, Alfred. A.Sg.
Steinberg, S. Henry. S.H.St.
Steiner, H. Arthur. H.A.S.
Steiner, William Glenn. W.G.St.
Stellar, Eliot. El.S.
Stendahl, Krister. K.St.
Stengel, Erwin. E.St.
Stephan, Ruth. Ru.S.
Stephens, Richard Walton. Ri.W.S.
Stephens, Wilson. Wi.S.
Stephenson, Ralph. R.St.
Stern, Henri. He.S.
Stern, Joshua. J.Sn.
Stern, William Louis. W.L.St.
Sternstein, Lawrence. La.S.
Steudel, Johannes. J.Ste.
Stevens, Denis William. D.W.S.
Stevens, Halsey. H.Ss.
Stevens, Sylvester K. S.K.S.
Stevenson, James. J.St.
Stevenson, Lloyd Grenfell. L.G.S.
Stewart, David B. D.B.S.
Stewart, John Harris. J.H.St.
Stewart, John I.M. J.I.M.S.
Stewart, Robert E. R.E.S.
Stewart, W. Earl. W.E.St.
Stibitz, George R. G.R.St.
Stigler, George J. G.J.S.
Stilwell, Rear Adm. James Joseph. Ja.J.S.
Stock, Noel. N.St.
Stokes, Sewell. S.St.
Stoll, Robert R. R.R.S.
Stoller, Robert J. R.J.S.
Stone, F. Gordon A. F.G.A.S.
Stone, Julius. Ju.S.
Stoner, John Oliver, Jr. J.O.S.
Storer, Robert W. R.W.St.
Størmer, Leif. L.St.
Stotz, Elmer H. E.H.St.
Stoudt, John J. J.J.S.
Strahan, Ronald. Ro.S.
Strakosch, George R. G.R.S.
Strand, Kaj Aa. K.A.S.
Strange, Edward Fairbrother. E.F.S.
Strasberg, Lee. Le.S.
Stratford, Alan Howard. A.H.St.
Street, Brian Vincent. B.V.S.
Streeter, Victor L. V.L.S.
Streng, Frederick J. F.J.S.
Strickmann, Michel. M.St.
Strode, Hudson. Hu.S.
Strugnell, John. Jo.St.
Struik, Dirk Jan. D.J.S.
Strygin, Valery Mikhailovich. V.M.St.
Stubbs, William Edward. W.E.S.
Sturley, Kenneth Reginald. K.R.S.
Sturmberger, Hans. H.St.
Sturmthal, Adolf F. A.F.St.
Styan, J.L. J.L.S.
Suárez, Jorge A. J.A.S.
Suckling, Eustace E. E.E.S.
Suggs, M. Jack. M.J.Su.
Suggs, Robert Carl. R.C.Su.
Sukhopara, Fyodor Nikolayevich. F.N.S.
Sullivan, Michael. M.Su.
Summers, William Cofield. W.C.S.
Summerson, Sir John (Newenham). J.Sum.
Sundaram, K.V. K.V.Su.
Suppes, Patrick. P.Su.
Supranovich, Tatyana Yosifovna. T.Y.S.
Suryadinata, Leo. L.Sur.
Süsskind, Charles. Ch.S.
Sutcliffe, Reginald C. R.C.S.
Sutherland, James Kenneth. J.K.S.
Sutherland, James R. J.R.Su.
Sutherland, N.M. N.M.Su.
Sutton, Denys. D.Su.
Sutton, John. J.Su.
Suzuki, Chusei. C.Su.
Sverdrup, Harald Ulrik. H.U.S.
Swain, Frederick M. F.M.Sw.
Swan, Bradford Fuller. B.F.S.
Swanberg, W.A. W.A.S.
Swanson, Don R. D.R.Sw.
Sweet, L.E. L.E.S.
Sweet-Escott, Bickham A.C. B.S.-E.
Swenson, J. Patricia Morgan. J.P.M.S.
Swink, Roland Lee. R.L.Sw.
Sykes, Gresham M'Cready. G.M'C.S.
Sylvain, Edmond. E.Sy.
Synge, Patrick Millington. P.M.Sy.
Szebehely, Victor G. V.G.S.
Szilágyi, Mary. M.Sz.

Tahmankar, Dattatraya Vishwanath. D.V.T.
Tait, Hugh. H.Ta.
Takeuchi, Yoshinori. Y.T.
Takhtajan, Armen. A.T.
Talbi, Mohamed. M.Ta.
Talbot, William John. W.J.T.
Talbot Rice, David. D.T.R.
Talbot Rice, Tamara. T.T.R.
Tám, Quách-Thanh-. Q-T.-T.
Tanaka, Otoya. O.Ta.
Tanenbaum, Morris. M.T.
Tani, Shin'Ichi. S.Ta.
Tannenbaum, Steven R. S.R.T.
Tanner, James M. J.M.T.
Tansey, Richard G. R.G.T.
Tapié, Victor-Lucien. V.L.T.
Tarmisto, Vello Julius. V.J.T.
Tassie, James S. J.S.T.
Tate, Allen. A.Ta.
Taube, Arved, Baron von. A.v.T.
Taubenfeld, Howard J. H.J.T.
Tax, Sol. So.T.
Tayler, Roger John. R.J.T.
Taylor, A.J.P. A.J.P.T.
Taylor, Alfred Edward. A.E.Ta.
Taylor, B.N. B.N.T.
Taylor, Gordon Ernest. G.E.T.
Taylor, H. Anthony. H.A.T.
Taylor, Sir Hugh S(tott). H.S.Ta.
Taylor, John Russell. J.R.T.
Taylor, John W.R. J.W.R.T.
Taylor, William. W.Ta.
Teal, John M. J.M.Te.
Teall, John L. J.L.Te.
Tebeau, Charlton W. C.W.T.
Teichert, Curt. C.T.
Temir, Ahmet. A.Te.
Temperley, Nicholas. N.T.
Tenzing Norgay. T.N.
Tepper, Frederick. F.T.
ter Heide, H. H.t.H.
Terrasse, Henri-Louis-Étienne. H.-L.-É.T.
Terry, Walter. W.T.
Thapar, Romila. R.Th.
Thayer, H.S. H.S.T.
Thelen, David P. D.P.T.
Théodoridès, Aristide Émile. A.É.T.
Thesleff, Holger. H.T.
Thibaudet, Albert. A.Tt.
Thielicke, Helmut. H.Th.
Thieret, John W. J.W.Th.
Thin Kyi. T.Ky.
Thom, René Frédéric. R.F.T.
Thomas, David Christopher Traherne. D.C.Th.
Thomas, Harold E. H.E.T.
Thomas, John Gareth. J.G.Th.
Thomas, John L. J.L.T.
Thomas, John Patrick. J.Th.
Thomas, Sidney. Si.T.
Thomas, Terence Barrington. T.B.T.
Thomas, William Harford. W.H.Th.
Thomasson, Gordon Conrad. G.C.T.
Thompson, Brian J. B.J.T.
Thompson, Carol Lewis. C.L.T.
Thompson, E.A. E.A.T.
Thompson, Sir Eric. J.E.S.T.
Thompson, Laura. L.Th.
Thompson, Laurence G. L.G.T.
Thompson, Lawrance R. L.R.T.
Thompson, Stith. S.T.
Thompson, William R. W.R.T.
Thomsen, Helmuth. He.Th.
Thomson, Sir A. Landsborough. A.L.T.
Thomson, Derick S. D.S.T.
Thomson, Sir George Paget. G.P.T.
Thomson, Robert Young. R.Y.T.
Thomson, William Archibald Robson. Wm.A.R.T.
Thomson, William E. W.E.T.
Thöne, Friedrich. F.Th.
Thorne, Robert Folger. R.F.Th.
Thorpe, Lewis. L.T.
Thorpe, William Homan. W.H.T.
Tickner, Fred J. F.J.T.
Tigner, James L. J.L.Ti.
Tikhotskiy, Constantine Gennadiyevich. C.G.T.
Tilley, Cecil Edgar. C.E.T.
Timmers, Jan Joseph Marie. J.J.M.T.
Tinker, Hugh Russell. H.R.T.
Tinkle, Donald W. D.W.T.
Tissot, B. B.T.
Titley, Spencer Rowe. S.R.Ty.
Tjia, Hong Djin. H.D.T.
Tobias, Cornelius A. C.A.T.
Tobias, Phillip Vallentine. P.V.T.
Todd, John Walford. J.W.T.
Toffoletto, Ettore. E.T.
Tolansky, Samuel. S.To.

Tompkins, Joyce M.S. J.M.S.T.
Toni, Youssef T. Y.T.T.
Tooker, Elisabeth. E.To.
Torre, Augusto. A.To.
Totman, Conrad D. C.D.T.
Toulmin, Stephen E. S.E.T.
Toupet, Charles Henri. C.H.T.
Toussaint, Auguste. Au.T.
Tout, Thomas Frederick. T.F.T.
Townsend, Clifford Charles. C.C.T.
Toynbee, Arnold Joseph. A.J.T.
Toynbee, Jocelyn M.C. J.M.C.T.
Toyoda, Takeshi. T.T.
Tracey, Andrew. A.Ty.
Tracey, Hugh. H.Ty.
Traub, Hamilton P. H.P.Tr.
Traub, Col. Robert. R.T.
Travis, Martin Bice, Jr. M.B.T.
Tregear, Thomas R. T.R.T.
Tregonning, Kennedy G. K.G.T.
Treharne, Reginald Francis. R.F.Tr.
Treves, François. F.Tr.
Treves, Piero. P.T.
Tricart, Jean-Léon-François. J.-L.-F.T.
Tricker, Ronald A.R. R.A.R.T.
Trigg, George L. G.L.T.
Trinterud, L.J. L.J.T.
Truchet, Jacques. J.T.
Trypanis, Constantine Athanasius. C.A.Tr.
Tseng, Hsu-pai. H.-p.T.
Tsevegmid, Sh. Sh.Ts.
Tsoumis, George Thomas. G.Ts.
Tsuji, Frederick Ichiro. F.I.T.
Tucci, Giuseppe. Gi.T.
Tucker, A.W. A.W.T.
Tucker, Rt. Rev. Cyril James. C.J.T.
Tucker, David Gordon. D.G.T.
Tucker, Glenn. G.Tu.
Tuma, Elias H. E.H.T.
Turkevich, Anthony Leonid. A.L.Tu.
Turnbull, John G. J.G.T.
Turnell, (George) Martin. M.Tu.
Turner, B.L. B.L.T.
Turner, Edward Lewis. E.L.T.
Turner, Eric Gardner. E.G.T.
Turner, Harold Walter. H.W.T.
Turner, Ralph H. R.H.T.
Turnock, David. D.T.
Turville-Petre, E.O.G. E.O.G.T.-P.
Tuttle, William Julian. W.J.Tu.
Twersky, Isadore. I.T.
Twidale, Charles Rowland. C.R.T.
Twitchett, Denis C. D.C.T.
Tyler, James Chase. J.C.T.

Uda, Michitaka. M.U.
Udo, Reuben Kenrick. R.K.U.
Uibopuu, Valev. V.U.
Ullmann, Walter. W.U.
Ulrich, Homer. H.U.
Underwood, Benton J. B.J.U.
Underwood, E(dgar) Ashworth. E.A.U.
Underwood, Vernon Philip. V.P.U.
Unhjem, Arne. A.U.
Untermann, Jürgen. J.U.
Unwin, George. G.U.
Unwin, Philip Soundy. P.U.
Uotila, Urho A. U.A.U.
Upton, Caroline Jean. C.J.U.
Urry, William G. W.G.U.

Vaizey, John Vaizey, Baron. J.V.
Vajda, Georges. G.V.
Valentine, Frederick Albert. F.A.V.
Valgiglio, Ernesto. E.Va.
Vallier, Dora. D.V.
Van Caenegem, Raoul Charles. R.C.V.C.
Vance, Robert W. R.W.V.
Vandam, Leroy David. L.D.V.
Vandenbosch, Amry. A.Va.
Vanderhill, Burke G. B.G.V.
Vanderpool, Eugene. E.V.
Van Deusen, Glyndon G. G.G.V.D.
Van Deusen, Hobart Merritt. H.M.V.D.
Vanger, Milton I. M.I.V.
Van Horn, Kent R. K.R.V.H.
Vann, Richard T. R.T.V.
Varela, René Santamaria. R.S.V.
Varma, Shanti Prasad. S.P.V.
Varty, Kenneth. K.Vy.
Vasović, Milorad. M.V.
Vaughan, Richard. R.Va.
Vázquez, Josefina Zoraida. J.V. de K.
Velásquez, M. Tulio. M.T.V.
Vella, Walter F. W.F.V.
Vendler, Zeno. Z.V.
Venkataramanan, Lalgudi S. L.S.V.
Vennesland, Birgit. B.V.
Verlinden, J. Charles. J.C.V.
Vernet Ginés, Juan. J.V.G.
Verniers, Louis. L.Ve.
Verschuur, Gerrit Laurens. G.L.Ve.
Veyret, Paul. P.V.
Viallaneix, Paul. P.Vi.
Vidalenc, Jean. J.Vi.
Vidyarthi, Lalita P. L.P.V.
Viereck, Peter. Pe.V.
Vierhaus, Rudolf. Ru.V.
Vignaux, Paul D. P.D.V.
Vigne, Randolph. R.V.
Villari, Letterio Carlo. L.C.V.
Villee, Claude A. C.A.V.
Villiers, Alan John. A.J.V.
Vinacke, W. Edgar. W.E.V.
Vinaver, Eugène. E.Vi.
Vine, Frederick J. F.J.V.
Vioux, Marcelle. M.Vi.
Virtanen, Reino. R.Vi.
Viscovo, Mario Del. M. Del V.
Vishny, Michele. Mi.V.
Vita-Finzi, Claudio. C.V.-F.
Vodovozov, Sergey Arsentyevich. S.A.V.
Voegelin, Charles F. C.F.V.
Voegelin, Florence M. F.M.V.
Vogt, Hans K. H.K.V.
Volkmann, Hans. H.V.
Von Eckardt, Wolf. W.V.E.
Vööbus, Arthur. A.V.
Voous, Karel Hendrik. K.H.V.
Voss, Gilbert L. G.L.V.
Voyce, (William) Arthur. A.Vo.
Vroman, Leo. L.V.

Waage, Frederick O. F.O.Wa.
Waage, Karl M. K.M.W.
Waddams, A.L. A.L.W.
Waddington, Conrad H. C.H.W.
Waerden, Bartel Leendert van der. B.L.v.d.W.
Waggoner, Hyatt H. H.H.W.
Waggoner, Paul Edward. P.E.W.
Wagley, Charles W. C.W.W.
Wagner, Peggy (Margaret D.). P.Wa.
Wagner, Warren H(erbert), Jr. W.H.Wa.
Wailes, Rex. R.W.
Waines, David. D.Wa.
Wake, David B. D.B.W.
Wakefield, Hugh. Hu.Wa.
Walbank, Frank W. F.W.W.
Walford, Lionel A. L.A.Wa.
Walker, Alan. A.W.
Walker, Paul W. P.W.
Walker, Warren F., Jr. W.F.W.
Wall, Bernard J. B.J.W.
Wallace, Irving. Ir.W.
Wallace, Willard M. W.M.Wa.
Wallace-Hadrill, John Michael. J.M.W.-H.
Wallerstein, Immanuel. I.W.
Walling, Cheves T. C.T.W.
Wallis, Helen Margaret. H.M.W.
Walsh, William Henry. W.H.W.
Walter, William Grey. W.G.W.
Walton, Harold F. H.F.W.
Wang, Hao. H.Wa.
Wang, Yi Chu. Y.C.W.
Wanous, Sam J. S.J.W.
Ward, Norman. N.W.
Wardman, Harold W. H.W.W.
Ware, James Hamilton, Jr. J.H.Wa.
Warid, Warid A. W.A.W.
Warmington, Brian H. B.H.W.
Warner, Robert Austin. R.A.Wa.
Warren, Andrew. A.Wa.
Warren, James V. J.V.W.
Washington, Joseph Reed, Jr. J.R.W.
Wasiolek, Edward. E.Wk.
Watanabe, Akira. Ak.W.
Waterhouse, Ellis K. E.K.W.
Waterhouse, John Bruce. J.B.W.
Watkins, John Howard. J.H.Ws.
Watson, Sir F.J.B. F.J.B.W.
Watson, James Wreford. J.W.W.
Watson, J. Garth. J.G.W.
Watson, John Steven. J.S.W.
Watson, Paul F. P.F.W.
Watson, Richard A. R.A.W.
Watson, William. W.W.
Watt, William Montgomery. W.M.W.
Watts, William Walter. W.W.W.
Waworoentoe, Willem Johan. W.J.W.
Waymouth, Charity. C.Wh.
Weaver, John D. J.D.W.
Weaver, Leo. L.We.
Weaver, Leon H. L.H.W.
Webb, Byron H. B.H.We.
Webb, Wilse B. W.B.W.
Weber, Lillian M. L.M.W.
Webster, Bruce. B.We.
Webster, Richard A. R.A.We.
Weck, Richard. R.Wk.
Wedgwood, Dame C(icely) V(eronica). C.V.W.
Weeks, Walter L. W.L.W.
Weibull, Jörgen. Jö.We.
Weichert, Charles Kipp. C.K.W.
Weidner, Richard Tilghman. R.T.We.
Weigmann, Hans-Dietrich H. H.-D.H.W.
Weigt, Ernst. E.Wt.
Weinstein, Donald. D.We.
Weinstein, Louis. L.W.
Weinstock, Herbert. H.We.
Weintal, Edward. E.W.
Weintraub, Stanley. S.We.
Weitzman, Stanley H. S.H.W.
Welch, C. Stuart. C.S.W.
Weller, Jac. J.We.
Weller, J. Marvin. J.M.W.
Wellington, John H. J.H.We.
Wells, Arthur Frederick. A.F.We.
Wells, James M. J.M.Ws.
Welzel, Hans Fritz. Ha.We.
Went, Frits W. F.W.We.
Wente, Edward F. E.F.W.
Wentworth-Sheilds, Francis William. F.W.W.-S.
Werblowsky, R.J. Zwi. R.J.Z.W.
Werkman, Evert. Ev.W.
Wermuth, Heinz Fritz. H.F.We.
Werner, Eric. E.We.
Werner, Robert. R.We.
Wernick, Jack H. Ja.H.W.
Wert, Charles A. C.A.W.
Wertheim, Gunther K. G.K.W.
Werveke H. van. H. van W.
West, Francis James. F.J.W.
West, Geoffrey Buckle. G.B.W.
West, Henry R. H.R.W.
West, James King. J.K.W.
West, Louis Jolyon. L.J.W.
Westerlund, Bengt E. B.E.W.
Westermann, Claus. C.W.
Westermann, Edwin J. E.J.W.
Westfall, Richard S. R.S.W.
Weston, J. Fred. J.F.W.
Westrup, Sir Jack Allan. J.A.W.
Wethey, Harold E. H.E.W.
Wever, Ernest Glen. E.G.W.
Whalen, William J. W.J.Wh.
Whedon, G. Donald. G.D.W.
Wheeler, Alwyne. A.Wh.
Wheeler, Geoffrey Edleston. G.E.Wh.
Wheeler, Gershon J. G.J.Wh.
Whewell, Charles S. C.S.Wh.
Whitaker, Thomas W. T.W.W.
White, D. Maxwell. D.M.Wh.
White, Eric Walter. E.W.W.
White, Fred N. F.N.W.
White, Gilbert F. G.F.W.
White, Herbert A. H.A.W.
White, Leslie A. L.A.W.
White, Vera Muriel. V.M.W.

Whitehead, Frederick. F.Wh.
Whitehill, Walter Muir. W.M.Wh.
Whitelock, Dorothy. D.W.
Whitfield, John Humphreys. J.H.W.
Whitrow, Gerald James. G.J.W.
Whittaker, Robert H. R.H.W.
Whitten, E.H. Timothy. E.H.T.W.
Whittington, Harry B. H.B.W.
Whyte, William Foote. W.F.Wh.
Wiarda, Howard J. H.J.Wi.
Wichers, Edward. E.Wi.
Wickert, Lothar F.K. L.F.K.W.
Wickler, Wolfgang J.H. W.J.H.W.
Wickstead, John H. Jo.W.
Widengren, Geo. G.Wn.
Wiencke, Matthew Immanuel. M.I.W.
Wiersma, C.A.G. C.A.G.W.
Wiesenberg, E.J. E.J.Wi.
Wiesflecker, Hermann. H.Wi.
Wiggins, Ira L. I.L.W.
Wigglesworth, Sir Vincent Brian. V.B.W.
Wightman, Arthur Strong. A.S.Wi.
Wilber, Donald N. D.N.W.
Wilbur, C. Martin. C.M.Wi.
Wilhelm, Hellmut. He.W.
Wilken, Robert L. Ro.W.
Wilkie, Donald Walter. D.W.W.
Wilkie, John Ritchie. J.R.We.
Wilkinson, Elizabeth M. E.M.Wn.
Wilkinson, John Bernard. J.B.Wi.
Wilks, Ivor G. I.G.W.
Willett, Frank. F.Wi.
Willetts, William Young. W.Y.W.
Willey, Basil. B.W.
Williams, Sir Edgar Trevor. E.T.W.
Williams, J. J.Wi.
Williams, J.E. Caerwyn. J.E.C.W.
Williams, John Alden. J.A.Wi.
Williams, J. Paul. J.P.W.
Williams, L. Pearce. L.P.W.
Williams, Nelson Raymond. N.R.W.
Williams, Owen. O.W.
Williams, Robert Deryck. R.D.W.
Williams, Theodore J. T.J.W.
Willis, Edwin O. E.O.W.
Wills, Geoffrey. G.Wi.
Wilshire, Bruce Withington. B.W.W.
Wilson, Bryan R. B.R.W.
Wilson, Carl Louis. C.L.W.
Wilson, Charles Henry. C.H.Wi.
Wilson, Charles Morrow. C.M.W.
Wilson, E. Bright. E.B.W.
Wilson, George Bulkeley Laird. G.B.L.W.
Wilson, John A. Jo.A.W.
Wilson, John Stuart Gladstone. J.S.G.W.
Wilson, J. Tuzo. J.T.W.
Wilson, Mitchell. M.Wi.
Wilson, Nixon A. N.A.W.
Wilt, Fred H. F.H.W.
Wina, Arthur N.L. A.N.L.W.
Winchester, A.M. A.M.W.
Wingert, Paul S. P.S.W.
Wingren, Gustaf. G.Win.
Winterbottom, Goddard Williams. G.W.W.
Wintrobe, Maxwell M. M.M.W.
Wise, Edmund Merriman. E.M.W.
Wise, Keith Arthur John. K.A.J.W.
Wise, S.F. S.F.W.
Wiseman, Donald John. D.J.W.
Witte, William. W.Wi.
Wojnowski, Jan. Ja.W.
Wolf, Gunther. Gu.W.
Wolfe, Raymond. Ra.W.
Wolff, Hans Julius. H.J.W.
Wolfson, Albert. A.Wo.
Wolman, M. Gordon. M.G.W.
Wolpert, Stanley. A. S.A.Wo.
Wolter, Rev. Allan Bernard. A.B.W.
Wolters, O.W. O.W.W.
Wood, Albert E. A.E.W.
Wood, Frank Osborne. F.O.W.
Woodall, Mary. M.Wo.
Woodard, Thomas. M. T.W.
Woodcock, George. G.W.
Woodford, Michael Henry. M.H.W.
Woodhead, A. Geoffrey. A.G.W.
Woodhouse, Christopher Montague. C.M.Wo.
Woodruff, Douglas. D.Wo.
Woodruff, Everett B. E.B.Wo.
Woodward, John. J.Wo.
Woolfenden, Glen E. G.E.W.
Woolley, Sir (Charles) Leonard. L.Wy.
Wormell, Donald Ernest Wilson. D.E.W.W.
Wormley, Edward J. E.J.Wo.
Worthy, Edmund H., Jr. E.H.W., Jr.
Wright, Almon Robert. A.R.W.
Wright, Arthur F. A.F.W.
Wright, Georg Henrik von. G.H. von W.
Wright, Gordon. G.Wr.
Wright, Quincy. Q.W.
Wright, Stephen Graham. S.G.W.
Wurfel, David O.D. D.O.D.W.
Wurm, Stepehn A. S.A.W.
Wu Shih-ch'ang. W.S.-cg.
Wylie, Turrell V. T.V.W.
Wyllie, Peter John. P.J.W.

Yale, David Eryl Corbet. D.E.C.Y.
Yamada, Tasaburo. To.Ya.
Yamane, Takeo. T.Y.
Yapp, Malcolm Edward. M.E.Y.
Yastrebov, Yevgeny Venyaminovich. Y.V.Y.
Yefremov, Yury Konstantinovich. Y.K.Y.
Yerger, Ralph W. R.W.Y.
Yerofeyev, Ivan Alekseyevich. I.A.Y.
Yeung, Yue-man. Y.-m.Y.
Yiannopoulos, A.N. A.N.Y.
Yinger, J. Milton. J.M.Yi.
Yoder, Dale. D.Y.
Yoder, Hatten Schuyler, Jr. H.S.Y.
Yoffey, Joseph M. J.M.Y.
Yoingco, Angel Quintana. A.Q.Y.
Yonge, C. Maurice. C.M.Y.
Yool, Air Vice Marshal William Munro. W.M.Y.
York, Richard Charles. R.C.Y.
Yoshida, Atsuhiko. A.Y.
Youlten, Lawrence J.F. L.J.F.Y.
Young, Ellen Louise. E.L.Y.
Young, Jay A. J.A.Y.
Young, Percy Marshall. P.M.Y.
Young, Philip. P.Y.
Young, R. Eric. R.E.Y.
Young, Roland S. R.S.Y.
Young, T. Cuyler, Jr. T.C.Y., Jr.

Zakharova, Tatyana Konstantinovna. T.K.Z.
Zangwill, Oliver Louis. O.L.Z.
Zaninović, Vice. V.Z.
Záruba, Quido. Q.Z.
Zasenko, Oleksa Eliseyovich. O.E.Z.
Zeeden, Ernst Walter. E.W.Z.
Zeiller, Warren. W.Z.
Zeisel, Hans. H.Z.
Zelinsky, Wilbur. W.Ze.
Zenkovich, Vsevolod Pavlovich. V.P.Z.
Zernov, Nicolas M. N.Z.
Zetlin, Lev. L.Z.
Zgusta, Ladislav. L.Zg.
Zhdanov, Vladimir Viktorovich. V.V.Z.
Zhmuida, Viktor Borisovich. V.B.Z.
Ziadeh, Nicola Abdo. N.A.Z.
Ziman, J.M. J.M.Z.
Zimmer, Russel Leonard. R.L.Zi.
Zimmermann, Martin Huldrych. M.H.Z.
Zirkel, Conway. C.Z.
Zöllner, Erich. E.Zö.
Zoltán, Imre. I.Z.
Zorn, Roman J. R.J.Z.
Zuberi, Matinuzzaman. M.Zu.
Zucker, Moses. M.Z.
Zuckerman, J.J. J.J.Z.
Zuckerman, Solly Zuckerman, Baron. S.Z.
Zudaire Huarte, E. E.Z.H.
Zug, George R. G.R.Z.
Zumberge, James Herbert. J.H.Z.
Zürcher, Erik. E.Z.
Zusi, Richard L. R.L.Z.
Zvelebil, Kamil V. K.V.Z.
Zygmund, Antoni. A.Zy.

Authorities for the Micropædia

volumes I–X

Material in these volumes was written by or is based on material submitted by the following authorities.

Part One. Matter and energy

Roger Adams (d. 1971). *Professor of Organic Chemistry, University of Illinois, Urbana, 1919–57.*

Henry Gavin Alexander. *Headmaster, Hampton Grammar School, Eng. Editor of the Leibniz-Clarke correspondence.*

Lawrence Hugh Aller. *Professor of Astronomy, University of California, Los Angeles.*

Edward Neville da Costa Andrade. (d. 1971). *Quain Professor of Physics, University of London, 1928–50.*

Larned B. Asprey. *Staff Member, Los Alamos Scientific Laboratory, N.M.*

Donald Baim. *Free-lance writer on physics.*

Robert Horace Baker (d. 1964). *Professor of Astronomy, University of Illinois, 1923–51.*

Virginia Bartow. *Associate Professor Emerita of Chemistry, University of Illinois, Urbana.*

William John Bishop (d. 1961). *Editor,* Medical History. *Librarian, Wellcome Historical Medical Library, London, 1946–53.*

J.W. Buchta (d. 1966). *Professor of Physics, University of Minnesota, Minneapolis, 1938–62.*

Anton B. Burg. *Professor of Chemistry, University of Southern California, Los Angeles.*

Horace R. Byers. *Emeritus Professor of Meteorology, Texas A & M University, College Station.*

Francis Edward Cislak. *Director of Research, Reilly Tar and Chemical Corporation, Indianapolis, Ind.*

Norman Clarke. *Deputy Secretary and Registrar, Institute of Mathematics and Its Applications, Southend-on-Sea, Eng.*

Alexander Cowie. *Emeritus Professor of Mechanical and Aerospace Engineering, Illinois Institute of Technology, Chicago. Associate Editor, Technology,* Encyclopædia Britannica, *Chicago, 1967–72.*

Raynor Duncombe. *Director, Nautical Almanac Office, U.S. Naval Observatory, Washington, D.C.*

Richard H. Eastman. *Professor of Chemistry, Stanford University, Calif.*

Olin Jeuck Eggen. *Professor of Astronomy; Director, Mt. Stromlo and Siding Spring Observatories, Australian National University, Canberra.*

Henry Feuer. *Professor of Chemistry, Purdue University, West Lafayette, Ind.*

Henry Michael Foley. *Professor of Physics, Columbia University.*

Thomas R.P. Gibb, Jr. *Professor of Chemistry, Tufts University, Medford, Mass.*

Henry Lee Giclas. *Astronomer and Executive Secretary, Lowell Observatory, Flagstaff, Ariz.*

Murray Goodman. *Professor of Chemistry, University of California, San Diego.*

Earle Covington Gregg. *Professor of Radiology, School of Medicine, Case Western Reserve University, Cleveland.*

Dirk ter Haar. *Reader in Theoretical Physics, University of Oxford; Fellow of Magdalen College, Oxford.*

Wayne B. Hadley. *Engineering Scientist, AMP Incorporated, Harrisburg, Pa.*

Dalziel Llewellyn Hammick (d. 1966). *Fellow of Oriel College, Oxford, 1921–52; Aldrichian Praelector in Chemistry, University of Oxford, 1949–52.*

Wilfried Heller. *Professor of Chemistry, Wayne State University, Detroit.*

Max H. Hey. *Senior Principal Scientific Officer, Department of Mineralogy, British Museum (Natural History), London, 1951–69.*

Maurice Loyal Huggins. *Research Consultant and Senior Research Associate, Arcadia Institute for Scientific Research, Woodside, Calif.*

Merkel Henry Jacobs (d. 1970). *Professor of General Physiology, University of Pennsylvania, Philadelphia, 1923–35.*

Stanley Eric Janson. *Keeper, Department of Astronomy and Geophysics, Science Museum, London, 1967–69; Keeper, Department of Chemistry, 1959–67.*

Hamilton Moore Jeffers. *Astronomer Emeritus, Lick Observatory, Mount Hamilton, Calif.*

Richard Kimmel. *Free-lance writer on physics.*

George B. Kistiakowsky. *Abbot and James Lawrence Professor of Chemistry, Harvard University.*

Martin Jesse Klein. *Eugene Higgins Professor of the History of Physics, Yale University.*

Polykarp Kusch. *Professor of Physics, Columbia University. Co-winner, Nobel Prize for Physics, 1955.*

Henry M. Leicester. *Emeritus Professor of Biochemistry, University of the Pacific, San Francisco.*

Raymond Arthur Lyttleton. *Professor of Theoretical Astronomy, University of Cambridge; Fellow of St. John's College, Cambridge.*

Douglas McKie (d. 1967). *Professor of History and Philosophy of Science, University of London, 1957–64.*

William Marshall MacNevin (deceased). *Professor and Chairman, Department of Chemistry, Ohio State University, Columbus.*

William Markowitz. *Adjunct Professor of Physics, Nova University, Dania, Florida. Professor of Physics, Marquette University, Milwaukee, Wisconsin, 1966–72.*

Paul Willard Merrill (d. 1961). *President, American Astronomical Society. Member of Staff, Mt. Wilson and Palomar Observatories, Pasadena, Calif., 1929–52.*

Rev. Daniel J.K. O'Connell, S.J. *Director of the Vatican Observatory, Castel Gandolfo, 1952–70.*

Peter Oesper. *Chairman of the Department of Chemistry, St. Lawrence University, Canton, N.Y.*

Ralph Edward Oesper. *Emeritus Professor of Analytical Chemistry, University of Cincinnati, Ohio.*

Donald E. Osterbrock. *Professor of Astronomy, University of Wisconsin, Madison.*

Bernard E.J. Pagel. *Deputy Chief Scientific Officer, Royal Greenwich Observatory, Herstmonceux, Eng. Visiting Professor of Astronomy, University of Sussex, Brighton, Eng.*

James Bayard Parsons. *Emeritus Professor of Chemistry, University of Chicago.*

Herman Pines. *Vladimir Ipatieff Professor Emeritus of Chemistry, Northwestern University, Evanston, Ill.*

Michael Polanyi, M.D. *Senior Research Fellow, Merton College, University of Oxford, 1959–61. Professor of Social Studies, 1948–58; Professor of Physical Chemistry, 1933–48, Victoria University of Manchester.*

Franklin Evans Roach. *Affiliate Astronomer, University of Hawaii, Honolulu. Physicist, U.S. National Bureau of Standards, 1954–65.*

Colin Alistair Ronan. *Science writer and lecturer. Editor,* Journal of the British Astronomical Association.

Arthur L. Schawlow. *Professor of Physics, Stanford University, Calif.*

Aurelia Keith Townes Schawlow (Mrs. Arthur L. Schawlow).

Hermann I(rving) Schlesinger (d. 1960). *Professor of Chemistry, University of Chicago.*

Frederick Hanley Seares (d. 1964). *Assistant Director, Mount Wilson Observatory of the Carnegie Institution of Washington, Pasadena, Calif., 1925–40.*

Emilio Gino Segrè. *Emeritus Professor of Physics, University of California, Berkeley. Nobel Prize for Physics, 1959.*

Ralph Pray Seward. *Emeritus Professor of Chemistry, Pennsylvania State University, University Park.*

Charles Donald Shane. *Astronomer Emeritus, Lick Observatory, University of California, Santa Cruz.*

Vernon Arthur Stenger. *Analytical Scientist, Dow Chemical Company, Midland, Mich.*

Ethel Truman. *Formerly Senior Science Tutor, Queen's College, London.*

Birgit Vennesland. *Head, Vennesland Research Laboratory, Max Planck Society; Director, Max Planck Institute for Cell Physiology, Berlin, 1968–70.*

George Willard Wheland (d. 1972). *Professor of Chemistry, University of Chicago.*

Donald H. White. *Professor of Physics, Oregon College of Education, Monmouth.*

Gerald James Whitrow. *Professor of the History and Applications of Mathematics, Imperial College of Science and Technology, University of London.*

Fritz Zwicky (d. 1973). *Professor of Astrophysics, California Institute of Technology, Pasadena, 1942–68. Staff Astronomer, Mt. Wilson and Palomar Observatories.*

Part Two. The Earth

Ernst (Valdemar) Antevs. *Private research geologist.*

Clifford A. Barnes. *Emeritus Professor of Oceanography, University of Washington, Seattle.*

Michel J. Batisse. *Director, Natural Resources Research Division, Department of Environmental Sciences, UNESCO, Paris.*

Louis J. Battan. *Professor of Atmospheric Sciences; Director, Institute of Atmospheric Physics, University of Arizona, Tucson.*

Werner A. Baum. *President, University of Rhode Island, Kingston. Formerly Deputy Administrator, Environmental Science Services Administration, Rockville, Md.*

Kenneth O. Bennington. *Research Chemist, Thermodynamics Laboratory, Albany Metallurgy Research Center, Bureau of Mines, U.S. Department of the Interior, Albany, Ore.*

Marland P. Billings. *Professor of Geology, Harvard University.*

F. Donald Bloss. *Professor of Mineralogy, Virginia Polytechnic Institute and State University, Blacksburg.*

William Frank Bradley. *Professor of Chemical Engineering, University of Texas at Austin.*

George William Brindley. *Professor of Mineral Sciences, Pennsylvania State University, University Park.*

Max Edwin Britton. *Director, Arctic Development and Environment Program, Arctic Institute of North America, Washington, D.C.*

Edward Morgan Brooks. *Professor of Geology and Geophysics, Boston College, Chestnut Hill, Mass.*

Arthur C. Barrington Brown. *Consulting oil geologist.*

Franklin Becker Brown. *Director of Research and Development, Union Carbide Corporation, Chemicals and Plastics Operations Division, South Charleston, W.Va.*

Wesley Carr Calef. *Professor of Geography, Illinois State University, Normal.*

Carleton Abramson Chapman. *Professor of Geology, University of Illinois, Urbana.*

Felix Chayes. *Petrologist, Geophysical Laboratory, Carnegie Institution of Washington, D.C.*

Robert Griffin Coleman. *Geologist, Experimental Geochemistry and Mineralogy Branch, Geological Survey, U.S. Department of the Interior, Menlo Park, Calif.*

Paul E. Damon. *Professor of Geosciences; Chief Scientist, Laboratory of Isotope Geochemistry, University of Arizona, Tucson.*

Hubert G. Davis. *Senior Research Fellow, Union Carbide Corporation, South Charleston, W.Va.; Assistant Director of Research and Development, Olefins Division, 1962–69.*

George A. Dawson. *Associate Professor of Atmospheric Sciences, University of Arizona, Tucson.*

George W. DeVore. *Professor of Geology, Florida State University, Tallahassee.*

Ernest George Ehlers. *Professor of Mineralogy, Ohio State University, Columbus.*

Richard Kempton Estelow. *Business Manager, Columbian Carbon Company, Princeton, N.J.*

George Tobias Faust. *Mineralogist–Petrologist, Division of Experimental Geochemistry and Mineralogy, Geological Survey, U.S. Department of the Interior, Washington, D.C.*

Carroll Lane Fenton (d. 1969). *Author of* Our Amazing Earth *and others.*

Mildred Adams Fenton. *Co-author of* Story of the Great Geologists *and others.*

Robert Louis Folk. *Professor of Geology, University of Texas at Austin.*

Barbara Downey Freson. *Educational Assistant, National Coal Association, Washington, D.C.*

Clifford Frondel. *Professor of Mineralogy; Chairman, Department of Geological Sciences, Harvard University.*

Fritiof Melvin Fryxell. *Professor of Geology, Augustana College, Rock Island, Ill.*

Julian R. Goldsmith. *Charles E. Merriam Distinguished Service Professor of Geochemistry; Chairman, Department of Geophysical Sciences; Associate Dean, Division of the Physical Sciences, University of Chicago.*

Allan Grierson. *Senior Lecturer in Mining, Royal School of Mines, Imperial College of Science and Technology, University of London.*

Walter Brian Harland. *Fellow of Gonville and Caius College, Cambridge; Reader in Tectonic Geology, University of Cambridge.*

Herbert Edwin Hawkes, Jr. *Consulting geologist. Professor of Mineral Exploration, University of California, Berkeley, 1957–65.*

E. William Heinrich. *Professor of Mineralogy, University of Michigan, Ann Arbor.*

Donald Munro Henderson. *Professor of Geology, University of Illinois, Urbana.*

Benjamin M. Herman. *Professor of Atmospheric Sciences, University of Arizona, Tucson.*

Jörgen Holmboe. *Professor of Meteorology, University of California, Los Angeles.*

Floyd Allen Hummel. *Professor of Ceramic Science, Pennsylvania State University, University Park.*

Cornelius Searle Hurlbut. *Professor of Mineralogy, Harvard University.*

Richard H. Jahns. *Professor of Geology; Dean, School of Earth Sciences, Stanford University, Calif.*

George Clayton Kennedy. *Professor of Geology, Institute of Geophysics, University of California, Los Angeles.*

Austin Long. *Associate Professor of Geosciences, University of Arizona, Tucson.*

Duncan McConnell. *Research Professor of Dentistry, Ohio State University, Columbus; Professor of Mineralogy, 1950–56.*

Wayne Anthony McCurdy. *Head, Division of Mining and Preparation, Office of Coal Research, U.S. Department of the Interior, Washington, D.C.*

D. Clay McDowell. *Professor of Meteorology; Director, Institute of Tropical Meteorology, University of Puerto Rico, Río Piedras.*

Wayne E. McGovern. *Meteorologist, Environmental Monitoring and Prediction, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Rockville, Md.*

J. Robert Moore. *Director, Marine Research Laboratory; Associate Director of Marine Studies; Professor of Geology, Institute for Environmental Studies, University of Wisconsin, Madison.*

Paul B. Moore. *Professor of Mineralogy and Crystallography, University of Chicago.*

Morris Neiburger. *Professor of Meteorology, University of California, Los Angeles.*

Bert E. Nordlie. *Associate Professor of Geosciences, University of Arizona, Tucson.*

Frederick J. North. *Formerly Keeper of the Department of Geology, National Museum of Wales.*

John Claud Trewinard Oates. *Under-Librarian, University Library, University of Cambridge; Fellow of Darwin College, Cambridge.*

Robert Joseph Pafford, Jr. *Regional Director, Bureau of Reclamation, U.S. Department of the Interior, Sacramento, Calif.*

Hans Arnold Albert Panofsky. *Evan Pugh Research Professor of Atmospheric Sciences, Pennsylvania State University, University Park.*

Kenneth Macaulay Papworth. *Brigadier (retired). Chief Survey Officer, Ordnance Survey, N.Ire., 1949–57.*

Ralph Brazelton Peck. *Professor of Foundation Engineering, University of Illinois, Urbana.*

F.J. Pettijohn. *Professor of Geology, Johns Hopkins University, Baltimore.*

Hans Ramberg. *Professor and Head, Department of Mineralogy and Petrology, University of Uppsala, Swed.*

Lewis S. Ramsdell. *Emeritus Professor of Mineralogy, University of Michigan, Ann Arbor.*

Kelvin S. Rodolfo. *Associate Professor of Geological Sciences, University of Illinois, Chicago.*

Edwin (Woods) Roedder. *Geologist, Experimental Geochemistry and Mineralogy Branch, Geological Survey, U.S. Department of the Interior, Washington, D.C.*

James Romanes. *Petroleum geologist.*

Della Roy. *Associate Professor of Materials Science, Pennsylvania State University, University Park.*

Rustum Roy. *Professor of the Solid State; Director, Materials Research Laboratory, Pennsylvania State University, University Park.*

William D. Sellers. *Professor of Atmospheric Sciences, University of Arizona, Tucson.*

Sol Robert Silverman. *Senior Research Associate, Chevron Oil Field Research Company, La Habra, Calif.*

John S. Sumner. *Professor of Geosciences and Mining and Geological Engineering, University of Arizona, Tucson.*

Reginald C. Sutcliffe. *Emeritus Professor of Meteorology, University of Reading, Eng.*

Sir Graham Sutton. *Vice President, University College of Wales, Aberystwyth. Director General, Meteorological Office, London, 1953–65.*

George S. Switzer. *Curator, Department of Mineral Sciences, Smithsonian Institution, Washington, D.C.*

Thomas Prence Thayer. *Geologist, Eastern Mineral Resources Branch, Geological Survey, U.S. Department of the Interior, Washington, D.C.*

James Burleigh Thompson, Jr. *Professor of Mineralogy, Harvard University.*

Charles Warren Thornthwaite (d. 1963). *Director, Laboratory of Climatology, Centerton, N.J. Principal Climatologist, U.S. Soil Conservation Service, 1935–46.*

Cecil Edgar Tilley (d. 1973). *Professor of Mineralogy and Petrology, University of Cambridge, 1931–61.*

Howel Williams. *Emeritus Professor of Geology, University of California, Berkeley.*

Richard F. Wilson. *Associate Professor of Geosciences, University of Arizona, Tucson.*

Donald Wolberg. *Free-lance writer on historical geology, stratigraphy, and paleontology.*

W.A. Wooster. *Director, Crystal Structures Ltd., Cambridge, Eng.*

Jerome J. Wright. *Associate Professor of Geosciences; Assistant Dean, College of Earth Sciences, University of Arizona, Tucson.*

Part Three. Life on Earth

Constantine John Alexopoulos. *Emeritus Professor of Botany, University of Texas at Austin.*

Edward William Baker. *Acarologist, U.S. Department of Agriculture, Washington, D.C.*

Fred Alexander Barkley. *Professor of Biology, Northeastern University, Boston.*

J. Laurens Barnard. *Curator, Division of Crustacea, Smithsonian Institution, Washington, D.C.*

Roger Lyman Batten. *Professor of Geology, Columbia University. Curator, American Museum of Natural History, New York City.*

Victor Rickman Boswell. *Assistant Director, Crops Research Division, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Md., 1965–68.*

Andrew Gavin Brown. *Senior Experimental Officer, Department of Applied Genetics, John Innes Institute, Norwich, Eng.*

John Bonner Buck. *Chief, Laboratory of Physical Biology, National Institutes of Health, Bethesda, Md.*

John Walford Bundy. *Company Agricultural General Manager, Birds Eye Foods Ltd., Eng.*

F.M. Carpenter. *Fisher Professor of Natural History, Curator of Fossil Insects, Museum of Comparative Zoology, Harvard University.*

Jackson Leaphart Cartter. *Director, U.S. Regional Soybean Laboratory, U.S. Department of Agriculture, Urbana, Ill., 1950–65.*

Robert H. Catlett. *Associate Professor of Zoology, San Diego State College, Calif.*

Phil Clark. *Free-lance writer on botany.*

Ira Judson Condit. *Emeritus Professor of Subtropical Horticulture, University of California, Citrus Research Center, Riverside.*

Donovan Stewart Correll. *Program Director, Division of Biological and Medical Sciences, National Science Foundation. Chief Botanist; Head of Botanical Laboratory, Texas Research Foundation, Renner, Texas, 1956–71.*

Alistair Cameron Crombie. *Senior Lecturer in the History of Science, University of Oxford.*

Frank P. Cullinan. *Collaborator, U.S. National Arboretum, Washington, D.C.*

R.L. Cushing. *Director, Experiment Station, Hawaiian Sugar Planters Association, Honolulu.*

George McMillan Darrow. *Consultant, U.S. Department of Agriculture, Beltsville, Md.; Principal Horticulturist in Charge of Small Fruit Investigations, 1954–57.*

Elizabeth C. Dudley. *Research Associate, Zoology, University of Maryland, College Park.*

L.C. Dunn (d. 1974). *Professor of Zoology, 1928–62; Senior Research Associate in Biological Sciences, 1962–74, Columbia University.*

Stephen Porter Dunn. *Director of Research, Highgate Road Social Science Research Station, Inc., Berkeley, Calif.*

O.J. Eigsti. *Professor of Botany, Chicago State University.*

Alfred E. Emerson. *Emeritus Professor of Biology, University of Chicago.*

Marshall Gates. *Charles Frederick Houghton Professor of Chemistry, University of Rochester, N.Y.*

Ernest M. Gifford, Jr. *Professor of Botany, University of California, Davis.*

Clarence James Goodnight. *Professor of Biology, Western Michigan University, Kalamazoo.*

Marie Louise Goodnight. *Free-lance writer. Instructor in Biological Sciences, Purdue University, West Lafayette, Ind., 1946–1965.*

Ellwood Scott Harrar. *James B. Duke Professor of Wood Science, School of Forestry, Duke University, Durham, N.C.*

Hudson Thomas Hartmann. *Professor of Pomology, University of California, Davis.*

Joel W(alker) Hedgpeth. *Professor of Oceanography; Head Yaquina Biological Laboratory, Marine Science Center, Oregon State University, Newport.*

Edward Hindle. *Scientific Director, Zoological Society of London, 1944–51. Regius Professor of Zoology, University of Glasgow, 1935–43.*

Cecil Arthur Hoare. *Wellcome Research Fellow, Wellcome Laboratories of Tropical Medicine, London.*

W(alter) H(enricks) Hodge. *Section Head for Ecological and Systematic Botany, National Science Foundation, Washington, D.C.*

Turner Harcourt Hopper. *Former Chief, Oilseed Crops Laboratory, Southern Utilization Research and Development Division, New Orleans.*

Carl L. Hubbs. *Emeritus Professor of Biology, Scripps Institution of Oceanography, University of California, San Diego.*

Clark Hubbs. *Professor of Zoology, University of Texas at Austin.*

Hilary Mary Hughes. *Horticulturalist, Ministry of Agriculture, Wolverhampton, Great Britain.*

Theodor (Karl) Just (d. 1960). *Chief Curator, Department of Botany, Field Museum of Natural History, Chicago.*

Chester Scott Keefer, M.D. *Wade Professor Emeritus of Medicine, Boston University.*

Keith R. Kelson. *Acting Assistant Director for Education and Executive Assistant, National Science Foundation, Washington, D.C. Co-author of* The Mammals of North America.

James Edward Knott. *Emeritus Professor of Vegetable Crops, University of California, Davis; Chairman of the Department, 1940–64.*

Paulden Ford Knowles. *Professor of Agronomy; Chairman, Department of Agronomy and Range Science, University of California, Davis.*

Sir Hans (Adolf) Krebs. *Emeritus Professor of Biochemistry, University of Oxford. Co-winner, Nobel Prize for Physiology or Medicine, 1953.*

Morris Cecil Leikind. *Scientist Administrator, National Clearinghouse for Mental Health Information, National Institutes of Health, Bethesda, Md., 1963–66.*

Joseph Colvin McDaniel. *Assistant Professor of Horticulture (Research), University of Illinois, Urbana.*

John Robert Magness. *Former Chief, Fruit and Nut Crops Research Branch, U.S. Department of Agriculture, U.S. Plant Industry Station, Beltsville, Md.*

Leonard Harrison Matthews. *Scientific Director, Zoological Society of London, 1951–66. Fellow of the Royal Society.*

Florence Moog. *Professor of Biology, Washington University, St. Louis, Mo.*

Thomas Edwin Moore. *Curator of Insects, Museum of Zoology; Professor of Zoology, University of Michigan, Ann Arbor.*

Ernst Trier Mörch, M.D. *Clinical Professor of Surgery (Anesthesia), University of Illinois, Chicago.*

James William Moulder. *Professor of Microbiology, University of Chicago.*

Walter Conrad Muenscher (d. 1963). *Professor of Botany, Cornell University, Ithaca, N.Y.*

Carl F.W. Muesebeck. *Honorary Collaborator, U.S. Department of Agriculture and U.S. National Museum, 1954–65. Chief, Division of Insect Identification, U.S. Department of Agriculture, 1935–54.*

John Spangler Nicholas (d. 1963). *Sterling Professor of Biology, Yale University, 1939–63.*

George Torao Okita. *Professor of Pharmacology, Northwestern University, Chicago.*

Jane M. Oppenheimer. *Professor of the History of Science, Bryn Mawr College, Pa.*

Gilbert Fred Otto. *Professor of Zoology, University of Maryland, College Park, 1966–72.*

Fernandus Payne. *Emeritus Professor of Zoology; Emeritus Dean of the Graduate School, Indiana University, Bloomington.*

Bernard George Peters (d. 1967). *Professor of Parasitology, Imperial College of Science and Technology, University of London, 1955–67.*

Sir Rudolph Albert Peters. *Professor of Biochemistry, University of Oxford, 1923–54. Head, Biochemistry Department, Agricultural Research Council, Institute of Animal Physiology, Babraham, Cambridge, Eng., 1954–59.*

(Frederick) Wilson Popenoe. *Director Emeritus, Escuela Agricola Panamericana, Tegucigalpa, Honduras, Author of* Manual of Tropical and Subtropical Fruits *and others.*

John Ramsbottom. *Keeper, Department of Botany, British Museum (Natural History), London, 1930–50.*

Austin L. Rand. *Research Associate, Archbold Biological Station, Lake Placid, Fla. Chief Curator of Zoology, Field Museum of Natural History, Chicago, 1955–70.*

Alfred S. Romer (d. 1973). *Alexander Agassiz Professor of Zoology, Harvard University, 1947–65.*

Anthony H. Rose. *Professor of Microbiology, University of Bath, Eng.*

Herbert Holdsworth Ross. *Professor of Entomology, University of Georgia, Athens.*

Aaron J. Sharp. *Alumni Distinguished Service Professor Emeritus of Botany, University of Tennessee, Knoxville.*

Malcolm C. Shurtleff, Jr. *Professor of Plant Pathology; Extension Plant Pathologist, University of Illinois, Urbana.*

Walton B. Sinclair. *Emeritus Professor of Biochemistry, University of California, Riverside.*

William Louis Stern. *Professor of Botany, University of Maryland, College Park.*

Norman Taylor (d. 1967). *Assistant Curator, New York Botanical Garden, 1905–11. Author of* Guide to Garden Flowers *and others.*

John W. Thieret. *Professor and Chairman, Faculty of Biological Sciences, Northern Kentucky University, Highland Heights.*

Robert Templeton Van Tress. *Former Horticulturist, Chicago Park District.*

Paul Dirks Voth. *Emeritus Professor of Botany, University of Chicago.*

Lionel A. Walford. *Emeritus Director, Sandy Hook Marine Laboratory, Highlands, N.J.*

Rupert L. Wenzel. *Chairman, Department of Zoology, Field Museum of Natural History, Chicago; Curator of Insects, 1951–70.*

G(eorge) W(illard) Wharton. *Professor and Director, Acarology Laboratory, Ohio State University, Columbus.*

Gordon Roy Williams. *Head, New Zealand Wildlife Service, Department of Internal Affairs, Wellington.*

Louis O. Williams. *Chief Curator of Botany, Field Museum of Natural History, Chicago.*

A.J. Winkler. *Emeritus Professor of Viticulture and Emeritus Viticulturist, College of Agriculture, University of California, Davis.*

Dorothea Woodruff. *Herbarium Associate and Research Assistant, Department of Biology, University of Utah, Salt Lake City.*

A.H. Wright (d. 1966). *Professor of Agronomy, University of Wisconsin, Madison, 1931–57.*

Kanichiro Yashiroda. *Proprietor, Yashiroda Acclimatization Garden, Tonosho, Japan. Author of* Bonsai: Japanese Miniature Trees.

Wolfram Winfried Zillig. *Director, Max-Planck Institute for Biochemistry, Munich.*

Part Four. Human life

Fred Lyman Adair, M.D. (d. 1972). *Mary Campau Ryerson Professor of Obstetrics and Gynecology, University of Chicago, 1931–42.*

Rodolfo Almeida Pintos (deceased). *Phthisiologist, Institute of Epidemiology and Contagious Diseases, School of Medicine, University of Montevideo, Uruguay.*

Jack Andresen. *Consulting Engineer. Underwater Photographer, World Champion Figure Water Skier, 1950.*

Robert Auty. *Professor of Comparative Slavonic Philology, University of Oxford; Fellow of Brasenose College, Oxford.*

(Edith Kathleen) Charlotte Banks. *Lecturer in Psychology, University College, University of London.*

Eric Arthur Barber (d. 1965). *Rector of Exeter College, University of Oxford, 1943–56.*

Frank Barron. *Research Psychologist, Institute of Personality Assessment and Research, University of California, Berkeley.*

Sir Frederic Charles Bartlett (d. 1969). *Professor of Experimental Psychology, University of Cambridge, 1931–52; Director, Psychological Laboratory, 1922–52.*

Charles-Louis de Beaumont (d. 1972). *President, Amateur Fencing Association of Great Britain. President, British Commonwealth Fencing Federation. Deputy Chairman, British Olympic Association.*

Marc Oliver Beem, M.D. *Professor of Pediatrics, University of Chicago.*

Ernest Bender. *Professor of Indo-Aryan Languages and Literatures, University of Pennsylvania, Philadelphia. General Editor,* Journal of the American Oriental Society.

Walter Reginald Bett. *Medical Editor, Wm. Douglas McAdams, Inc., New York City. Author of* The Infirmities of Genius *and others.*

Emma Mary Birch. *Head Occupational Therapist, Royal Free Hospital Group, London.*

Max Black. *Susan Linn Sage Professor of Philosophy; Director, Society for the Humanities, Cornell University, Ithaca, N.Y.*

Edwin Garrigues Boring (d. 1968). *Edgar Pierce Professor of Psychology, Harvard University, 1956–57; Professor of Psychology, 1928–56.*

Marjorie Boulton. *Principal, Charlotte Mason College, Ambleside, Eng., 1962–70. Member of the Esperanto Academy. Author of* Zamenhof, Creator of Esperanto *and others.*

Arthur Hills Brayfield. *Professor and Chairman, Department of Psychology, Claremont Graduate School, Calif.*

Lloyd Vernet Bridges. *Actor. Author of* Masks and Flippers.

Henry W. Brosin, M.D. *Professor of Psychiatry, University of Arizona, Tucson.*

Avery Brundage (d. 1975). *President, International Olympic Committee, 1952–72.*

Carroll L. Bryant. *Director, Office of Publications, American National Red Cross, 1954–60.*

William Burrows. *Professor of Microbiology, University of Chicago.*

Sir Cyril Lodowic Burt (d. 1971). *Professor of Psychology, University College, University of London, 1931–50.*

Asa S. Bushnell. *Former Commissioner, Eastern College Athletic Conference.*

Schuyler van Rensselaer Cammann. *Professor of East Asian Studies, University of Pennsylvania, Philadelphia.*

Donald E. Cassels, M.D. *Professor of Pediatrics, University of Chicago.*

Conrad Chyatte. *Associate Professor of Psychology, De Paul University, Chicago.*

Robert Coope, M.D. *Honorary Consulting Physician, Liverpool United Hospitals, Eng.*

William Stewart Cornyn. *Professor of Slavic and Southeast Asian Linguistics, Yale University.*

Paul Frederic Cranefield. *Associate Professor of Physiology, Rockefeller University, New York City.*

Jean-Marie Crépin. *Electroradiologist, Léopold Bellan Hospital, Paris.*

Robert Croly Darling, M.D. *Simon Baruch Professor of Rehabilitation Medicine, Columbia University.*

Bernard Darwin (d. 1961). *Golf Correspondent,* Country Life, *1907–61, and* The Times (*London*), 1919–58.

John P. Davis. *Editor of Special Publications, Phelps-Stokes Fund, N.Y. Editor of* The American Negro Reference Book.

Peter P.H. De Bruyn, M.D. *Emeritus Professor of Anatomy, University of Chicago.*

Susan J. Decker. *Free-lance writer on medical topics. Electron Microscopist, Department of Biology, University of Illinois, Chicago.*

Martin Dell (d. 1966). *Cartoonist and Puzzle Maker, Chicago Tribune Syndicate.*

Helen Aird Dickie, M.D. *Professor of Medicine, University of Wisconsin, Madison.*

John Holmes Dingle, M.D. *Elisabeth Severance Prentiss Professor of Preventive Medicine and Professor of Medicine, Case Western Reserve University, Cleveland.*

Joseph Lewi Donhauser (d. 1964). *Professor of Surgery, Albany Medical College, N.Y. Senior Surgeon, Albany Medical Center Hospital.*

Roy Melvin Dorcus (d. 1968). *Professor of Psychology, 1944–65; Dean, Division of Life Sciences, University of California, Los Angeles, 1950–63.*

Isidore Dyen. *Professor of Malayo-Polynesian and Comparative Linguistics, Yale University.*

James Russell Eckman. *Senior Consultant, Section of Publications, Mayo Clinic, Rochester, Minn.*

Robert Romain Edge. *Former Associate Editor,* Sports Afield. *Outdoor Editor, American Broadcasting Company.*

Lillian Eichelberger. *Emeritus Professor of Biochemistry, Department of Surgery, University of Chicago.*

William Fisher Enneking, M.D. *Professor of Surgery and Pathology; Chief, Division of Orthopedics, College of Medicine, University of Florida, Gainesville.*

Ralph Erickson. *Physical Education Instructor; Swimming and Water Polo Coach, Loyola University, Chicago.*

George Hoben Estabrooks. *Emeritus Professor of Psychology, Colgate University, Hamilton, N.Y.*

Hans Jurgen Eysenck. *Professor of Psychology, University of London.*

Ernest Carroll Faust. *Emeritus Professor of Parasitology, Tulane University, New Orleans.*

John Henry Webb Fingleton. *Journalist. International Cricketer, 1931–38. Author of* Cricket Crisis *and others.*

Louis B. Flexner, M.D. *Professor of Anatomy, University of Pennsylvania, Philadelphia.*

Robert Allen Fowkes. *Professor of Germanic Languages, New York University, New York City.*

Henry Waller Fowler, Jr. *Securities Trader. Author of* Kites *and others.*

Phyllis Frederick. *Toy and Game Designer, Mattel Inc., Hawthorne, Calif.*

Anna Freud. *Director of the Hampstead Child-Theory Course and Clinic, London. Author of* The Ego and the Mechanisms of Defence *and others.*

Richard L(incoln) Frey. *Editor in Chief,* Official Encyclopaedia of Bridge. *Associate Editor,* Bridge World *magazine; Emeritus Editor,* The Contract Bridge Bulletin; *Chief of Editorial Board, Charles H. Goren publications. President, International Bridge Press Association.*

(Jerome) Ed(ison) Friel. *Sports Writer,* Newark (*N.J.*) News. *Former President, New York Track Writers Association.*

Richard Nelson Frye. *Aga Khan Professor of Iranian, Harvard University. President, Asia Institute, Pahlavi University, Shīrāz, Iran.*

Esther Garvey. *Registered Nurse, specializing in geriatric care.*

Ignace J. Gelb. *Frank P. Hixon Distinguished Service Professor Emeritus, Oriental Institute and Departments of Linguistics and Near Eastern Languages and Civilizations, University of Chicago.*

Jacob Warren Getzels. *R. Wendell Harrison Distinguished Service Professor of Educational Psychology, University of Chicago.*

Peter Robin Gimbel. *Filmmaker.*

Alexander Hayden Girard. *Architect.*

Edward Girden. *Professor of Psychology, Brooklyn College, City University of New York.*

Francis Byron Gordon, M.D. (d. 1973). *Director, Department of Microbiology, Naval Medical Research Institute, Bethesda, Md., 1962–72.*

Lealand Roger Gustavson (d. 1966). *Artist and Illustrator. Author of* Winning Badminton *and others.*

Douglas James Guthrie, M.D. *Medical Historian. Lecturer on the History of Medicine, University of Edinburgh, 1945–56.*

Ward Campbell Halstead (d. 1969). *Professor, Department of Psychology and Medicine, University of Chicago, 1946–69.*

Eric P. Hamp. *Robert Maynard Hutchins Distinguished Service Professor of Linguistics and of Behavioral Sciences; Director, Center for Balkan and Slavic Studies, University of Chicago.*

Henry Nelson Harkins, M.D. (d. 1967). *Professor of Surgery, University of Washington, 1947–67; Surgeon-in-Chief, University Hospital, Seattle, 1957–64.*

Réjane M. Harvey, M.D. *Professor of Medicine, Columbia University. Visiting Physician, Harlem Hospital, New York City.*

R.L. Hay. *Professor of Geology, University of California, Berkeley. Author of* Geology of the Olduvai Gorge.

Ralph William Heine. *Professor of Psychology and Chief Clinical Psychologist, University of Michigan, Ann Arbor.*

Roger Moss Herriott. *Professor and Chairman, Department of Biochemistry, School of Hygiene and Public Health, Johns Hopkins University, Baltimore.*

Howard Francis Hunt. *Chief of Psychiatric Research (Psychology), New York State Psychiatric Institute. Professor of Psychology, Faculty of Pure Science, and Professor of Medical Psychology, College of Physicians and Surgeons, Columbia University.*

Ford Hutchinson. *Free-lance writer.*

Jacques André Istel. *President, Intramanagement, Incorporated, New York City. Former President, Parachutes Incorporated, Orange, Mass.*

Oswald Jacoby. *Author of* Oswald Jacoby's Complete Canasta *and many other works on card playing.*

Saul Jarcho, M.D. *Associate Attending Physician, Mt. Sinai Hospital, New York City. Consultant to the Surgeon General of the U.S. Army and to the National Institute of Health, Bethesda, Md.*

Herbert Henry Jasper, M.D. *Professor of Neurophysiology, University of Montreal. Consultant in Neurophysiology, Montreal Neurological Institute, McGill University.*

Franklin Davis Johnston, M.D. (d. 1971). *Professor of Internal Medicine, University of Michigan, Ann Arbor.*

J.R. Kantor. *Emeritus Professor of Psychology, Indiana University, Bloomington.*

Ben Zion Kaplan. *President, Universal Hairpieces, New York City.*

George Alexander Kelly (d. 1967). *Professor of Psychology, Brandeis University, Waltham, Mass., 1965–67.*

Pearl L(uella) Kendrick. *Emeritus Lecturer, Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor.*

Meave Kenny, M.D. *Former University Reader in Obstetrics and Gynecology, Postgraduate Medical School of London.*

John Franklin Kenward, M.D. *Associate Professor, Departments of Pediatrics and Psychiatry, University of Chicago.*

Thomas Edward Keys. *Emeritus Professor of the History of Medicine, Mayo Graduate School of Medicine, University of Minnesota, Rochester.*

Joseph Barnett Kirsner, M.D. *Louis Block Professor of Medicine; Chief of Staff and Deputy Dean for Medical Affairs, University of Chicago.*

Lincoln Edward Kirstein. *General Director, New York City Ballet Company.*

Arthur Paul Klotz, M.D. *Professor of Medicine, Head of Section of Gastroenterology, University of Kansas, Kansas City.*

Heinrich Klüver. *Sewell L. Avery Distinguished Service Professor Emeritus of Biological Psychology, University of Chicago.*

Helen Lois Koch. *Emeritus Professor of Child Psychology, University of Chicago.*

Sigmund Koch. *Stiles Professor of Comparative Studies, University of Texas at Austin. Professor of Psychology, Duke University, Durham, N.C., 1952–64.*

Dieter Koch-Weser, M.D. *Professor of Preventive and Social Medicine; Associate Dean for International Programs, Medical School, Harvard University.*

Sheldon Jerome Korchin. *Professor of Psychology; Head, Psychology Clinic, University of California, Berkeley.*

Raymond G. Kuhlen (d. 1967). *Professor of Psychology, Syracuse University, N.Y.*

Peter N. Ladefoged. *Professor of Phonetics, University of California, Los Angeles.*

George E. Lardner (deceased). *Associate Editor, Bell-McClure Syndicate, Inc., New York City.*

Olof Larsell (d. 1964). *Professor of Neuroanatomy, University of Minnesota, Minneapolis.*

James P. Leake, M.D. *Former Medical Director, U.S. Public Health Service, Washington, D.C.*

Mary Leakey. *Director of Research, Olduvai Gorge, Tanzania.*

Edwin Herman Lennette, M.D. *Chief, Viral and Rickettsial Disease Laboratory, California State Department of Public Health. Lecturer in Epidemiology and Virology, School of Public Health, University of California, Berkeley.*

Max Levin, M.D. *Neurologist and Psychiatrist. Former Clinical Professor of Neurology, New York Medical College, New York City.*

Joseph Colville Lincoln. *Author of* Soaring for Diamonds.

Allan L. Lorincz, M.D. *Professor of Dermatology, University of Chicago.*

Douglas McAlpine, M.D. *Emeritus Consulting Physician, Middlesex Hospital and Maida Vale Hospital, London.*

John Dennis McCallum. *Author of* That Kelly Family; The Tiger Wore Spikes; This Was Football; *and others.*

Morton McCutcheon, M.D. (d. 1962). *Professor of Pathology, University of Pennsylvania, Philadelphia.*

Norris Dewar McWhirter. *Television Commentator, British Broadcasting Corporation. Compiler,* Guinness Book of World Records; Dunlop Book of Facts.

Ralph Hermon Major, M.D. (d. 1970). *Professor of Medicine and of the History of Medicine, University of Kansas, Kansas City.*

Yakov Malkiel. *Professor of Linguistics and Romance Philology, University of California, Berkeley.*

Sir James Gow Mann (d. 1962). *Surveyor of the Queen's Works of Art, 1946–62. Master of the Armouries, The Tower of London, 1939–62.*

Judd Marmor, M.D. *Director, Divisions of Psychiatry, Cedars-Sinai Medical Center, Los Angeles.*

Patrick Denis Mehigan (deceased). *Author of* History of Hurling; History of Irish Athletics; *and others.*

Albert H. Morehead (d. 1966). *Writer and Editor. Bridge Editor,* The New York Times, *1935–63.*

Geoffrey Mott-Smith (d. 1960). *Editor,* The Bridge World, *1936–46;* Games Digest, *1938–39. Author of* Book of Hobbies *and others.*

Manning Nash. *Professor of Anthropology, University of Chicago.*

John Douglas Newth. *Former Honorary Secretary, British Council for Doctor Schweitzer's Hospital.*

Charles Donald O'Malley. *Professor of Medical History, University of California Medical Center, Los Angeles.*

Thomas Parran, M.D. (d. 1968). *Surgeon General, U.S. Public Health Service, 1936–48. Dean, Graduate School of Public Health, University of Pittsburgh, 1948–58. President, Avalon Foundation, New York City, 1958–61.*

Donald G. Paterson (d. 1961). *Professor of Psychology; Member of Staff, Industrial Relations Center, University of Minnesota, Minneapolis.*

Virgil Wallace Peterson. *Executive Director, Chicago Crime Commission, 1942–70. Author of* Gambling—Should It Be Legalized? *and others.*

Donald L. Piccard. *Balloon Designer and Manufacturer.*

Jean Felix Piccard (d. 1963). *Professor of Aeronautical Engineering, University of Minnesota, Minneapolis. F.A.I. Balloon Pilot.*

Jeannette Piccard. *Consultant to the Director, National Aeronautical and Space Administration Manned Spacecraft Center, Houston, Texas, 1964–70.*

Cecil Wilson Plant. *Honorary Secretary, International Water Polo Board.*

Jaan Puhvel. *Professor of Indo-European Studies, University of California, Los Angeles.*

Ernst Pulgram. *Professor of Romance and Classical Linguistics, University of Michigan, Ann Arbor.*

C. Stanford Read, M.D. *Former Lecturer in Psychological Medicine, Bethlem Royal Hospital, London. Former Clinical Psychologist, West End Hospital for Nervous Diseases, London.*

Ivor Armstrong Richards. *Emeritus Professor of English, Harvard University.*

J. Alfred Rider, M.D. *Director, Gastrointestinal Research Laboratory, Franklin Hospital, San Francisco.*

Walther Riese, M.D. *Associate Professor Emeritus of the History of Medicine and of Neurology and Psychiatry, Medical College of Virginia, Richmond.*

Austin Herbert Riesen. *Professor of Psychology, University of California, Riverside.*

Samuel Rosenblatt. *Associate Professor of Oriental Languages, Johns Hopkins University, Baltimore.*

Arturo Stearns Rosenblueth, M.D. *Director, Centre for Investigation and Advanced Studies, National Polytechnic Institute, Mexico City.*

Raymond A. Ruge. *President, Eastern Ice Yachting Association, 1948, 1959–60; Secretary, 1938–42.*

Paul Farr Russell, M.D. *Visiting Professor, Harvard University School of Public Health, 1960–63. Staff member, Rockefeller Foundation, 1923–59.*

Donald Schiffer (d. 1964). *Editor, Sport and Outdoor Book Division, Thos. Nelson and Sons, New York City.*

T.C. Schneirla (d. 1968). *Curator of Animal Behaviour, American Museum of Natural History, New York City, 1947–68.*

Sidney Schulman, M.D. *Ellen C. Manning Professor of Neurology, University of Chicago.*

Thomas A. Sebeok. *Distinguished Professor of Linguistics; Professor of Anthropology and of Uralic and Altaic Studies; Chairman, Research Center for the Language Sciences, Indiana University, Bloomington.*

Laurance F. Shaffer. *Emeritus Professor of Psychology and Education, Teachers College, Columbia University.*

Pincus Sober. *Chairman, National A.A.U. Law and Legislation Committee; Track and Field Committee, 1956–61. Chairman, U.S. Olympic Track and Field Committee, 1957–61.*

Wesley William Spink, M.D. *Regents' Professor of Medicine, University of Minnesota, Minneapolis.*

Howard Burnham Sprague, M.D. *Honorary Physician to the Massachusetts General Hospital. Lecturer in Medicine, Harvard University, 1956–59.*

Ross Stagner. *Professor and Chairman, Department of Psychology, Wayne State University, Detroit.*

Mario Stefanini, M.D. *Director of the Laboratories, St. Elizabeth's Hospital, Danville, Ill.*

C.D. Stein, V.M.D. (d. 1965). *Consultant Animal Disease Eradication Division, Agricultural Research Service, U.S. Department of Agriculture.*

William H. Taliaferro (d. 1973). *Eliakim Hastings Moore Distinguished Service Professor of Microbiology, University of Chicago, 1954–60. Senior Immunologist, Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Ill., 1960–69.*

Lynn Thorndike (d. 1965). *Professor of History, Columbia University, 1924–52.*

Robert Henry Thouless. *Emeritus Reader in Educational Psychology, University of Cambridge; Fellow of Corpus Christi College, Cambridge.*

Bettey Tomasi. *Free-lance Writer on medical topics. Scuba Diving Instructor, Northern Michigan University, Marquette.*

Lorenzo Dow Turner (d. 1972). *Professor of English, Roosevelt University, Chicago, 1946–69.*

Richard Tuttle. *Researcher, Trudeau Institute, Saranac Lake, N.Y.*

Arthur Walter Tyler. *Former President, TYCO, Inc., Waltham, Mass.*

Frederick John Underhill. *Secretary, National Greyhound Racing Society of Great Britain.*

Ilza Veith. *Professor and Vice Chairman, Department of the History of Health Sciences, University of California, San Francisco.*

Nancy Theilgaard Watts. *Assistant Professor of Physical Therapy, Bouvé-Boston School, Tufts University, Medford, Mass.*

Louis Weinstein, M.D. *Professor of Medicine, Harvard University. Director, Clinical Service, Division of Infectious Disease, Peter Bent Brigham Hospital, Boston.*

Michael M. Wertheimer. *Professor of Psychology, University of Colorado, Boulder. Consultant, Veterans Administration Hospital, Denver.*

Emil Witschi (d. 1971). *Senior Scientist, Bio-Medical Division of the Population Council, Rockefeller University, New York City, 1967–71.*

Henry D. von Witzleben, M.D. *Emeritus Director of Professional Education, Veterans Administration Hospital, Palo Alto, Calif. Associate Clinical Professor Emeritus of Psychiatry, Stanford University, Calif.*

Rose Wolfson. *Clinical Psychologist. Author of* A Study in Handwriting Analysis and others.

William Lower Wonderly. *Translations Coordinator for Latin America, United Bible Societies, Mexico City.*

Robert Henry Yager, V.M.D. *Executive Secretary, Institute on Laboratory Animal Resources, National Research Council, National Academy of Sciences, Washington, D.C.*

Leo M. Zimmerman, M.D. *Professor of Surgery, Chicago Medical School. Senior Attending Surgeon, Michael Reese Hospital, Chicago.*

Joseph Zubin. *Emeritus Professor of Psychology, Columbia University. Chief, Psychiatric Research (Biometrics), New York State Department of Mental Hygiene, New York State Psychiatric Institute and Hospital.*

Part Five. Human society

John C. Abbott. *Deputy Director, Economic Analysis Division, Food and Agriculture Organization of the United Nations, Rome.*

George Plimpton Adams, Jr. *Professor of Economics, Cornell University, Ithaca, N.Y.*

John H. Adler. *Former Director, Programming and Budgeting Department, International Bank for Reconstruction and Development, Washington, D.C.*

Leslie Ronald Aldous. *Head of Information Department, United Nations Association of Great Britain and Northern Ireland, 1947–66. Editor,* United Nations Association Yearbook *and* New World.

Francis A. Allen. *Edson R. Sunderland Professor of Law, University of Michigan, Ann Arbor.*

Hans Herman Baerwald. *Professor of Political Science, University of California, Los Angeles; Director, Study Center of the University of California, Tokyo, 1965–67.*

Harry Elmer Barnes (d. 1968). *Historian, Sociologist, and Writer. Author of* A History of Historical Writing *and others.*

Richard Reeve Baxter. *Professor of Law, Harvard University.*

John Matthew Beck. *Executive Director, Chicago Consortium of Colleges and Universities.*

Cyril S(hirley) Belshaw. *Professor of Anthropology, University of British Columbia, Vancouver.*

George C.S. Benson. *Director of ROTC Programs, U.S. Department of Defense, Washington, D.C. Author of* The New Centralization *and others.*

Siegfried F. Bethke. *Marketing Economist, Food and Agriculture Organization of the United Nations, Rome.*

David Bidney. *Professor of Anthropology and of Education, Indiana University, Bloomington.*

George W. Bishop, Jr. *Professor and Head, Department of Finance, Northern Illinois University, De Kalb.*

George Gleason Bogert. *James Parker Hall Professor Emeritus of Law, University of Chicago.*

Marc Bouloiseau. *Former Secretary, Commission for the Economic and Social History of the French Revolution. Emeritus Teaching Assistant in the History of the French Revolution, University of Paris.*

Colin Fraser Brockington, M.D. *Emeritus Professor of Social and Preventive Medicine, Victoria University of Manchester, Eng.*

Dorothy Margaret Brodie. *Editor of Edmund Dudley's* Tree of Commonwealth.

Martin Bronfenbrenner. *Kenan Professor of Economics, Duke University, Durham, N.C.*

Lionel Neville Brown. *Professor of Comparative Law, University of Birmingham, Eng.*

James Robert Browning. *Circuit Judge, United States Court of Appeals for the Ninth Circuit, San Francisco.*

Arthur F. Burns. *John Bates Clark Professor of Economics, Columbia University. President, National Bureau of Economic Research, Inc., New York City.*

Thomas Ferrier Burns. *Chairman of Burns and Oates Ltd., Publishers, London, 1948–67. Editor,* The Tablet.

R. Freeman Butts. *William F. Russell Professor in the Foundations of Education; Associate Dean for International Studies, Teachers College, Columbia University.*

Raoul C. van Caenegem. *Professor of Medieval History, State University of Ghent, Belgium.*

Joseph R. Caldwell. *Professor of Anthropology, University of Georgia, Athens.*

Robert Graham Caldwell. *Professor of Criminology, University of Iowa, Iowa City.*

Charles Clifford Callahan. *Professor of Law, Ohio State University, Columbus.*

Archibald Hunter Campbell. *Regius Professor of Public Law, University of Edinburgh.*

George Barr Carson, Jr. *Chairman, Department of History, Oregon State University, Corvallis.*

John Philip Carter. *Professor of Business Administration, University of California, Berkeley.*

Brian Chapman. *Professor of Government, Victoria University of Manchester.*

Elliott E. Cheatham (d. 1972). *Charles Evans Hughes Professor of Law, Columbia University, 1950–57. Research Professor of Law, Vanderbilt University, Nashville, Tenn., 1968–72.*

Charles Edward Clark (d. 1963). *Judge, 1939–63. Chief Judge, U.S. Court of Appeals, 2nd Circuit, 1954–59. Dean, Law School, Yale University, 1929–39.*

Inis Lothair Claude, Jr. *Edward R. Stettinius, Jr., Professor of Government and Foreign Affairs, University of Virginia, Charlottesville.*

Luella Cole (Mrs. R.H. Lowie). *Author of* History of Education, from Socrates to Montessori *and others.*

J(ohn) B. Condliffe. *Senior Economist, Stanford Research Institute, Menlo Park, Calif., 1961–67. Author of* The Commerce of Nations *and others.*

Denis Victor Cowen. *Former Professor of Law, University of Chicago. Former Professor of Comparative Law, University of Cape Town, S.Af.*

Robert A. Cromie. *Daily Columnist,* Chicago Tribune.

Brainerd Currie (d. 1965). *Professor of Law, Duke University, Durham, N.C., 1961–65.*

Stanley James Curtis (deceased). *Reader in Education, University of Leeds, Eng., 1955–58; Honorary Lecturer in Medieval Philosophy, 1934–58.*

Alan Charles Lynn Day. *Professor of Economics, London School of Economics and Political Science, University of London.*

George Henry John Daysh. *Deputy Vice Chancellor; Emeritus Professor of Geography, University of Newcastle upon Tyne, Eng.*

Carl Thomas Devine. *Professor of Accounting, Florida State University, Tallahassee.*

Dudley Dillard. *Professor and Head, Department of Economics, University of Maryland, College Park.*

Mary Earhart Dillon. *Professor of Political Science, Queens College, City University of New York.*

William H. Dodge. *Professor of Business, University of Wisconsin, Madison.*

Joseph Dorfman. *Professor of Economics, Columbia University.*

Douglas F. Dowd. *Lecturer in Economics, California State University, San Jose and San Francisco.*

Harold Edson Driver. *Former Professor of Anthropology, Indiana University, Bloomington.*

Ralph Craigon Dudrow, Jr. *Former Director for the Red Cross Centenary, League of Red Cross Societies, Geneva.*

John F. Due. *Professor of Economics, University of Illinois, Urbana.*

Allison Dunham. *Arnold I. Shure Professor of Urban Law, University of Chicago.*

Charles Émile Durand. *Professor of Constitutional Law, University of Aix-Marseille, Aix-en-Provence, France.*

John K. Dyer, Jr. *Independent Actuary.*

Karl August Eckhardt. *Former Professor of Law, University of Berlin.*

John Percy Eddy. *Queen's Counsel; Judge, High Court of Judicature, Madras, 1929–30; Recorder of West Ham, 1936–49. Stipendiary Magistrate for East and West Ham, 1949–54.*

Robert Regan Edminster. *Professor of Economics, University of Utah, Salt Lake City.*

Fred R. Eggan. *Harold H. Swift Distinguished Service Professor Emeritus of Anthropology; Director, Philippine Studies Program, University of Chicago.*

Paul Einzig (d. 1973). *London Correspondent, the* Commercial and Financial Chronicle *(New York), 1945–73.*

Adolphus Peter Elkin. *Emeritus Professor of Anthropology, University of Sydney.*

Norman Robson Elliott. *Senior Lecturer in Geography, University of Edinburgh.*

Manuel C(onrad) Elmer. *Emeritus Professor and Head, Department of Sociology, University of Pittsburgh.*

Alex Elson. *Attorney. Co-author of* Illinois Civil Practice Forms *and others.*

Emory Gibbons Evans. *Professor and Head, Department of History, Northern Illinois University, De Kalb.*

Gordon Page Evans. *Secretary, Standing Conference on the Economic and Social Work of the United Nations.*

Gwynfor Evans. *Member of Parliament for Carmarthen, Wales, 1966–70. Author of* Plaid Cymru and Wales.

Charles Fairman. *Emeritus Professor of Law, Harvard University.*

Charles G. Fenwick. *Consultant, Department of Legal Affairs, Pan American Union, Washington, D.C. Professor of Political Science, Bryn Mawr College, Pa., 1918–40.*

Cornelia Van Hook Ferber. *Economist, Office of Programs and Research, Export-Import Bank of the United States.*

Ossip K. Flechtheim. *Professor of Political Science, Free University, Berlin.*

Henry Hubbard Foster, Jr. *Emeritus Professor of Law, New York University, New York City.*

Michel François. *Professor of the History of French Institutions, École Nationale des Chartes, Paris. Secretary General, International Committee of Historical Sciences.*

Lon L. Fuller. *Carter Professor of General Jurisprudence, Harvard University.*

Joseph William Garbarino. *Professor of Business Administration, University of California, Berkeley.*

Charles Garratt-Holden. *Former Secretary, The Building Societies Association, London.*

O. Benjamin Gerig (d. 1976). *Director, Office of Dependent Area Affairs, U.S. Department of State, 1945–62.*

Oscar R. Goodman. *Professor and Chairman, Department of Finance, Roosevelt University, Chicago.*

E. Kathleen Gough Aberle. *Former Professor of Anthropology, Simon Fraser University, Burnaby, B.C.*

Frank Graner. *Professor of Finance, University of Wisconsin, Madison.*

Leo Gross. *Professor of International Law, Tufts University, Medford, Mass.*

David Lawrence Grove. *Chief Economist, International Business Machines Corp., Armonk, N.Y.*

Claude William Guillebaud. *Emeritus Reader in Economics, University of Cambridge; Lecturer in Economics, 1926–56.*

Harry G. Guthmann. *Morrison Professor Emeritus of Finance, Northwestern University, Evanston, Ill.*

Gottfried Haberler. *Professor of International Trade, Harvard University.*

Moffatt Hancock. *Kirkwood Professor of Law, Stanford University, Calif.*

Frank Hamilton Hankins (d. 1970). *Professor of Sociology, Smith College, Northampton, Mass., 1922–46.*

Fred Harvey Harrington. *Vilas Research Professor of History, University of Wisconsin, Madison; President of the University of Wisconsin, 1962–70.*

Joseph R. Hartley. *Vice President and Dean for Academic Affairs, Indiana University, Bloomington.*

Harlan Henthorne Hatcher. *President Emeritus, University of Michigan, Ann Arbor.*

Forest Garrett Hill. *Professor of Economics, University of Texas at Austin.*

John Edward Christopher Hill. *Master, Balliol College, University of Oxford, 1956–78.*

Norman Llewellyn Hill. *Emeritus Professor of International Law and Relations, University of Nebraska, Lincoln.*

Finn Hiorthøy. *Judge of the Supreme Court of Norway, Oslo.*

Frank Hole. *Professor of Anthropology, Rice University, Houston, Texas; Director, Rice University Expeditions to Iran.*

George Kenneth Holland. *President, Institute of International Education, Inc., New York City.*

Bert Frank Hoselitz. *Professor of the Social Sciences and Economics, University of Chicago.*

Cyril O. Houle. *Professor of Education, University of Chicago.*

Ralph Gordon Hoxie. *President, Center for the Study of the Presidency, New York City. Chancellor, Long Island University, Greenvale, N.Y., 1964–68.*

Terence Wilmot Hutchison. *Professor of Economics, University of Birmingham, Eng.*

John Henry Hutton (d. 1968). *William Wyse Professor of Social Anthropology, University of Cambridge, 1937–50.*

James Nevins Hyde. *Lawyer.*

Elmore Jackson. *Vice President, United Nations Association of the U.S.A. Special Assistant for Policy Planning to the Assistant Secretary of State for International Organization Affairs, U.S. Department of State, 1961–64. Former Personal Assistant and Political Officer to the United Nations Representative for India and Pakistan.*

William Turrentine Jackson. *Professor of American History, University of California, Davis.*

Per Jacobsson (d. 1963). *Managing Director, International Monetary Fund, Washington, D.C., 1956–63.*

Fred W. Jameson (deceased). *Manager of Educational Services, Public Relations Department, Montgomery Ward and Company, Chicago.*

John E. Jeuck. *Robert Law Professor of Business Administration, University of Chicago.*

Nicholas deBelleville Katzenbach. *Vice President and General Counsel, International Business Machines Corporation, Armonk, N.Y. Attorney General, U.S. Department of Justice, 1965–66. Under Secretary, U.S. Department of State, 1966–68.*

George Williams Keeton. *Professor of Law, Brunel University, Uxbridge, Eng. Emeritus Professor of English Law, University of London.*

William H. Kelly. *Professor of Anthropology, University of Arizona, Tucson.*

Raymond P. Kent. *Professor of Finance and Business Economics, University of Notre Dame, Ind.*

Marshall D. Ketchum. *Emeritus Professor of Finance, University of Chicago.*

V.O. Key, Jr. (d. 1963). *Jonathan Trumbull Professor of American History and Government, Harvard University, 1955–63.*

Frank Leroy Kidner. *Vice President of Educational Relations; Professor of Economics, University of California, Berkeley.*

Charles P. Kindleberger. *Professor of Economics, Massachusetts Institute of Technology, Cambridge.*

Vernon Kinietz. *Educator. Author of* Chippewa Village *and others.*

Clyde Vernon Kiser. *Senior Research Demographer, Office of Population Research, Princeton, N. J.*

Paul Lincoln Kleinsorge. *Professor of Economics, University of Oregon, Eugene.*

Ole Ferdinand Knudsen. *Editor, Export Council of Norway, Oslo.*

Herman Kogan. *Corporate Historian, Field Enterprises, Inc. Author of* The Great EB.

Philip B. Kurland. *Professor of Law, University of Chicago. Editor of* The Supreme Court Review.

Harry Wellington Laidler (d. 1970). *Executive Director, League for Industrial Democracy.*

Clay Lancaster. *Author of* Japanese Influence in America; Architectural Follies in America; *and others.*

Gerard Eduard Langemeijer. *Attorney General, Supreme Court of the Netherlands, The Hague.*

Elihu Lauterpacht. *Barrister-at-Law. Fellow of Trinity College, Cambridge; Lecturer in Law, University of Cambridge.*

Edmund Ronald Leach. *Provost of King's College, Cambridge; Reader in Social Anthropology, University of Cambridge.*

James Elzar Lebensohn, M.D. *Associate Professor Emeritus of Ophthalmology, Northwestern University, Chicago.*

Colin Legum. *Associate Editor,* The Observer, *London. Editor,* Africa Contemporary Record, *1968–78.*

George Eidt Lent. *Chief, Tax Policy Division, International Monetary Fund, Washington, D.C.*

Don Divance Lescohier (d. 1961). *Professor of Economics, University of Wisconsin, Madison, 1918–61.*

Robert Alan LeVine. *Professor of Anthropology and Human Development, University of Chicago.*

Choh-Ming Li. *Professor of Business Administration, University of California, Berkeley. Vice Chancellor, Chinese University of Hong Kong.*

Alfred Lief. *Biographer and Business Historian.*

Genevieve Collins Linebarger. *Associate Professor of Political Science, Trinity College, Washington, D.C., 1967–68.*

Paul M.A. Linebarger (d. 1966). *Professor of Asiatic Politics, School of Advanced International Studies, Johns Hopkins University, Washington, D.C., 1946–66.*

Kwang-Ching Liu. *Professor of History, University of California, Davis.*

Laurence Lockhart (d. 1975). *Member of the Faculty of Oriental Studies, University of Cambridge.*

Erwin Hugo Loewenfeld. *Solicitor of the Supreme Court, Great Britain. Member of the Faculty of Law, University of Cambridge. Legal Adviser, Liechtenstein Government.*

James Rubert Longstreet. *Professor and Chairman, Department of Finance, University of South Florida, Tampa.*

Jo Desha Lucas. *Professor of Law, University of Chicago.*

Alma Lutz. *Author of* Susan B. Anthony, Rebel, Crusader, Humanitarian *and others.*

John P. Lyall. *Marine Information Specialist and Sailing Directions Writer, Sailing Directions Branch, U.S. Naval Oceanographic Office, Washington, D.C.*

Wendell McClean. *Research Assistant, Institute of Social and Economic Research, University of the West Indies, Kingston, Jamaica.*

John McDowell. *Director for Social Welfare, National Council of the Churches of Christ in the U.S.A.*

James Angell MacLachlan (d. 1967). *Professor of Law, Harvard University, 1927–60.*

Charles R. Head McLoud. *Sailing Directions Branch, U.S. Naval Oceanographic Office, Washington, D.C.*

(Ardee) Wayne McMillen. *General Consultant, Bay Area Social Planning Council, Oakland, Calif. Professor of Social Service Administration, University of Chicago, 1936–60.*

Arnold Duncan McNair, 1st Baron McNair. *President, International Court of Justice, 1952–55; Judge, 1946–55.*

Edward McWhinney. *Professor, Institute of Air and Space Law, McGill University, Montreal.*

Reginald Francis Malcolmson. *Associate Professor, Department of Architecture and City Planning, Illinois Institute of Technology, Chicago.*

Julius Margolis. *Professor and Director, Fels Institute, University of Pennsylvania, Philadelphia. Professor of Economics, Stanford University, Calif., 1964–69.*

McKim Marriott. *Professor of Anthropology and of the Social Sciences, University of Chicago.*

John C. Martin. *Director, Navigational Information Services Division, U.S. Naval Oceanographic Office, Washington, D.C.*

Roscoe C. Martin (d. 1972). *Professor of Political Science, Syracuse University, N.Y., 1949–72.*

Harold M. Mayer. *Professor of Geography; Associate Director, Center for Great Lakes Studies, University of Wisconsin, Milwaukee.*

Ben Scudder Meeker. *Chief U.S. Probation Officer and Director of Training Center, Chicago.*

Lois Bannister Merk. *Lecturer in History, Northeastern University, Boston, 1956–68.*

Ford Messamore (d. 1962). *Professor of Stockton College, Canton, Mo.*

Michael Charles Meston. *Professor of Scots Law, University of Aberdeen, Scot.*

Adolphe Erich Meyer. *Emeritus Professor of Educational History, New York University, New York City.*

John Francis Marchment Middleton. *Professor of Anthropology, New York University, New York City.*

Elmer Mayse Million. *Professor of Law, New York University, New York City.*

Aron Leonard Minkes. *Director, Graduate Centre for Management Studies, University of Birmingham, Eng.*

Broadus Mitchell. *Emeritus Professor of Economics, Rutgers University, New Brunswick, N. J.*

(Montague Francis) Ashley Montagu. *Biological and cultural anthropologist. Professor and Chairman, Department of Anthropology, Rutgers University, New Brunswick, N.J., 1949–55.*

Patrick Wykeham Montague-Smith. *Editor,* Debrett's Peerage; *Assistant Editor, 1946–62.*

John Michael Montias. Professor of Economics, Yale University.

Lynn Montross (d. 1961). *Historian, United States Marine Corps, 1950–61.*

Rev. E. Garth Moore. *Barrister-at-Law. Chancellor, Dioceses of Durham, Southwark and Gloucester. Fellow of Corpus Christi College, University of Cambridge.*

Hans J. Morgenthau. *Albert A. Michelson Distinguished Service Professor Emeritus of Political Science and Modern History, University of Chicago. Leonard Davis Distinguished Professor of Political Science, City College, City University of New York.*

James William Morley. *Professor of Government, Columbia University.*

George Peter Murdock. *Andrew Mellon Professor of Social Anthropology, University of Pittsburgh.*

Lawrence Nabers. *Professor of Economics, University of Utah, Salt Lake City.*

Phil Caldwell Neal. *Dean and Professor, Law School, University of Chicago.*

Carl Leroy Nelson. *George O. May Professor of Financial Accounting, Columbia University.*

Jeannette Paddock Nichols. *Research Associate in Economic History, University of Pennsylvania, Philadelphia; Associate Professor of History, 1957–61.*

Maurice Nockles. *Press and Information Officer, Board of Customs and Excise, London.*

Val Nolan, Jr. *Professor of Law and of Zoology, Indiana University, Bloomington.*

Douglass Cecil North. *Professor of Economics, University of Washington, Seattle.*

Robert C. North. *Professor of Political Science, Stanford University, Calif.*

A.C. Olshen. *Actuarial Consultant. Former Senior Vice President and Director, West Coast Life Insurance Company, San Francisco.*

Morris Edward Opler. *Professor of Anthropology, University of Oklahoma, Norman.*

Herbert L. Packer (d. 1972). *Professor of Law, Stanford University, Calif.*

Cyril Northcote Parkinson. *Raffles Professor of History, University of Malaya, 1950–58.*

Maureen L.P. Patterson. *Assistant Professor of South Asian Languages and Civilizations; South Asia Bibliographic Specialist, University of Chicago.*

Kosta Stevan Pavlowitch. *Librarian, Department of Slavonic Studies, University of Cambridge. Author of* The Struggle of the Serbs *and others.*

Adamantios A. Pepelasis. *Professor of Economics, Virginia Polytechnic Institute and State University, Blacksburg.*

Frederick William Pethick-Lawrence, 1st Baron Pethick-Lawrence (d. 1961). *Secretary of State for India and Burma, 1945–47. Privy Councillor.*

Joseph Dexter Phillips. *Research Professor, Bureau of Economic and Business Research, University of Illinois, Urbana.*

George Wilson Pierson. *Larned Professor of History, Yale University.*

William M. Pinkerton. *News Officer for the University, Harvard University.*

Frederick P. Pittera. *Chairman, International Exposition Consultants Co. President, Frederick Pittera and Associates, Inc. Author of* The Art and Science of International Fairs and Exhibitions *and others.*

Earl Edward Pollock. *Member of the law firm of Sonnenschein, Levinson, Carlin, Nath & Rosenthal, Chicago.*

David Morris Potter (d. 1971). *William R. Coe Professor of American History, Stanford University, Calif., 1961–71.*

Pitman Benjamin Potter. *Emeritus Professor of International Law, American University, Washington, D.C. Member, Board of Editors,* American Journal of International Law.

Raphael Powell (d. 1965). *Professor of Roman Law, University of London, 1955–64.*

Francis Douglas Price. *Lecturer in Modern History, University of Oxford; Fellow and Tutor, Keble College, Oxford.*

Roy Pryce. *Reader in Contemporary European Studies; Director, Centre for Contemporary European Studies, University of Sussex, Brighton, Eng.*

Peter George Julius Pulzer. *Lecturer in Politics, University of Oxford; Official Student and Tutor in Politics, Christ Church, Oxford.*

Nathan Marsh Pusey. *President of Harvard University, 1953–71.*

Robert Mantle Rattenbury (d. 1970). *Registrary, University of Cambridge, 1953–69.*

David Allen Revzan. *Professor of Business Administration, University of California, Berkeley.*

Max Y. Rheinstein. *Max Pam Professor Emeritus of Comparative Law, University of Chicago.*

Madeleine Hooke Rice. *Professor of History, Hunter College, City University of New York.*

John Henry Richardson (d. 1970). *United Nations Technical Assistance Adviser (International Labour Office), 1956–65. President, Aden Industrial Court, 1960–66. Professor of Industrial Relations, University of Leeds, Eng., 1930–55.*

Benjamin Charles Roberts. *Professor of Industrial Relations, London School of Economics and Political Science, University of London.*

John Morris Roberts. *Fellow and Tutor of Merton College, University of Oxford.*

Sir Dennis Holme Robertson (d. 1963). *Professor of Political Economy, University of Cambridge, 1944–57.*

Robert Robson. *Fellow and Tutor of Trinity College, University of Cambridge. Author of* The Attorney in Eighteenth Century England.

William Alexander Robson. *Emeritus Professor of Public Administration, University of London; Honorary Fellow and Lecturer, London School of Economics and Political Science. Vice President, Royal Institute of Public Administration.*

C.H. Rolph. *Legal and Sociological Correspondent,* New Statesman, *London. Author of* Law and the Common Man *and others.*

Raymond de Roover (d. 1972). *Professor of History, Brooklyn College, City University of New York. Foreign Member, Royal Flemish Academy of Science, Section of Letters, Brussels.*

Margaret Keeney Rosenheim. *Professor, School of Social Service Administration, University of Chicago.*

M.J. Ryan. *Former Professor of Constitutional Law, University College, Dublin.*

Wolfgang Sauer. *Professor of History, University of California, Berkeley.*

Elmer Schmierer. *Colonel, U.S. Army, Infantry (retired).*

Helmut Schoeck. *Professor of Sociology, Johannes Gutenberg University, Mainz, W.Ger.*

Gerhard Schulz. *Professor of Contemporary History; Director, Seminar of Contemporary History, University of Tübingen, W.Ger.*

Egon Schwelb. *Former Principal Officer, Office of Legal Affairs, United Nations, New York City; Deputy Director, Division of Human Rights, 1947–62. Senior Fellow and Emeritus Lecturer in Law, Yale University.*

Austin Wakeman Scott, Jr. (d. 1966). *Professor of Law, University of Colorado, Boulder.*

Odell Shepard (d. 1967). *Author of* Pedlar's Progress, The Life of Bronson Alcott *and others.*

Stanley C. Silverberg. *Senior Economist, Office of the Comptroller of the Currency, Washington D.C.*

Helen Silving. *Professor of Law, University of Puerto Rico.*

Edwin Howard Simmons. *Brigadier General, U.S. Marine Corps; Director, Marine Corps History and Museums, Arlington, Va.*

Denis Sinor. *Distinguished Professor of Uralic and Altaic Studies and of History; Chairman, Department of Uralic and Altaic Studies, Indiana University, Bloomington.*

Gabriel Smith. *Barrister-at-Law. Lecturer in Industry and Finance, City of London College. Departmental Editor,* Journal of Business Law.

Theodore H. Smith. *Emeritus Professor of Marketing, California State College, Fullerton.*

Ernst Frithiof Söderlund. *Former Professor of Economic History, University of Stockholm.*

Wallace Sokolsky. *Associate Professor of History, Bronx Community College, City University of New York. Lecturer, New York University and New School for Social Research, New York City.*

Ezra Solomon. *Dean Witter Professor of Finance, Graduate School of Business, Stanford University, Calif., 1961–71.*

Dorothy Mary Spencer. *Visiting Lecturer in South Asia Regional Studies, University of Pennsylvania, Philadelphia.*

Edward H. Spicer. *Professor of Anthropology, University of Arizona, Tucson.*

Mysore Narasimhachar Srinivas. *Professor of Sociology, University of Delhi, India.*

Michael Steed. *Lecturer in Government, Victoria University of Manchester.*

Walter Marcel Stern. *Senior Lecturer in Economic History, London School of Economics and Political Science, University of London.*

Henry Noel Cochrane Stevenson. *Managing Director, Scottish Television Ltd., 1961–66. Lecturer in Social Anthropology, University of Glasgow, 1950–57. Burma Frontier Service, 1926–47.*

Omer C. Stewart. *Professor of Anthropology, University of Colorado, Boulder.*

Marcel Henri Stijns (d. 1967). *President of Honour, International Federation of Journalists. Editor in Chief,* Het Laatste Nieuws, *Brussels.*

John E. Stoner. *Emeritus Professor of Government, Indiana University, Bloomington.*

John Ford Stover. *Professor of History, Purdue University, West Lafayette, Ind.*

Ruth Strang (d. 1971). *Professor of Education, Teachers College, Columbia University, 1940–60.*

Robert Strausz-Hupé. *U.S. Ambassador to Belgium. Professor of Political Science, University of Pennsylvania, Philadelphia.*

Donald Stuart Strong. *Professor of Political Science, University of Alabama, Tuscaloosa.*

Roland Stucki. *Professor of Banking and Finance; Head, Department of Finance, University of Utah, Salt Lake City.*

William C. Sturtevant. *Curator, Department of Anthropology, Smithsonian Institution, Washington, D.C.*

Ernst W. Swanson. *Emeritus Professor of Economics, North Carolina State University at Raleigh.*

Philip Taft. *Emeritus Professor of Economics, Brown University, Providence, R.I.*

Lawrence Edward Tanner. *Librarian, Westminster Abbey, London; Keeper of the Muniments, 1926–66.*

Sheldon Tefft. *James Parker Hall Professor Emeritus of Law, University of Chicago.*

Georges Tessier (d. 1967). *Professor of Diplomacy, École Nationale des Chartes (School of Paleography), Paris, 1930–61.*

Brinley Thomas. *Professor of Economics, University College, Cardiff, University of Wales.*

Joseph Anthony Charles Thomas. *Professor of Roman Law, University of London.*

William Miles Webster Thomas, Baron Thomas. *Chairman, Britannia Airways Ltd.; Neumo Ltd.; and other companies. Director, Sun Insurance Office, Ltd. President, National Savings Committee, 1965–72.*

David Thomson (d. 1970). *Master, Sidney Sussex College, University of Cambridge, 1957–70. Author of* Europe Since Napoleon *and others.*

Samuel Edmund Thorne. *Professor of Legal History, Harvard University.*

Nicholas S. Timasheff (d. 1970). *Professor of Sociology, Fordham University, New York City, 1949–57.*

Mischa Titiev. *Former Professor of Anthropology, University of Michigan, Ann Arbor.*

Bursley Howland Titus. *Former Analyst, Department of the Army, Washington, D.C.*

Frederick Porter Todd. *Colonel, U.S. Army Reserve (retired). Director, West Point Museum, U.S. Military Academy, 1953–65.*

Frederick B. Tolles. *Howard M. Jenkins Professor Emeritus of Quaker History, Swarthmore College, Pa.; Director, Friends Historical Library, 1941–70.*

Stanley Trapido. *Lecturer in the Government of New States, University of Oxford.*

Philip N(orton) Tucker. *Military Intelligence Research Specialist, Office of Assistant Chief of Staff, Intelligence, Department of the Army, Washington, D.C.*

Will C. Turnbladh. *Commissioner of Corrections, State of Minnesota.*

Dorothy Firman Van Ess (Mrs. John Van Ess). *Retired Missionary, Arabian Mission of the Reformed Church in America. Educational and social worker, Basra, Iraq, 1909–55.*

Harold Goodhue Vatter. *Professor of Economics, Portland State University, Ore.*

Francis Joseph Violich. *Professor of City Planning and of Landscape Architecture, University of California, Berkeley.*

Charles De Visscher. *Honorary President of the Institute of International Law. Judge, International Court of Justice, 1945–52.*

Sir Claud Humphrey Meredith Waldock. *Chichele Professor of Public International Law, University of Oxford, 1947–72.*

Donovan William Mockford Waters. *Professor of Law, McGill University, Montreal.*

Hans W. Weigert. *Director, Georgetown Research Project, Washington, D.C. Former Research Professor of Political Geography, Georgetown University.*

Joseph Sidney Weiner. *Professor and Director, Environmental Physiology Research Unit, London School of Hygiene and Tropical Medicine, University of London. Reader in Physical Anthropology, University of Oxford, 1945–62.*

William Thomas Wells. *Queen's Counsel. Member of Parliament for Walsall, Eng., 1945–55; Walsall North, 1955– . General Staff Officer, 2nd Grade, Directorate of Military Training, War Office, London, 1942–45.*

Roger J.R. Whistler. *Major; Regimental Secretary, Regimental Headquarters, Royal Military Police, Roussillon Barracks, Chichester, Eng.*

Harry George Whiteman. *Writer and critic.*

Neill Compton Wilson. *Author of* Treasure Express: Epic Days of Wells Fargo *and others.*

Robert Renbert Wilson. *James B. Duke Professor Emeritus of Political Science, Duke University, Durham, N.C.*

Arthur Evans Wood (d. 1960). *Professor of Sociology, University of Michigan, Ann Arbor.*

Ruth Frances Woodsmall (d. 1963). *United Nations Representative of International Alliance of Women. Chief of Women's Affairs, U.S. High Commission of Germany, 1948–52. General Secretary, World YWCA, 1934–48.*

Quincy Wright (d. 1970). *Professor of International Law, University of Chicago, 1931–56.*

Frederick S. Wyle. *Vice President and General Counsel, Schroders Inc., New York City.*

Kimball Young. *Emeritus Professor of Sociology, Northwestern University, Evanston, Ill.*

Carle Clark Zimmerman. *Emeritus Associate Professor of Sociology, Harvard University.*

Robert Walter Zimmermann. *Adviser to the Special Assistant for Southeast Asia Treaty Organization Affairs, U.S. Department of State.*

George William Zinke. *Professor of Economics and Director, Center for Labor Education and Research, University of Colorado, Boulder.*

Roman J. Zorn. *Professor of History, University of Nevada, Las Vegas.*

Part Six. Art

Gerald E.H. Abraham. *President, Royal Musical Association, 1970–74. Assistant Controller of Music, British Broadcasting Corporation, London, 1962–67. James and Constance Alsop Professor of Music, University of Liverpool, 1947–62.*

Irving Abrahamson. *Professor of English, Kennedy-King College, City Colleges of Chicago.*

Percy G. Adams. *Former Professor of English, Louisiana State University, Baton Rouge.*

Reed Anderson. *Assistant Professor of Spanish and Portuguese, University of California, Davis.*

J.A. Andrups. *Author of* Latvian Literature *and others.*

Noel Gilroy Annan, Baron Annan. *Provost of University College, University of London. Author of* Leslie Stephen.

Joseph Anthony. *Former Special Assignments Editor,* Encyclopaedia Britannica, *Chicago.*

Giovanni Aquilecchia. *Professor of Italian, Bedford College, University of London.*

Arthur John Arberry (d. 1969). *Sir Thomas Adams Professor of Arabic, University of Cambridge, 1947–69.*

Elizabeth Mary Aslin. *Assistant Keeper, Victoria and Albert Museum, London.*

Anthony Cuthbert Baines. *Curator of the Bate Collection, University of Oxford. Editor of* Musical Instruments Through the Ages.

Peter P. Baldass. *Author of* Romanische Kunst in Österreich *and others.*

Rev. John Francis Bannon, S.J. *Professor of History, St. Louis University, Mo.*

William Barr. *Lecturer in Latin and Greek, University of Liverpool.*

Eleanor Dodge Barton. *Professor and Chairman, Department of Art History, University of Hartford, West Hartford, Conn. Professor and Chairman, Department of Art, Sweet Briar College, Va., 1952–71.*

Annette K. Baxter. *Professor of History, Barnard College, Columbia University. Author of* Henry Miller, Expatriate.

William Beare (d. 1963). *Professor of Latin, University of Bristol, Eng., 1931–63.*

Alexander Munro Beattie. *Professor of English, Carleton University, Ottawa.*

Charles G. Bell. *Poet and novelist. Tutor, St. John's College, Santa Fe, N.M. Author of* Delta Return; The Married Land; *and others.*

Benedikt Sigurdur Benedikz. *Head of Special Collections, Library, University of Birmingham, Eng.*

Michel N. Benisovich (d. 1963). *Art historian. Instructor, New York University.*

Albert S. Bennett. *Free-lance writer. Senior Editor and Biographies Editor,* The American Heritage Dictionary of the English Language, *1966–68.*

Joan Bennett. *Fellow of Girton College, Cambridge; former Lecturer in English, University of Cambridge.*

Ian D. Bent. *Professor of Music, University of Nottingham, Eng.*

John Dagfinn Bergsagel. *Former Senior Lecturer in the History of Music, Victoria University of Manchester.*

Joshua Berrett. *Assistant Professor of Humanities, Wayne State University, Detroit.*

Albert Bettex. *Author and lecturer. Editor,* Librarium.

Easley Blackwood. *Professor of Music, University of Chicago.*

James Blades. *Lecturer on music. Professional Timpanist, English Opera Group and English Chamber Orchestra.*

Claude Blair. *Keeper of Metalwork, Victoria and Albert Museum, London.*

Walter Blair. *Emeritus Professor of English, University of Chicago.*

José Manuel Blecua. *Professor of the History of Spanish Language and Literature, University of Barcelona.*

Joseph Sullivan Bolt. *Professor of Art, University of Alabama, Tuscaloosa.*

Marvin Sidney Borowsky (d. 1969). *Professor of Theatre Arts, University of California, Los Angeles.*

Margaret Innes Bouton. *Curator in Charge of Educational Work, National Gallery of Art, Washington, D.C.*

Alan Bowness. *Reader in the History of Art, Courtauld Institute of Art, University of London.*

Charles Ralph Boxer. *Professor of History, Yale University, 1969–72. Camoens Professor Emeritus of Portuguese, King's College, University of London.*

Muriel Clara Bradbrook. *Professor of English Literature, University of Cambridge; Mistress of Girton College, Cambridge.*

Johannes Christiaan Brandt Corstius. *Professor of Comparative Literature, State University of Utrecht, Neth.*

Otto J. Brendel. *Professor of Art History and Archaeology, Columbia University.*

Liliana Brisby. *Author of* Les Relations russo-bulgares, 1878–1886.

Oscar Gross Brockett. *Professor of Theatre and Drama, Indiana University, Bloomington.*

Bernard Jocelyn Brooke (d. 1966). *Author of* The Military Orchid *and others.*

Anita Brookner. *Lecturer at Courtauld Institute of Art, University of London.*

Conrad Brown. *Chief Editor, Adult Books, Grosset and Dunlap Inc., New York City.*

Reginald Francis Brown. *Cowdray Professor of Spanish Language and Literature, University of Leeds, Eng.*

Robert Browning. *Professor of Classics and Ancient History, Birkbeck College, University of London.*

J.A.B. Van Buitenen. *Professor of Sanskrit and Indic Studies; Chairman, Department of South Asian Languages and Civilizations, University of Chicago.*

John Burton-Page. *Reader in the Art and Archaeology of South Asia, School of Oriental and African Studies, University of London.*

Douglas Bush. *Gurney Professor Emeritus of English Literature, Harvard University.*

Joseph T. Butler. *Curator, Sleepy Hollow Restorations, Tarrytown, N.Y. American Editor,* The Connoisseur. *Adjunct Associate Professor of Architecture, Columbia University.*

Henry Seidel Canby (d. 1961). *Literary critic. Founder and Editor,* Saturday Review of Literature, *1924–36.*

Harry Caplan. *Goldwin Smith Professor Emeritus of the Classical Languages and Literature, Cornell University, Ithaca, N.Y.*

Sir Neville Cardus. *Music Critic, the* Guardian *(London).*

Margret A. Carey. *Former Assistant Keeper, Department of Ethnography, British Museum, London.*

Pierre-Georges Castex. *Professor of Modern French Literature, University of Paris.*

Homero Castillo. *Professor of Spanish, University of California, Davis.*

James Caswell. *Associate Professor of Art History, University of British Columbia, Vancouver.*

John Chalker. *Senior Lecturer in English, University College, University of London.*

Moti Chandra. *Director, Prince of Wales Museum of Western India, Bombay.*

Pramod Chandra. *Professor of Art and of South Asian Languages and Civilizations, University of Chicago.*

Charles Manning Hope Clark. *Professor and Head, Department of History, Australian National University, Canberra.*

James Midgley Clark (d. 1961). *Professor of German, University of Glasgow, 1951–54.*

Derek Plint Clifford. *Free-lance writer. Author of* A History of Garden Design *and others.*

Pierre Cogny. *Senior Lecturer in French Literature, University of Caen, France.*

John Michael Cohen. *Fellow of the Royal Society of Literature. Editor of* More Comic and Curious Verse; A History of Western Literature; *and others.*

Carl Wilbur Condit. *Professor of Art and Urban Affairs, Northwestern University, Evanston, Ill.*

Douglas Cooper. *Art historian and critic. Author of* Courtauld Collection, a Catalogue *and others.*

Wayne F. Cooper. *Hospital Care Investigator, Department of Social Services, New York City.*

Gertrude Mary-Anne Coor (d. 1962). *Art historian. Assistant, Institute for Advanced Study, Princeton, N.J., 1959–62.*

Solange Corbin. *Professor of Musicology, University of Poitiers, Fr.*

Charles Philip Corney. *Deputy Librarian, British Library of Political and Economic Science, University of London.*

Robert B. Costello. *Publications Editor, Museum of Modern Art, New York City.*

David Cowan. *Senior Lecturer in Arabic, School of Oriental and African Studies, University of London.*

Edward Croft-Murray. *Keeper, Department of Prints and Drawings, British Museum, London.*

Anthony Cronin. *Poet and critic.*

Margaret Campbell Crum. *Assistant, Department of Western Manuscripts, Bodleian Library, University of Oxford.*

Charles L.E. Cudworth. *Curator, Pendlebury Library of Music, University of Cambridge; Fellow of University College, Cambridge.*

William Aubrey Darlington. *Chief Drama Critic,* London Daily Telegraph, *1920–68. London Theatre Correspondent,* The New York Times, *1939–60.*

Ronald Austin Davey. *Professor and Head, Department of Fine Art, University of Alberta, Edmonton.*

Donald Alfred Davie. *Professor of English, Stanford University, Calif.*

Harold Hess Davis (d. 1964). *Phebe Estelle Spalding Professor of English Literature, Pomona College, Claremont, Calif.*

J. Cary Davis. *Professor of Romance Languages, Southern Illinois University, Carbondale.*

Margaret Josephine Dean-Smith. *Author of* A Guide to English Folk Song Collections *and others.*

Joseph-Edouard-Marie-Ghislain Delmelle. *Member, Académie Internationale de Culture Française. Poet, essayist, and critic of art and literature.*

Frederic Paul Deloffre. *Professor of French Literature, University of Paris III.*

Bernard Denvir. *Principal Lecturer, Ravensbourne College of Art and Design, Bromley, Eng.*

Leon Townsend Dickinson. *Professor of English, University of Missouri, Columbia.*

Paul Dinnage. *Free-lance writer, translator, and book reviewer. Formerly reviewer for literature,* The Times (*London*) Literary Supplement, *and for art,* The Spectator.

Maurice Willson Disher (d. 1969). *Author of* Blood and Thunder; Clowns and Pantomimes; *and others.*

Armel Hugh Diverres. *Carnegie Professor of French, University of Aberdeen, Scot.*

John V. Dodge. *Vice-President Emeritus, International Editorial, Encyclopædia Britannica, Inc., Chicago; Assistant and Managing Editor, 1938–60; Executive Editor, 1960–64.*

Charles Reginald Dodwell. *Pilkington Professor of the History of Art; Director, Whitworth Art Gallery, Victoria University of Manchester.*

Robert Donington. *Musicologist. Author of* The Instruments of Music; The Interpretation of Early Music; *and others.*

Filippo Donini. *Cultural Expert, Cultural Relations Department, Italian Ministry of Foreign Affairs, Rome, 1972–76. Director, Italian Institute, London, 1961–72.*

Richard M. Dorson. *Director, Folklore Institute, and Editor,* Journal of Folklore Studies; *Distinguished Professor of History and Folklore, Indiana University, Bloomington.*

Brian Westerdale Downs. *Master of Christ's College, Cambridge, 1950–63; Professor of Scandinavian Studies, University of Cambridge, 1950–60.*

Laura Dru. *Records and Archives Department, Madame Tussaud's Ltd., London.*

Anne Schley Duggan. *Professor and Dean, College of Health, Physical Education and Recreation, Texas Woman's University, Denton.*

René Dumesnil (d. 1967). *Literary and music critic. Member, Academy of Fine Arts, Institute of France, 1965–67.*

Archibald A.M. Duncan. *Professor of Scottish History and Literature, University of Glasgow.*

Lowell Dunham. *Professor of Modern Languages, University of Oklahoma, Norman.*

Wilma Robb Ebbitt. *Author. Former Professor of English, University of Chicago.*

Edwin Harold Eby. *Emeritus Professor of English, University of Washington, Seattle.*

Christopher Edmunds. *Composer. Examiner for the Trinity College of Music, London.*

Hugh Edwards. *Curator of Photography; Associate Curator, Department of Prints and Drawings, Art Institute of Chicago.*

Tudor Edwards. *Formerly Investigating Officer of Historic Buildings, Ministry of Town and Country Planning, England.*

Lorenz E.A. Eitner. *Executive Head, Department of Art and Architecture, Stanford University, Calif.*

Sverker Ek. *Emeritus Professor of Literary History, Göteborg University, Swed.*

Charles Grant Ellis. *Research Associate, The Textile Museum, Washington, D.C.*

Elmer Ellis. *Emeritus President; Former Professor of History, University of Missouri, Columbia.*

Abdulla el-Tayib. *Professor of Arabic; Dean, Faculty of Arts, University of Khartoum, Sudan.*

David Fagan. *Assistant Professor of Spanish and Portuguese, Indiana University, Bloomington.*

Alison (Anna Bowie) Fairlie. *Professorial Fellow of Girton College, Cambridge; Professor of French, University of Cambridge.*

Dennis Larry Ashwell Farr. *Director, City Museum and Art Gallery, Birmingham, Eng.*

Roger Elwyn Fiske. *Author of* Listening to Music; Ballet Music; *and others.*

Louis-Fernand Flutre. *Emeritus Professor of Old French Language and Literature, University of Lyon.*

John Stuart Forbes. *Deputy Warden, The Worshipful Company of Goldsmiths, London.*

Nigel Fortune. *Reader in Music, University of Birmingham, Eng.*

George Sutherland Fraser. *Poet and critic. Reader in Modern English Literature, University of Leicester, Eng.*

Oluf Anker Friis. *Former Professor of Literature, University of Copenhagen.*

Holger Elof Uno Frykenstedt. *Literary historian. Former Assistant Professor, University of Stockholm.*

Jean Overton Fuller. *Co-director, Fuller d'Arch Smith Ltd., Rare Books, London. Author of* Swinburne: A Critical Biography *and others.*

Richard Clair Gabriel. *Senior History Master, King's School, Worcester, Eng. Former Research Assistant, Institute of Historical Research, University of London.*

Hans Gal. *Composer and Musicologist. Former Lecturer on Music, University of Edinburgh. Director of Municipal College of Music, Mainz, Ger., 1929–33.*

Robert Gayre of Gayre and Nigg. *Editor,* Armorial, *Edinburgh.*

Willi Geismeier. *Director, National Gallery, National Museum of Berlin.*

Margaret Oliver Gentles. *Keeper of the Buckingham Collection of Japanese Prints; Associate Curator of Oriental Art, Art Institute of Chicago.*

Giuseppe Giangrande. *Reader in Classics, Birkbeck College, University of London.*

Robert Donald Davidson Gibson. *Professor of French, University of Kent at Canterbury, Eng.*

Alexander Gillies (d. 1977). *Professor of German Language and Literature, University of Leeds, Eng., 1945–72.*

Giovanni Pietro Giorgetti. *Lecturer in Italian, Birkbeck College, University of London.*

Cuthbert Morton Girdlestone. *Emeritus Professor of French, Universities of Durham and Newcastle upon Tyne, Eng.*

Frederick Goldbeck. *Critic and musicologist. Adviser for Music, Radiotélévision Française.*

Dale Good. *Librarian, Music Division, New York Public Library's Research Center for the Performing Arts at Lincoln Center.*

Robert Marshall Goodwin. *Racing correspondent, London.*

Sydney Charles Gould. *Former Reader in French and Comparative Literature, University of Bristol.*

Andrew Sydenham Farrar Gow. *Fellow of Trinity College, University of Cambridge. Author of* Theocritus (*text, translation, and commentary*) *and others.*

Alan Gowans. *Professor and Chairman, Department of History in Art, University of Victoria, B.C.*

Philip Graham (d.1967). *Professor of American Literature, University of Texas at Austin.*

Serge Grandjean. *Keeper, Department of* Objets d'Art, *Louvre Museum, Paris.*

Benny Green. *Jazz critic,* The Observer, *London. Record reviewer, British Broadcasting Corporation.*

David Greene. *Senior Professor, School of Celtic Studies, Dublin Institute for Advanced Studies.*

Eric Halfpenny. *Honorary Editor, The Galpin Society Journal.*

Enriqueta Harris. *Honorary Fellow of the Warburg Institute, University of London. Author of* Spanish Painting; Goya.

Francis Llewellyn Harrison. *Professor of Ethnomusicology, University of Amsterdam. Reader in the History of Music, University of Oxford, 1962–70.*

Arnold Lionel Haskell. *Governor, Royal Ballet; Governor, Royal Ballet School, London; Vice President, Royal Academy of Dancing, London.*

David Mackness Hayne. *Professor of French, University College, University of Toronto.*

John A. Haywood. *Former Reader in Arabic, University of Durham, Eng.*

Julian Herbage. *Free-lance musicologist, broadcaster, and writer.*

Barnard Hewitt. *Professor and Chairman, Department of Theatre, University of Illinois, Urbana.*

Ronald Francis Hingley. *Fellow of St. Antony's College, Oxford; University Lecturer in Russian, University of Oxford.*

André Hodeir. *Composer, conductor, and writer. Author of* Jazz: Its Evolution and Its Essence.

Christina Stanley Hole. *Honorary Editor,* Folklore. *Author of* English Custom and Usage; English Folklore; *and others.*

Kenneth Hopkins. *Novelist and poet. Professor of English, Southern Illinois University, Carbondale.*

John Horden. *Author of* Francis Quarles: A Bibliography of His Works to the Year 1800.

Paul Horgan. *Emeritus Professor of English; Author in Residence, Wesleyan University, Middleton, Conn.*

Louis Horst (d. 1964). *Teacher of Dance Composition, Juilliard School of Music. Managing Editor,* Dance Observer.

William Driver Howarth. *Professor of Classical French Literature, University of Bristol, Eng.*

Garfield Hopkin Hughes (d. 1969). *Senior Lecturer in Welsh Language and Literature, University College of Wales, Aberystwyth, 1960–69.*

G(eorge) Haydn Huntley. *Professor of Art, Northwestern University, Evanston, Ill.*

Jethro Hurt. *Instructor in the History of Art and Architecture, University of Illinois, Chicago.*

Dyneley Hussey (d. 1972). *Music critic,* The Times (*London*), *1923–46;* The Listener, *1946–60. Author of* Verdi; Some Composers of Opera.

Hans Huth. *Art historian. Emeritus Curator of Decorative Arts, Art Institute of Chicago.*

Gerard Willem Huygens. *Professor of History and Dutch Literature, Rotterdam Lyceum.*

Stuart Wallace Hyde. *Professor and Chairman, Department of Broadcast Communication Arts, California State University, San Francisco.*

Catherine Mills Ing. *Fellow of St. Hilda's College, Oxford; Senior Lecturer in English Literature, University of Oxford.*

Ian Jack. *Fellow and Librarian of Pembroke College, Cambridge; Lecturer in Literature, University of Cambridge.*

Stephen W. Jacobs. *Professor of Architecture, Cornell University, Ithaca, N.Y.*

Richard Edward Warwick James. *Assistant Curator, Barber Institute of Fine Arts; Lecturer in History of Art, University of Birmingham, Eng.*

William Louis G. James. *Senior Lecturer in English, University of Kent at Canterbury, Eng.*

Harold Jenkins. *Emeritus Professor of Rhetoric and English Literature, University of Edinburgh.*

Romilly James Heald Jenkins (d. 1969). *Professor of Byzantine History and Director of Studies, Harvard University Dumbarton Oaks Research Library and Collection, 1960–69.*

Frederick L. Jones. *Professor of English, University of Pennsylvania, Philadelphia.*

Joseph Jay Jones. *Professor of English, University of Texas at Austin.*

Bertram Leon Joseph. *Professor of Drama; Chairman, Department of Theatre, Queens College, City University of New York.*

Edgar Kaufmann, Jr. *Adjunct Professor of the History of Architecture, Columbia University. Former Director, Department of Industrial Design, Museum of Modern Art, New York City.*

Elspeth Mary Kennedy. *Lecturer in Modern Languages, University of Oxford; Fellow of St. Hilda's College, Oxford.*

Arnold Charles Kettle. *Professor of Literature, Open University, Walton, Eng.*

Donald King. *Deputy Keeper, Victoria and Albert Museum, London.*

Peter K. King. *Director, Institute of Modern Dutch Studies, University of Hull, Eng.*

A.M. Kinghorn. *Reader in English. University of the West Indies, Mona, Jamaica.*

Romas Kinka. *Lecturer in Lithuanian, University of Chicago; Vice Director of the Lithuanian Institute of Education, Chicago.*

Rev. James Kinsley. *Professor and Head, Department of English Studies; Dean of the Faculty of Arts, University of Nottingham, Eng. Member of the Council of the Scottish Text Society. General Editor, Oxford English Novels.*

F.E. Kirby. *Professor of Music, Lake Forest College, Ill.*

Michael William Lely Kitson. *Reader in the History of Art, Courtauld Institute of Art, University of London.*

Tibor Klaniczay. *Assistant Director, Institute for the History of Literature, Hungarian Academy of Sciences, Budapest.*

Margaret Brown Klapthor. *Associate Curator, Division of Political History, National Museum of History and Technology, Smithsonian Institution, Washington, D.C.*

Carl Frederick Klinck. *Senior Professor of English, University of Western Ontario, London.*

Dorothy Knowles. *Historian of modern French drama. Honorary Research Fellow, Bedford College, University of London.*

Leonie Judith Kramer. *Professor of Australian Literature, University of Sydney.*

Sven Møller Kristensen. *Professor of Scandinavian Literature, University of Copenhagen, Den.*

George Alexander Kubler. *Robert Lehman Professor of the History of Art, Yale University.*

Kai L.K. Laitinen. *Associate Professor of Finnish Literature, University of Helsinki.*

Basil Raymond Lam. *Conductor and harpsichordist. Organizer of Pre-Classical Music Programmes, British Broadcasting Corporation.*

Norman Jones Lamb. *Senior Lecturer in Portuguese and Spanish, University of Liverpool.*

Paul M. Laporte. *Professor of Art History, Immaculate Heart College, Los Angeles.*

Mary Madge Lascelles. *Fellow of the British Academy. Reader in English Literature, University of Oxford, 1966–67; Fellow of Somerville College, Oxford.*

Jan Lauts. *Director, Karlsruhe Art Gallery, W.Ger.*

Pierre Lavedan. *Director, Institute of Town Planning, University of Paris, 1940–65; Professor, Faculty of Letters, 1930–55.*

Reginald Norcom Lawrence (d. 1967). *Playwright. Lecturer in Speech, City College, City University of New York.*

Frederick Laws. *Free-lance journalist and art critic.*

Luis Leal. *Professor of Spanish, University of Illinois, Urbana.*

Raymond Lebègue. *Emeritus Professor of 16th- and 17th-Century French Literature, University of Paris. Officer of the Legion of Honour.*

Laurence Elliot Libin. *Associate Curator of Musical Instruments, Metropolitan Museum of Art, New York City.*

Ronald William Lightbown. *Assistant Keeper, Department of Metalwork, Victoria and Albert Museum, London.*

Sten Hjalmar Lindroth. *Professor of the History of Science and Ideas, University of Uppsala, Swed.*

René Felix Lissens. *Professor of Dutch and General Literature, St. Ignatius University Faculty, Antwerp. Member, Royal Flemish Academy of Language and Literature.*

Edward Lockspeiser (d. 1973). *Writer and broadcaster on music. Author of* Debussy: His Life and Mind *and others.*

David Loshak. *Assistant Professor of Art History, University of Wisconsin, Madison, 1958–64.*

John Evelyn Lowe. *Director, Weald and Downland Open Air Museum, Sussex, Eng. Principal, West Dean College.*

Wilfrid Irvine Lucas. *Emeritus Professor of German, University of Southampton, Eng.*

Kenneth Schuyler Lynn. *Professor of History, Johns Hopkins University, Baltimore.*

Henry Julius Philip Maas. *Joint Head of Academic Staff and Tutor in Classics, Moreton Hall, Oswestry, Eng. Co-editor of* The Letters of Ernest Dowson *and others.*

Richard Dyer MacCann. *Former Professor of Radio-TV-Film, University of Kansas, Lawrence.*

Ivy Lilian McClelland. *Reader in Spanish, University of Glasgow.*

Arthur Kilgore McComb (deceased). *Author of* The Baroque Painters of Italy *and others.*

Raven I(oor) McDavid, Jr. *Professor of English and Linguistics, University of Chicago.*

Rev. Eric McDermott, S.J. *Associate Professor of History, Georgetown University, Washington, D.C.*

Robert Law McDougall. *Professor of English; Carleton University, Ottawa; General Editor,* The Carleton Library.

Hugo A. McPherson. *Professor of English, McGill University, Montreal. Chairman and Commissioner, National Film Board of Canada, Montreal, 1967–70.*

Walter James Macqueen-Pope (d. 1960). *Writer on the theatre. Author of* Haymarket: Theatre of Perfection *and others.*

David Magarshack (d. 1977). *Author of* Chekhov the Dramatist; Dostoevsky; Pushkin: A Biography *and many other works on Russian writers.*

Claude-Edmonde Magny (d. 1966). *Teacher of Philosophy, University of Paris.*

Francis Peabody Magoun, Jr. *Emeritus Professor of English, Harvard University.*

Jean Mallion. *Lecturer, Faculty of Literature and Humane Studies, University of Grenoble, France.*

William P. Malm. *Professor of Music, University of Michigan, Ann Arbor.*

William Somervell Mann. *Music Critic,* The Times *(London).*

Sidney Marrat. *Journalist, literary critic, and theatre historian.*

Leonard Cyril Martin. *King Alfred Professor of English Literature, University of Liverpool, 1929–51.*

Colin Mason. *Music critic. Editor,* Tempo.

Claude Albert Mayer. *Professor and Head, Department of French, University of Liverpool.*

Ralph Mayer. *Painter. Director, Artists Technical Research Institute. Lecturer in Painting, Columbia University, 1944–64.*

Henry Armand Millon. *Professor of Architecture, Massachusetts Institute of Technology, Cambridge.*

Donald (Charles Peter) Mitchell. *Music critic and publisher. Managing Director, Faber Music Ltd., London. Visiting Fellow in Music, University of Sussex.*

Lillian Moore (d. 1967). *Dancer, Member of Faculty, American Ballet Center, New York City.*

Will G. Moore (d. 1978). *Reader in French Literature, University of Oxford.*

Albert Mordell (deceased). *Author of* Quaker Militant: John Greenleaf Whittier *and others.*

Edwin George Morgan. *Poet. Titular Professor of English, University of Glasgow.*

Frank Luther Mott (d. 1964). *Dean, School of Journalism, University of Missouri, Columbia, 1942–51.*

Peter J. Murray. *Professor of the History of Art, Birkbeck College, University of London.*

Reginald P.C. Mutter. *Reader in English Literature; Dean, School of English and American Studies, University of Sussex, Brighton, Eng.*

Bernard S. Myers. *Art historian. Editorial Director, Art Programs Unit, McGraw-Hill Book Company, New York City.*

Rollo H. Myers. *Writer on music. Author of* Music in the Modern World; Ravel: Life and Works *and others.*

Alois M. Nagler. *Henry McCormick Professor of Dramatic History and Criticism; Director of Graduate Studies in the History of the Theatre, Yale University.*

James Thompson Nardin. *Professor of English, Louisiana State University, Baton Rouge.*

Ray Nash. *Emeritus Professor of Art, Dartmouth College, Hanover, N.H.*

Arthur Hobart Nethercot. *Franklyn Bliss Snyder Professor Emeritus of English, Northwestern University, Evanston, Ill.*

Norman Cornthwaite Nicholson. *Poet and critic. Author of* H.G. Wells *and others.*

Robert Niklaus. *Emeritus Professor of French, University of Exeter, Eng.*

Arnoldus Noach. *Author of* De Oude Kerk te Amsterdam.

J. Jeremy Noble. *Associate Professor of Music, State University of New York at Buffalo.*

Linda Weinberg Nochlin (Mrs. Philip Nochlin). *Professor of Art History, Vassar College, Poughkeepsie, N.Y.*

Paul F. Norton. *Professor of Art, University of Massachusetts, Amherst.*

Francis Valentine O'Connor. *Co-editor,* Jackson Pollack: A Catalogue Raisonné of Paintings, Drawings, and Other Works. *Senior Visiting Research Associate, National Collection of Fine Arts, Smithsonian Institution, Washington, D.C., 1970–72.*

Donald Mitchell Oenslager. *Designer of scenery and theatre consultant. Professor of Scene Design, Yale University.*

Kenneth O'Leary. *Assistant Professor of English, Seton Hall University, South Orange, N.J.*

Aladar Olgyay (d. 1963). *Architect. Author of* Solar Control and Shading Devices *and others.*

Peter M. Opie. *Folklorist. Co-author of* The Oxford Dictionary of Nursery Rhymes; The

Lore and Language of Schoolchildren; Children's Games in Street and Playground.

(William Cyril) Desmond Pacey. *Vice President; Professor of English, University of New Brunswick, Fredericton.*

Sir Denys (Lionel) Page. *Regius Professor of Greek, University of Cambridge.*

Dorothy Margaret Partington. *Literary historian and critic.*

Roy Pascal. *Emeritus Professor of German. University of Birmingham, Eng.*

David Patterson. *Director, Oxford Centre for Post-Graduate Hebrew Studies; Cowley Lecturer in Post-Biblical Hebrew, University of Oxford; Fellow of St. Cross College, Oxford.*

Damião António Peres. *Former Professor of History, University of Coimbra, Port. Member, Portuguese Academy of History.*

Helene Peters. *Professor of French, Macalester College, St. Paul, Minn.*

Edwin Burr Pettet. *Former Schulman Professor of Theatre Arts, Brandeis University, Waltham, Mass.*

Friedrich Pfister (deceased). *Professor of Classical Philology, University of Würzburg, W.Ger.*

James Smith Pierce. *Professor and Chairman, Department of Art, University of Kentucky, Lexington.*

André Pierre (d. 1966). *Member of Editorial Staff,* Le Monde, *Paris, 1944–58.*

Vivian de Sola Pinto (d. 1969). *Professor of English, University of Nottingham, Eng., 1938–61.*

Henry C. Pitz. *Writer and painter. Emeritus Professor of Art, Philadelphia College of Art.*

Adolf K. Placzek. *Avery Librarian, Columbia University.*

Henry A. Pochmann. *Professor of English, University of Wisconsin, Madison.*

Georg Poensgen. *Formerly Director of the Palatinate Museum, Heidelberg, W.Ger.*

Sir John Wyndham Pope-Hennessy. *Consultative Chairman, Department of European Paintings, Metropolitan Museum of Art, New York City. Professor of Art, New York University.*

Anthony Powell. *Novelist, playwright, and literary critic.*

Mario Praz. *Emeritus Professor of English Language and Literature, University of Rome.*

Joseph Prescott. *Professor of English, Wayne State University, Detroit.*

Brian Priestman. *Orchestral Conductor. Former Musical Director, Royal Shakespeare Theatre Co.*

Chaim Rabin. *Professor of Hebrew Language, Hebrew University of Jerusalem.*

Frederic James Edward Raby (d. 1966). *Fellow and Lecturer, Jesus College, University of Cambridge, 1948–54. Author of* A History of Christian Latin Poetry *and others.*

Kathleen Raine. *Poet and scholar. Author of* Collected Poems; Blake and Tradition *and others.*

Gilbert Reaney. *Professor of Musicology, University of California, Los Angeles.*

Frederick Stephen Reckert. *Camoens Professor of Portuguese, King's College, University of London.*

Hans Siegbert Reiss. *Professor of German, University of Bristol, Eng.*

Edgar Preston Richardson. *President, Pennsylvania Academy of the Fine Arts, 1968–70. Director, Detroit Institute of Arts, 1945–62, and Winterthur Museum, Del., 1962–66.*

Gisela Marie Augusta Richter (d. 1972). *Curator, Greek and Roman Department, Metropolitan Museum of Art, New York City.*

Christopher Bruce Ricks. *Professor of English, University of Bristol, Eng.*

Charles Martin Robertson. *Lincoln Professor of Classical Archaeology and Art, University of Oxford.*

Jean Robertson. *Senior Lecturer in English Literature, University of Southampton, Eng.*

Charles Alan Robson. *Senior Lecturer in French Philology and Old French Literature, University of Oxford; Fellow of Merton College, Oxford.*

Sybil (Marion) Rosenfeld. *Joint Editor,* Theatre Notebook; *Joint Honorary Secretary, Society for Theatre Research.*

Marion Dean Ross. *Professor of Architecture, University of Oregon, Eugene.*

Cecil Roth (d. 1970). *Editor in Chief,* Encyclopaedia Judaica. *Reader in Jewish Studies, University of Oxford, 1939–64.*

Rev. Erik Reginald Routley. *Minister, St. James United Reformed (formerly Congregational) Church, Newcastle upon Tyne, Eng. Author of* Hymns and Human Life *and others.*

Harold Rutland. *Music critic. Examiner, Trinity College of Music, London. Editor,* The Musical Times, *1957–60.*

Stanley John Sadie. *Music critic,* The Times *(London). Editor of* The Musical Times; Grove's Dictionary of Music.

Kaarlo Salo. *Attaché for Press and Cultural Affairs, Finnish Embassy, London.*

Lionel Salter. *Assistant Controller of Music, British Broadcasting Corporation, London.*

Angiola Sartorio. *Choreographer. Director of International Summer Dance School, Corona Del Mar, Calif. Former Head of the Dance Department, Sullins College, Bristol, Va.*

Richard Anthony Sayce. *Fellow of Worcester College, Oxford; Reader in French Literature, University of Oxford.*

Laurence E. Schmeckebier. *Professor of Fine Arts and Emeritus Dean, School of Art, Syracuse University, N.Y.*

Paul Waldo Schwartz. *Art Critic in Paris for* The New York Times *and* Studio International. *Author of* The Sculptor in His Studio.

Alexander Mackie Scott. *Senior Lecturer in Scottish Literature, University of Glasgow.*

Edward G. Seidensticker. *Professor of Japanese, University of Michigan, Ann Arbor.*

Charles Coleman Sellers. *Former Librarian, Dickinson College, Carlisle, Pa. Author of* Charles Willson Peale *and others.*

Alexandrino E. Severino. *Associate Professor of Portuguese, Vanderbilt University, Nashville, Tenn.*

Charles Seymour, Jr. *Professor of the History of Art, Yale University.*

Isaac Avi Shapiro. *Former Senior Lecturer in English, University of Birmingham, Eng.*

Claude L. Shaver. *Alumni Professor of Speech, Louisiana State University, Baton Rouge.*

Donald Leslie Shaw. *Reader in Hispanic Studies, University of Edinburgh.*

David Julian Silverman. *Lecturer on Music, University of London.*

João Gaspar Simões. *Literary Critic,* Diario de Noticias, *Lisbon.*

Denis Sinor. *Distinguished Professor of Uralic and Altaic Studies and of History; Chairman, Department of Uralic and Altaic Studies, Indiana University, Bloomington.*

Otto Skutsch. *Professor of Latin, University College, University of London.*

Nicolas Slonimsky. *Conductor, composer, writer, and editor. Lecturer in Music, University of California, Los Angeles, 1964–67.*

Arthur J(ames) M(arshall) Smith. *Professor of English, Michigan State University, East Lansing.*

Gilbert G. Smith. *Instructor in Spanish, Vanderbilt University, Nashville, Tenn.*

Sheila Mary Smith. *Lecturer in English, University of Nottingham, Eng.*

Whitney Smith. *Executive Director, Flag Research Center; Editor,* The Flag Bulletin, *Winchester, Mass.*

William Stevenson Smith (d. 1969). *Curator, Department of Egyptian Art, Museum of Fine Arts, Boston, 1956–69. Lecturer in Fine Arts, Harvard University, 1948–69.*

Craig Hugh Smyth. *Director, Institute of Fine Arts; Professor and Head, Department of Fine Arts, Graduate School of Arts and Science, New York University, New York City.*

M.R. Snodin. *Curatorial staff member, Department of Metalwork, Victoria and Albert Museum, London.*

Wilbert Snow. *Benjamin L. Waite Professor Emeritus of English, Wesleyan University, Middletown, Conn.*

David Sokol. *Associate Professor of the History of Art and Architecture, University of Illinois, Chicago.*

Eileen Margaret Souffrin (Mrs. Eileen Le Breton). *Reader in French, Bedford College, University of London.*

John Sparrow. *Warden of All Souls College, University of Oxford.*

Robert (William) Speaight. *Biographer, critic, and fiction writer. Author of* Life of Hilaire Belloc *and others.*

Albert Sperisen. *Vice President in Charge of Production, Foote, Cone & Belding, San Francisco.*

James Radcliffe Squires. *Professor of English, University of Michigan, Ann Arbor.*

William Bedell Stanford. *Senior Fellow of Trinity College, Dublin; Regius Professor of Greek, University of Dublin.*

Wolfgang Stechow. *Emeritus Professor of Fine Arts, Oberlin College, Ohio.*

Richard G. Stern. *Professor of English, University of Chicago.*

Frederick William Sternfeld. *Reader in the History of Music, University of Oxford.*

Denis William Stevens. *Professor of Musicology, Columbia University, 1964–76.*

Eric Stone. *Fellow and Tutor in Medieval History, Keble College, University of Oxford.*

Gleb Struve. *Emeritus Professor of Slavic Languages and Literatures, University of California, Berkeley.*

Frederick A. Sweet. *Curator of American Painting and Sculpture, Art Institute of Chicago, 1952–68.*

Jean-Guy Sylvestre. *National Librarian of Canada, Library of Parliament, Ottawa.*

Stanley Taikeff. *Playwright and poet.*

James S. Tassie. *Professor of French-Canadian Literature, Carleton University, Ottawa.*

Owen Reece Taylor. *Professor of French, Queen Mary College, University of London.*

Ronald Jack Taylor. *Professor of German, University of Sussex, Brighton, Eng.*

David Christopher Traherne Thomas. *Former Assistant Director of Art, Arts Council of Great Britain, London. Joint compiler of* The

First Hundred Years of the Royal Academy 1769–1868 (*catalog of Royal Academy Winter Exhibition, London, 1951–52*).

Anthony Thwaite. *Poet and critic. Literary Editor,* New Statesman, *London. Author of* Contemporary English Poetry *and others.*

Marion Rose Tinling. *Social Worker, Sacramento, Calif. Editor of* The Secret Diary of William Byrd *and others.*

Brian Lewis Trowell. *Head of radio opera programs, British Broadcasting Corporation, London.*

C.H. Truman. *Curatorial staff member, Victoria and Albert Museum, London.*

Constantine Athanasius Trypanis. *Minister of Culture and Science, Government of Greece. Professor of Classical Languages and Literatures, University of Chicago, 1968–74.*

Arlin Turner. *Professor of American Literature, Duke University, Durham, N.C.*

Darwin T. Turner. *Dean, College of Liberal Arts, Howard University, Washington, D.C.*

Milos Velimirovic. *Professor of Music, University of Virginia, Charlottesville.*

Michele Vishny. *Lecturer in the History of Art, Northwestern University, Evanston, Ill.*

Klaus Philipp Wachsmann. *Professor of Music, Northwestern University, Evanston, Ill.*

John Wain. *Novelist, poet, and critic. Professor of Poetry, University of Oxford.*

Frank Walker (d. 1962). *Musicologist and broadcaster.*

David Harold Wallace. *Curator, Independence National Historical Park, Philadelphia.*

Francis James Warne. *Former Senior Lecturer in French, University of Bristol, Eng.*

Ellis K. Waterhouse. *Director of Studies, Paul Mellon Centre for Studies in British Art, London. Barber Professor of Fine Arts; Director, Barber Institute of Fine Arts, University of Birmingham, Eng., 1952–70.*

Sir F.J.B. Watson. *Director of the Wallace Collection, London, 1963–74. Surveyor of the Queen's Works of Art, 1963–72.*

Max Wehrli. *Professor of the History of German Literature, University of Zürich.*

John S. Weissmann. *Musicologist.*

David Welch. *Assistant Professor of Music, Ramapo College, Ramsey, N.J.*

Enid Elder Hancock Welsford. *Honorary Fellow of Newnham College, University of Cambridge. Author of* The Court Masque; The Fool; *and others.*

Francis William Wentworth-Sheilds (d. 1969). *Artist. Principal Lecturer, Department of Printing and Graphic Design, Twickenham College of Technology, Middlesex, Eng., 1966–69.*

Algot Werin. *Former Professor of Literature, University of Lund, Sweden.*

Carroll W. Westfall. *Assistant Professor of the History of Art and Architecture, University of Illinois, Chicago.*

Geoffrey Weston. *Editorial staff member,* The Times (*London*). *Former Senior Sub-editor,* Country Life.

Sir Jack Allan Westrup. *Emeritus Professor of Music, University of Oxford; Fellow of Wadham College, Oxford, 1947–71.*

Margaret Dickens Whinney. *Reader in the History of Art, University of London, 1950–64.*

David White. *Faculty member, Department of Visual Arts, Trinity College, University of Dublin.*

D. Maxwell White. *Professor and Head, Department of Italian Language and Literature, University of Leeds, Eng.*

E.B. White. *Contributing Editor,* The New Yorker.

Dorothy Whitelock. *Elrington and Bosworth Professor Emeritus of Anglo-Saxon, University of Cambridge; Honorary Fellow of Newnham College, Cambridge. Honorary Fellow of St. Hilda's College, University of Oxford.*

John Ritchie Wilkie. *Professor of German, University of Aberdeen, Scot.*

Frank Willett. *Professor of African Art, Northwestern University, Evanston, Ill.*

John William Mills Willett. *Planning Editor,* The Times (*London*) Literary Supplement.

Rudolf Wittkower. *Avalon Foundation Professor Emeritus in the Humanities, Columbia University.*

Friedrich Wilhelm Wodtke. *Professor of German Literature, Kiel University, W.Ger., and Athens University, Greece.*

Raymond Bernard Wood-Jones. *Senior Lecturer in Architecture, Victoria University of Manchester.*

John E. Woods. *Instructor in History, University of Chicago.*

Patrick Maurice Yarker. *Senior Lecturer in English Literature, King's College, University of London.*

Leon M. Zolbrod. *Associate Professor of Asian Studies, University of British Columbia, Vancouver.*

Part Seven. Technology

Samuel Roy Aldrich. *Professor, Soils Fertility Extension in Agronomy, University of Illinois, Urbana.*

Robert Theodore Alexander. *Captain, U.S. Coast Guard (retired); former Chief, Civil Engineering Division, U.S. Coast Guard Headquarters, Washington, D.C.*

Bruce E. Anderson. *Consultant, Illinois Institute of Technology Research Institute. Former Head, (gun) Propellant Research, U.S. Army Ordnance, Research and Development Division.*

Stanley S. Ballard. *Professor of Physics, University of Florida, Gainesville.*

Karl A. Bauer. *Former President, Carl Zeiss, Inc., New York City.*

Sir Frederick Charles Bawden (d. 1972). *Director of Rothamsted Experimental Station, Harpenden, Eng., 1958–72.*

Orlan William Boston. *Emeritus Professor of Mechanical and Production Engineering, University of Michigan, Ann Arbor.*

John E. Brekke. *Head, Hawaii Fruit Laboratory, U.S. Department of Agriculture, University of Hawaii, Honolulu.*

Benjamin Arthur Brock. *Director and Factory Manager, Brock's Fireworks Ltd., Eng.*

Matthew Joseph Bruccoli. *Professor of English, University of South Carolina, Columbia.*

Nelson Hitchcock Budd. *Former Information and Public Relations Director, National Canners Association.*

Donald George Coleman. *Compiler, Computerized Information Retrieval System,* Wood Science and Forest Products Journal, *Forest Products Research Society, Madison, Wis.*

John Paul Comstock. *Former Naval Architect, Newport News Shipbuilding and Dry Dock Company, Va.*

Grace Rogers Cooper. *Curator, Division of Textiles, Smithsonian Institution, Washington, D.C.*

Edwin Alfred Course. *Senior Tutor, Department of Extra-Mural Studies, University of Southampton, Eng. Author of* London Railways.

Milton Rockwood Daniels. *Commodore, U.S. Coast Guard (retired).*

C.W. Dannatt (d. 1962). *Professor, Royal School of Mines, University of London.*

Francis Donaldson (d. 1970). *Vice President, Mason & Hanger—Silas Mason, Inc., New York City. Author of* Practical Shaftsinking.

Peter Duff. *Former Editor,* The Shipping World, *London.*

LeRoy Dugan. *Professor of Food Science, Michigan State University, East Lansing.*

Victor A. Endersby. *Consulting civil engineer.*

Daniel Snell Eppelsheimer. *Professor of Metallurgical and Nuclear Engineering, University of Missouri, Rolla.*

Valeska Evertsbusch. *Biochemist and Technical Editor, Biomedical Research Division, Lawrence Radiation Laboratory, University of California, Livermore.*

Gordon Maskew Fair (d. 1970). *Abbott and James Lawrence Professor of Engineering; Gordon McKay Professor of Sanitary Engineering, Harvard University.*

Gerald Reginald Mansel Garratt. *Keeper, Department of Aeronautics and Marine Transport, Science Museum, London.*

Frank Gerrard. *President, Institute of Meat, London, 1960–62. Head of Department, National College of Food Technology, Smithfield, London, 1947–61.*

George Sweet Gibb. *Director of Public Relations, L.G. Balfour Company, Attleboro, Mass.*

Charles Harvard Gibbs-Smith. *Lindbergh Professor of Aerospace History, National Air and Space Museum, Smithsonian Institution, Washington, D.C. Research Fellow, Science Museum, London.*

Keith Reginald Gilbert (d. 1973). *Keeper, Department of Mechanical and Civil Engineering, Science Museum, London.*

John B. Gordon (d. 1964). *Secretary, Bureau of Raw Materials for American Vegetable Oils and Fats Industries, Washington, D.C.*

Linton E. Grinter. *Emeritus Dean, Graduate School; former Executive Vice President, University of Florida, Gainesville. Author of* Design of Modern Steel Structures *and others.*

Harold James Grossman (d. 1967). *Marketing consultant on beverages. Author of* Grossman's Guide to Wines, Spirits and Beers *and others.*

Andrew Edward Hahn. *Former Managing Editor,* Quality of Sheffield, *Sheffield, Eng.*

Stanley Baines Hamilton. *Chartered civil and structural engineer. Writer and editor on engineering history.*

Wayne V. Harsha. *Editor,* Inland Printer/ American Lithographer. *Former Assistant Professor of Journalism, Ohio State University, Columbus.*

Alden Hatch. *Novelist, biographer, and historian. Author of* Remington Arms in American History *and others.*

John M. Hayes. *Professor of Structural Engineering, Purdue University, West Lafayette, Ind.*

John Forrest Hayward. *Associate Director, Sotheby Parke-Bernet and Company, London and New York City. Deputy Keeper, Victoria and Albert Museum, London, 1946–65.*

Phyllis West Heathcote. *Former Paris Correspondent for Women's Topics,* The Guardian (*Manchester*) *and* Glasgow Herald.

John B. Heffernan. *Rear Admiral, U.S. Navy (retired). Secretary, Naval Historical Foundation, Washington, D.C. Director of Naval History, Navy Department, 1946–56.*

Philip Heiberger. *Licensing Coordinator, E.I. du Pont de Nemours & Company, Inc., Philadelphia.*

Solomon Cady Hollister. *Consulting Engineer. Emeritus Professor of Civil Engineering, Cornell University, Ithaca, N.Y.; Dean of Engineering, 1937–59.*

W.E. Howland. *Emeritus Professor of Sanitary Engineering, Purdue University, West Lafayette, Ind.*

John Cyril Herbert Hurd. *Textiles consultant. Former Head, School of Textiles, Leicester College of Technology and Commerce, Eng.*

William G. Ibberson. *Chairman, George Ibberson and Company Ltd.; Sheffield Testing Works Ltd.; and Cutlery Research Council, Sheffield, Eng.*

Miles Hopkins Imlay. *Rear Admiral (retired), U.S. Coast Guard.*

William Thorton Innes (d. 1969). *Founder and Director, Typothetae Printing Trade School, Philadelphia.*

Emerson C. Itschner. *Lieutenant General, U.S. Army (retired); Chief of Engineers, U.S. Army Corps of Engineers, 1956–61.*

S. Paul Johnston. *Consultant, R. Dixon Speas, Inc., Manhasset, N.Y. Director, National Air and Space Museum, Smithsonian Institution, Washington, D.C., 1964–69.*

C. Clyde Jones. *Professor of Business Administration, Kansas State University, Manhattan.*

Ralph Kenyon Kilbon. *Director, Creative Services, RCA Corporation, New York City.*

Rudolf Kingslake. *Professor of Optics, University of Rochester. Director of Optical Design, Eastman Kodak Company, Rochester, N.Y., 1939–69.*

D.C. Kiplinger. *Professor of Horticulture, Ohio State University, Columbus.*

Arthur Koehler (d. 1967). *Wood consultant, 1948–67. Chief, Division of Silvicultural Relations, Forest Products Laboratory, U.S. Forest Service, 1927–48. Lecturer, School of Forestry, Yale University, 1951–53.*

Dietrich Küchemann. *Consultant, Aerodynamics Department, Royal Aircraft Establishment, Farnborough, Eng.; Head of Department, 1966–71.*

Alexander McDonald (d. 1968). *Secretary, The Institution of Civil Engineers, London, 1954–67.*

Fred Devereux McHugh. *Editor for the Office, Chief of Ordnance (Army), Washington, D.C. Author of* How To Be an Engineer.

Donald LeCrone McMurry. *Author of* The Great Burlington Strike of 1888 *and others.*

Clarence Thomas Marek. *Former Professor of Metal Processing, School of Materials Science and Metallurgical Engineering, Purdue University, West Lafayette, Ind.*

George Peterkin Meade. *Vice President, International Commission for Uniform Methods of Sugar Analysis. Former Manager, Colonial Sugars Company, Gramercy, La.*

John Lawrence Mero. *President, Ocean Resources, Inc., La Jolla, Calif.*

Malcolm Monroe. *Former Vice President, Monroe Calculating Machine Company, Orange, N.J.*

James Charles Moran. *Editor,* Graphic Technology (*London*).

William Alvin Mudge. *Former Assistant to the President as Special Representative on Educational Programs, International Nickel Company, Inc., New York City.*

Herbert Lownds Nichols, Jr. *Publisher, Greenwich, Conn. Author of* Moving the Earth *and others.*

St. John Cousins Nixon. *Author of* The Invention of the Automobile; Wolseley: A Saga of the Motor Industry; *and others.*

Richard Marian Ogorkiewicz. *Senior Lecturer in Mechanical Engineering, Imperial College of Science and Technology, University of London.*

William David Ollis. *Professor of Organic Chemistry, University of Sheffield, Eng.*

Christabel Susan Orwin. *Co-author of* The Open Fields; History of British Agriculture, 1846–1914.

Robert P. Pace. *Account Executive, R. Hoe & Company, Inc., New York City.*

John Bingham Parkinson. *Chief, Aerodynamics, Aeronautical Vehicles, National Aeronautics and Space Administration, Washington, D.C.*

Harold Leslie Peterson. *Chief Curator, National Park Service, U.S. Department of the Interior. Author of* Arms and Armor in Colonial America, 1526–1783 *and others.*

Jack Pickthall. *Consultant to International Flavours and Fragrances Ltd., Enfield, Eng. Former President, Society of Cosmetic Chemists, Great Britain, and British Society of Perfumers.*

John Bell Rae. *Emeritus Professor of the History of Technology, Harvey Mudd College, Claremont, Calif.*

L.T.C. Rolt (d. 1974). *Member, Executive Committee, American Society for the History of Technology. Chairman, Talyllyn Railway Company, England, 1963–68.*

John Kerr Rose. *Senior Specialist in Natural Resources and Conservation, Library of Congress.*

Hunter Rouse. *Dean, College of Engineering, University of Iowa, Iowa City.*

Sir (Edward) John Russell (d. 1965). *Director, Rothamsted Experimental Station, Harpenden, Eng., 1912–43.*

Harold Eugene Saunders (d. 1961). *Captain, U.S. Navy; Technical Assistant to Chief of Bureau of Ships, Navy Department.*

Julian L. Schueler (d. 1962). *Consultant, Continental Steel Corporation, Kokomo, Ind.*

Bernard Sylvester Schweigert. *Chairman, Department of Food Science and Technology, University of California, Davis.*

Donald Shannon. *Former Manager, Public Relations Department, Otis Elevator Company, New York City.*

Mitchell R. Sharpe. *Science writer and rocketry historian. Author of* Living in Space: The Astronaut and His Environment *and others.*

Orson Cutler Shepard. *Emeritus Professor of Metallurgy, Stanford University, Calif.*

Charles Ely Rose Sherrington. *Secretary, British Railways Research Service, 1924–62. Director, Research Information Division, British Transport Commission.*

Thomas Mortimer Simmons. *Deputy Keeper, Department of Transport and Mining, Science Museum, London.*

Alec Westley Skempton. *Professor of Civil Engineering, Imperial College of Science and Technology, University of London.*

Albert Lewis Slover. *Technical Assistant to the Chief, Naval Engineering Division, U.S. Coast Guard.*

F.D. Smith. *Consultant, Monsanto Chemical Company, St. Louis, Mo.; Manager, University Development, Research and Engineering Division, 1956–63.*

Harry J. Solberg. *Director of Corporate Planning, American Express Company. Former Associate Professor of Commerce, University of Wisconsin, Madison.*

Hereward Philip Spratt. *Deputy Keeper, Science Museum, London, 1930–67.*

Arthur Stowers. *Keeper, Department of Mechanical and Civil Engineering, Science Museum, London, 1950–62.*

Frank Whitworth Stubbs, Jr. (d 1967). *Professor of Civil Engineering, Purdue University, West Lafayette, Ind.*

Harry C. Thomson. *Chairman, Political Science Department, De Paul University, Chicago. Assistant Editor,* Encyclopædia Britannica, *Chicago, 1959–66.*

Forrest Glenn Tucker. *Emeritus Professor of Physics, Oberlin College, Ohio.*

William Arthur Vine (d. 1966). *Professor and Head, Department of Mining Engineering, Montana College of Mineral Science and Technology.*

Francis Walley. *Under Secretary, Director of Post Office Services, Department of the Environment, London.*

Frederick Victor Wells. *Editor,* Soap, Perfumery and Cosmetics, *London. Founder-President, Society of Cosmetic Chemists of Great Britain.*

Harold Francis Williamson. *Professor of Economics, Northwestern University, Evanston, Ill., 1948–69. Author of* Winchester: The Gun That Won the West.

Melville Lawrence Wolfrom (d. 1969). *Regents' Professor of Chemistry, Ohio State University, Columbus, 1965–69.*

Ellen Louise Young. *Historical research specialist (manufactures).*

Part Eight. Religion

Nigel James Abercrombie. *Chief Regional Adviser, Arts Council of Great Britain, London; Secretary General, 1963–68. Author of* The Origins of Jansenism *and others.*

Charles Joseph Adams. *Professor and Director, Institute of Islāmic Studies, McGill University, Montreal.*

Rev. Joseph Denis Agius, O.S.B. *Monk of Downside Abbey, Eng.*

Sydney Eckman Ahlstrom. *Professor of Modern Church History and American History; Chairman, American Studies Program, Yale University.*

Kye-hyon Ahn. *Director, Dong-kook University Museum, Seoul.*

Kurt Aland. *Professor of Church History, University of Münster, W.Ger.*

Hamilcar S. Alivisatos (d. 1969). *State Procurator of the Holy Synod of the Church of Greece. Professor of Canon Law and Pastoral Theology, University of Athens, 1918–56.*

Rev. Arthur MacDonald Allchin. *Librarian, Pusey House, Oxford. Author of* The Silent Rebellion: Anglican Religious Communities 1845–1900 *and others.*

Robert W. Allison. *Manuscript Research Specialist, Department of Special Collections, University of Chicago Library.*

Milton Vasil Anastos. *Professor of Byzantine Greek and History, University of California, Los Angeles.*

Rev. George Wishart Anderson, D.D. *Professor of Hebrew and Old Testament Studies, University of Edinburgh.*

Very Rev. Laurence Thomas Anderson. C.R.P. *President, St. Norbert's College, Kilnacrott, Cavan, Ire.*

William Scovil Anderson. *Professor of Latin and Comparative Literature, University of California, Berkeley.*

Max Artz. *Vice Chancellor, Jewish Theological Seminary of America, New York City.*

Donald Attwater (d. 1977). *Author of* Penguin Dictionary of Saints; St. John Chrysostom, Pastor and Preacher.

Peter William Avery. *Lecturer in Persian, University of Cambridge; Fellow of King's College, Cambridge.*

Roland H. Bainton. *Emeritus Professor of Church History, Yale University.*

Rev. Msgr. Joseph W. Baker. *Officialis, Archdiocese of Saint Louis, Mo.*

Ernst Bammel. *Lecturer in Divinity, University of Cambridge.*

Wade Crawford Barclay. *Former Historian, Board of Missions, Methodist Church, New York City.*

Rt. Rev. Msgr. John Mackintosh Tilney Barton. *Priest-in-Charge, S.S. Peter and Edward, London. English Consultor, Pontifical Biblical Commission.*

František M. Bartoš. *Emeritus Professor of Church History, Comenius Protestant Theological Faculty, Prague.*

Robert Pierce Beaver. *Emeritus Professor of Missions, Divinity School, University of Chicago.*

Very Rev. Msgr. Henry G.J. Beck. *Emeritus Professor of Church History, Immaculate Conception Seminary, Darlington, N.J.*

Count Michael de la Bedoyere. *Editor of* Search *newsletter, 1965–68.*

Alan Lewis Berger. *Instructor in Religion, Miami University, Oxford, Ohio.*

Reginald Robert Betts (d. 1961). *Masaryk Professor of Central European History, University of London, 1946–61.*

Rev. Maurice Bévenot, S.J. *Professor of Ecclesiology, Heythrop College, University of London.*

Jean Elfride Bickersteth. *Senior Lecturer in Religion, Kingston upon Hull College of Education, Yorkshire, Eng.*

Ludwig G.J. Bieler. *Emeritus Professor of Palaeography and Late Latin, University College, Dublin, National University of Ireland.*

Rev. Anselm Gordon Biggs, O.S.B. *Professor of History, Belmont Abbey College, N.C.*

Rev. Nicholas Frederick Bisheimer, S.V.D. (d. 1966). *President, Society of the Divine Word, Western Province.*

Ernst Bizer. *Former Professor of Church History, Rhenish Friedrich Wilhelm University of Bonn.*

William Barnett Blakemore. *Professor of Divinity; Dean, Disciples Divinity House, University of Chicago.*

Edwin Boardman (d. 1968). *Professor of Church History and Senior Counselor, Ashland Theological Seminary, Ohio.*

Pieter Arie Hendrik de Boer. *Professor of Old Testament, State University of Leiden, Neth.*

Arthur Stanley Bolster, Jr. *Professor of Education, Harvard University.*

Gerald Bonner. *Reader in Church History, University of Durham, Eng.*

Rev. William Joseph Bosch, S.J. *Associate Professor of History, LeMoyne College, Syracuse, N.Y.*

Carroll Julian Bourg. *Associate Professor of Sociology, Fisk University, Nashville, Tenn. Former Director, Office of Social Research, Maryland Province of Jesuits, Baltimore.*

Rev. Charles Samuel Braden (d. 1970). *Resident Scholar, Perkins School of Theology, Southern Methodist University. Professor of History and Literature of Religions, Northwestern University, Evanston, Ill., 1943–54.*

Rev. Ignatius Charles Brady, O.F.M. *Director of the theological section, College of St. Bonaventura, Grottaferrata, Italy.*

Keith Richard Bridston. *Professor of Systematic Theology, Pacific Lutheran Theological Seminary and the Graduate Theological Union, Berkeley, Calif.*

Harmon Hartzell Bro. *Director, Institute for Research in Psychology and Religion, Park Forest, Ill.*

Rev. John Francis Broderick, S.J. *Professor of Ecclesiastical History, Weston College, Mass.*

Rev. James Patrick Brodrick, S.J. *Author of* Origin of the Jesuits *and others.*

Victor John Knight Brook. *Fellow of All Souls College, Oxford, 1938–59; former Lecturer in Reformation Theology, University of Oxford.*

Christopher Nugent Lawrence Brooke. *Professor of History, Westfield College, University of London.*

Frederick Fyvie Bruce. *Rylands Professor of Biblical Criticism and Exegesis, Victoria University of Manchester, Eng.*

Rev. Erwin Buck. *Pastor, St. Peter Lutheran Church, Medicine Hat, Alberta.*

Robert J. Buck. *Professor and Chairman, Department of Classics, University of Alberta, Edmonton.*

Barbara Buckmaster (The Hon. Mrs. Barbara Miller) (d. 1966). *Writer on Balkan Affairs, London. Member of the Staff, Foreign Research and Press Service, Royal Institute of International Affairs.*

J.A.B. van Buitenen. *Professor of Sanskrit and Indic Studies, Chairman, Department of South Asian Languages and Civilizations, University of Chicago.*

Rev. Sebastian Bullough, O.P. (d. 1967). *Lecturer in Hebrew, University of Cambridge.*

Rev. Ernest Joseph Burrus, S.J. *Historian of Jesuit Order, Jesuit Historical Institute, Rome, Italy, and St. Louis, Mo.*

Harold Butcher. *Free-lance writer.*

Theodore Vern Buttrey, Jr. *Professor of Classics, University of Michigan, Ann Arbor.*

Charles Robert Byrnes. *Executive Director, International Association of Auditorium Managers, Chicago Heights, Ill.*

Rev. William James Byron, S.J. *Associate Professor of Social Ethics, Woodstock College, New York City.*

Carnegie Samuel Calian. *Professor of Theology, University of Dubuque Theological Seminary, Iowa.*

Mother Louise Callan, R.S.C.J. (d. 1966). *Professor of History, Maryville College of the Sacred Heart, St. Louis, Mo.*

Rev. Philip Caraman, S.J. *Editor,* The Month, *1948–63.*

Clifford M. Carey. *Assistant Executive Director, National Council of the Young Men's Christian Associations, New York City.*

John Carey. *Fellow of St. John's College, Oxford; Lecturer in English Literature, University of Oxford.*

William David James Cargill Thompson. *Lecturer in Ecclesiastical History, King's College, University of London.*

Rev. Edward Wilson Carlile. *Chief Secretary of the Church Army, London, 1949–60.*

Henry Stewart Carter (deceased). *Minister, Memorial Church, Cambridge, Eng.*

Ernest Cassara. *Professor and Chairman, Department of History, George Mason University, Fairfax, Va.*

Nora Kershaw Chadwick (d. 1972). *University Lecturer, University of Cambridge, 1950–58. Editor and contributor,* Studies in Early British History *and others.*

W. Owen Chadwick. *Regius Professor of Modern History, University of Cambridge.*

Wing-tsit Chan. *Emeritus Professor of Chinese Philosophy and Culture, Dartmouth College, Hanover, N.H. Anna R.D. Gillespie Professor of Philosophy, Chatham College, Pittsburgh.*

Byong-gil Chang. *Professor of Religion, Seoul National University.*

Kenneth K.S. Chen. *Emeritus Professor of Oriental Languages, University of California, Los Angeles.*

Rev. Sok-u Choe. *Pastor, Myong-dong Catholic Cathedral, Seoul.*

Francis P(almer) Clarke. *Emeritus Professor of Philosophy, University of Pennsylvania, Philadelphia.*

A.O.J. Cockshut. *G.M. Young Lecturer in 19th Century English Literature, University of Oxford; Fellow of Hertford College, Oxford. Author of* Anglican Attitudes: A Study of Victorian Religious Controversies *and others.*

Rev. Louis Cognet. *Director of Studies, Collège de Juilly, France.*

Very Rev. Francis J. Connell (d. 1967). *Dean for Religious Communities, Catholic University of America, Washington, D.C., 1957–67; Professor of Moral Theology, 1949–58.*

Thomas L. Coonan. *Former Professor of History, St. Louis University, Mo.*

Patricia Louise Cox. *Free-lance writer on religion.*

Rev. Frank Leslie Cross (d. 1968). *Lady Margaret Professor of Divinity, University of Oxford, 1944–68. Editor of* The Oxford Dictionary of the Christian Church.

Alice Curtayne. *Author of* St. Catherine of Siena; The Irish Story; *and others.*

Jean Dagens. *Professor of Classical French Literature, University of Strasbourg, Fr.*

Rev. J. Gordon Davies. *Edward Cadbury Professor and Head, Department of Theology, University of Birmingham, Eng.*

Rev. Victor Cyril De Clercq, C.I.C.M. *Former Professor of Patrology and Church History, Pontifical College Josephinum, Worthington, Ohio.*

Rt. Rev. Carl Gustav Diehl. *Bishop of Tranquebar, Tamil Evangelical Lutheran Church, South India.*

Rev. Godfrey Leo Diekmann, O.S.B. *Professor of Theology, St. John's University, Collegeville, Minn. Editor of* Worship.

George Edward Dimock, Jr. *Professor of Classical Languages and Literatures, Smith College, Northampton, Mass.*

Jacques Duchesne-Guillemin. *Professor of Indo-Iranian Studies, State University of Liège, Belg.*

Rev. George H. Dunne, S.J. *Secretary, Committee on Society, Development and Peace, World Council of Churches and the Pontifical Commission for Justice and Peace, Ecumenical Centre, Geneva, Switz.*

Very Rev. Joseph William Dunne. *Canon of Metropolitan Chapter of Birmingham; Parish Priest, St. Mary's, The Mount, Walsall, Eng.*

H. Byron Earhart. *Associate Professor of Religion, Western Michigan University, Kalamazoo.*

Rt. Rev. John Tracy Ellis. *Professor of Church History, University of San Francisco.*

Rev. John Adney Emerton. *Regius Professor of Hebrew, University of Cambridge.*

Rev. Carl Evans. *Pastor, Door Village United Methodist Church, La Porte, Ind.*

Rev. Edward Every. *Canon, St. George's Collegiate Church, Jerusalem.*

Rev. Eugene Rathbone Fairweather. *Keble Professor of Divinity, Trinity College, University of Toronto.*

Andrea Faste. *Free-lance writer on religion.*

Floyd V. Filson. *Emeritus Dean and Emeritus Professor of New Testament, McCormick Theological Seminary, Chicago.*

Louis Finkelstein. *Chancellor, Jewish Theological Seminary of America, New York City.*

Thomas Fish. *Professor of Mesopotamian Studies, University of Manchester, 1948–60.*

Rev. Joseph Augustine Fitzmyer, S.J. *Professor of Sacred Scripture, Fordham University, New York City.*

Ven. Charles Robert Forder. *Archdeacon of York, Eng.; Canon and Prebendary of Fenton in York Minster, 1957–72.*

Rev. Kenelm Francis Foster, O.P. *Former Lecturer in Italian, University of Cambridge.*

Brian Fothergill. *Author of* The Cardinal King; Nicholas Wiseman; *and others.*

Walter Freitag. *Dean, Luther Theological Seminary, University of Saskatchewan, Saskatoon.*

Rev. Reginald Michael French. *Vicar of St. James', London, 1930–55. Author of* Serbian Church Life *and others.*

William Hugh Clifford Frend. *Professor of Ecclesiastical History, University of Glasgow.*

Asaf Ali-Asghar Fyzee. *Vice Chancellor, University of Jammu and Kashmir, Srinagar, India, 1957–58. Indian Ambassador to Egypt, 1949–51.*

Rev. Maynard Joseph Geiger, O.F.M. *Historian of the Franciscan Fathers of the Pacific Coast and Archivist of Mission, Santa Barbara, Calif.*

Nahum N. Glatzer. *Samuel Lane Professor Emeritus of Jewish History and Social Ethics, Brandeis University, Waltham, Mass.*

John Grace (d. 1972). *National Chief Secretary, The Salvation Army, New York City, 1961–70.*

Hilda Charlotte Graef. *Author of* The Light and the Rainbow; Mary, A History of Doctrine and Devotion; *and others.*

Ernest (Eugene) Graf (d. 1962). *Monk of Buckfast Abbey, Eng.*

Robert M. Grant. *Carl Darling Buck Professor of Humanities; Professor of Early Christian History, Divinity School, University of Chicago.*

John Evelyn Bury Gray. *Reader in Sanskrit, School of Oriental and African Studies, University of London.*

Rev. Paul Grosjean, S.J. (d. 1964). *Bollandist. Author of* Henrici VI Angliae Regis Miracula Postuma *and others.*

G. E. von Grunebaum (d. 1972). *Professor of History; Director, Near Eastern Center, University of California, Los Angeles, 1957–72.*

Rev. Pierre Joseph G'sell, O.S.B. (deceased). *Monk at Solesmes Abbey, France.*

Herbert V. Guenther. *Professor and Head, Department of Far Eastern Studies, University of Saskatchewan, Saskatoon.*

Rev. Walter George Gumbley, O.P. (d. 1968). *Occasional Lecturer at Blackfriars, Oxford, 1942–45; 1950–61. Author of* Parish Priests Among the Saints *and others.*

Oliver Robert Gurney. *Professor of Assyriology, University of Oxford.*

Oskar Halecki. *Professor of Eastern European History, Graduate School, Fordham University, New York City, 1944–61. Honorary President, Polish Institute of Arts and Science, New York City.*

Edward Elton Young Hales. *Author of* Revolution and Papacy *and others.*

Rev. François Halkin, S.J. *Bollandist. Author of* Bibliotheca Hagiographica Graeca *and others.*

Rev. Basil Hall. *Professor of Ecclesiastical History, Victoria University of Manchester.*

Robert Theodore Handy. *Professor of Church History, Union Theological Seminary, New York City.*

Edward R. Hardy. *Fellow of Jesus College, University of Cambridge.*

Rev. Carl John Hemmer, S.J. *Former Research Assistant of Ecclesiastical History, Colegio de San Estanislao, Salamanca, Spain.*

Rev. Ben Mohr Herbster. *President, United Church of Christ, 1961–69.*

Ferdinand Aloys Hermens. *Professor of Political Science, University of Cologne.*

Naofusa Hirai. *Professor of Shinto Studies, Kokugakuin University, Tokyo.*

Rev. Ian Hislop, O.P. *Provincial of the English Dominican Province.*

John Thayer Hitchcock. *Professor of Anthropology and Indian Studies, University of Wisconsin, Madison.*

Philip Khuri Hitti. *Emeritus Professor of Semitic Literature, Princeton University.*

Winthrop S. Hudson. *Distinguished Seminary Professor, Colgate Rochester Divinity School, Rochester, N.Y.; James B. Colgate Professor of the History of Christianity, 1948–77.*

Rev. Gordon Huelin. *Vicar, St. Margaret Pattens, London. Lecturer, Theological Department, King's College, University of London.*

William Robert Hutchison. *Charles Warren Professor of the History of Religion in America, Harvard University.*

Edmond Jacob. *Professor of Old Testament Exegesis, Evangelical Theological Faculty, University of Strasbourg, France.*

Rev. Jerome Vincent Jacobsen, S.J. (d. 1970). *Professor of History, Loyola University, Chicago.*

Thorkild Jacobsen. *Emeritus Professor of Assyriology, Harvard University.*

Rev. Edwin Oliver James (d. 1972). *Chaplain of All Souls College, University of Oxford. Professor of the History and Philosophy of Religion, University of London.*

Rev. Daniel T. Jenkins. *Reader in Religious Studies, University of Sussex, Brighton, Eng., 1970–73.*

Eric John. *Senior Lecturer in Medieval History, Victoria University of Manchester, Eng.*

Sherman Elbridge Johnson. *Dean, Church Divinity School of the Pacific, Berkeley, Calif.*

Rev. John N.D. Kelly. *Principal of St. Edmund Hall, Oxford; Former Lecturer in Patristic Studies, University of Oxford.*

Rt. Rev. Sylvester Michael Killeen, O. Praem. *Chancellor, Saint Norbert College, De Pere, Wis.*

Joseph M. Kitagawa. *Professor of the History of Religions and of Far Eastern Languages and Civilizations; Dean, Divinity School, University of Chicago.*

Rev. Michael David Knowles, O.S.B. (d. 1974). *Regius Professor of Modern History, University of Cambridge, 1954–63.*

Gottfried Georg Krodel. *Professor of History and Church History, Valparaiso University, Ind.*

Werner Georg Kummel. *Professor of New Testament, Philipps University of Marburgh, W.Ger.*

Stephan George Kuttner. *T. Lawrason Riggs Professor of Religious Studies, Yale University. President, Institute of Research and Study in Medieval Canon Law.*

Gerhart B. Ladner. *Professor of History, University of California, Los Angeles.*

Most Rev. Pio Laghi. *Apostolic Delegate, Jerusalem.*

Helen B. Lamb (d. 1975). *Author of* Economic Development of India.

Rev. John William Lamb. *Canon of York. Member, National Church Assembly, Eng. Author of* The Archbishopric of Lichfield *and others.*

Eugene N. Lane. *Associate Professor of Classics, University of Missouri, Columbia.*

Rev. M.-H. Laurent, O.P. (deceased). *Keeper of the Vatican Library.*

Clifford Hugh Lawrence. *Professor of Medieval History, Bedford College, University of London.*

Du-hyon Lee. *Professor, Teacher's College, Seoul National University.*

Rev. Augustin Pierre Léonard, O.P. *Professor of Theology, Dominican College of La Sarte, Belg., and University of Notre Dame, Ind.*

Rev. Joseph Leonard, C.M. (deceased). *Lecturer at St. Mary's College, London. Author of* Saint Vincent de Paul and Mental Prayer.

Rev. William Paul Le Saint, S.J. *Professor of Theology; President of the Faculty, St. Mary of the Lake Seminary, Mundelein, Ill.*

Sir Shane Leslie (d. 1971). *Author of* Memoir of Cardinal Gasquet *and others.*

Fairy von Lilienfeld. *Professor of the Theology of the Christian East, Friedrich Alexander University of Erlangen-Nürnberg, W.Ger.*

Rev. Poul Georg Lindardt. *Professor of Church History, University of Århus, Den.*

Franklin Hamlin Littell. *Professor of Religion, Temple University, Philadelphia.*

Rev. Charles Patrick Loughran, S.J. *Assistant Professor of Early Christian History, Graduate School, Fordham University, New York City.*

Frederick Stanley Lusby. *Professor and Head, Department of Religious Studies, University of Tennessee, Knoxville.*

Rev. Thomas Timothy McAvoy, C.S.C. (d. 1969). *Archivist and Professor of History, University of Notre Dame, Ind.*

George Englert McCracken. *Professor of Classical Languages, Drake University, Des Moines, Iowa. Editor and translator of* Arnobius of Sicca; The Case Against the Pagans *and others.*

Sister Mary Emmanuel McIver, O.S.U. *Former Professor of Theology, College of New Rochelle, N.Y.*

Joseph Cumming McLelland. *Professor of Philosophy of Religion, McGill University, Montreal.*

William Gerald McLoughlin. *Professor of History, Brown University, Providence, R.I. Author of* Modern Revivalism: Charles Grandison Finney to Billy Graham.

John F. McMahon. *General and Commander in Chief, Volunteers of America, New York City.*

Rev. Francis Gerard McManamin, S.J. *Former Associate Professor of History, Loyola College, Baltimore.*

Rev. Robert Edward McNally, S.J. *Professor of Historical Theology, Fordham University, New York City.*

Very Rev. Joseph McSorley (d. 1963). *Superior General of the Paulist Fathers, 1924–29.*

Right Rev. Monsignor Richard C. Madden. *Pastor, St. Andrew's Church, Myrtle Beach, S.C.*

Cyril Alexander Mango. *Professor of Byzantine Archaeology, Harvard University.*

Rev. William W. Manross. *Librarian and Professor of Church History, Philadelphia Divinity School, Pa.*

Rev. Joseph M.-F. Marique, S.J. *Director, Institute of Early Christian Iberian Studies, College of the Holy Cross, Worcester, Mass.*

Ira Jay Martin III. *Henry Mixter Penniman Professor of Philosophy and Religion, Berea College, Ky.*

Martin E. Marty. *Fairfax M. Cone Distinguished Service Professor, Divinity School, University of Chicago. Associate Editor,* The Christian Century.

Rev. Vivian John Manley Matthews. *Priest of the London Oratory, Eng.*

Louis Mazoyer. *Former Teacher at the Lycée Condorcet, Paris.*

Sidney Earl Mead. *Professor of History and of Religion, University of Iowa, Iowa City.*

Rev. William Moelwyn Merchant. *Professor of English Language and Literature, University of Exeter, Eng. Canon of Salisbury Cathedral.*

Rev. John Meyendorff. *Professor of Church History and Patristics, St. Vladimir's Orthodox Theological Seminary, Tuckahoe, N.Y. Professor of Byzantine and East European History, Fordham University, New York City.*

Rabbi Eugene Mihaly. *Professor of Homiletics and Midrash, Hebrew Union College–Jewish Institute of Religion, Cincinnati, Ohio.*

Rev. Raymond Joseph Miller, C.SS.R. *Pastor, St. Leo's Church, Versailles, Ky.*

Nicholas Byram Millet. *Associate Professor of Near Eastern Studies, University of Toronto.*

Kyong-bae Min. *Professor of Religion, Yonsei University, Seoul.*

Christine Mohrmann. *Professor of Early Christian Greek and Latin, and Medieval Latin, Catholic University of Nijmegen, Neth.*

Mary Moriarty. *Benedictine of Stanbrook Abbey, Worcester, Eng. Author of* The Saints in Silhouette; *translator and editor of* A Capuchin Chronicle.

Rev. Claude Beaufort Moss (d. 1964). *Lecturer at Bishop's College, Cheshunt, Eng.*

James DeForest Murch. *Member, Board of Administration, 1958–71; Publications Director, 1945–58, National Association of Evangelicals.*

A. Victor Murray (d. 1967). *President of Cheshunt College, Cambridge, 1945–59. Professor of Education, University of Hull, Eng., 1933–45.*

Tiruppattur Ramaseshayyar Venkatachala Murti. *Emeritus Professor of Philosophy, Banaras Hindu University, Varanasi, India.*

Rev. Wilfrid Myatt, C.J.M. *Co-editor of* Saint John Eudes: a Spiritual Portrait *and others.*

Rt. Rev. Stephen Charles Neill. *Professor of Philosophy and Religious Studies, University of Nairobi, Kenya, 1969–73.*

David Hay Newsome. *Fellow of Emmanuel College, University of Cambridge, 1959–70. Headmaster of Christ's Hospital, Horsham, Eng.*

Rev. Richard Patrick Noonan, S.J. *Director of Development, McQuaid Jesuit High School, Rochester, N.Y.*

Morgan Phelps Noyes (d. 1972). *Associate Professor of Practical Theology, Union Theological Seminary, New York City, 1945–51. Minister, Central Presbyterian Church, Montclair, N.J., 1932–57.*

Geoffrey Fillingham Nuttall. *Lecturer in Church History, New College, University of London.*

Rev. Austin Oakley. *Honorary President, Anglican and Eastern Churches Association, London. Vicar of St. Johns, London. 1944–62.*

Dimitri Obolensky. *Professor of Russian and Balkan History, University of Oxford.*

Rev. Elmer O'Brien, S.J. *Research Professor of Theology, Loyola College, Montreal.*

Rev. Thomas Gerald O'Callaghan, S.J. *Professor of Theology, Fairfield University, Conn.*

Rev. William James O'Shea. *Professor of Church History and Liturgy, St. Mary's Seminary, Baltimore.*

Eberhard Otto (d. 1974). *Professor of Egyptology, Rupert Charles University of Heidelberg, W.Ger.*

Rev. Paul F. Palmer, S.J. *Professor of Theology, Fordham University, New York City.*

Pascal P. Parente (d. 1971). *Professor of Ascetical and Mystical Theology, Catholic University of America, Washington, D.C., 1938–60.*

Herbert William Parke. *Professor of Ancient History, Trinity College, University of Dublin, 1934–73.*

Rev. Thomas Maynard Parker. *Emeritus Fellow of University College, Oxford; University Lecturer in Theology, University of Oxford, 1950–73.*

Rev. Ernest Alexander Payne. *Chairman of the Executive Committee, British Council of Churches, 1962–71.*

Jaroslav Jan Pelikan. *Sterling Professor of History and Religious Studies, Yale University.*

Gerald Bernard Phelan (d. 1965). *Professor of Philosophy, St. Michael's College, University of Toronto, and Pontifical Institute of Medieval Studies, Toronto.*

Rev. Arthur Carl Piepkorn. *Graduate Professor of Systematic Theology, Concordia Seminary, St. Louis, Mo.*

Rev. Martin Pierce. *Vicar of St. John's Mickleover, Derby, Eng.*

Harry Culverwell Porter. *Lecturer in History, University of Cambridge. Fellow of Selwyn College, Cambridge.*

Eli Daniel Potts. *Senior Lecturer in History, Monash University, Clayton, Australia. Author of* British Baptist Missionaries in India, 1793–1837.

Rev. Leon Pouliot, S.J. *Former Teacher of Church History, Collège Sainte-Marie, Montreal.*

Very Rev. Msgr. William Joseph Quinn. *Executive Secretary, Bishops' Committee for Migrant Workers, Chicago, Ill. Co-director, Latin American Bureau, National Catholic Welfare Conference, Washington, D.C.*

Gilles, Quispel. *Professor of Early Church History, State University of Utrecht, Neth.*

Fazlur Rahman. *Professor of Islāmic Thought, University of Chicago.*

Helen Louise Redpath (Sister Dominic) (d. 1965). *Bridgettine Nun of Syon Abbey, Devon, Eng.*

Ernest Edwin Reynolds. *Author of* Baden-Powell; Three Cardinals; *and others.*

Rev. James A. Reynolds. *Former Professor of Church History, St. Joseph's Seminary, Yonkers, N.Y.*

Rev. Joseph Alfred Richard. *Society of Missionaries of Africa, the White Fathers.*

Theodore Henry Robinson (d. 1964). *Professor of Semitic Languages, University College of South Wales and Monmouthshire, Cardiff, 1927–44.*

Very Rev. Gerard Rooney, C.P. *Director, Department of Education, Diocese of Worcester, Mass.*

Herbert Jennings Rose (d. 1961). *Professor of Greek, University of St. Andrews, Scot., 1927–53.*

Franz Rosenthal. *Sterling Professor of Near Eastern Languages, Yale University.*

Judah M. Rosenthal. *Professor of Biblical Exegesis, College of Jewish Studies, Chicago.*

Anne Ross. *Free-lance writer on Celtic mythology.*

Rev. Ernest Gordon Rupp. *Dixie Professor Emeritus of Ecclesiastical History, University of Cambridge.*

Rev. Edward A. Ryan, S.J. (d. 1964). *Rector, Our Lady of Martyrs Tertianship, Auriesville, N.Y., 1962–64. Professor of Church History, Woodstock College, Md., 1936–62.*

Rt. Rev. Msgr. J(ohn) Joseph Ryan. *Professor of Church History, St. John's Seminary, Brighton, Mass. Professor of Medieval History, Pontifical Institute of Medieval Studies, Toronto.*

J. Coert Rylaarsdam. *Emeritus Professor of Old Testament Theology, University of Chicago. Professor of Theology, Marquette University, Milwaukee.*

William Merritt Sale III. *Associate Professor of Classics, Washington University, St. Louis, Mo.*

Matti Salo. *Free-lance writer on religion.*

Dittakavi Subrahmanya Sarma. *Principal Emeritus of Vivekananda College, Madras.*

Joseph Herman Schauinger. *Professor of History, College of St. Thomas, St. Paul, Minn.*

Alexander Schmemann. *Dean, St. Vladimir's Orthodox Theological Seminary, Tuckahoe, N.Y. Adjunct Professor, Columbia University.*

Rev. Ronald Duncan Mackintosh Shaw. *Missionary Professor, Central Theological College, Rikkyo University, Tokyo, 1922–37.*

Rt. Rev. Msgr. George William Shea. *Pastor, Our Lady of Sorrows Church, South Orange, N.J.*

Most Rev. Fulton John Sheen. *Bishop of the Diocese of Rochester, N.Y., 1966–69.*

Lancelot Capel Sheppard. *Former Editor, "Faith and Fact Series,"* Twentieth Century Encyclopaedia of Catholicism.

David Clark Shipley. *Emeritus Professor of Theology, Methodist Theological School, Delaware, Ohio.*

Donald Howard Shively. *Professor of Japanese History and Literature, Harvard University.*

Rev. Joachim Frederick Smet, O.Carm. *Editor of* Philippe de Mézières's The Life of St. Peter Thomas.

Rev. B.T.D. Smith. *Lecturer in Divinity, University of Cambridge, 1915–50; Fellow of Sidney Sussex College, Cambridge.*

Rev. Norman Henry Snaith. *Principal, 1954–61; Tutor in Old Testament Languages and Literature, 1936–61, Wesley College, Leeds, Eng.*

Ida Sloan Snyder. *Associate and News Director, Bureau of Communications, National Board of the Young Women's Christian Association, New York City.*

Rev. John Songster, S.J. *Professor of History, Georgetown University, Washington, D.C.*

Jacques Soustelle. *Professor of Social Anthropology, School of Advanced Studies in the Social Sciences, Paris.*

Rev. Dom Anselm Strittmatter, O.S.B. *Prior, St. Anselm's Abbey, Washington, D.C., 1961–67.*

Herbert P. Sullivan. *Professor and Chairman, Department of Religion, Vassar College, Poughkeepsie, N.Y.*

Very Rev. Norman Sykes (d. 1961). *Dean of Winchester, Eng., 1958–61.*

Rev. William Telfer (d. 1968). *Canon of Ely. Master of Selwyn College, University of Cambridge, 1947–56.*

Sydney A. Temple, Jr. *Lecturer in Classical Languages, University of Hawaii, Honolulu.*

Mary Frances Thelen. *Professor of Religion, Randolph-Macon Woman's College, Lynchburg, Va. Author of* Man as Sinner in Contemporary American Realistic Theology.

Rev. Antonine Severin Tibesar, O.F.M. *Professor of History, Catholic University of America, Washington, D.C. Former Director, Academy of American Franciscan History, Washington, D.C.*

L.J. Trinterud. *California Professor of Church History, San Francisco Theological Seminary, San Anselmo, and Graduate Theological Union, Berkeley, Calif.*

Harold Walter Turner. *Director, Project for New Religious Movements in Primal Societies, University of Aberdeen, Scot.*

James Herman Van der Veldt. *Emeritus Professor of Psychology, Catholic University of America, Washington. D.C. Co-author of* Psychiatry and Catholicism.

Rev. Alexander Roper Vidler. *Fellow and Dean of King's College, Cambridge, 1956–66; Lecturer in Divinity, University of Cambridge, 1959–67.*

Rev. Aubrey Russell Vine (d. 1973). *General Secretary, Free Church Federal Council.*

Rev. Canon Herbert Montague Waddams (d. 1972). *Residentiary Canon of Canterbury Cathedral, Eng., 1962–72.*

Francis Redding Walton. *Director of the Gennadius Library, American School of Classical Studies, Athens.*

Rt. Rev. and Rt. Hon. John William Charles Wand. *Canon and Treasurer of St. Paul's Cathedral, and Editor,* Church Quarterly Review, *1956–69. Bishop of London, 1944–55.*

James Hamilton Ware, Jr. *Professor of Philosophy and Religion; Chairman, Asian Studies Program, Austin College, Sherman, Texas.*

Edward Ingram Watkin. *Author of* Neglected Saints *and others.*

Very Rev. Hugh Watt (d. 1968). *Professor of Church History, New College, 1919–50; University of Edinburgh, 1935–50.*

William Montgomery Watt. *Professor of Arabic and Islāmic Studies, University of Edinburgh.*

Rabbi Meyer Waxman (d. 1969). *Professor, Hebrew Theological College, Skokie, Ill.*

Rev. Gustave Weigel, S.J. (d. 1964). *Professor of Ecclesiology, Woodstock College, Md., 1948–64.*

Egon Joseph Wellesz. *Fellow of Lincoln College, University of Oxford.*

R.J. Zwi Werblowsky. *Professor of Comparative Religion, Hebrew University of Jerusalem.*

John Lloyd White. *Provincial Director of Education, Washington Province of the Society of Mary.*

Very Rev. Henry Charles Whitley. *Emeritus Minister of St. Giles' Cathedral, Edinburgh. Dean of the Order of the Thistle.*

Allen Paul Wikgren. *Emeritus Professor of New Testament Language and Literature, University of Chicago.*

Hellmut Wilhelm. *Emeritus Professor Chinese History and Literature, University of Washington, Seattle.*

George Huntston Williams. *Hollis Professor of Divinity, Harvard University.*

Rev. Allan Bernard Wolter, O.F.M. *Professor of Philosophy, Catholic University of America, Washington, D.C.*

Donald Ernest Wilson Wormell. *Senior Fellow of Trinity College, Dublin; Professor of Latin, University of Dublin.*

Franklin Woodrow Young. *Amos Ragan Kearns Professor of New Testament and Patristic Studies; Director of Graduate Studies in Religion, Duke University, Durham, N.C.*

Ying-shih Yu. *Professor of Chinese History, Harvard University.*

Sa-sun Yun. *Professor, Teacher's College, Seoul National University.*

Rev. John H. Ziegler, C.S.P. *Former Chaplain to Catholic Students, University of Connecticut, Storrs.*

Larzer Ziff. *Professor of English, University of California, Berkeley.*

Part Nine. The history of mankind

William Wright Abbot. *James Madison Professor of History, University of Virginia, Charlottesville.*

Thomas Perkins Abernethy. *Richmond Alumni Professor Emeritus of History, University of Virginia, Charlottesville.*

Anthony Dolphin Alderson. *Historian and translator. Director of Transouth Ltd., Fareham, Eng.*

Frank Raymond Allchin. *Reader in Indian Studies, University of Cambridge.*

Antony Andrewes. *Wykeham Professor of Ancient History, University of Oxford.*

Roy Edgar Appleman. *Lieutenant Colonel, U.S. Army (retired). Historian, National Park Service; U.S. Department of the Interior, Washington, D.C.*

Karl Otmar, Baron von Aretin. *Professor of Contemporary History, Technical University of Darmstadt, W.Ger.*

Maurice Percy Ashley. *Research Fellow, Loughborough University of Technology, Eng., 1967–70. Author of* England in the Seventeenth Century *and others.*

Arthur C.V.D. Aspinall (d. 1972). *Professor of Modern History, University of Reading, Eng., 1947–65.*

Clement Richard Attlee, 1st Earl Attlee (d. 1967). *Prime Minister of Great Britain, 1945–51. Labour Party Leader, 1935–56.*

Jacques, Comte d'Avout. *Historian. Author of* La Querelle des Armagnacs et des Bourguignons; Le Meutre d'Étienne Marcel.

Evan Whyte-Melville Balfour-Melville (deceased). *Senior Lecturer in History, University of Edinburgh.*

Kenneth A. Ballhatchet. *Professor of the History of South Asia, University of London.*

John P.V. Dacre Balsdon (d. 1977). *Fellow of Exeter College, University of Oxford, 1928–69.*

Margaret Amelia Banks. *Law Librarian, University of Western Ontario, London.*

Cyril Nelson Barclay. *Brigadier, The Cameronians (Scottish Rifles), retired. Free-lance writer on military subjects. Editor,* The Army Quarterly and Defence Journal, *1950–66. Co-editor,* Brassey's Annual: The Armed Forces Year Book, *1950–69.*

Thomas Swain Barclay. *Emeritus Professor of Political Science, Stanford University, Calif.*

William Eldon Baringer. *Historical writer. Professor of Social Sciences, University of Florida, Gainesville.*

Geoffrey Wallis Steuart Barrow. *Professor of Scottish History, University of St. Andrews, Scot.*

Arthur Llewellyn Basham. *Professor of Asian Civilizations, Australian National University, Canberra.*

John Cawte Beaglehole (d. 1971). *Professor of British Commonwealth History, Victoria University of Wellington, N.Z., 1963–66.*

Hubert Irving Beatty. *Professor of History; Chairman, Division of Social Science and Philosophy, West Virginia State College, Institute.*

Norman de Mattos Bentwich (d. 1971). *Professor of International Relations, Hebrew University of Jerusalem, 1932–51.*

Marvin David Bernstein. *Professor of History, State University of New York College at Fredonia.*

Guillaume de Bertier de Sauvigny. *Professor of History, Catholic Institute of Paris.*

Wilfred E. Binkley (d. 1965). *Professor of Political Science, Ohio Northern University, Ada.*

Adrian David Hugh Bivar. *Lecturer in Iranian and Central Asian Art and Archaeology, School of Oriental and African Studies, University of London.*

Robert Norman William Blake, Baron Blake. *Provost, Queen's College, University of Oxford.*

Martin Blumenson. *Historian, Office of Chief of Military History, Department of the Army, Washington, D.C. 1952–67.*

John Boardman. *Professor of Classical Art and Archaeology, University of Oxford.*

Derk Bodde. *Professor of Chinese, University of Pennsylvania, Philadephia.*

Robert Ralph Bolgar. *Fellow and Director of Studies in Modern Languages, King's College, University of Cambridge.*

Hans A. Bornewasser. *Professor at the Theologian Faculty, Catholic University of Tilburg, Neth.*

Jean Bourdon. *Emeritus Professor of Modern History, University of Nancy, Fr.*

Robert Boutruche. *Professor, Faculty of Letters, University of Paris. Director of Studies, École Pratique des Hautes Études, Paris.*

Mary Boyce. *Professor of Iranian Studies, University of London.*

John Francis Boyd. *Political Correspondent,* The Guardian (*Manchester and London*)

Robert J. Braidwood. *Emeritus Professor of Old World Prehistory, Oriental Institute, University of Chicago; Field Director, Oriental Institute Prehistoric Projects.*

Elias Lunn Bredsdorff. *Reader and Head, Department of Scandinavian Studies, University of Cambridge; Fellow of Peterhouse, Cambridge.*

Sidney Reed Brett. *Second Master, King Edward VI School, Nuneaton, Eng., 1921–54.*

Author of British History, 1485–1939; John Pym, 1583–1643; *and others.*

Asa Briggs, Baron Briggs. *Provost of Worcester College; University of Oxford.*

Thomas Robert Shannon Broughton. *Paddison Professor Emeritus of Classics, University of North Carolina at Chapel Hill.*

B. Katherine Brown. *Historian.*

Delmer M. Brown. *Professor of History, University of California, Berkeley.*

Andrew Browning. *Professor of History, University of Glasgow, 1931–57.*

Eleanor Stephens Bruchey. *Seminar Associate, Columbia University.*

Peter Astbury Brunt. *Camden Professor of Ancient History, University of Oxford; Fellow of Brasenose College, Oxford.*

Barbara Buckmaster (the Hon. Mrs. Barbara Miller) (d. 1966). *Writer on Balkan affairs, London. Member of the Staff, Foreign Research and Press Service, Royal Institute of International Affairs.*

Daniel Meredith Bueno de Mesquita. *Lecturer in Modern History, University of Oxford; Student and Tutor of Christ Church, Oxford.*

Andrew Robert Burn. *Visting Professor, A College Year in Athens, Inc., 1969–72. Reader in Ancient History, University of Glasgow, 1965–69.*

Sir Alan Cuthbert Burns. *Governor and Commander in Chief, Gold Coast, 1941–47; Acting Governor, Nigeria, 1942.*

Thomas Ferrier Burns. *Editor,* The Tablet.

Alfred Leroy Burt. *Emeritus Professor of History, University of Minnesota, Minneapolis.*

Claude A. Buss. *Emeritus Professor of History, Stanford University, Calif.*

Sir James Ramsay Montagu Butler. *Fellow of Trinity College and Emeritus Professor of Modern History, University of Cambridge. Chief Historian,* Official United Kingdom History of the Second World War *(military series).*

Claude Cahen. *Professor of Islāmic History, University of Paris.*

James Ford Cairns. *Member, House of Representatives, for the Division of Lalor, Victoria. Lecturer in Economic History, University of Melbourne, Australia, 1946–55.*

North Callahan. *Professor of History, New York University, New York City.*

Wilfrid Hardy Callcott (d. 1969). *Professor of History, University of South Carolina, Columbia.*

George Glenn Cameron. *Chairman, Department of Near Eastern Languages and Literatures; Professor of Near Eastern Cultures, University of Michigan, Ann Arbor.*

Manoel Cardozo. *Professor of Brazilian History and Portuguese; Head of the Department of History, Catholic University of America, Washington, D.C., 1961–71.*

J.M.S. Careless. *Professor of History, University of Toronto.*

Sten C.O. Carlsson. *Professor of History, University of Uppsala, Swed.*

André Castelot. *Biographer and historical scriptwriter for radio and television.*

John W. Caughey. *Professor of American History, University of California, Los Angeles, 1946–70.*

B.D. Chattopadhyaya. *Faculty member, Jawaharlal Nehru University, New Delhi, India.*

Marquis William Childs. *Columnist, reporter, and biographer.*

Guy Edward Farquhar Chilver. *Professor of Classical Studies, University of Kent at Canterbury, Eng.*

Ian R. Christie. *Professor of Modern British History, University College, University of London.*

William Bell Clark (d. 1968). *Naval biographer. Vice President, N.W. Ayer & Son, 1939–50. Editor,* Documentary Naval History of the American Revolution.

Henry Jacob Cohn. *Senior Lecturer in History. University of Warwick, Coventry, Eng.*

Hugh Marshal Cole. *Vice President, Research Analysis Corporation, McLean, Va. Author of* The Lorraine Campaign; The Ardennes: Battle of the Bulge.

Douglas Colyer. *Air Marshal (retired). Civil Aviation Representative, Western Europe, Ministry of Transport and Civil Aviation, 1952–60.*

James Richard Connor. *Professor of History; Provost and Academic Vice President, Western Illinois University, Macomb.*

F. Hilary Conroy. *Professor of Far Eastern History, University of Pennsylvania, Philadelphia.*

James A(rthur) Corbett. *Professor of Medieval History, University of Notre Dame, Ind.*

Cornelius P. Cotter. *Professor of Political Science, University of Wisconsin, Milwaukee.*

Avery Craven. *Emeritus Professor of American History, University of Chicago.*

John Anthony Crook. *Fellow of St. John's College, Cambridge; Reader in Roman History and Law, University of Cambridge. Fellow of the British Academy.*

François Marie-Joseph Crouzet. *Professor of Economic History, University of Paris.*

William Culican. *Senior Lecturer in History, University of Melbourne, Australia.*

Noble E. Cunningham, Jr. *Professor of History, University of Missouri, Columbia.*

Richard N. Current. *University Distinguished Professor of History, University of North Carolina, Greensboro.*

Douglas Dakin. *Vice Master; Professor and Head, Department of History, Birkbeck College, University of London.*

Adrien Dansette. *Member of the Academy of Moral and Political Sciences, Paris.*

Cuthbert Collin Davies. *Reader in Indian History, University of Oxford, 1936–63.*

Ernest Albert John Davies. *Editor,* Traffic Engineering and Control. *Member of Parliament for Enfield East, Eng., 1945–59. Chairman, Labour Party Transport Committee, 1945–59.*

William Robert Davies. *Secretary, Liberal Party Organization, 1936–55.*

Warren Royal Dawson (d. 1968). *Hon. Fellow, Imperial College of Science. Hon. Member, Egypt Exploration Society.*

Ann Dearden. *Author of* Jordan.

Alexander De Conde. *Professor of History, University of California, Santa Barbara.*

Juliette C. Decreus. *Senior Lecturer in French, Queen Mary College, University of London.*

Herbert Stanley Deighton. *Lecturer in International Politics, Brunel University, Uxbridge, Eng.*

John Duncan Martin Derrett. *Professor of Oriental Laws, University of London.*

Jean Devisse. *Teacher, University of Paris-Vincennes.*

Porphyrios Dikaios (d. 1971). *Archaeological Institute, Rupert Charles University of Heidelberg, W.Ger. Director of Antiquities, Nicosia, Cyprus, 1960–63.*

Gordon Donaldson. *Professor of Scottish History and Palaeography, University of Edinburgh.*

Margaret Stefana Drower. *Reader in Ancient History, University College, University of London.*

Joaquin Milton Duarte, Jr. *Professor of Latin American Studies; Director, Department of International and Area Studies, Thunderbird Graduate School of International Management, Phoenix, Ariz.*

Trevor Nevitt Dupuy. *Colonel, U.S. Army (retired). President and Executive Director, Historical Evaluation and Research Organization, McLean, Va.*

Brainerd Dyer. *Emeritus Professor of History, University of California, Los Angeles.*

Denys G. Dyer. *University Lecturer in German, University of Oxford; Fellow of Exeter College, Oxford.*

Robert Harris Dyson, Jr. *Professor of Anthropology; Curator, Near Eastern Section, University Museum, University of Pennsylvania, Philadelphia, Director, Joint Expedition of the Archaeological Service of Iran, the University Museum, and the Metropolitan Museum of Art to Iran.*

Robert Walter Dudley Edwards. *Professor of Modern Irish History, University College, National University of Ireland, Dublin.*

Sir Ivo D'Oyly Elliott (d. 1961). *Indian Civil Service, 1906–32.*

Geoffrey R. Elton. *Professor of English Constitutional History, University of Cambridge.*

William Richard Emerson. *Director, Division of Research and Publication, National Endowment for the Humanities, National Foundation on the Arts and the Humanities, Washington, D.C.*

Philippe Erlanger. *Minister Plenipotentiary. Former Director of Cultural Activities, Ministry of Foreign Affairs, Paris.*

(Henry) Outram Evennett (d. 1964). *Fellow of Trinity College, Cambridge; Lecturer in History, 1930–55, University of Cambridge.*

Stanley Lawrence Falk. *Professor of International Relations, Industrial College of the Armed Forces, U.S. Department of Defense, Washington, D.C.*

Cyril Bentham Falls (d. 1971). *Military Correspondent of* The Times *(London), 1939–53. Chichele Professor of the History of War, University of Oxford, 1946–53.*

Raymond Oliver Faulkner. *Fellow of University College, London; Lecturer in Ancient Egyptian, University College, University of London, 1955–67.*

Isaac M. Fein. *Emeritus Professor of Jewish History, Baltimore Hebrew College.*

John Lister Illingworth Fennell. *Professor of Russian, University of Oxford.*

William Ferguson. *Senior Lecturer in Scottish History, University of Edinburgh.*

Sir James Fergusson of Kilkerran, 8th Bart. *Keeper of the Record of Scotland.*

Ronald Whitaker Ferrier. *Assistant Professor and Head, Department of English, Pahlavi University, Iran, 1963–65.*

Russell H. Fitzgibbon. *Professor of Political Science, University of California, Santa Barbara.*

Geoffrey Bernard Abbott Fletcher. *Professor of Latin, University of Newcastle upon Tyne, Eng., 1963–69. Author of* Annotations on Tacitus.

David Floyd. *Special correspondent on Communist affairs,* The Daily Telegraph *and* The Sunday Telegraph, *London.*

Michael Richard Daniell Foot. *Professor of History, Victoria University of Manchester, 1967–73.*

William George Forrest. *Fellow and Senior Tutor of Wadham College, Oxford; Lecturer in Ancient History, University of Oxford.*

André Fugier. *Former Professor of Modern History, University of Lyon, Fr.*

Roger Thomas Baldwin Fulford. *Author of* Royal Dukes *and others; co-editor of* The Greville Memoirs.

Cyril John Gadd (d. 1969). *Professor of Ancient Semitic Languages and Civilizations, University of London, 1955–60. Keeper, Egyptian and Assyrian Antiquities, British Museum, 1948–55.*

Vivian Hunter Galbraith. *Regius Professor Emeritus of Modern History, University of Oxford.*

Kenneth Garrad. *Professor of Spanish, Flinders University of South Australia, Bedford Park (Adelaide).*

Noel George Garson. *Professor of History, University of the Witwatersrand, Johannesburg.*

Raymond Leonard Garthoff. *Counsellor for Political-Military Affairs, U.S. Mission to NATO.*

Lucien Genet. *Inspector General of Public Instruction, Paris.*

Sir Hamilton Alexander Rosskeen Gibb (d. 1971). *University Professor and J.R. Jewett Professor of Arabic, Harvard University, 1955–64.*

Frederick Wellington Gibson. *Professor of History, Queen's University at Kingston, Ont.*

Aleksander Gieysztor. *Professor of Medieval History, University of Warsaw.*

Robert Louis Gilmore, *Professor of History, University of Kansas, Lawrence.*

Marija Gimbutas. *Professor of European Archaeology; Curator of Old World Archaeology, University of California, Los Angeles.*

Alfred Goldberg. *Senior Social Scientist, Rand Corporation, Washington, D.C. Chief, Current History Branch, U.S. Department of the Air Force, 1944–65.*

L. Carrington Goodrich. *Dean Lung Professor Emeritus of Chinese, Columbia University.*

Albert Goodwin. *Emeritus Professor of Modern History, Victoria University of Manchester.*

Norman A. Graebner. *Edward R. Stettinius Professor of History, University of Virginia, Charlottesville.*

William Roger Graham. *Douglas Professor of Canadian History, Queen's University at Kingston, Ont.*

Bruce Grant. *Author of* Isaac Hull: Captain of Old Ironsides *and others.*

Constance McLaughlin Green. *Author of* Washington: Village and Capital, 1800–1878; Washington, Capital City, 1879–1950; *and others.*

Fletcher Melvin Green. *Kenan Professor Emeritus of History, University of North Carolina, Chapel Hill.*

George William Greenaway. *Former Senior Lecturer in History, University of Exeter, Eng.*

Jonas Carl Greenfield. *Professor of Semitic Languages, University of California, Berkeley.*

Thomas Hoag Greer. *Professor of Humanities, Michigan State University, East Lansing.*

Ian Grey. *Author of* Catherine the Great; The First Fifty Years: Soviet Russia 1917–67; *and others.*

Géza Grosschmid. *Professor of Economics, Duquesne University, Pittsburgh; Former Director, Institute of African Affairs.*

Denis Rolleston Gwynn (d. 1971). *Research Professor of Modern Irish History, University College, Cork, National University of Ireland, 1946–63.*

Richard Carleton Haines. *Field Architect and Emeritus Assistant Professor, Oriental Institute, University of Chicago.*

John Whitney Hall. *Griswold Professor of History, Yale University.*

Mary Agnes Hamilton (d. 1966). *Editor,* English-Speaking World. *Author of* Sidney and Beatrice Webb *and others.*

Rev. Raphael Noteware Hamilton, S.J. *Emeritus Professor of History and Archivist, Marquette University, Milwaukee.*

Nicholas G.L. Hammond. *Henry Overton Wills Professor Emeritus of Greek, University of Bristol, Eng.*

Eric Walter Handley. *Professor of Greek, University College, University of London.*

Cyril Francis James Hankinson. *Editor,* Debrett's Peerage, *London, 1935–62.*

Sidney Harcave. *Professor of History, State University of New York at Binghamton.*

Peter Hardy. *Reader in the History of Islām in South Asia, School of Oriental and African Studies, University of London.*

John A. Harrison. *Senior Academic Dean, University of Miami, Coral Gables, Fla. Editor,* The Journal of Asian Studies, *1969–72.*

John Bennett Harrison. *Reader in Indian History, School of Oriental and African Studies, University of London.*

Erich Hugo Hassinger. *Professor of Modern History, Albert Ludwig University of Freiburg, Freiburg im Breisgau, W.Ger.*

Warren W. Hassler, Jr. *Professsor of American History, Pennsylvania State University, University Park.*

Zenos Eric Myhren Hawkinson. *Professor of History, North Park College, Chicago.*

Walter Heinemeyer. *Professor of Medieval History, Philipps University of Marburg, W.Ger.*

Charles Alistair Hennessy. *Professor of History, University of Warwick, Coventry, Eng.*

Hans Herzfeld. *Emeritus Professor of Modern History, Free University of Berlin.*

William B. Hesseltine (d. 1963). *Professor of History, University of Wisconsin, 1940–63.*

Agnes H. Hicks. *Member and Honorary Consultant on Scandinavian Affairs, Royal Institute of International Affairs.*

Richard Leslie Hill. *Professor of History, Abdullahi Bayero College, Ahmadu Bello University, Kano, Nigeria, 1968–69. Lecturer in Modern Near Eastern History, University of Durham, Eng., 1949–66.*

Fritz L(eo) Hoffmann. *Professor of Latin-American History, University of Colorado, Boulder.*

J.C. Holt. *Professor of Medieval History, University of Cambridge.*

Jean Hubert. *Professor of Medieval Archaeology, École Nationale des Chartes (School of Paleography), Paris.*

Harri Llwyd Hudson-Williams. *Professor of Greek, University of Newcastle upon Tyne, Eng.*

Joel Hurstfield. *Astor Professor of English History, University College, University of London.*

Joan Mervyn Hussey. *Emeritus Professor of History, Royal Holloway College, University of London.*

Richard Wyatt Hutchinson. *Former Lecturer in Classical Archaeology, University of Cambridge and University of Liverpool.*

William Thomas Hutchinson. *Preston and Sterling Morton Professor Emeritus of American History, University of Chicago.*

Nobutaka Ike. *Professor of Political Science, Stanford University, Calif.*

Denis Liddell Ireland. *Senator, Republic of Ireland, 1948–51. Author of* Patriot Adventure *and others.*

Fahir İz. *Professor of Turkish Literature, Boğaziçi University, Istanbul.*

Marius B. Jansen. *Professor of History, Princeton University.*

Barbara Jelavich. *Professor of History, Indiana University, Bloomington.*

Dafydd Jenkins. *Senior Lecturer in Law, University College of Wales, Aberystwyth, University of Wales.*

Robert Thomas Jenkins (d. 1969). *Professor of Welsh History, University College of North Wales, Bangor, University of Wales, 1945–48.*

Rt. Hon. Roy Jenkins. *President of the European Commission. Member of Parliament, 1948–76. Chancellor of the Exchequer, 1967–70.*

John J. Johnson. *Professor of History, Stanford University, Calif. Author of* Political Change in Latin America *and others.*

Robert Carl Johnson. *Associate Professor of History, Temple University, Philadelphia.*

Arnold Hugh Martin Jones (d. 1970). *Professor of Ancient History, University of Cambridge, 1951–70.*

Frits de Jong. *Professor of Modern and Contemporary History, University of Amsterdam. Director of the International Institute of Social History, Amsterdam.*

Adriaan G. Jongkees. *Professor of Medieval History, State University of Groningen, Neth.*

Eino Kaarlo Ilmari Jutikkala. *Professor of Finnish History, University of Helsinki.*

Enver Ziya Karal. *Professor of Contemporary History; Director, Turkish Revolutionary Institute, University of Ankara.*

Thomas L(indas) Karnes. *Professor of History, Arizona State University, Tempe.*

Hugh Francis Kearney. *Richard Pares Professor of History, University of Edinburgh.*

J.L. Howard Keep. *Professor of Russian History, University of Toronto.*

Harper Kelley (deceased). *Head of Research, National Center for Scientific Research, Paris. Head, Department of Prehistory, Musée de l'Homme, Paris.*

Annajane Kennard. *Librarian,* Straits Times Press, *Malaysia.*

John P. Kenyon. *Professor of Modern History, University of Hull, Eng.*

George Briscoe Kerferd. *Hulme Professor of Greek, Victoria University of Manchester, Eng.*

Stefan Kieniewicz. *Professor of 19th and 20th Century Polish History, University of Warsaw.*

Russell Amos Kirk. *Editor,* The University Bookman. *Research Professor of Politics, C.W. Post College, Long Island University, N.Y., 1957–69.*

Donald W. Klein. *Research Associate, East Asian Institute, Columbia University.*

Wilfrid F. Knapp. *Fellow and Tutor in Politics, St. Catherine's College, University of Oxford.*

George Harmon Knoles. *Margaret Byrne Professor of American History; Director, Institute of American History, Stanford University, Calif.*

Bernhard Knollenberg. *Fellow of Saybrook College, Yale University; Yale Librarian, 1938–44. Author of* Origin of the American Revolution *and others.*

Hans Kohn (d. 1971). *Emeritus Professor of History, City College, City University of New York, 1949–62.*

E.H. Kossmann. *Professor of Modern History, State University of Groningen, Neth.*

Carl H(ermann) Kraeling (d. 1966). *Professor of Archaeology, 1950–62; Director, Oriental Institute, 1950–60, University of Chicago.*

Hyman Kublin. *Professor of History, Brooklyn College, City University of New York.*

Robert George Dalrymple Laffan (d. 1972). *University Lecturer, University of Cambridge, 1927–53; Fellow of Queen's College, Cambridge.*

Ursula Schaefer Lamb. *Senior Lecturer in History, Yale University; Fellow of Calhoun College and Helen Hadley Hall.*

Gustave Lanctot. *Emeritus Professor of History, University of Ottawa.*

Aubrey C(hristian) Land. *Research Professor of History, University of Georgia.*

Taft Alfred Larson. *William Robertson Coe Distinguished Professor of American Studies, University of Wyoming, Laramie.*

Hugh Talmage Lefler. *Kenan Professor of History, University of North Carolina at Chapel Hill.*

George Alexander Lensen. *Professor of History, Florida State University, Tallahassee.*

Reuben Levy (d. 1966). *Professor of Persian, University of Cambridge, 1950–58.*

Lucjan Ryszard Lewitter. *Professor and Head, Department of Slavonic Studies, University of Cambridge; Fellow of Christ's College, Cambridge.*

K.J. Leyser. *Official Fellow and Tutor in Modern History, Magdalen College, University of Oxford.*

Alphons Lhotsky (d. 1968). *Professor of Austrian History, University of Vienna, 1951–68.*

Hans Liebeschütz. *Reader in Medieval History, University of Liverpool, 1955–59.*

Charles Christopher Lloyd. *Professor of History, Royal Naval College, Greenwich, Eng., 1962–66.*

Robert Bruce Lloyd. *Professor and Chairman, Department of Classics, Randolph-Macon Woman's College, Lynchburg, Va.*

Henry Cabot Lodge. *Personal Envoy of the President to the Vatican, 1970. United States Ambassador to South Vietnam, 1963–64, 1965–67. Representative of the United States to the United Nations, 1953–60.*

Leo Loewenson. *Deputy Librarian and Tutor in Russian History, School of Slavonic Studies, University of London, 1939–56.*

Stephen Hemsley Longrigg. *Historian and orientalist. Author of* Four Centuries of Modern Iraq *and others.*

Donald William Lucas. *P.M. Laurence Reader in Classics, University of Cambridge, 1952–69.*

John Lynch. *Professor of Latin American History; Director, Institute of Latin American Studies, University of London.*

Carlile Aylmer Macartney. *Research Fellow, All Souls College, University of Oxford, 1936–65. Montagu Burton Professor of International Relations, University of Edinburgh, 1951–57.*

Alexander Hugh McDonald. *Fellow of Clare College, Cambridge; Lecturer in Ancient History, University of Cambridge.*

Robert Brendan McDowell. *Associate Professor of History, Trinity College, University of Dublin.*

Thomas F. McGann. *Professor of History, University of Texas at Austin.*

Daniel Doyle McGarry. *Professor of Medieval History, St. Louis University, Mo.*

Clarence Fredric McIntosh. *Professor of History, California State University, Chico.*

Edward Anthony MacLysaght. *Chairman, Irish Manuscripts Commission. Author of* Irish Families *and others.*

Philip Magnus (Sir Philip Magnus-Allcroft). *Fellow of the Royal Society of Literature. Author of* Kitchener *and others.*

Sir Max Mallowan. (d. 1978). *Emeritus Professor of Western Asiatic Archaeology, University of London, 1947–62. President, British School of Archaeology in Iraq, 1970–78. Archaeologist on staff of the British Museum Expedition to Nineveh, 1931–32, later led many other archaeological expeditions.*

Robert Mandrou. *Professor of History, University of Paris X.*

(Philip) Nicholas Seton Mansergh. *Smuts Professor of the History of the British Commonwealth, University of Cambridge, 1953–70; Master of St. John's College, Cambridge.*

Thomas Powderly Martin (d. 1963). *Assistant Chief and Acting Chief, Manuscript Division, Library of Congress, 1928–48.*

J. Alden Mason (d. 1967). *Curator, American Section, University Museum, University of Pennsylvania, 1926–55.*

Donald Campbell Charles Masters. *Professor of Canadian History, University of Guelph, Ont.*

Therkel Mathiassen (deceased). *Curator, Prehistoric Department, National Museum, Copenhagen.*

Neville Maxwell. *Senior Fellow in Politics, School of Oriental and African Studies, University of London. Former South Asia correspondent,* The Times *(London).*

Russell Meiggs. *Fellow of Balliol College, Oxford; Lecturer in Ancient History, University of Oxford, 1939–70.*

Lucy Shoe Meritt. *Archaeologist. Editor of Publications, American School of Classical Studies at Athens, 1950–72. Member, Institute for Advanced Study, Princeton, N.J., 1948–73.*

Vladimir F. Minorsky (d. 1966). *Professor of Persian, University of London, 1938–44. Fellow of the British Academy, 1943–66.*

Michel J. Mollat. *Professor of History, University of Paris.*

Arnaldo Dante Momigliano. *Professor of Ancient History, University of London.*

Nicholas Ivan Momtchiloff (d. 1964). *Economic Adviser, Industrial and Commercial Finance Corporation, London.*

Georges Mongrédien. *Historian. Honorary Director of the Municipal Council of Paris and General Council of the Seine.*

Rev. Joseph Nestor Moody. *Professor of History, Catholic University of America, Washington, D.C.*

Dale Lowell Morgan. *Specialist, Bancroft Library, University of California, Berkeley. Author of* Jedediah Smith and the Opening of the West *and others.*

John Robert Morris. *Senior Lecturer in Ancient History, University College, University of London.*

Rudolf Morsey. *Professor of Modern History, Postgraduate School for Administrative Sciences, Speyer, W.Ger.*

Louis Morton. *Daniel Webster Professor and Professor of History, Dartmouth College, Hanover, N.H.*

Charles Loch Mowat (d. 1970). *Professor of History, University College of North Wales, Bangor, University of Wales, 1958–70.*

George E. Mowry. *William Rand Kenan Professor of History, University of North Carolina, Chapel Hill.*

Joan Margaret Munn-Rankin. *Lecturer in Near Eastern History, University of Cambridge.*

Jean Mary Munro (Jean Dunlop). *Author of* Clan Mackenzie; Clan Gordon *and others.*

Raymond Muse. *Professor and Chairman, Department of History, Washington State University, Pullman.*

Alexander Reginald Myers. *Professor of Medieval History, University of Liverpool.*

A.K. Narain. *Professor of History and Indian Studies, University of Wisconsin, Madison.*

Herbert Blair Neatby. *Professor and Chairman, Department of History, Carleton University, Ottawa.*

Allan Nevins (d. 1971). *Historian. Senior Research Associate, Henry E. Huntington Library and Art Gallery, San Marino, Calif., 1958–69. Dewitt Clinton Professor of History, Columbia University, 1931–58.*

Herbert G. Nicholas. *Rhodes Professor of American History and Institutions, University of Oxford; Fellow of New College, Oxford.*

Roy Franklin Nichols (d. 1973). *Professor of History; Vice Provost, 1953–66; and Dean of the Graduate School of Arts and Sciences, 1952–66, University of Pennsylvania, Philadelphia.*

Donald MacGillivray Nicol. *Koraës Professor of Byzantine and Modern Greek History, Language, and Literature, King's College, University of London.*

Louis Nicolas. *Former Professor of Naval History, Naval School, Lanvéoc-Poulmic, Fr.*

Russel Blaine Nye. *Professor of English, Michigan State University, East Lansing.*

Roland Anthony Oliver. *Professor of the History of Africa, University of London, 1963–72.*

George Coleman Osborn. *Professor of History and Social Sciences, University of Florida, Gainesville.*

Andrei Otetea. *Director, Institute of History; Member, Academy of the Socialist Republic of Romania, Bucharest. Former Professor of Medieval Universal History, University of Bucharest.*

Marcel Pacaut. *Professor of the History of the Middle Ages; Director, Institute of Political Studies, University of Lyon, Fr.*

Joseph Howard Parks. *Professor and Head, Department of History, University of Georgia, Athens, 1958–69; Alumni Foundation Distinguished Professor, 1967–71.*

V.J. Parry. *Reader in the History of the Near and Middle East, School of Oriental and African Studies, University of London.*

Ante Smith Pavelić. *Author of* Dr. Ante Trumbić: Problemi hrvatsko-srpskih odnosa *and others.*

Howard Henry Peckham. *Director, William L. Clements Library of Americana; Professor of History, University of Michigan, Ann Arbor.*

Luis Pericot García. *Former Professor of Prehistory, University of Barcelona, Spain.*

Stewart Henry Perowne. *Orientalist, historian, and lecturer. Author of* The Life and Times of Herod the Great *and others.*

Charles-Edmond Perrin. *Member, Institute of France. Emeritus Professor of Medieval History, University of Paris.*

Jean Perrot. *Director of the French Archaeological Delegation in Iran.*

Ann Petry. *Author of* Harriet Tubman: Conductor on the Underground Railroad; Tituba of Salem Village.

Edward Hake Phillips. *Bryan Professor of History, Austin College, Sherman, Texas.*

Thomas Jones Pierce (deceased). *Professor of Medieval Welsh History, University College of Wales.*

Francis Stewart Gilderoy Piggott (d. 1966). *Major General, British Army. Author of* Broken Thread; The Elements of Sosho.

Stuart Piggott. *Abercromby Professor of Prehistoric Archaeology, University of Edinburgh.*

Richard E. Pipes. *Frank B. Baird, Jr., Professor of History, Harvard University.*

Richard Pittioni. *Emeritus Professor of Prehistory and Protohistory, University of Vienna.*

John Harold Plumb. *Master of Christ's College, Cambridge; Professor of Modern English History, University of Cambridge.*

Forrest C. Pogue. *Director, Dwight D. Eisenhower Institute for Historical Research, Smithsonian Institution, Washington, D.C.*

Ernesto Pontieri. *Professor of Medieval and Modern History, University of Naples.*

Rev. Stanley Burke-Roche Poole. *Vicar of Littlebourne, Eng., 1948–70. Former Assistant Editor,* Debrett's Peerage.

Rollie Edward Poppino. *Professor of History, University of California, Davis.*

Cecil John Layton Price. *Professor of English Language and Literature, University College of Swansea, University of Wales.*

Morgan Philips Price. *Member of Parliament, 1929–31 and 1935–59. Author of* A History of Turkey *and others.*

Thomas Brynmor Pugh. *Senior Lecturer in History, University of Southampton, Eng.*

Sergei Germanovich Pushkarev. *Historian. Author of* The Emergence of Modern Russia, 1801–1917 *and others.*

Robert Emmett Quirk. *Professor of History, Indiana University, Bloomington.*

Horst Rabe. *Professor, University of Constance, W.Ger.*

Juan Reglá. *Professor of Modern History, University of Valencia, Spain.*

Robert Vincent Remini. *Professor and Chairman, Department of History, University of Illinois, Chicago.*

Yves Renouard (d. 1965). *Professor of Medieval History, University of Paris.*

Jean B. Richard. *Dean, Faculty of Letters and Human Sciences, University of Dijon, Fr.*

Sir Ian Archibald Richmond (d. 1965). *Professor of the Archaeology of the Roman Empire, University of Oxford, 1956–65.*

Edgar Eugene Robinson (d. 1977). *Margaret Byrne Professor of American History, Stanford University, Calif., 1931–52.*

George William Robinson. *Professor and Chairman, Department of History, Eastern Kentucky University, Richmond.*

Judith Mary Rodden. *Research Student, Department of Archaeology and Anthropology, University of Cambridge.*

Andrew Frank Rolle. *Robert Glass Cleland Professor of History, Occidental College, Los Angeles.*

Eugene Holloway Roseboom, Sr. *Emeritus Professor of History, Ohio State University, Columbus.*

Henry Godfrey Roseveare. *Lecturer in History, King's College, University of London.*

Ralph J. Roske. *Professor of History, University of Nevada, Las Vegas.*

C.D. Ross. *Reader in Medieval History, University of Bristol, Eng.*

Stanley Robert Ross. *Professor of History; Provost for Arts and Sciences, University of Texas at Austin.*

Emanuel Rostworowski. *Professor of Modern History, Historical Institute, Polish Academy of Sciences, Cracow.*

Gordon Oliver Rothney. *Professor of History, University of Manitoba, Winnipeg.*

Nicolai Rubinstein. *Emeritus Professor of History, University of London.*

Nils Göran Rystad. *Associate Professor of History, University of Lund, Swed.*

Leland Livingston Sage. *Emeritus Professor of History, University of Northern Iowa, Cedar Falls.*

Theodore Saloutos. *Professor of History, University of California, Los Angeles.*

Leonard Bertram Schapiro. *Professor of Political Science (Russian Studies), London School of Economics and Political Science, University of London.*

Theodor Schieffer. *Professor of Medieval and Modern History, University of Cologne, W.Ger.*

Karl Michael Schmitt. *Professor of Government, University of Texas at Austin.*

Ronald Milton Schneider. *Professor of Political Science, Queens College, City University of New York.*

Howard Hayes Scullard. *Emeritus Professor of Ancient History, University of London.*

M.V. Seton-Williams. *Lecturer in Western Asiatic Archaeology, University of London. Former director of archaeological expeditions in Turkey, Syria, Jordan, Egypt, and Cyprus.*

Charles Seymour (d. 1963). *President, Yale University, 1937–50; Professor of History, 1918–37.*

Irfan Arif Shahîd. *Professor of Arabic, Georgetown University, Washington, D.C.*

David Allen Shannon. *Professor of History; Dean, Faculty of Arts and Sciences, University of Virginia, Charlottesville, 1969–71.*

Ivan Peter Shaw. *Fellow and Secretary, King's College, University of London. Author of* Nationality and the Western Church Before the Reformation.

Hugh Shearman. *Historian and writer on politics and world affairs. Author of* Modern Ireland; Ulster; *and others.*

Eric William Sheppard. *Major, British Army (retired). Author of* A Short History of the British Army *and others.*

James Henry Shideler. *Professor of History, University of California, Davis.*

Winant Sidle. *Brigadier General, U.S. Army.*

Henry Harrison Simms. *Emeritus Professor of History, Ohio State University, Columbus.*

Roger Henry Simpson. *Historian and lecturer.*

Otis Arnold Singletary. *President, University of Kentucky. Former Vice Chancellor for Academic Affairs, University of Texas System.*

Fridlev Skrubbeltrang. *Lecturer in Agricultural History, University of Copenhagen, 1956–71.*

Bradford Smith (d. 1964). *Author of* Bradford of Plymouth; Captain John Smith; *and others.*

Robert Ross Smith. *Former Historian, Office of the Chief of Military History, U.S. Department of the Army.*

Thomas C. Smith. *Professor of History, Stanford University, Calif. Author of* The Agrarian Origins of Modern Japan *and others.*

Kazimierz Maciej Smogorzewski. *Founder and Editor,* Free Europe, *1939–45. Foreign correspondent, 1919–39.*

Albert M. Soboul. *Professor of the History of the French Revolution, University of Paris I.*

Ramón Solís Llorente. *Writer and historian. Corresponding member, Royal Academy of History, Madrid.*

Albert Somit. *Professor of Political Science, State University of New York at Buffalo.*

T.G. Percival Spear. *Fellow of Selwyn College, Cambridge; Lecturer in History, University of Cambridge, 1963–69.*

Arnold Spekke (d. 1972). *Author of* History of Latvia *and others.*

S. Henry Steinberg (d. 1969). *Editor,* The Statesman's Year-Book, *1946–69.*

Doris Mary Stenton (d. 1971). *Reader in History, University of Reading, Eng.*

George R. Stewart. *Emeritus Professor of English, University of California, Berkeley.*

Arndt Mathis Stickles. *Emeritus Professor of History, Western Kentucky University, Bowling Green.*

Hudson Strode (d. 1976). *Professor of English, University of Alabama, Tuscaloosa, 1924–63. Author of* Timeless Mexico *and others.*

David Brian Stronach. *Director, British Institute of Persian Studies, Teheran, Iran.*

John Taylor. *Reader in Medieval History, University of Leeds, Eng.*

Geoffrey Templeman. *Vice Chancellor, University of Kent at Canterbury, Eng.*

Romila Thapar. *Professor of Ancient Indian History, Jawaharlal Nehru University, New Delhi.*

Alfred Barnaby Thomas. *Emeritus Professor of History, University of Alabama, Tuscaloosa.*

Nicholas de L'Eglise Wolferstan Thomas. *Keeper, Department of Archaeology, City Museum, Birmingham, Eng.*

Arthur Frederick Thompson. *Fellow and Tutor of Wadham College, Oxford; Lecturer in Modern History, University of Oxford.*

E.A. Thompson. *Professor of Classics, University of Nottingham, Eng.*

Roy Gilbert Thurburn. *Brigadier, the Cameronians (Scottish Rifles) (retired). Secretary, Army Museums Ogilby Trust, Ministry of Defence, London, 1957–72.*

Hans Louis Trefousse. *Professor of History, Brooklyn College, City University of New York.*

Reginald Francis Treharne (d. 1967). *Professor of History, University College of Wales, Aberystwyth, University of Wales, 1930–67.*

Eric Gardner Turner. *Professor of Papyrology, University College, University of London; Director, Institute of Classical Studies, 1953–63.*

Edward Ullendorff. *Professor of Ethiopian Studies, University of London.*

Frank Everson Vandiver. *Professor of History, Rice University, Houston, Texas.*

J. Charles Verlinden. *Emeritus Professor of History, State University of Ghent, Belg. Director, Belgian Historical Institute, Rome.*

Jean Vidalenc. *Professor of Contemporary History, University of Rouen, Fr.*

Rev. Edward Robert Vollmar, S.J. *Professor of History and Associate Director of Libraries, St. Louis University, Mo.*

John Waechter. *Lecturer in Paleolithic Archaeology, Institute of Archaeology, University of London.*

Peter Busby Waite. *Professor of History, Dalhousie University, Halifax, Nova Scotia.*

Frank W. Walbank. *Rathbone Professor Emeritus of Ancient History and Classical Archaeology, University of Liverpool.*

William Stewart Wallace (d. 1970). *Librarian, University of Toronto. Author of* A History of the Canadian People.

Friedrich Walter (d. 1968). *Extraordinary Professor of Modern Austrian History, University of Vienna, 1955–67.*

William Reginald Ward. *Professor of Modern History, University of Durham, Eng.*

John Bryan Ward-Perkins. *Director, British School at Rome.*

Brian H. Warmington. *Reader in Ancient History, University of Bristol, Eng.*

Oliver Martin Wilson Warner. *Naval historian. Member, Council of the Society of Nautical Research, 1955–60; Council of the Navy Records Society, 1969–70.*

Saul S. Weinberg. *Professor of Classical Archaeology, University of Missouri, Columbia.*

C. Bradford Welles (d. 1969). *Professor of Ancient History, Yale University, 1940–69.*

Manly Wade Wellman. *Novelist and writer on American history. Author of* Giant in Gray: A Biography of Wade Hampton of South Carolina *and others.*

Edward F. Wente. *Professor of Egyptology, Oriental Institute. Professor of Near Eastern Languages, University of Chicago.*

Richard Bruce Wernham. *Professor of Modern History, University of Oxford; Fellow of Worcester College, Oxford, 1951–72.*

Gunnar Torvald Westin. *Professor of History, University of Stockholm.*

Matthew Immanuel Wiencke. *Professor of Classics, Dartmouth College, Hanover, N.H.*

Oscar O. Winther. *University Professor of History, Indiana University, Bloomington.*

Donald John Wiseman. *Professor of Assyriology, School of Oriental and African Studies, University of London.*

Elizabeth Wiskemann (d. 1971). *Montague Burton Professor of International Relations, University of Edinburgh, 1958–61. Tutor in Modern History, University of Sussex, Eng., 1961–64.*

James Madison Wood, Jr. *Professor of History, Santa Monica College, Calif.*

Brian Harvey Goodwin Wormald. *Fellow of Peterhouse, Cambridge; University Lecturer in History, University of Cambridge.*

John Howard Young. *W.H. Collins Vickers Foundation Professor of Archaeology, Johns Hopkins University, Baltimore.*

Mary Elizabeth Young. *Professor of History, Ohio State University, Columbus.*

T(heodore) Cuyler Young. *Horatio Whitridge Garrett Professor of Persian Language and History; Chairman, Oriental Studies Department, Princeton University.*

Andrzej Zahorski. *Professor of Modern History, University of Warsaw.*

Ernst Walter Zeeden. *Professor of Modern and Medieval History, Eberhard Karl University of Tübingen, W. Ger.*

Herbert Zeiden. *Free-lance writer in the area of history.*

Part Ten. The branches of knowledge

Alexander Altmann. *Philip W. Lown Professor of Jewish Philosophy, Brandeis University, Waltham, Mass.*

A. Hilary Armstrong. *Gladstone Professor of Greek, University of Liverpool.*

George Alfred Barnard. *Professor of Mathematics, University of Essex, Eng.*

Eric Temple Bell (d. 1960). *Professor of Mathematics, California Institute of Technology, Pasadena, 1926–60.*

Delwin Brown. *Associate Professor of Philosophy and Religion, Anderson College, Ind.*

Chung-hwan Chen. *Professor of Philosophy, University of South Florida, Tampa.*

Alonzo Church. *Professor of Mathematics and Philosophy, University of California, Los Angeles.*

I. Bernard Cohen. *Professor of the History of Science, Harvard University.*

Frederick Coppotelli. *Free-lance writer on mathematics.*

Paul Dibon. *Director, École Pratique des Hautes Études, Paris.*

William R. Eckhardt. *Free-lance writer on mathematics.*

Dorothy Mary Emmet. *Emeritus Professor of Philosophy, Victoria University of Manchester.*

Raphael Finkel. *Free-lance writer on mathematics.*

Andrew M. Gallant. *Free-lance writer on mathematics.*

William Keith Chambers Guthrie. *Laurence Professor of Ancient Philosophy, University of Cambridge, 1952–73; Master of Downing College, Cambridge, 1957–72.*

Roland John Hill. *London Correspondent, Stuttgarter Zeitung, Stuttgart, W.Ger.*

Dewey J. Hoitenga, Jr. *Professor of Philosophy, Calvin College, Grand Rapids, Mich.*

Constantin Ludwig Adolph Rudolph Hope. *Vicar, St. Michael's and All Angels, New Marston, Oxford, Eng.*

Kung-chuan Hsiao. *Emeritus Professor of the History of Chinese Thought, University of Washington, Seattle.*

Yasuke Ikari. *Instructor, Seminar for Indology, Kyōto University.*

Jim Kenevan. *Free-lance writer on mathematics.*

Sir T. Malcolm Knox. *Principal, University of St. Andrews, Scot., 1953–66; Professor of Moral Philosophy, 1936–53.*

Casimir Lewy. *Fellow and Lecturer in Moral Sciences, Trinity College, Cambridge; Sidgwick Lecturer in Philosophy, University of Cambridge.*

Antony Charles Lloyd. *Professor of Philosophy, University of Liverpool.*

John David Mabbott. *President, St. John's College, University of Oxford, 1963–69. Author of* An Introduction to Ethics *and others.*

Herbert S. Matsen. *Assistant Professor of Philosophy, University of South Carolina, Columbia.*

Yi Pao Mei. *Henry Luce Professor of Humanities, Tunghai University, T'ai-chung, Taiwan, 1973–77. Professor of Oriental Studies, University of Iowa, Iowa City, 1955–70.*

Philip Merlan (d. 1968). *Professor of German Philosophy and Literature, Scripps College, Claremont, Calif., 1942–68.*

Lorenzo Minio-Paluello. *Emeritus Reader in Mediaeval Philosophy, University of Oxford; Fellow of Oriel College, Oxford, 1962–75. Director of Aristoteles Latinus, 1959–72.*

M.L. Modica. *Free-lance writer on mathematics.*

Otto E. Neugebauer. *Emeritus Professor of the History of Mathematics, Brown University, Providence, R.I.*

Oystein Ore (d. 1968). *Sterling Professor of Mathematics, Yale University, 1931–68.*

Rt. Rev. Ian Thomas Ramsey (d. 1972). *Lord Bishop of Durham, Eng., 1966–72. Nolloth Professor of the Philosophy of the Christian Religion, University of Oxford, 1951–66.*

D.D. Raphael. *Professor of Philosophy, Imperial College of Science and Technology, University of London.*

Rev. Charles Earle Raven (d. 1964). *Regius Professor of Divinity, University of Cambridge, 1932–50. Canon of Liverpool, 1924–32.*

Joan Saberhagen. *Free-lance writer on mathematics.*

V.C. Samuel. *Dean, Theological College, National University, Addis Ababa, Eth.*

Francis Henry Sandbach. *Fellow of Trinity College, Cambridge; Professor of Classics, University of Cambridge, 1967–70.*

Vera Sanford (deceased). *Professor of Mathematics, State University of New York College at Oneonta, 1943–59.*

Robert Shackleton. *Bodley's Librarian, University of Oxford; Fellow of Brasenose College, Oxford; Lecturer in French, 1949–65.*

Gertrude Smith. *Edward Olson Professor Emeritus of Greek, University of Chicago.*

Dirk Jan Struik. *Emeritus Professor of Mathematics, Massachusetts Institute of Technology, Cambridge.*

Takeuchi Yoshinori. *Emeritus Professor of Philosophy of Religion, Kyōto University.*

Tang Chun-i. *Professor of Philosophy, New Asia College, Chinese University of Hong Kong.*

Brian Tierney. *Professor of Medieval History, Cornell University, Ithaca, N.Y.*

Walter Tuvell. *Free-lance writer on mathematics.*

Bartel Leendert van der Waerden. *Emeritus Professor of Mathematics, University of Zürich.*

William Henry Walsh. *Professor of Logic and Metaphysics, University of Edinburgh. Fellow of the British Academy.*

Yi-T'ung Wang. *Professor of Classical Chinese; Director, East Asian Languages and Area Center, University of Pittsburgh.*

Fritz Wehrli. *Professor of Classical Philology, University of Zürich.*

Dallas Willard. *Associate Professor of Philosophy, University of Southern California, Los Angeles.*

Paul August Wilpert (d. 1967). *Professor of Philosophy and Director of the Thomas Institute, University of Cologne.*

Lien-sheng Yang. *Harvard-Yenching Professor of Chinese History, Harvard University.*

Theodore F. Zelman. *Free-lance writer on mathematics.*

Geography

Jan Achterstraat. *Director, Sociografisch Bureau, Haarlemmermeer, Neth.*

Evelyn Martha Acomb. *Professor of History, State University of New York College at New Paltz.*

Ebenezer Acquaah-Harrison. *Managing Director and Chairman, Obonoma Press, Ghana.*

André Adam. *Professor of Muslim Sociology, University of Aix-Marseille I, Marseille, Fr.*

Elizabeth S. Adams. *Member, Michigan Historical Commission.*

Frederick Wayne Adrian. *Professor of History, University of Nebraska at Omaha.*

Dwight Luther Agnew. *Dean, School of Liberal Studies, University of Wisconsin-Stout, Menomonie.*

Enayat Ahmad. *Professor and Head, Department of Geography; Dean, Faculty of Arts, University of Ranchi, India.*

Syed Ahmed (deceased). *Reader and Head of the Department of Geography, Osmania University, Hyderabad, India.*

Frank Oswald Ahnert. *Professor of Geography, University of Maryland, College Park.*

Robert Edwin Albright (d. 1969). *Professor of Social Studies, State University of New York College at Buffalo.*

William Thomas Alderson. *Director, American Association for State and Local History, Nashville, Tenn.; Editor,* History News.

John Edmund Allison. *Supervisor, Department of Education, University of Liverpool, 1959–64. Head, Department of Geography, Birkenhead Institute, Eng., 1921–58.*

David Nelson Alloway. *Professor of Sociology; Director, Title I Programs, Montclair State College, N.J.*

Roger M. Anthoine. *Public Information Officer, CERN (European Organization for Nuclear Research), Geneva.*

John Conrad Appel. *Professor of History, East Stroudsburg State College, Pa.*

Donald Ecklund Armagost. *Chairman, Department of Anthropology-Sociology, State University of New York College at Potsdam.*

T.E. Armstrong. *Assistant Director of Research, Scott Polar Research Institute, University of Cambridge.*

Ethel Stephens Arnett. *Author of* Greensboro, North Carolina, the County Seat of Guilford; Confederate Guns Were Stacked [at] Greensboro, North Carolina *and others.*

B.W. Atkinson. *Lecturer in Geography, Queen Mary College, University of London.*

Jack Nelson Averitt. *Professor of History; Dean, Graduate School, Georgia Southern College, Statesboro.*

Paul Bachetta. *Director of Administrative Services, Office of the Mayor, Chambéry, Fr.*

E. Badian. *Professor of History, Harvard University.*

Leslie Henry Baines. *Clerk of the Peace and Clerk of the County Council, Isle of Wight.*

Albert Wilford Baisler. *Education Consultant, Heald Hobson & Associates, New York City. President, Jamestown Community College, N.Y., 1957–69.*

Frederick Thomas Baker. *Director, Lincoln Public Library, City and County Museum, and Usher Gallery, Lincoln, Eng.*

Samuel John Kenneth Baker. *Emeritus Professor of Geography, Makerere University, Kampala, Uganda. Honorary Lecturer in Geography, University of Leicester, Eng., 1968–74.*

Frank Arnold Barnes. *Senior Lecturer in Geography, University of Nottingham, Eng.*

Lucy Goodell Barnes. *Former Research Associate, Massachusetts Institute of Technology, Cambridge.*

Norman Farley James Batchelor. *Public Relations Officer, London Borough of Haringey, Eng.*

Merrill D. Beal. *Emeritus Professor of History, Idaho State University, Pocatello.*

J. Murray Beck. *Professor of Political Science, Dalhousie University, Halifax, Nova Scotia.*

Virginia Beck. *Emeritus Professor of History, Millersville State College, Pa.*

Natalia Maree Belting. *Assistant Professor of History, University of Illinois, Urbana.*

S. Ann Berich. *Instructor in Geography, Youngstown State University, Ohio.*

Norman Thomas Berry. *Town Clerk, Slough, Eng.*

Simone Bertrand. *Director of the Library and of the Tapestry, Bayeux, Fr.*

Jozef Marie Nicolas Beugels. *Senior Official, Kerkrade Municipality, Neth.*

George Athan Billias. *Professor of American History, Clark University, Worcester, Mass.*

Louis Robert Binding. *Committee Clerk, Luanshya Municipal Council, Zambia.*

Claude T. Bissell. *President, University of Toronto.*

Lloyd Deacon Black. *Professor of Geography, Northern Illinois University, De Kalb.*

(Miss) Phyllis Ruth Blakeley. *Assistant Archivist, Province of Nova Scotia, Halifax.*

Mary Joyce Boast. *Administration Officer of the Libraries, Southwark, London.*

Ernest Amano Boateng. *Executive Chairman, Environmental Protection Council of Ghana, Accra. Vice Chancellor, University of Cape Coast, Ghana, 1971–73.*

Hans Bobek. *Emeritus Professor of Geography, University of Vienna.*

Eugene Reeves Bock. *Editor of the Editorial Page,* Anderson (*Ind.*) Daily Bulletin.

Norbert Bodenstedt. *Chief Director of Archives, Freising, W.Ger.*

Victor Morton Bogle. *Chancellor; Professor of History, Indiana University, Kokomo.*

Allan G. Bogue. *Professor of American History, University of Wisconsin, Madison.*

Janis A. Bokalders. *Former Professor of Economics, University of Latvia, Riga.*

Paul Yvan Bonnard. *Municipal Archivist, Aix-en-Provence, Fr.*

James Calvin Bonner. *Professor and Chairman, Department of History and Political Science, Georgia College, Milledgeville, 1944–69.*

Ernst Borchorst. *Town Clerk of Esbjerg, Den.*

Vishnu Vinayak Borkar. *Professor and Head, Department of Economics, Marathwada University, Aurangabad, India.*

Otto Borst. *Civic Archivist, Esslingen, W.Ger.*

Gérard Boulet. *Schoolteacher, Nimes, Fr.*

John P. van Brakel. *Municipal Works Officer and President, Historical Society, Katwijk, Neth.*

Peter Alexander Brannon (d. 1967). *Director, Alabama Department of Archives and History, Montgomery.*

James Shober Brawley. *Telegraph Editor,* Salisbury (*N.C.*) Post.

Edward Joseph Breen. *Lawyer. Editor of* History of Early Fort Dodge and Webster County, Iowa.

John Otis Brew. *Peabody Professor of American Archaeology and Ethnology, Harvard University.*

William Charles Brice. *Reader in Geography, Victoria University of Manchester.*

Harold Edward Briggs. *Emeritus Professor of History, Southern Illinois University, Carbondale.*

George Mercer Brooke, Jr. *Professor of History, Virginia Military Institute, Lexington.*

Harold Chillingworth Brookfield. *Former Professorial Fellow in Geography, Australian National University.*

Alfred Edward Brown. *Director, Enfield Public Library, London Borough of Enfield, Eng.*

Chester Sidney Brown. *Former Director of Parks and Conservation, Department of Natural Resources, Government of Saskatchewan, Regina.*

Richard Holbrook Brown. *Director, Committee on the Study of History, Hampshire College, Amherst, Mass., and the Newberry Library, Chicago.*

Robert Eugene Burke. *Professor of History, University of Washington, Seattle. Managing Editor,* Pacific Northwest Quarterly.

Devereux Butcher. *Author and photographer. Author of* Exploring Our National Parks and Monuments *and others.*

Gilbert James Butland. *Foundation Professor of Geography, University of New England, Armidale, Australia.*

Robin Alan Butlin. *Lecturer in Geography, Queen Mary College, University of London.*

Victor Harrison Cahalane. *President, Defenders of Wildlife, 1962–71. Assistant Director, New York State Museum, Albany, 1955–67. Collaborator, National Park Service, 1955–70.*

George H. Callcott. *Professor of History; Vice Chancellor for Academic Affairs, University of Maryland, College Park.*

Eila M.J. Campbell. *Professor and Head, Department of Geography, Birkbeck College, University of London.*

Erminio Canova. *Schoolmaster and journalist, Guastalla, Italy.*

Gerald M. Capers. *Emeritus Professor of History, Tulane University, New Orleans.*

Albert Sigfrid Carlson. *Professor of Geography, Dartmouth College, Hanover, N.H.*

Carole-Ann Carter. *Tutor in geography.*

Harvey Lewis Carter. *John and Harriet Parker Campbell Professor of American History and Curator of the Archer B. Hulbert Memorial Collection of Western Americana, Colorado College, Colorado Springs.*

Theodore J. Cassady. *Director, Illinois State Archives, Springfield.*

John Edwards Caswell. *Professor of History, Stanislaus State College, Turlock, Calif.*

Shiba Chatterjee. *Emeritus Professor of Geography, University of Calcutta.*

Charles B. Clark. *Professor and Chairman, Department of Political Science; Academic Dean, Upper Iowa College, Fayette.*

Ira Granville Clark. *Professor of History, New Mexico State University, Las Cruces.*

Thomas D. Clark. *Emeritus Professor of History, University of Kentucky. Distinguished Professor of History, Indiana University, Bloomington.*

Frans de Clercq. *Community Official, Roosendaal en Nispen, Neth.*

Carolyn M. Clewes. *Professor of History, Wheaton College, Norton, Mass.*

Morris Harold Cohen. *Professor of Government, Clark University, Worcester, Mass.*

John Peter Cole. *Reader in Geography, University of Nottingham, Eng.*

John M. Coleman. *Associate Professor of History, Lafayette College, Easton, Pa.*

J(ohn) Winston Coleman, Jr. *Author of* Slavery Times in Kentucky; Stage-Coach Days in the Bluegrass; *and others.*

David de Lancey Condon. *Former Assistant Superintendent, Grand Canyon National Park, Ariz.*

Paul Keith Conkin. *Professor of History, University of Wisconsin, Madison.*

James Robert Constantine. *Professor of History, Indiana State University, Terre Haute.*

Michael Garnet Cook. *University Archivist; Lecturer in Medieval History, University of Liverpool.*

John Terence Coppock. *Ogilvie Professor of Geography, University of Edinburgh.*

Jean Coppolani. *State Town Planner, Toulouse, Fr.*

Edmund Victor Corbett. *Librarian, Wandsworth Public Library, London Borough of Wandsworth, Eng.*

Paul Grant Cornell. *Professor of History, University of Waterloo, Ont.*

William Ainsworth Cornell. *Assistant Executive Secretary, Pennsylvania State Education Association, Harrisburg.*

Robert Cornevin. *Permanent Secretary, Overseas Academy of Sciences, Paris. Head, Centre for Studies and Documentation of Africa and Overseas Departments.*

E. Merton Coulter. *Regents Professor Emeritus of History, University of Georgia.*

John Wesley Coulter (d. 1968). *Professor of Geography, University of Cincinnati, Ohio.*

Joseph Francis Courtney. *Attorney. Lecturer in Public Administration, Northeastern University, Boston.*

Raymond Gibson Cowherd. *Professor of History, Lehigh University, Bethlehem, Pa.*

James Stevens Cox. *Editor,* Proceedings of the Dorset Natural History and Archaeological Society, *and others.*

Clark Nixon Crain. *Former Professor of Geography and Regional Development, University of Denver, Colo.*

Albert Charles Crane. *Clerk, Border Rural District Council. Former Deputy Clerk, Malvern Urban District Council, Eng.*

Leland Hargrave Creer. *Emeritus Professor of History, University of Utah, Salt Lake City.*

Bernarr Cresap. *Professor of History; Chairman, Department of Social Science, Florence State University, Ala.*

John Clark Crighton. *Professor of History, Stephens College, Columbia, Mo.*

Virgil Charles Crisafulli. *Professor of Economics, Utica College of Syracuse University, N.Y.*

Gerald Roe Crone. *Librarian and Map Curator, Royal Geographical Society, London, 1945–66.*

Jesse Crawford Crowe. *Professor of History, Western Kentucky University, Bowling Green.*

Kenneth Brailey Cumberland. *Professor of Geography, University of Auckland, N.Z.*

Alden (Denzel) Cutshall. *Professor and Head, Department of Geography, University of Illinois, Chicago.*

Ernest Rockwell Dalton. *Dean of Instruction, Centenary College for Women, Hackettstown, N.J.*

Arthur Davies. *Reardon-Smith Professor of Geography, University of Exeter, Eng., 1948–71.*

James Treadwell Davis. *Professor of History, University of Southern Mississippi, Hattiesburg.*

John Armstrong Davison (d. 1966). *Professor of Greek Language and Literature, University of Leeds, Eng., 1951–66.*

Raul d'Eça. *Lecturer on Latin-American affairs. Assistant Career Planning Officer, U.S. Information Agency, 1959–61. Branch Public Affairs Officer, Recife and Belo Horizonte, Braz., Office of International Information and Cultural Affairs, 1947–58.*

John Alvin Decker. *Professor of Political Science, Stephens College, Columbia, Mo.*

Henry Delmont. *Curator, J.B. Rames Museum, Aurillac, Fr.*

René Julien C. de Roo. *Curator, Royal Museums of Art and History, Brussels. Archivist and Museum Director, Mechelen, Belg., 1949–63.*

Hans Otto Jerphaas de Ruyter de Wildt. *Chief of Educational and Cultural Affairs, Hoorn, Neth.*

P.B. Desai. *Former Professor and Head, Department of Ancient Indian History and Culture, Karnatak University, Dharwar, India.*

Jean-Jacques Despois. *Emeritus Professor of Geography, University of Paris-Sorbonne.*

Jack J. Detzler. *Senior Vice President, Provost, and Professor of History, Saint Mary's College, Notre Dame, Ind.*

Samuel Newton Dicken. *Professor of Geography, University of Oregon, Eugene.*

Robert Eric Dickinson. *Professor of Geography, University of Arizona, Tucson.*

Alonzo Thomas Dill. *Public Relations Director, Chesapeake Corporation of Virginia, West Point, Va.*

Ernest H.G. Dobby. *Former Professor of Geography, University of Malaya, Singapore.*

William Mann Dobriner. *Charles A. Dana Professor of Sociology, Lafayette College, Easton, Pa.*

J. Don. *Archivist, Kampen, Neth.*

Garland Downum. *Professor of History, Northern Arizona University, Flagstaff.*

Jean Dresch. *Professor of Geography, University of Paris VII.*

Robert Roland Drummond. *Professor of Geography, Indiana State University, Terre Haute.*

George Harry Dury. *Professor of Geography and Geology, University of Wisconsin, Madison.*

André Duval. *Former Deputy Mayor, Clichy, Fr.*

Donald Ray Dyer. *Regional Geographic Attache, U.S. Department of State, Washington, D.C.*

David Livingstone Dykstra. *Associate Professor of History, Hofstra University, Hempstead, N.Y.*

Rev. George Herbert Eastman. *Principal of the London Missionary Society's Training College at Beru, Gilbert and Ellice Islands, 1918–48.*

Herbert Leeson Edlin. *Publications Officer, Forestry Commission of Great Britain, London.*

Kenneth Charles Edwards. *Emeritus Professor of Geography, University of Nottingham, Eng.*

Robert Neal Elliott. *Associate Professor of History, North Carolina State University, Raleigh.*

Joseph Waldo Ellison. *Emeritus Professor of History, Oregon State University, Corvallis.*

Sirri Erinc. *Professor of Geography, University of Istanbul.*

Sir Robert Charles Evans. *Principal, University College of North Wales, Bangor, University of Wales. Author of* Kangchenjunga: The Untrodden Peak *and others.*

Russell Charles Ewing. *Head, Department of History, University of Arizona, Tucson, 1959–69.*

J.D. Eyles. *Lecturer in Geography, Queen Mary College, University of London.*

John Douglas Eyre. *Professor and Chairman, Department of Geography, University of North Carolina at Chapel Hill.*

John Donnelly Fage. *Director, Centre of West African Studies; Professor of African History, University of Birmingham, Eng.*

Albert Leonard Farley. *Associate Professor of Geography, University of British Columbia, Vancouver.*

Bertram Hughes Farmer. *Fellow of St. John's College, Cambridge; Reader in South Asian Geography; Director, Centre of South Asian Studies, University of Cambridge.*

Francis Peloubet Farquhar. *Author of* Place Names of the High Sierra *and others.*

Irmgard Feldhaus. *Director, Clemens Sels Museum, Neuss, W.Ger.*

A.M. Ferrar. *Map Curator, University of Hull, Eng.*

George Leonard Fersh. *Associate Director, Joint Council on Economic Education, New York City.*

George Michael Fitzpatrick. *Emeritus Editor,* New Mexico Magazine.

Betty Lorraine Fladeland. *Professor of History, Southern Illinois University, Carbondale.*

Allen Richard Foley. *Emeritus Professor of History, Dartmouth College, Hanover, N.H.*

Lachlan Maxwell Forbes. *Editor,* Polar Record, *Scott Polar Research Institute, University of Cambridge.*

Charles Nelson Forward. *Professor and Head, Department of Geography, University of Victoria, B.C.*

Abram John Foster. *Professor of History, Millersville State College, Pa.*

Catharine Osgood Foster. *Former Member, Literature Faculty, Bennington College, Vt.*

Lucien Fourez. *Judge, Tribunal of First Instance, Belgium.*

Reginald Sharpe France. *County Archivist, Lancashire, Eng.*

Thomas Walter Freeman. *Reader in Economic Geography, Victoria University of Manchester.*

Marion R. (Miller) Fremont-Smith. *Project Director, Russell Sage Foundation Study: Government Supervision of Charitable Foundations and Corporate Philanthropy. Assistant Attorney General, Commonwealth of Massachusetts, 1959–63.*

Richard Antony French. *Senior Lecturer in the Geography of the U.S.S.R., University College and School of Slavonic and East European Studies, University of London.*

Robert F. Fries. *Dean of the University College, De Paul University, Chicago.*

Edward John Gallagher. *Publisher,* Laconia (*N.H.*) Evening Citizen.

Hans Gamma. *Editor. Former Mayor, Altdorf, Switz.*

Vico Garbesi. *Assistant Librarian, Library of Imola, Italy.*

John H. Garland. *Professor of Geography, University of Illinois, Urbana.*

George Roosevelt Gayler. *Professor of History, Northwest Missouri State University, Maryville.*

Alastair George Geddes. *Tutor in Local History, Department of Extra-Mural Studies, University of Southamptom, Eng.*

Clyde Christian Gelbach. *Professor of History, Indiana State University, Pa.*

Susannah C. Gentry. *Associate Editor,* Independence (*Mo.*) Examiner.

Arch C. Gerlach (d. 1972). *Chief Geographer, Geological Survey, U.S. Department of the*

Interior, 1967–72. Incumbent, Chair of Geography, Library of Congress.

Percy Amorey Beufort Gethin. *Tutor in English and Political Institutions, Lennox Cook School of English, Cambridge, Eng.*

Huricihan Ghaznavi. *Teaching Assistant in Middle Eastern History and Turkish, University of Wisconsin, Madison.*

G.K. Ghori. *Professor of Geography; Principal, Maharaja's College, University of Mysore, India.*

Arrell Morgan Gibson. *Professor and Chairman, Department of History; Curator, Western History Collection, University of Oklahoma, Norman.*

Frans Gijzels. *Mayor of Heerlen, Neth.*

Robert Creighton Gilmore. *Associate Professor of History, University of New Hampshire, Durham.*

Charles Nelson Glaab. *Professor of History, University of Toledo, Ohio.*

Robert Morton Glendinning. *Professor of Geography, University of California, Los Angeles.*

Stephen Goddard. *Assistant Librarian, Queen Mary College, University of London.*

António Armando Gonçalves Pereira. *Professor of Commercial and Maritime Law, Technical University of Lisbon.*

George Goodwin, Jr. *Chairman, Department of Politics, University of Massachusetts, Boston.*

Jean Grandmaison. *Keeper of the Archives and Library, Tarascon, Fr.*

Lee Albert Graver. *Professor of History and Political Science, Kutztown State College, Pa.*

Donald Paul Greene. *Former Associate Professor of History and Anthropology, Adams State College, Alamosa, Colo.*

Richard A. Greene. *Columnist and Editorial Writer,* Muncie (*Ind.*) Star.

Gwilym David Gregory. *Principal Assistant, London Borough of Camden Public Libraries, Eng.*

Jack Irving Grenfell. *Justice of the Peace; Town Clerk and Treasurer, City of Ararat, Australia.*

Edward Frederick Greve. *Reference and Research Librarian, Jim Dan Hill Library, University of Wisconsin, Superior.*

Thomas Melvin Griffiths. *Professor and Chairman, Department of Geography, University of Denver, Colo.*

Theodore Gregory Gronert (d. 1966). *Chairman, Department of History, Wabash College, Crawfordsville, Ind.*

Bernard Victor Gutsell. *Associate Professor of Geography, York University, Toronto. Publisher and Editor,* The Canadian Cartographer.

LeRoy R. Hafen. *Professor of History, Brigham Young University, Provo, Utah. State Historian of Colorado, 1924–54.*

Daniel George Edward Hall. *Emeritus Professor of the History of South-East Asia, University of London.*

J.M. Hall. *Lecturer in Geography, Queen Mary College, University of London.*

Ray Hall. *Lecturer in Geography, Queen Mary College, University of London.*

Robert Burnett Hall. *Colonel, U.S. Army (retired). Former Professor of Geography; former Director, Center for Japanese Studies, University of Michigan, Ann Arbor.*

Edward Hamming. *Professor of Geography, Augustana College, Rock Island, Ill.*

F. Kenneth Hare. *University Professor and Director, Institute for Environmental Studies, University of Toronto.*

George Dewey Harmon. *Emeritus Professor of American History, Lehigh University, Bethlehem, Pa.*

John Lauren Harr. *Professor of History; Chairman, Division of Social Sciences, Northwest Missouri State University, Maryville.*

Mary Harvey. *Lecturer in Geography, Goldsmiths' College, University of London.*

Raymond Hastey. *Teacher, Lycée, Cherbourg, Fr.*

Richard Walter Haupt. *Director, The Cincinnati Historical Society, Ohio.*

H. Bowman Hawkes. *Professor of Geography, University of Utah, Salt Lake City.*

Hubert Howard Hawkins. *Director, Indiana Historical Bureau and Indiana Historical Society, Indianapolis.*

Hermann-Heino Heine. *Taxonomic Botanist, Kew Gardens, London.*

Herbert Lynn Heller. *Professor of Education, Baldwin-Wallace College, Berea, Ohio.*

Walter Brookfield Hendrickson. *Emeritus Professor of History, MacMurray College, Jacksonville, Ill.*

Henri Henneguelle. *Mayor of Boulogne, Fr.*

Roger Chatsey Heppell. *Associate Professor of Geography, State University of New York, College at Cortland.*

Thomas Herdman (d. 1970). *Senior Lecturer in Geography and Education, Training College, Dudley, Eng.*

Herman Heupers. *Manager, Public Relations Office, Enschede, Neth.*

Sanford Wilson Higginbotham. *Professor of History, Rice University, Houston, Texas. Editor,* Journal of Southern History.

Ernest Gotthold Hildner, Jr. *William and Charlotte Gardner Professor of History and Geography, Illinois College, Jacksonville.*

Mark David Hirsch. *Professor and Head, Department of Social Studies, Bronx Community College, City University of New York.*

Edward Henry Hobbs. *Dean of Arts and Sciences, Auburn University, Ala.*

Walter Hoffelner. *Official of the Municipal Council, Steyr, Austria.*

Hans Högn. *Mayor of Hof, W.Ger.*

Stanley Charles Holliday. *Chief Librarian, Kensington and Chelsea Public Libraries, London.*

Madhusudan Shriniwas Honrao. *Professor and Head of the Department of Geography, Karnatak Science College, Karnatak University, Dharwar, India.*

Reginald Horsman. *Professor of American History, University of Wisconsin, Milwaukee.*

Jack Luin Hough. *Emeritus Professor of Meteorology and Oceanography and of Geology and Mineralogy, University of Michigan, Ann Arbor.*

Henry Forbush Howe, M.D. *Author of* Salt Rivers of the Massachusetts Shore; Massachusetts: There She Is—Behold Her; *and others.*

Lewis Grenfell Huddy. *Town Clerk, London Borough of Hackney, Eng.*

Jean Hugli. *Teacher, Technical College, Lausanne, Switz.*

Robert Edward Huke. *Professor of Geography, Dartmouth College, Hanover, N.H.*

John Owen Hunt. *Clerk, Urban District Council, Matlock, Eng.*

Thomas John Hunt. *Chairman, Somerset Archaeological Society and Somerset Record Society, Eng.*

Georg Illert. *Director, State Library, Worms, W.Ger.*

Robert Henry Irrmann. *Professor and Chairman, Department of History; Archivist of the College, Beloit College, Wis.*

William Harold Irvine. *Secretary General, Nigerian Tourist Association, Lagos, 1963–68.*

John David Ives. *Professor of Geography; Director, Institute of Arctic and Alpine Research, University of Colorado, Boulder.*

Phil Rowland Jack. *Professor of History, California State College, Pa.*

Wilbur R. Jacobs. *Professor of History, University of California, Santa Barbara.*

Orville John Jaebker. *Professor and Head, Department of History, University of Evansville, Ind.*

Karel Frederik Otto James. *President, Central Committee of Regional Gasboards, Amerongen. Former Burgomaster, Gouda, Neth.*

Preston E(verett) James. *Maxwell Professor Emeritus of Geography, Syracuse University, N.Y.*

John Leonard Jennewein (d. 1968). *Associate Professor of History, Dakota Wesleyan University, Mitchell, S.D.*

Dorothy O. Johansen. *Emeritus Professor of History, Reed College, Portland, Ore.*

John Edwin Johns. *President, Stetson University, De Land, Fla.*

Bert Willard Johnson. *County Manager, Arlington, Va. City Manager, Evanston, Ill., 1953–62.*

William Stephen Kwesi Johnston (Nana Amoah IV). *Vice Chairman, Ghana Boy Scouts Association, Central Region. Senior Divisional Chief of Ognaa (Cape Coast) Traditional Area; Local Court Magistrate, Cape Coast, Ghana, 1960–66.*

Clarence F. Jones. *Emeritus Professor of Geography, Northwestern University, Evanston, Ill.*

Lewis Pinckney Jones. *John M. Reeves Professor of History, Wofford College, Spartanburg, S.C.*

Robert Leslie Jones. *Head, Department of History and Political Science, Marietta College, Ohio.*

Ronald Jones. *Reader in Geography, Queen Mary College, University of London.*

Stanley Llewellyn Jones. *Professor of History; Vice Chancellor of Academic Affairs, University of North Carolina at Greensboro.*

Weymouth Tyree Jordan (d. 1968). *Professor, 1949–68, and Head of the Department of History, 1955–68, Florida State University, Tallahassee.*

Derrick Neville Edwin Kain. *Industrial and Business Editor,* Natal Witness, *Pietermaritzburg, S.Af.*

James Samuel Kaleem. *Former Principal Education Officer, Ministry of Education, Tamale, Ghana.*

Samuel Richey Kamm. *Professor of History and Social Science, Wheaton College, Ill.*

Helene Juliet Kantor. *Professor of Archaeology, University of Chicago.*

John Horace French Kelley. *Public Relations Officer, London Borough of Newham, Eng.*

John Haskell Kemble. *Professor of History, Pomona College, Claremont, Calif.*

Peter Alexander Kennedy. *County Archivist, Devon County Council, Eng.*

Joan Margaret Kenworthy. *Lecturer in Geography, University of Liverpool.*

Hendrik Jakob Keuning. *Professor of Economics and Social Geography; Director, Geographical Institute, State University of Groningen, Neth.*

Rudolf Kiepke. *Publisher of* Die Warte, *Paderborn, W.Ger.*

Harold Godfrey King. *Librarian and Information Officer, Scott Polar Research Institute, University of Cambridge.*

Patrick Irvine King. *Archivist, Northamptonshire Record Office, Eng.*

Spencer Bidwell King, Jr. *Professor of History, Mercer University, Macon, Ga.*

George Kish. *Professor of Geography, University of Michigan, Ann Arbor.*

Anton C.F. Koch. *Town archivist and librarian, Deventer, Neth.*

Rudolf Koller. *Director of the Municipal Department of Culture and the Arts, Ingolstadt, W.Ger.*

John G.J. Koreman. *Chief Assistant, Municipal Record Office, Maastricht, Neth.*

Werner Kugler. *Burgomaster of Schleswig, W.Ger.*

Wiebren Hendrik Kuipers. *Public Relations Officer, Community of Leeuwarden, Neth.*

Eeva-Sinikka Kurikka. *Chief Correspondent, Werner Söderström Osakeyhtiö, Publishers, Helsinki.*

Pieter Th.J. Kuyer. *Keeper of Municipal Records, 's Hertogenbosch, Neth.*

Alexander Atta Yaw Kyerematen. *Director, Ghana National Cultural Centre, Kumasi.*

Howard Lackman. *Professor of History, University of Texas at Arlington.*

Ernest McPherson Lander, Jr. *Alumni Professor of History, Clemson University, S.C.*

Elfrieda Wilhelmina Henrietta Lang. *Curator of Manuscripts, Lilly Library, Indiana University, Bloomington.*

Robert Millard Langdon (d. 1967). *Associate Professor of History, Civilian Faculty, U.S. Naval Academy.*

Helge Larsen. *Minister of Education, Danish Government, 1968–71.*

Geoffrey Charles Last. *Adviser, Imperial Ethiopian Ministry of Education and Fine Arts, Addis Ababa.*

Louis-Noël Latour. *Curator, Museum of the Hôtel-Dieu, Beaune, Fr.*

Keith Eric Lauder. *Town Clerk, London Borough of Barking, Eng.*

Heinz Lauenroth. *Chief City Official and Director, Cultural and Sport Department, Hanover, W.Ger.*

J.H.G. Lebon (d. 1969). *Reader in Geography, School of Oriental and African Studies, University of London, 1966–69.*

Enoch Lawrence Lee. *Professor of History, The Citadel, Charleston, S.C.*

Roger Kendrick Lee. *Lecturer in Geography, Queen Mary College, University of London.*

Robert Lemaire. *Librarian of the Municipal Library, Beauvais, Fr.*

Walter John Lemke (d. 1968). *Professor of Journalism, University of Arkansas, Fayetteville.*

John Herbert Le Patourel. *Research Professor of Medieval History, University of Leeds, Eng.*

Edith Veronica Lewis. *Reference Librarian, Finsbury Library, London Borough of Islington, Eng.*

George Knowlton Lewis. *Professor of Geography, Boston University.*

Reginald George Lickfold. *Town Clerk, Weston-super-Mare, Eng.*

George Lighton. *Principal of Stevenage College of Further Education, Stevenage, Eng. Former Senior Geography Master, Queen's College, Georgetown, British Guiana.*

Georges Livet. *Professor of Modern History, University of Strasbourg, Fr.*

Donald Lloyd. *Deputy Clerk, Urban District Council of Winsford, Eng.*

Seton H.F. Lloyd. *Emeritus Professor of Western Asiatic Archaeology, University of London.*

W. Duane Lockard. *Professor of Political Science; Chairman, Department of Politics, Princeton University.*

M. John Loeffler. *Professor of Geography, University of Colorado, Boulder.*

Julius Loennechen. *British Vice Consul, Kristiansund, Nor.*

Rayford Whittingham Logan. *Emeritus Professor of History, Howard University, Washington, D.C.*

Richard F. Logan. *Professor of Geography, University of California, Los Angeles.*

Richard Lowitt. *Professor of History, University of Kentucky, Lexington.*

Myron Harper Luke. *Professor of History, C.W. Post College, Long Island University, Greenvale, N.Y.*

Gustav Johannes Luntowski. *Town Archivist, Dortmund. Former Town Archivist and Chief Librarian, Lüneburg, W.Ger.*

Charles Maas. *Director, Cultural Office, Villach, Austria.*

John Morris McClelland, Jr. *Editor and Publisher,* Longview (*Wash.*) Daily News.

Margaret McDerby. *Librarian in Charge, Reference and Museum Services, London Borough of Barnet, Eng.*

William Duff Mackay. *Town Clerk and Treasurer, Richmond, S.Af. Town Clerk, Ladysmith, S.Af., 1946–61.*

Henry Miller Madden. *Librarian, California State University, Fresno.*

Desiderio Maggioni. *Member for Milano-Pavia, Chamber of Deputies, Italy.*

William Richard Maidment. *Borough Librarian, London Borough of Camden, Eng.*

Gordon Manley. *Emeritus Professor of Environmental Sciences, University of Lancaster, Eng.*

Albert John Marino. *Assistant City Editor,* New Britain (*Conn.*) Herald.

Hendrik Michiel Martens. *Burgomaster, Ermelo, Neth., 1938–62.*

Jean Martin-Demezil. *Archivist, Département of Loir-et-Cher, France.*

Kenneth Mason. *Lieutenant Colonel, formerly with the Royal Engineers. Professor of Geography, University of Oxford, 1932–53.*

Philip Parker Mason. *Professor of History, Wayne State University, Detroit.*

Eberhard Matthes. *Town Archivist, Eisenach, E.Ger.*

William Richard Mead. *Professor of Geography, University College, University of London.*

Howard Brett Melendy. *Vice President for Community Colleges, University of Hawaii, Honolulu.*

Ralph Robertson Mellon, M.D. *Consultant. Director, Institute of Pathology, Western Pennsylvania Hospital, Pittsburgh, 1927–53.*

Alberto Mennella. *Archivist and Departmental Head, Municipality of Torre del Greco, Italy.*

Jean Michel Mercadier. *Director, Honoré de Balzac College of Secondary Education, Albi, Fr.*

(Ethel) Doris Mercer. *Head Archivist, Greater London Council.*

Horst Messerschmidt. *Burgomaster of Bernburg, E.Ger.*

Patricia Meyer. *Reference Librarian, Borough of Wandsworth, Eng.*

Dorothy Middleton. *Assistant Editor,* Geographical Journal, *1953–71. Author of* Baker of the Nile *and others.*

R.E. Millard. *Clerk of the Peace and Clerk of the County Council, Buckinghamshire, Eng.*

Paul Eugene Million, Jr. *Associate Professor of History, Purdue University, West Lafayette, Ind.*

Norah Mitchell. *Teacher at the Kodai School, Madurai District, Tamil Nadu, India.*

Maurice P. Moffatt. *Former Professor and Chairman, Department of Social Studies, Montclair State College, N. J.*

Jay Monaghan. *Consultant, Wyles Collection of Lincolniana and Western Americana, University of California, Santa Barbara. State Historian of Illinois, 1946–51.*

Robert Scott Monahan. *Forester and Manager of Outing Properties, Dartmouth College, Hanover, N.H.*

Annie Monginoux. *Librarian, Saint-Étienne Municipal Library, Fr.*

Francis John Monkhouse. *Professor of Geography, University of Southampton, Eng., 1954–66.*

Powell A. Moore (d. 1967). *Professor of History, Indiana University, Bloomington.*

Gladys Margery Morris. *Clerk, Ashburton Urban District Council, Eng.*

James Davidson Morrison. *Professor of History, Southeastern State College, Durant, Okla.*

Ralph Ernest Morrow. *Professor of History, Washington University, St. Louis, Mo.*

Richard Lee Morton. *Chancellor Professor Emeritus of History, College of William and Mary, Williamsburg, Va.*

Heinz Motel. *Chief of Tourist Office, Göttingen, W.Ger.*

Malcolm Herbert Moule. *Professor and Chairman, Department of History, University of the Pacific, Stockton, Calif.*

Alan Bertram Mountjoy. *Reader in Geography, Bedford College, University of London.*

Pieter Mourik. *Municipal Economic Adviser, Haarlem, Neth.*

Ottheinz Münch. *City Archivist, Kaiserslautern, W.Ger.*

John A. Munroe. *H. Rodney Sharp Professor of History, University of Delaware, Newark.*

Keith A. Murray. *Professor of History, Western Washington State College, Bellingham.*

Maurice Murzeau. *Director, Information Bureau, Angers, Fr.*

Alice F.A. Mutton. *Reader in Geography, Queen Mary College, University of London.*

Geoffrey Myers. *Former United Nations Correspondent,* The London Daily Telegraph.

Merle Wentworth Myers. *Professor of Geology and Geography, Mississippi State University, Starkville.*

Sarah K. Myers. *Editor,* The Geographical Review.

Dnyandeo Giraji Narkhede. *Lecturer in Geography, Nagpur Mahavidyalaya, Nagpur University, India.*

Maria Teresa Anzidei Natali. *Teacher of Literature, Scuola Media Statale Petrocchi, Rome.*

Philippus Rudolph Nell. *Town Clerk, Boksburg, S.Af.*

Edward J. Nichols. *Emeritus Professor of English Composition, Pennsylvania State University, University Park.*

Henri Nicolaï. *Professor of Applied Geography, Free University of Brussels.*

Willem Petrus van Niekerk. *Town Clerk and Treasurer, Jagersfontein, S.Af.*

Ursula Niemann. *Curator of Bielefeld Town Archives, W.Ger.*

Nancy Paine Norton. *Professor of History, Wheaton College, Norton, Mass.*

John Gerard O'Connor. *Former Instructor of Art, University of New Mexico. Director, Gallup Museum of Indian Arts and Crafts, N.M., 1956–60.*

Andrew Charles O'Dell (d. 1966). *Professor of Geography, University of Aberdeen, 1951–66.*

Herman Martinus Oldenhof. *Burgomaster of Ede, Neth., 1952–62.*

Kjeld Olsen. *Municipal Official of Randers, Den.*

Frederick Irving Olson. *Professor of History, University of Wisconsin, Milwaukee.*

Leonard Edwin Ortzen. *Normandy Correspondent, French Radio's English-Language Service, 1949–64. Author of* The Gallic Land *and others.*

George Augustus Osborn. *Editor,* Sault Ste. Marie (*Mich.*) Evening News.

Fred Mallery Packard. *International Specialist, National Park Service, U.S. Department of the Interior, Secretary, International Commission on National Parks, International Union for Conservation of Nature and Natural Resources.*

Elwin Lawrence Page. *Lawyer. Author of* Judicial Beginnings in New Hampshire, 1640–1700 *and others.*

Clarke Jaye Pahlas. *General Manager, The A.N. Palmer Company, Publishers, Schaumburg, Ill.*

Manohar Ramchandra Palande (deceased). *Chief Editor, Gujarat District Gazetteers, Government of Gujarat, India, 1960–64.*

William Henry Parker. *Lecturer in Geography, Christ Church, University of Oxford. Author of* Canada: A Travel Guide *and others.*

Edward Caffrey Parr. *Town Clerk and Chief Executive Officer, Teesside County Borough Council, Eng.*

James Jerome Parsons. *Professor of Geography, University of California, Berkeley.*

Pascal Ntsomo Payanzo. *Assistant Professor of Sociology, National University of Zaire, Lubumbashi.*

Dick N. Pazen. *Research Analyst, Wisconsin Legislative Reference Bureau, Madison.*

Kenneth Pearce. *Town Clerk, Warley, Eng.*

Anne Merriman Peck. *Writer, illustrator, and painter. Instructor of Creative Writing, Extension Department, University of Arizona, Tucson.*

Mary Tunstall Pedoe (d. 1965). *Lecturer, University of Sudan, Khartoum.*

George Pendle (d. 1977). *Managing Director, Pendle & Rivett Ltd., London. Author of* Pelican History of Latin America *and others.*

Pietro Perin. *Assistant Secretary, Commune of Pordenone (Udine), Italy.*

Maurice Perret. *Chief Editor,* Académie International du Tourisme: Revue. *Director, Syndicat d'Initiative de Grenoble, Fr., 1945–56.*

Eugene Thor Peterson. *Director, Mackinac Island State Park Commission, Mich.*

H. St. John Bridger Philby (d. 1960). *Explorer in Arabia. Author of* The Heart of Arabia *and others.*

David Joshua Pittman. *Director, Social Science Institute; Professor of Sociology, Washington University, St. Louis.*

Cyril Ernest Charles Reginald Platten. *Town Clerk, London Borough of Enfield, Eng.*

Henri Polge. *Town Archivist, Gers, Fr.*

Philip Wayland Porter. *Professor of Geography, University of Minnesota, Minneapolis.*

Bernard A. Pothier. *Research Editor,* Dictionary of Canadian Biography, *1967–69.*

Merritt Bloodworth Pound. *Emeritus Professor of Political Science, University of Georgia, Athens.*

William Stevens Powell. *Curator, North Carolina Collection, University of North Carolina at Chapel Hill.*

Charles Aloysius Paul Prangers. *Information Officer, City of The Hague, Neth.*

Pierre du Prey. *Novelist and journalist. Technical Adviser to the Minister of State, Abidjan, Ivory Coast.*

Dalias Adolph Price. *Head, Department of Geography, Eastern Illinois University, Charleston.*

Colette Prieur. *Keeper, Jean de la Fontaine Museum; Keeper, Library and Archives, Château Thierry, Fr.*

Joseph Prinz. *Director of City Archives, Münster, W.Ger.*

Frank Cyril Pritchard. *Borough Librarian, Halifax Public Libraries, Eng.*

Ralph Mansell Prothero. *Reader in Geography, University of Liverpool.*

Merle C. Prunty, Jr. *Professor and Head, Department of Geography, University of Georgia, Athens.*

Friedrich (Johann Diedrich) Prüser. *Director, Bremen State Archives, Bremen, W.Ger., 1937–57.*

Giuseppe Raimondi. *Official in the Press Office, City House, Rapallo, Italy.*

William Francis Raney (d. 1962). *Professor of European History, Lawrence College, Appleton, Wis.*

Wilhelm Felix Rausch. *City Archivist, Linz, Austria.*

Charles Wyatt Raymond. *Geographer, Policy and Planning Branch, Federal Department of Energy, Mines and Resources, Truro, Nova Scotia.*

Leo Franklyn Redfern. *President, Keene State College, N.H.*

Robert William Richmond. *State Archivist, Kansas State Historical Society, Topeka.*

Dorothy Lois Riker. *Editor, Indiana Historical Bureau, Indianapolis.*

Brian Birley Roberts. *Research Associate, Scott Polar Research Institute, University of Cambridge.*

Blackwell Pierce Robinson. *Associate Professor of History, University of North Carolina at Greensboro.*

Rolland C. Rogers. *Associate Professor of History, San Jose State College, Calif.*

Irmentraud Rohrmayr. *Town Archivist, Straubing, W.Ger.*

Guido Rotthoff. *Director of Municipal Archives, Krefeld, W.Ger.*

Joseph S. Roucek. *Professor of Social Science, Queensborough Community College, City University of New York, Bayside.*

Jean-Maurice Rouquette. *Curator of the Museum, Arles, Fr.*

William Willis Ruff. *Clerk of the Surrey County Council, Eng.*

A. Bower Sageser. *Professor of American History, Kansas State University, Manhattan.*

Frank Sainsbury. *Deputy Librarian, London Borough of Newham, Eng.*

Henry de Surirey de Saint-Remy. *Chief Librarian, Historical Library of the City of Paris.*

Leslie Arthur Sallnow. *Public Relations and Information Officer, Waltham Forest, Eng.*

Irwin Taylor Sanders. *Chairman, Department of Sociology and Anthropology, Boston University.*

Ann Margaret Savours. *Assistant Librarian, Curator of Manuscripts, Scott Polar Research Institute, University of Cambridge, 1954–66.*

James Ralston Scobie. *Professor and Chairman, Department of History, Indiana University, Bloomington.*

Thomas Morris Hornby Scott. *Town Clerk, Sutton, Eng.*

Se-Il Sonn. *Senior editorial writer,* Dong-A Ilbo *newspaper, Seoul.*

Donald Henry Sheehan. *President and Professor of History, Whitman College, Walla Walla, Wash.*

Hugh de Sausmarez Shortt. *Curator, Salisbury and South Wiltshire Museum, Eng.*

Phillip Raymond Shriver. *President, Miami University, Oxford, Ohio.*

Francis Butler Simkins (d. 1966). *Professor of History, Longwood College, Farmville, Va.*

David Stanley Simonett. *Director, Land Evaluation and Land Use Studies, Earth Satellite Corporation, Washington, D.C.*

Edward Smethurst Simpson. *Professor of Geography, University of the South Pacific, Suva, Fiji.*

Karl Aemilian Sinnhuber. *Reader in Geography, University of Surrey, Eng.*

Raleigh Ashlin Skelton (d. 1970). *Superintendent, Map Room, British Museum, 1950–67.*

Arthur Eltringham Smailes. *Emeritus Professor of Geography, Queen Mary College, University of London.*

Gerald Wayne Smith. *Academic Dean, Waynesburg College, Pa.*

Helen L. Smith. *Former Associate Professor of Geography, Wheaton College, Ill.*

Walter Charles Dudley Smith. *Town Engineer, Boksburg, S.Af.*

Felix Eugene Snider. *Librarian and Director, Department of Library Science, Southeast Missouri State College, Cape Girardeau.*

Jacob Spelt. *Professor of Geography, University of Toronto.*

Joseph E. Spencer. *Emeritus Professor of Geography, University of California, Los Angeles.*

Sir Laurence Dudley Stamp (d. 1966). *Professor of Social Geography, University of London, 1948–58.*

William Richard Stanley. *Associate Professor of Geography, University of South Carolina, Columbia.*

Martin Purefoy Statham. *County Archivist, West Suffolk, Eng.*

Robert Walter Steel. *Principal, University College of Swansea, University of Wales. John Rankin Professor of Geography, University of Liverpool, 1957–74.*

Harriet Grace Steers. *Lecturer in Geography, University of Cambridge, 1936–66.*

Hugo Steneberg. *Municipal Official, Witten, W.Ger.*

Cj Stevens. *Professor and Chairman, Department of Speech and Theatre, Herbert H. Lehman College, City University of New York.*

David Stick. *Author of* Graveyard of the Atlantic; Outer Banks of North Carolina.

Joseph Stocker. *Author of* Arizona: A Guide to Easier Living.

Wilma Dykeman Stokely. *Author of* The French Broad (*Rivers of America Series*); The Border States*; and others.*

Henry Gordon Stokes. *Author of* English Place-Names *and others.*

James Herbert Stone. *Professor of Humanities; Coordinator, American Studies, California State University, San Francisco.*

Goffe Struiksma. *Municipal Official, Heerenveen, Neth.*

Alfred Donald Sumberg. *Former Professor of Social Studies, East Stroudsburg State College, Pa.*

Charles Grayson Summersell. *Head, Department of History, University of Alabama, Tuscaloosa, 1954–71.*

Robert M. Sutton. *Professor of History; Director of the Illinois Historical Survey, University of Illinois, Urbana.*

Arthur Ronald Taffs. *Public Relations Officer, London Borough of Lewisham, Eng.*

Tamotsu Takahashi. *Senior Researcher, Institute of Developing Economies, Tokyo.*

Charles Antoine Peter Takes. *Director, International Institute for Land Reclamation and Improvement, Wageningen, Neth.*

Ken-Chi Tanabe. *Professor of Geography, University of Tokyo.*

Charlton W. Tebeau. *Emeritus Professor of History, University of Miami, Coral Gables, Fla.*

Johannes Theodoor Thijsse. *Professor of Hydraulics, Technological University of Delft, Neth., 1938–63.*

John Thompson. *Professor of Geography, University of Illinois, Urbana.*

Robert Ribblesdale Thornton. *Town Clerk, Leicester, Eng.*

Harry Thorpe. *Former Professor and Head, Department of Geography, University of Birmingham, Eng.*

Robert H. Thorsbro. *Chief of Production, Danish Tourist Board, Copenhagen.*

Arthur E. Tiedemann. *Professor of History, City College, City University of New York.*

James L. Tigner. *Associate Professor of History, University of Nevada, Reno.*

Robert Tinthoin. *Chief Archivist, Deux-Sèvres, Fr., 1959–63. Chief Archivist, Department of Oran, 1938–56, and Director of Museum of Oran, Alg., 1941–56.*

Pietro Torrione. *Director of Biella Library and Museum, Italy.*

J. Allen Tower (d. 1961). *Professor of Geography, Birmingham-Southern College, Birmingham, Ala.*

(Mrs.) Mary Curry Tresidder. *Honorary Chairman of the Board, Yosemite Park & Curry Company, Yosemite National Park, Calif.*

Raymond Thérèse Troprès. *Clerk, Town Hall, Avranches, Fr.*

Erol Tümertekin. *Professor of Geography, University of Istanbul.*

Necdet Tunçdilek. *Associate Professor of Geography, University of Istanbul.*

Thomas John Turner. *Clerk, Wymondham Urban District Council, Norfolk, Eng.*

Denis C. Twitchett. *Professor of Chinese, University of Cambridge.*

Roger Henry Van Bolt. *Director, Sloan Museum, Flint, Mich.*

Albert Edward Van Dusen. *Professor of History, University of Connecticut, Storrs. State Historian.*

R. Suzanne Van Meter. *Assistant Professor of History, Clarion State College, Pa.*

Christiaan van Veen. *Minister of Education and Science, Government of the Netherlands, 1971–73.*

Gustave Vaucher. *State Archivist, Geneva, Switz., 1940–66.*

Anna Johanna Versprille. *Keeper of the Public Records, Leiden, Neth.*

Hermann Wahl. *Town Archivist, Pforzheim, W.Ger.*

Frank Walker. *Senior Lecturer in Geography, University of Bristol, Eng.*

Peter Franklin Walker. *Professor of History, University of North Carolina at Chapel Hill.*

Joseph Frazier Wall. *Earl Strong Distinguished Professor of History, Grinnell College, Iowa.*

Ernest Wallace. *Horn Professor of History, Texas Tech University, Lubbock.*

Helen Margaret Wallis. *Superintendent of the Map Room, British Museum, London.*

Mildred Marie Walmsley. *Associate Professor of Geography, Case Western Reserve University, Cleveland.*

Peter Walne. *County Archivist, Hertfordshire County Council, Eng.*

Clyde C. Walton. *Director of Libraries, Northern Illinois University, DeKalb. Illinois State Historian, 1956–67.*

Herbert Ward. *Borough Librarian, London Borough of Tower Hamlets, Eng.*

Judson Clements Ward, Jr. *Vice President and Dean of Faculties, Emory University, Atlanta, Ga.*

William Stanley Alphonsus Warren. *Town Clerk, Blantyre, Malawi.*

Burton DeWitt Watson. *Professor of Chinese, Columbia University.*

Richard John Waygood. *Municipal Committee Clerk, Romsey, Eng.*

Glenn Weaver. *Professor of History, Trinity College, Hartford, Conn.*

Herbert Weaver. *Professor of History, Vanderbilt University, Nashville, Tenn.*

Wilfrid Webster. *Executive Editor,* Atlas of the Marine Environment, *American Geographical Society, New York City.*

Russell Frank Weigley. *Professor of History, Temple University, Philadelphia.*

John H. Wellington. *Emeritus Professor of Geography, University of the Witwatersrand, Johannesburg.*

Merle William Wells. *Director, Idaho State Historical Society. Associate Professor of History, Boise College, Idaho.*

Paul Frank Wheeler. *Professor of Sociology, State University of New York at Albany.*

Nathan Laselle Whetten. *Professor of Sociology, University of Connecticut, Storrs; Dean of the Graduate School, 1940–70.*

(Charles) Langdon White. *Emeritus Professor of Geography, Stanford University, Calif.*

Edward Stanley White. *Town Clerk, Bulawayo, Rhodesia.*

Maurice Leslie White. *Public Relations Officer, London Borough of Hillingdon, Eng.*

Daniel Jay Whitener. *Former Dean, Appalachian State Teachers College, Boone, N.C.; Head, Social Studies Department, 1932–57.*

Vincent Heath Whitney. *Chairman, Graduate Group in Demography; Director, Population Studies Center, University of Pennsylvania, Philadelphia.*

John Byron Whittow. *Lecturer in Geography, University of Reading, Eng.*

Willard Chester Wichers. *Director, Midwestern Division, Netherlands Information Service; Director, Netherlands Museum, Holland, Mich.*

Johan de Widt. *Burgomaster, Amersfoort, Neth.*

Fritz Wiegand. *Director of the Municipal Archives, Erfurt, E.Ger.*

Eliot Churchill Williams, Jr. *Professor of Biology, Wabash College, Crawfordsville, Ind.*

Frank B. Williams, Jr. *Professor and Chairman, Department of History, East Tennessee State University, Johnson City.*

Richmond Dean Williams. *Director, Eleutherian Mills Historical Library, Greenville, Del.*

George Ernest Willis. *Justice of the Peace, Newbury, Eng. Former Alderman, Newbury Borough Council.*

Harold Fisher Wilson. *Former Professor of Social Studies, Glassboro State College, N.J.*

Conrad L. Wirth. *Former Director, National Park Service, U.S. Department of the Interior, Washington, D.C.*

Malverne Ray Wolfe. *Emeritus Professor of History, California State College, Pa.; Director of Guidance Services, 1957–69.*

Robert Coldwell Wood. *President, University of Massachusetts, Amherst.*

Christopher Montague Woodhouse. *Member of Parliament for Oxford. Fellow of the Royal Society of London. Fellow of Trinity Hall, University of Cambridge.*

L.W. Wright. *Lecturer in Geography, Queen Mary College, University of London.*

Paul Zabel. *Public Relations Officer, Gelsenkirchen, W.Ger.*

Clifford Maynard Zierer. *Emeritus Professor of Geography, University of California, Los Angeles.*

Joseph Francis Zimmerman. *Professor of Political Science, State University of New York at Albany. Research Director, New York State Joint Legislative Committee on Transportation.*

Friedrich Zollhoefer. *Town Archivist, Kempten, W.Ger.*