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BRITANNICA



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The New

ENCYCLOPEDIA BRITANNICA

in 30 Volumes

FOUNDED 1768
15TH EDITION



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William Benton, Publisher, 1943–1973
Helen Hemingway Benton, Publisher, 1973–1974
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to
The 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 *Propredia* is dealt with in the section *How to use the Propcedia* in the *Propredia* volume, pages 8–9, and in the *Table of contents* in the *Propredia* volume, pages 10–16.

2. The use of the *Micropcedia* is dealt with in sections entitled *How to use this volume,* opposite page 1 in volumes I–X; *Introduction* to the addenda in the *Micropredia* in volume X, pages 910–911; *Maps in Encyclopredia Britannica,* with glossary and abbreviations of geographical terms, in volume X, pages 1027–1031.

3. The use of the *Macropredia* without reference first to either the alphabetical list of subjects in the *Micropcedia* or to the topical list of contents in the *Propredia* is not to be encouraged.

4. The initials at the ends of *Macropcedia* articles are those of contributors, whose names are provided in the list entitled *Initials of Contributors and Consultants to the Macropcedia* in the *Propcedia* volume, pages 7–106; a list of *Names of Contributors and Consultants to the Macropædia* is printed in the *Propredia* volume, pages 107–123.

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 ***Propadia, Macropadia,*** and ***Micropadia,*** 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 ***Encyclopadia 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 encyclopaedi'a. 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 Macropedia 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 Micropredia 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 *Micro*-pedia 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 Macropadia his topic of interest is dealt with in its more general aspects, where else in the Micropadia 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 Britannic 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 Britannic 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'ud. 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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ENCYCLOPEDIA
BRITANNICA



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 Micropadia, 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 Macropadia. 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.*

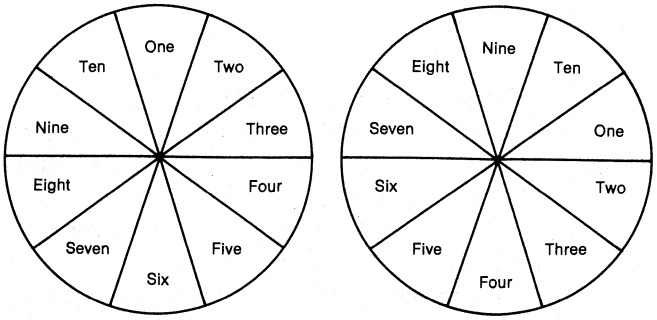
The second point is that the Outline of Knowledge is conceived as a circle of learning. To say that the contents of an *en-cyclo-paedia* form a circle of learning is more than a literal transliteration from Greek to English. In Greek or English, reference to the circle introduces a powerful metaphor, 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.

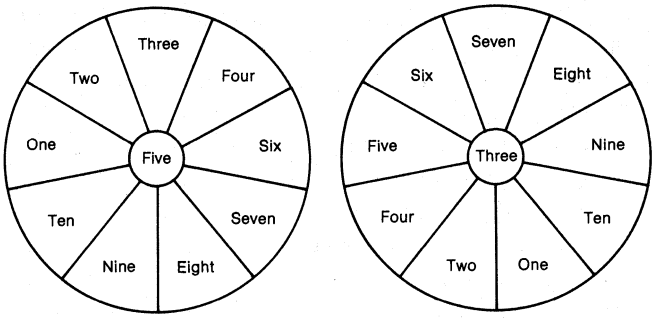
This view of the Outline of Knowledge can be represented in a number of diagrams. The first pair of diagrams shows the ten parts of the outline as segments of the circle. (For a synopsis of the subject matter covered in each part, and its various divisions and sections, the reader is referred to the 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	

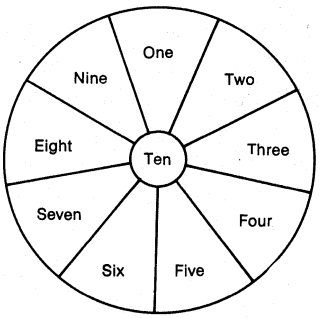
In the first pair of diagrams, below, Part One is placed at the top of the diagram to the left, and Part Nine is at the top of the diagram to the right, to illustrate the effect achieved by rotating the circle.



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 11), 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 Propaedia

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 *Macropadia,* 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 *Macropadia* 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 *Propmdia,* 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* 1 *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 *Micropmdia.* The subject will be treated briefly there. In addition, directions are given for finding places in the *Macropmdia* where that subject is treated at greater length or in broader contexts.

The difference between the *topics,* which are the basic elements in the *Propadia,* 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 *Propmdia'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 *Propmdia,* 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 *Macropadia.* 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 *Macropadia.* 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

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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
A. The structure of the atomic nucleus, and general nuclear phenomena	NUCLEUS, ATOMIC **13**:334–345		
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	MAGNETIC RESONANCE 11:305–309	**13**:336c–f / **11**:320c–h	**9**:97e / **15**:590d–e / **17**:474g–475a
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.8.1]			
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	

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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	

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F. The splitting of atomic nuclei by nuclear fission	NUCLEAR FISSION **13**:301–307		
1. Phenomena of nuclear fission		**13**:302f–304f	**13**:343e–g
a. Spontaneous and induced fission reactions		**13**:302f–303b / **15**:437h–438b	**18**:681d–e
b. Products of nuclear fission		**13**:303c–304d	
i. Fission fragments: radioactive decay chains		**13**:303c–304a	
ii. Prompt and delayed neutrons		**13**:304a–d / **12**:1073g	
iii. Radiation: X-rays and gamma rays [see E.1.a.i., above]			
c. The energy released in fission		**13**:304d–f	
2. Fission chain reactions: the critical mass		**13**:304g–305f	
a. Nuclear explosions: nuclear, or atomic, bombs		**13**:305a–c	**13**:301h–302a / **13**:324e–326g *passim*
b. Controlled nuclear fission		**13**:305d–f	
3. Nuclear models and theories of nuclear fission		**13**:305f–307a / **18**:681f–h	
a. Liquid drop model		**13**:305g–306b	**18**:681f
b. Adiabatic models		**13**:306b–d	
c. Statistical models		**13**:306d–g	
G. The fusion of atomic nuclei	NUCLEAR FUSION **13**:307–313		
1. Phenomena of nuclear fusion		**13**:307b–d	
2. Nuclear fusion reactions		**13**:307d–309e	
a. General types of fusion reactions		**13**:307d–f	
b. The energy released in fusion reactions		**13**:307f–g	
c. Requirements for intensive fusion reactions		**13**:308g–309e	
3. Occurrence of thermonuclear reactions		**13**:309e–310f	
a. Thermonuclear reactions in the Sun and the stars		**13**:309e–310c / **4**:120g–121g / **17**:598f–600a	**3**:848f–g / **4**:119a–c / **17**:807h–808b
b. Thermonuclear explosions: the hydrogen, or thermonuclear, bomb		**13**:310c–f / **13**:326g–327c	
4. Basic conditions required for a thermonuclear reactor		**13**:310g–312d	
a. The formation of a suitable plasma		**13**:310g–311e	
b. The confinement and control of high-temperature plasma		**13**:311f–312d	**14**:508d–f
5. The possible approaches to controlled fusion: progress and prospects for the future		**13**:312d–313h	**6**:623b–c
H. Subatomic, or elementary, particles	PARTICLES, SUBATOMIC **13**:1022–1035		
1. Development of the concept of subatomic particles as the fundamental units of matter and energy		**13**:1022e–1026c	
a. The discovery of the various particles		**2**:335c–e / **5**:206f–207a	**11**:703e–g / **12**:1071c–e / **13**:334e–335a / **13**:1023b–d
b. Yukawa mesons and the theory of nuclear forces		**13**:1023g–1025a / **5**:35e–36b / 12:1072c–d	
c. Advances in quantum field theory: renormalization theory; dispersion theory		13:1025a–1026c / **14**:420f–422a	**6**:656d–657c *passim*
d. The known elementary particles		**5**:34e–35e / **11**:703c–h	**11**:317f–g / **12**:870a–b / **15**:399e–h
i. The electron	ELECTRON **6**:665–672	**6**:550e–551e	**11**:305b–c / **11**:320a–c / **11**:795h–796a / **12**:306h–307a
ii. The positron		**6**:668a–c	**11**:703e–f
iii. The proton		**5**:77f–g / **13**:337c–f	
iv. The neutron		**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 201

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	ATOMIC STRUCTURE **2**:330–343		
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		**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		
g. The development of mass spectrometry		**11**:605b–h	
h. The development of scattering and resonance studies with atomic and molecular beams			**12**:304c–309a *passim*
4. Models of atomic structure		**2**:336b–339g / **6**:666d–g	**13**:334h–335a
a. The Rutherford nuclear model of the atom, based on the alpha-scattering phenomena		**2**:336b–c	**16**:107h–108b
b. The Bohr–Sommerfeld atomic model, based on the conception of energy levels and quantization		**2**:336c–338a / **19**:1061b–d	**2**:1203c–f / **11**:797a–e / **15**:517c–f
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	MECHANICS, QUANTUM **11**:793–799	**2**:338a–339g / **6**:669c–d	**4**:169d–g / **4**:86h–87e / **12**:870b–f / **14**:79d–80a
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 *Macropsdia*
(Additional biographical entries may also be found in the *Micropsdia)*

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HAHN, OTTO **8**:545
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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 201

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	CARBONGROUP 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	OXYGENGROUP 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**:136c–h	
ii. Chlorine		**8**:566d–570e / **3**:872f–h / **7**:929a–c	**3**:49c–e
iii. Bromine		**8**:570e–572e / **4**:136h–137b	
iv. Iodine		**8**:572e–575c / **4**:137c / **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
i. By volatility differences: distillation, sublimation, evaporization		**4**:158e–h / **14**:181d–182b	
ii. By chromatography: liquid phase, gas phase, thin layer	CHROMATOGRAPHY **4**:565–569	**4**:159a–d	**2**:997a–b / **4**:79c–f / **9**:801g–802a / **12**:321a–b / **17**:680c–d
iii. By solubility differences: precipitation, crystallization, zone melting, solvent extraction		**4**:159d–160a / **15**:521g–522a / **15**:523c–f	**1**:598c–d / **4**:78h–79b
iv. By ion-exchange reactions	ION-EXCHANGE REACTIONS **9**:800–804	**4**:160a–c / **15**:522b–523c / **19**:1141f–h	**18**:684b–d
v. By electrophoresis and electrolytic methods		**4**:160e–g	**4**:157e–f / **6**:606d–607e / **15**:87d–f
vi. By mechanical methods: filtration, sedimentation, sieving, flotation, centrifugation		**4**:160g–161f / **19**:1142a–c	**3**:1144b–c
b. Classical methods of qualitative and quantitative analysis		**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
c. Instrumental methods used to identify functional groups, molecular sub-units, and structural features		**4**:80h–83h	**13**:693c–e
i. Spectrochemical methods: microwave, infrared, ultraviolet, Raman spectroscopy, colorimetry, atomic absorption spectroscopy		**4**:81c–82b	**8**:835h–836b / **12**:316h–317g / **13**:693c–e / **14**:295e–f / **15**:88e–f
ii. Mass spectrometry		**4**:82b–c	**2**:344h–345d / **11**:609d–h / **12**:320a
iii. Magnetic resonance spectrometry		**4**:82d–f / **11**:306e–308d	**12**:317h–318a / **15**:423e–g
iv. Thermometric methods: thermogravimetry, calorimetry, cryoscopy		**4**:82f–g	
v. Radiochemical methods: radiometric analysis, activation analysis, isotopic dilution		**4**:82h–83b	**14**:368b–d
vi. Electrochemical methods: potentiometry, polarography, electrodeposition, oscillometry		**4**:83b–h	**15**:87c–d
d. Diffraction methods for determining molecular structures		**12**:316e–h	
i. Electron diffraction		**12**:316e–f	
ii. X-ray and neutron beam diffraction		**12**:316f–h / **12**:1074c–e / **15**:87g–88e / **17**:474b–c	**8**:208f–209d
e. Physical methods used to determine optical activity, magnetic susceptibility, calorific values, heat of combustion, activation energy, and reaction rates		**4**:83h–84a	**3**:831g–832a / **15**:423d–e

	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, nonstoichiornetric 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.I.c., below]			
e. Catenates		**4**:103h–104e	**13**:812d–e
f. Inorganic polymers		**4**:104f–105c/ **14**:767f–768a	
g. Special nonmetallic derivatives		**4**:105c–106a	
3. Methods of preparation of inorganic compounds		**5**:140e–h/ **18**:432c–h	**14**:195h–196b
4. Reactions of inorganic compounds; *e.g.*, acid–base, substitution, isomerization, oxidation–reduction, addition		**5**:141a–142d	**13**:818e–g
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 291

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 reacf 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	**4**:145c–146f / **3**:822b–h / **4**:112c–113d / **13**:699d–h	
3. Classification and nomenclature of the principal kinds of chemical reactions		
a. According to the relationship involved between the starting materials and the final products		**13**:719f–g / **13**:813g–814a
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		**13**:805g–809f	
a. The concept of oxidation state		**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 / 1 0 :1024g–h **18**:299a–d / **7**:1023c–1024c	
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

articles	article sections	other references
TRANSPORT PHENOMENA **18**:674–677		
1. The kinetic molecular theory of the transport properties of gases, liquids, suspensions, and polymers	**18**:675b–676a	**4**:956b–c / **10**:1027d–g / **16**:1052c–e
2. Phenomenological expressions of transport: equations relating transport properties and the rates at which mass, energy, and momentum are transported	**18**:676a–h / **7**:920a–h / **18**:309b–311a	
3. Hydrodynamic aspects of transport phenomena: equations of change expressing the laws of conservation of mass, energy, and momentum; transfer coefficients at boundary surfaces	**18**:676h–677e / **11**:790d–791b	
4. Transport phenomena in macrosystems: mass, energy, and momentum balance	**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 outiine of subject A treats crystai 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

articles	article sections	other references
CRYSTALLOGRAPHY **5**:339–347		
1. Patterns of atoms in crystals	**5**:340b–344a / **7**:213a–215a / **16**:752d–754g / **16**:1035c–1036c	
a. The three-dimensional periodic arrangement of atoms in crystals: crystal planes and their notation	**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
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	**5**:341b–343g / **5**:33g–h / **13**:561g–562a	14: 284e–287d *passim*
2. Diffraction of X-rays, electrons, and neutrons by crystal structures	**5**:344a–346c / **12**:1074c–e / **14**: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 BFFECT **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, antiferrornagnetism, 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**:512f–513c
		16:524f–525e	
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 291

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 291

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: Ampere'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 eauations 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
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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
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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
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ii. Mossbauer radiation: the recoilless radiation and absorption of gamma radiation	MÖSSBAUER EFFECT **12**:491–493		**18**:615d–e
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b. Masers; *e.g.*, solid-state masers, gas masers		**10**:687f–688b	
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a. Through matter			**2**:321c–d/**12**:119g–h/**16**:264d–h
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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
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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
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i. Mechanical effects of light		**10**:945g–946d	
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8. The quantum theory of light: the photon		**10**:946d–949c	
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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	
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d. Applications of lenses and mirrors in optical systems [see 723.E.1.]			
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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.l.a. and 624.B.]			

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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

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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.

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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 modem 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	

	articles	article sections	other references
B. Gravitation: a universal force of mutual attraction that is postulated as acting between all matter	GRAVITATION **8**:286–294		
1. Development of gravitational theory		**8**:286h–288e	
a. Early concepts: the Aristotelian viewpoint; contributions of Kepler and Galileo		**8**:268h–287b	**7**:853c–f/**10**:432h–433b
b. Newton's law of gravity [see also 126.A.3.b.]		**8**:287c–288e	**6**:19c–e/**6**:851a–c/**8**:556f–h/ **11**:758b–c/**13**:19d–g
2. Interpretation of gravity measurements		**8**:288e–289b/ **12**:418a–419a	
a. Potential theory: mathematical representation of the gravitational fields of irregular mass distributions [see also 10/22.D.2.c.]		**8**:288e–289a/ **6**:20g–h	**1**:730f–731a
b. Effects of local mass differences: measurement of small gravity anomalies		**8**:289a–b/ **12**:418e–419a	**6**:20h–23h *passim*
3. Modern gravitational theory and its relation to other aspects of physical theory		**8**:289b–290f	
a. Field theories of gravity: their general properties and predictions		**8**:289c–g	
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		**8**:292g–294h/ **5**:77c–e	
C. Celestial mechanics [see also 126.A.]	MECHANICS, CELESTIAL **11**:756–761	**2**:224c–225e/ **2**:250d–g	**10**:352c–e
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		**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
2. The two-body problem and perturbations that cause the orbits of planets and satellites to deviate from ellipses		**11**:759d–760e/ **4**:971g–972c/ **6**:21e–f	
3. The unsolved three-body problem: modern mathematical methods for approximating solutions		**11**:760e–761e/ **12**:416f–417e	
4. The general *n*-body problem		**11**:761e–g	
D. Properties of the space-time continuum: the astronomical implications of relativity theory	RELATIVITY **15**:581–588	**14**:426g–427b	
1. The special theory of relativity		**15**:581h–584e	**6**:656d–g
a. Historical background: the search for the ether		**15**:581h–582g	**6**:649a–b/**12**:103g–104b
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		**15**:582g–583d/ **14**:410e–416c	**9**:869g–h/**11**:744f–g
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		**15**:583e–584e/ **18**:417f–418d	**19**:668d–f
2. The general theory of relativity		**15**:584f–587e/ **8**:289h–290h/ **18**:1015d–f	**6**:657c–e
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		**15**:584f–585g/ **6**:853d–f/ **8**:289h–290b	**12**:867e–868b
b. Experimental confirmation of the theory: the advance of Mercury's perihelion, the gravitational red shift, the gravitational deflection of light, gravitational waves		**15**:585g–586e/ **8**:290c–f/ **11**:916g–917a	**6**:193e–f/**12**:492b–c
c. Implications of general relativity: inhomogeneity of the space-time continuum; the properties of strong gravitational fields		**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 C headnote see page 20
for Division III headnote see page 631

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.

articles	article sections	other references
A. Galaxies in general		
GALAXIES, EXTERNAL **7**:828–833	**18**:1014e–1015d	
1. Statistical properties	**7**:828g–830c	
a. Classification of galaxies	**7**:828g–829b	**2**:244b–d
b. The extragalactic distance scale: observational methods of determining the distances to galaxies	**7**:829b–d / **13**:997b–c	
c. Distribution of galaxies: counts per unit area of sky; numbers and distribution in depth; clusters of galaxies; the Local Group	**7**:829d–830c / **18**:1014h–1015d	**17**:608f–609a
2. Physical properties	**7**:830d–832b / **2**:244a–d / **18**:1014e–g	
a. Galactic stellar populations and evolution: variations of stellar properties with location in galaxies	**7**:830d–831b / **7**:837g–840d	
b. Rotation of spiral galaxies: the direction of rotation and the persistence of spiral structure	**7**:831b–e / **7**:846b–847d / **7**:848c–e	
c. Masses of galaxies	**7**:831f–832a	
d. Peculiar galaxies: galaxies with unusual structure or properties	**7**:832a–b	
3. Radio emissions from galaxies	**7**:832b–833d / **7**:841d–842c	
RADIO SOURCES, ASTRONOMICAL **15**:474–476		
a. Line radiation from sources in nearer galaxies	**7**:832c–d	
b. Continuum radiation: thermal radiation produced by hot gas clouds; synchrotron radiation produced by charged particles accelerated in magnetic fields	**7**:832d–g	**7**:841d–f
c. Radiation from violent events in the nuclei of galaxies	**7**:832h–833d	**15**:329g–330b
4. X-ray emissions from galaxies	**19**:1067f–1068b	**7**:842h
B. The Galaxy: the Milky Way system		
GALAXY, THE **7**:833–849		
1. Distance determinations in the Galaxy: the parsec, the basic unit of measure of galactic distances	**7**:835e–836b / **12**:933b–c	
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)	**7**:836c–g	
3. The stars and star clusters nearest the Sun: the Galaxy in the neighbourhood of the Sun	**7**:836g–837c	**9**:797h–798a
4. The classification of stars according to Hertzsprung–Russell diagram: the concept of stellar populations; the ages of components of the Galaxy	**7**:837c–f / **12**:933e	**7**:830d–831a / **17**:592e–f
5. The galactic composition: the stars and interstellar material; sources of electromagnetic and particulate radiation	**7**:837g–843a	
a. The stellar populations: extreme population I, older population I, the disk population, intermediate population II, halo population II	**7**:837g–840d	
b. Nebulae		
NEBULA **12**:926–935	**9**:792a–794e	
i. Structure, physical properties, and spectra of nebulae	**12**:926f–930e / **2**:242e–244a / **19**:1065h–1067a	**7**:832f–g / **9**:582g–583b
ii. Diffuse, dark, and reflection nebulae	**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	

	articles	article sections	other references
b. Galactic evolution		7:847g–849b	
i. Hydromagnetic and gravitational theories of the formation of spiral structure		7:848c–e	9:797g–h
ii. Chemical evolution: the problem of the distribution of heavy elements		7:848f–g	
iii. Star formation: theories concerning the gravitational condensation of galactic dust and gas clouds		7:848g–849b / 9:798d–799b	9:792e–f / 12:931d–g / 18:1009g–1010a
C. Star clusters and stellar associations	STAR CLUSTERS AND STELLAR ASSOCIATIONS 17:604–609	7:836h–837c	6:852f–g / 17:601a–f
1. Globular clusters: systems containing thousands to hundreds of thousands of old stars in a symmetrical, roughly spherical form		17:605a–606g / 13:996h–997a	7:839h–840c
2. Open clusters: systems containing a dozen to hundreds of stars, usually in an unsymmetrical arrangement		17:606g–607g	9:791g–h
3. Stellar associations: systems containing a few dozen to hundreds of stars of similar type and common origin		17:607g–608c	7:838f–839a / 12:931h–932b
4. Relationship of clusters to the Galaxy: the formation and dispersion of clusters and their locations in the Galaxy		17:608c–f	
5. Clusters in external galaxies		17:608f–609b	
D. Stars	STAR 17:584–604		
1. The identification and nomenclature of the stars	ASTRONOMICAL MAPS 2:223–231	17:586c–e	
a. The celestial sphere and celestial coordinate systems		2:224c–225e / 11:675g–676g	
b. The constellations and other sky divisions		2:225e–228d	
c. Star names and designations		2:228g–229h	
d. Modern star maps and catalogs		2:229h–231c	
2. Observable stellar characteristics		17:586h–589c	
a. Stellar positions and motions		17:586h–587e / 7:836c–g / 13:995e–996h	2:240a–c
b. The apparent brightness or apparent luminosity of the stars: the UBV and other systems	PHOTOMETRY, ASTRONOMICAL 14:346–352	17:587e–588b	
i. Stellar colours		17:587g–588a	13:996f–g
ii. Stellar magnitude systems		17:588a–b / 14:347h–348b	
c. Stellar spectra [see also 112.C.]	ASTRONOMICAL SPECTROSCOPY, PRINCIPLES OF 2:232–241	17:588c–589c	
i. The general nature of stellar spectra: spectral lines and bands, continuum spectra, physical principles of spectrum formation		2:232h–234h / 17:801h–802c	
ii. Spectral classes: their relation to stellar temperature and chemical composition		2:239d–240e / 17:588c–589a	13:996d–e
iii. Effects of density, luminosity, and other factors on stellar spectra: unusual stellar spectra		2:240e–241c / 17:589a–c / 9:793b–f	
3. Derived, or calculated, stellar characteristics		17:589d–590h	
a. Intrinsic stellar brightness: absolute magnitudes and total luminosities		17:589d–h	
b. Stellar masses		17:589h–590c	
c. Stellar diameters		17:590c–e	
d. Stellar temperatures		17:590e–f / 2:240c–e / 17:801e–g	
e. The average characteristics of main-sequence, or dwarf, stars		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 631

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	**12**:47b–48a	**11**:761a–c
PLANET, MINOR **14**:491–493		
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		**16**:1030d–e
COMET **4**:969–978		
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	**2**:242c–e / **9**:785h–786e	**4**:977d–e / **16**:1030e–f
METEOR **12**:36–39		
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	**12**:36f–g	**10**:907e–g / **12**:244d–f
METEORITE **12**:39–48		
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	SUN **17**:798–808	**16**:1028h–1029d	
1. The Sun's surface layers and their features: the quiet Sun		**17**:801a–805a / **15**:468c–f	**6**:192d–193d / **17**:596e–597a
a. Solar data derived from observations of the photosphere, the visible luminous surface of the Sun		**17**:801a–803d	
i. Granulation and limb darkening		**17**:801d–e	
ii. The Sun's temperature, rotation, and sphericity		**17**:801e–h	
iii. The chemical composition and spectrum of the Sun		**17**:802c–803d / **2**:237h–238g	
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**:803d–804c	
c. The corona, the luminous, high-temperature, rarefied gas envelope of the Sun		**17**:804c–805a / **5**:205h–206c	**14**:509g–510a / **19**:22h–23e
i. Form, structure, and physical properties		**17**:804d–h	
ii. The solar wind		**17**:804h–805a	**4**:977b–c
2. Solar features that occur with increased frequency during the active phase of the solar cycle: the active Sun		**17**:805a–807g	
a. Centres of activity: areas of localized strong magnetic fields at the Sun's surface		**17**:805b–d	
b. Sunspots: their physical nature and the sunspot cycle of about 11 years		**17**:805d–806b	**4**:739d–g
c. Other features; *e.g.*, faculae, prominences, flares, coronal condensations		**17**:806b–807g	**5**:204e–205a / **9**:814h–815b / **15**:468g–469c
3. The solar interior: energy generation and the evolution of the Sun [see also 132.D.7.]		**17**:807h–808d / **13**:309e–310c	**17**:598f–600a *passim*
4. Solar radiation, including light, radio waves, and particles		**5**:204e–205a / **9**:786e–h / **15**:468c–469c	**4**:739d–e
5. Solar-terrestrial relationships and interactions		**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	
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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.

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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.

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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	
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	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
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	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	
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	6:32e–h	
	6:32h–35c	**6**:61c–e
	6:32h–33d	**5**:512a–b

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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 thedynamo 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 /	**6**:36b–37a
i. Response to stress		**15**:914c–h / **12**:50h–52a	
ii. Elastic and plastic deformation: reversible and irreversible displacements		**15**:914h–916a	
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
	15:917g–918c	**12**:6a–d
	15:918c–e	**1**:633h–634c
SALT DOMES **16**:195–199	**15**:918e–f	
	15:918g–h / **16**:470f–471a	
	15:918h–922h	
	15:919a–920f	**8**:876f–g / **19**:703e–h
	15:920f–922h / **15**:843g–844b	**6**:68e–h / **16**:446b–e
	15:922h–923g	
	9:177f–178a / **9**:179a–d / **9**:182b–d / **9**:184c–g	**12**:154g–155c

ii. Foliation and lineation: linear features in rocks subjected to stress

iii. Nappes: large rock sheets that have moved over the rock formations beneath and in front of them

iv. Diapiric structures; *e.g.*, salt domes
[see also 724.B.1.c.ii.]

v. Nontectonic folding; *e.g.*, slumping of recently deposited sediments

c. Fracture in rocks

i. Joints, joint sets, and joint patterns

ii. Faults and faulting; *e.g.*, normal, transcurrent, and thrust faults

d. Structural interference: the superposition of strains produced by the tectonic events of different ages

e. The deformation of ice in sheets and glaciers: flow and fracture of ice
[see also 222.A.3.a.]

Section 213. **The structure and composition of the Earth's interior**
[for Part Two headnote see page 79
for Division I headnote see page 791

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
EARTH, STRUCTURE AND COMPOSITION OF **6**:48–57		
	6:49d–50e / **6**:10b–c	**6**:702h–703a
	6:50e–55c	
	6:50e–51e / **5**:120b–f / **6**:703h–709c / **13**:433h–434d	
	6:51e–h	
	6:51h–54f / **6**:703d–h / **16**:764a–d	
	6:51h–53e / **5**:120f–h / **9**:222g–223d	**5**:114d–f / **6**:703f–g / **12**:8f–g / **13**:562h–563c
	6:53e–54c	
	6:54c–f	
	6:54f–55c / **6**:703c–d	

A. The Earth's concentric layers

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]

2. The basic divisions of the solid Earth

a. The crust: the Earth's outer layer, which may be differentiated into continental and oceanic crust

b. The Mohorovičić Discontinuity: the zone that separates crust from mantle

c. The mantle: the layer between crust and core that comprises the bulk of the Earth's volume

i. The upper mantle

ii. The transition zone

iii. The lower mantle

d. The core: the Earth's innermost region, assumed to be liquid except for a probably solid inner core

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
B. The rocks that comprise the Earth's crust		**16**:763e–764a	
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.I.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.

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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 791

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 io'nosphere: 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	**19**:22f–h
e. Probing the ionosphere: the effects of the ionosphere on radio waves [see also 735.I.4.]		**9**:815g–816d / **15**:425g–426a	
5. The exosphere: the outermost layer of the atmosphere that grades into interplanetary space		**2**:312a–313f / **9**:788h–789b	**2**:321f–h
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**:312b–g	
b. Determination of the critical zone, the layer above which the number of particle collisions is negligible		**2**:312g–313a	
c. Particle trajectories in the exosphere: particles with ballistic trajectories, entrapped particles, particles with escape velocities, extraterrestrial particles		**2**:313a–f	
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	

	articles	article sections	other references
ii. Their relation to the magnetosphere and the solar wind [see also 133.B.]		**19**:22h–23g / **2**:326a–e	**2**:376h–377g / **6**:27e–g
B. The large-scale motions of the atmosphere [see also 224, 232.A.4., and 723.G.5.]	WINDS AND STORMS **19**:862–875		
1. The general nature and relative scales of atmospheric motions: the resolution of winds into zonal (east–west), meridional (north–south), and vertical components		**19**:862h–864c / **2**:322d–e	
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.]		**19**:864c–865h / **4**:718f–719c / **10**:161a–162a	
3. Jet streams: high-velocity, narrow air currents in the upper troposphere and the stratosphere	JET STREAMS **10**:160–164	**19**:869f–h	
a. The cause and formation of jet streams: transport of heat from the Equator to the poles; effects of the Earth's rotation		**10**:161a–162a	
b. Occurrence and behaviour of jet streams in atmospheric models: laboratory studies of jet streams		**10**:162a–f	
c. Mean and eddy transports in the jet stream region: the relation between jet streams and the general circulation of the atmosphere		**10**:162f–163f	
d. Occurrence and distribution of jet streams: the westerly Polar-Front, Subtropical, and Stratospheric Polar-Night jet streams; the easterly Tropical jet stream		**10**:163f–164b	
4. The westerlies of mid-latitudes		**19**:865h–872c	
a. Standing waves of the mid-latitude westerlies and related systems: differences between the Northern and Southern hemispheres		**19**:867h–868h	**10**:162f–163a
b. Mid-latitude travelling disturbances, or cyclones and anticyclones, that are the surface expression of waves in the westerlies [see also 224.B.1.]	CYCLONES AND ANTICYCLONES **5**:392–395	**19**:868h–872c	**4**:719c–e / **10**:163a–f
5. Tropical wind systems		**19**:872c–873f	
a. Trade winds: the Northeast and Southeast Trade Winds, and the Intertropical Convergence Zone		**19**:872d–h	**13**:837d–842b
b. Tropical disturbances		**19**:872h–873f	
i. Noncyclonic storms; *e.g.*, easterly-wave systems, shear-line storms		**19**:872h–873c	**12**:390d–e / **18**:364h–365a
ii. Cyclonic storms: hurricanes and typhoons	HURRICANES AND TYPHOONS **9**:58–64	**19**:873d–f	
c. Monsoons	MONSOONS **12**:389–394	**19**:868d–f	**2**:160h–161a / **4**:725b–c / **13**:842d
6. Stratospheric and mesospheric wind systems		**19**:873h–874e	
a. Polar Night Westerlies: their mean flow, wave disturbances, and sudden warmings		**19**:874b–d	**10**:164a–b
b. Summer Easterlies of the mesosphere and stratosphere: the 26-month cycle in the equatorial stratosphere		**19**:874d–e	
7. The mean meridional circulations of the atmosphere		**19**:874e–875a	
8. The driving mechanism of the atmosphere: the energy balance and the transport of heat and momentum		**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 921

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	**9**:113g–114g	
i. Origin and occurrence of groundwater		**8**:435c–436h	
ii. Fluctuations in groundwater levels		**8**:437a–h	
iii. Movement of groundwater		**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

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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.]			

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(Additional geographical entries may also be found in the ***Micropzdia)***

Oceans
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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 2321

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	
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	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 921

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
c. The weather under thunderstorms: phenomena observed on the ground			**14**:962h–963a
i. Strong winds and heavy rains associated with isolated or local thunderstorms		**18**:364d–h	
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 791

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.

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Section 231. Physical features of the Earth's surface

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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

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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	
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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 bf 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	

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a. Geophysical evidence: the interaction between sediment deposition and crustal subsidence		**5**:118c–119b	
b. Geological relationships: interpretations based on the theory of continental drift and sea-floor spreading		**5**:119b–e	
4. Submarine canyons incising the continental terrace	CANYONS, SUBMARINE **3**:786–791		
a. Types of submarine valleys		**3**:786g–h	**5**:115h–116b
b. Physical characteristics and geographic distribution of submarine canyons		**3**:786h–787h	
c. Relation of submarine canyons to adjacent land valleys		**3**:788a–c	
d. Transport of sediment through submarine canyons: turbidity currents and graded deposits		**3**:788c–789e / **5**:590b–591h	**8**:298g–299c
e. Origin of submarine canyons		**3**:789e–791d	
D. The oceanic deeps	OCEAN BASINS **13**:433–437		
1. Components of ocean basins		**13**:433h–436f	
a. The oceanic crust		**13**:433h–434d / **6**:51c–e	
b. Major features of the deep-ocean floor		**13**:434d–436d	
i. Mid-ocean ridges [see ***G.***, below]			
ii. Trenches [see also 241.G.]		**13**:435b–d	**9**:1026g–1027h *passim* / **16**:446g–h
iii. Fracture zones		**13**:435e–f	**16**:446b–c
iv. Seamounts and guyots		**13**:435f–436a	
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vi. Sediments of the ocean floor	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
c. Basin boundaries		**13**:436d–f	
i. The continental slope [see ***C.***, above]			
ii. The continental rise		**13**:436e–f	**8**:298g–299a
2. The origin of ocean basins		**13**:436g–437a / **9**:125a–b	
E. Coral islands, coral reefs, and atolls [see also **351.B.** and **354.B.**]	CORAL ISLANDS, CORAL REEFS, AND ATOLLS **5**:162–167		**4**:799d–g
1. Fossil reefs and reef-building organisms		**5**:163b–164a / **4**:731b–d / 7:560d–e	
2. Present reef accumulation: water conditions, reef geochemistry, biological factors		**5**:164a–165f	**10**:591h–593g ***passim***
3. Origins and development of reefs and atolls		**5**:165f–167f	**13**:435g–h
F. The major mountain ranges and fracture zones of the Earth's crust on the continents and beneath the oceans	MOUNTAIN RANGES AND MOUNTAIN BELTS **12**:588–592		
1. Types of mountains; *e.g.*, dome, block, fold, volcanic, alpine		**12**:588g–590d / **19**:505c–507a	**12**:577h–578g
2. The worldwide system of folded mountain ranges, fracture zones, and volcanic island arcs		**12**:590d–592d / **12**:578h–580c	
a. The Circum-Pacific System that includes the North and South American cordilleras and the west Pacific island arcs		**12**:590d–591d	**9**:215a–b / **9**:1028e–h
b. The Tethyan System that separates the continental platforms of Eurasia from Africa and India		**12**:591d–g	
c. Subsidiary mountain ranges: systems associated with regional domes of the continental platforms		**12**:591h–592d	

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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

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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 1041**

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.

	articles	article sections	other references
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	WEATHERING **19**:702–705		**5**:609f–610e
a. Processes involved in weathering		**19**:703b–705a / **13**:563f–h	**16**:475g–h
i. Physical processes; *e.g.*, freeze–thaw cycles, crystal-growth pressures		**19**:703b–704c	
ii. Chemical processes; *e.g.*, solution effects, hydration, hydrolysis, oxidation		**19**:704c–705a / **4**:705f–g / **16**:1018g–1020c	**3**:1023e–1024d / **7**:734c–735a / 7:1032h–1033c / **12**:94d–f / **13**:563f–h
b. Factors that control the type and rate of rock weathering; *e.g.*, rock composition and structure, climate		**19**:705a–e / **7**:1033g–1034f / **12**:118g–h	**3**:1024f–1025d / **16**:1022e
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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.

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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 modem 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.]			
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]		**5**:120h–121e	
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	STRATIGRAPHIC BOUNDARIES **17**:715–726		
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	

	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
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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.

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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 molecuies 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.

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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. Characteristicsof 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.

articles	article sections	other references
A. The general conception of life		
LIFE **10**:893–895		
1. Definitions of life: physiological, metabolic, biochemical, genetic, and thermodynamic definitions	**10**:893c–894f	**2**:994f–996e *passim* / **2**:1038f–1038h / **7**:542d–g
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	**2**:1014f–g / **3**:1050f–1051d / **13**:725b–726a	**14**:381g–h / **15**:676d–678f *passim*
B. Life on Earth: the distinctive properties of living things		
LIFE **10**:894–899	**2**:1015a–h	
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	**10**:895b–896a / **7**:985h–986f	
2. Metabolism: the process of self-maintenance	**10**:896a–897a / **3**:1054g–1055a / **11**:1022d–1025d	**13**:401f–402d / **15**:751c–e
3. Homeostasis: the maintenance of dynamic equilibrium through built-in steady-state controls	**8**:1014c–1015d / **13**:723f–724c	**4**:618e–g / **7**:546b–d / **8**:1015e–1017f *passim*
4. Reproduction and development: the succession of and the changes in living substance; sex as the basis of variability	**10**:897a–h / **5**:645f–649c / **15**:676b–677h / **16**:585d–g	**5**:658g–h
a. Eucaryotic and procaryotic cells: single cells possessing a distinct nucleus (eucaryotes) or lacking one (procaryotes)	**10**:897a–c / **1**:493e–494a / **3**:1048d–h / **5**:645f–g / **15**:676f–677e	**3**:1060h–1061c
b. Metazoa: many-celled organisms, from slime molds to man	**10**:897d–h / **5**:645h–649c / **16**:586b–f	**15**:677e–h
5. Variation among organisms: the adaptation of organisms through the operation of natural selection	**10**:897h–899c / **15**:679b–c	**16**:586f–h
6. Responsiveness: sensory and behavioral reactions to external stimuli	**10**:899c–h / **12**:975c–977b	

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*

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

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 modem 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.

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	

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
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

	articles	article sections	other references
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		7:16b–17c	1:880h–881a
D. The establishment of species and the process of speciation	SPECIES AND SPECIATION 17:449–455	7:17c–g	
1. The distinctiveness of species—a group of organisms reproductively isolated from other groups: the classification of a species		17:449d–h	
2. Species concepts: historical background; the concepts of typological, morphological, nondimensional, and biological species		17:449h–450g	4:687b–e
3. Application of the biological species concept: the criterion of reproductive isolation; examples of situations in which the species concept is difficult to apply		17:450h–451g	
a. Populations that appear closely related but differ in enough characteristics owing to geographical isolation to be called different species		17:450h–451b	
b. Hybridization between populations with resulting sterility or reduced fitness		17:451b–d	8:815f–g/8:817e–g
c. Other problematic situations: variants within a single species; asexual species and fossil species definable only on the basis of structure		17:451d–g	
4. The properties of species		17:451g–453b	
a. Distinctiveness that restricts random mating; *e.g.*, behavioral differences, physical differences		17:451g–452b	
b. Gene flow: relocation of offspring along with their inherited genes		17:452b–c	
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		17:452c–453b/ 8:815c–816c	7:1009g–1010a/ 8:1090f–1092a *passim*/ 12:755a–b/ 15:348b–355f passim
5. The evolution of species: gradual speciation in populations		17:453b–455b/ 8:816d–e	4:1029c–e/8:815c–d
a. Allopatric speciation: extrinsic barriers to gene exchange		17:453c–454b	
b. Sympatric speciation: intrinsic barriers to gene exchange		17:454b–h	12:218a–b
c. Stasipatric speciation: spread of a chromosomal rearrangement within the range of an existing species		17:454h–455b	
6. The relationship between species and other taxonomic categories—family, order, class, and phylum		17:455b–d	4:686a–h passim
E. The course of evolution	EVOLUTION 7:17–19		
1. Major steps of evolution: the progressive development of life forms and the spread of organisms from water to land		7:17g–18g/ 13:922h–927e	
2. Patterns of evolution; *e.g.*, improvement and adaptive radiation, mosaic evolution, parallel and convergent evolution		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.

	articles	article sections	other references
A. Systematic classification of organisms in a hierarchical arrangement	CLASSIFICATION, BIOLOGICAL **4**:683–691		**1**:978g–979a / **4**:691e–f
1. The objectives of biological classification: identification and the making of natural groups		**4**:684b–f	
2. History of biological classification		**4**:684f–685h / **2**:1021h–1022c / **19**:1165b–e	
a. From the Greeks to the Renaissance; *e.g.*, the Aristotelian method		**4**:684f–685a	
b. The Linnaean system		**4**:685a–c	**2**:1022b–c / **3**:66g–67a / **10**:1013b–e / **19**:1165b–d
c. Classification since Linnaeus: the importance of natural relationships; the influence of Darwin		**4**:685c–h	**17**:449h–450b / **19**:1165d–e
3. The taxonomic process		**4**:685h–689e	
a. Prerequisites		**4**:686a–687h	
i. A recognized system of ranks in classifying; *e.g.*, phylum, class, order		**4**:686a–h	**17**:449f–g
ii. Recognized rules for nomenclature: the naming of organisms		**4**:686h–687e / **4**:693f–g	**8**:1030d–g / **8**:1044b–f
iii. A procedure for verification and validation of descriptions of organisms by type specimens		**4**:687e–h	
b. Handling of material: the collecting, preserving, and labelling of suitable specimens		**4**:687h–688c	
c. Taxonomic characters: criteria for svstematic classification; *e.g.*, anatomical, biochemical, physiological, and behavioral characters		**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
d. Making a classification: fitting the hierarchical system to the group and suggesting its course of evolution		**4**:689a–e / **6**:185h–186b / **14**:382c–383d	**2**:70c–d / **4**:451a–c
4. Current systems of classification		**4**:689e–691c / **14**:377h–379a	
a. Division of organisms into kingdoms: problems in classification caused by organisms that do not fit into the traditional plant or animal kingdoms		**4**:689e–690e / **15**:120d–e	**2**:577c–d / **14**:377h–378f / **14**:379b–e / **16**:883h–884d
b. A classification of living organisms: a contemporary approach consisting of four kingdoms (Monera, Protista, Metaphyta, Metazoa)		**4**:690f–691c / **15**:129g–130a	**12**:767f–g / **14**:378f–379a
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	VIRUS **19**:163–172	**3**:765a–c / **5**:856g–857c / **7**:986b–987f	**3**:1060f–h / **4**:689h–690b / **10**:896h–897a
C. The monerans: the procaryotes		3:1048d–f	**10**:897b–c / **14**:377d–379a passim
1. Blue-green algae **[see D.2., below]**			
2. Bacteria and allies; *e.g.*, actinomycetes, mycoplasmas, rickettsias	BACTERIA **2**:568–577	**5**:959e–g	**5**:857c–888c *passim* / **5**:889a–890b *passim* / **14**:608a–f
D. The protists: the simpler eucaryotes			

	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		

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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		

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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	

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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		
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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	
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b. Barnacles	CIRRIPEDM **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		

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d. Orthopteran orders; *e.g.*, grasshoppers, crickets, cockroaches, stick insects	ORTHOPTERAN **13**:742–750		
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f. Louse order: chewing lice and sucking lice	PHTHIRAPTERA **14**:373–376		
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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		
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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
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p. Flea order	SIPHONAPTERA **16**:807–809		
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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		
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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
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a. Jawless fishes: lampreys, hagfishes, and ostrawderms	AGNATHA **1**:310–311	**7**:567h–568d	**4**:625b–e/**7**:336h–337f
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c. Cartilaginous fishes; *e.g.*, sharks, skates, rays	SELACHII **16**:492–500		**7**:337h–338d
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3. Bony fishes			
a. Crossopterygians; *e.g.*, osteolepiforms, coelacanths	CROSSOPTERYGII **5**:296–297		
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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. Crypriniform 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		
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	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 1301

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

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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 1441

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.

	articles	article sections	other references
A.	The inorganic milieu of living systems; *e.g.*, the necessity for water; the effects of gases	**2**:1039g–1042h / **15**:752a–f	**10**:899b–c / **10**:904b–905g passim / **13**:497c–498a / **19**:636c–637g passim
B.	Organic chemicals participating naturally in the life processes		
1.	Carbohydrates	CARBOHYDRATE **3**:823–832	
a.	Classification and nomenclature of carbohydrates	**3**:823c–g	
b.	Importance of carbohydrates in the biosphere, in human nutrition, in energy storage, and in plant and animal structure	**3**:823h–825a / **11**:1039b–1040b	**5**:777g–778a / **5**:778f–g / **13**:412e–g
c.	The structural features of carbohydrates	**3**:825a–826h	
d.	Classes of carbohydrates and their preparation and analysis	**3**:826h–832e / **11**:1026f–1030b	**11**:1043f–1044c
2.	Lipids	LIPID **10**:1015–1022	**13**:522a–523b passim
a.	The biological importance of lipids as food reserves and as structural components of cells	**2**:1016c–1017a / **11**:877d–e / **13**:405f–g / **13**:523e–524h	**5**:6f–h / **13**:412g–h
b.	Fatty acids	**2**:1017a–1019c / **3**:867d–868e / **11**:1030f–1031e	**11**:1040b–1041c
c.	Derivatives of fatty acids and other biologically important lipids; *e.g.*, triglycerides, sterols, lipoproteins	**2**:1019c–1022c	**5**:778b–c / **5**:779a / **11**:876e–g / **11**:1044d–h / **15**:93g–94a
3.	Proteins and peptides	PROTEIN **15**:81–98	**2**:1122g–1123d
a.	General structure and properties of proteins	**15**:81f–90c	**2**:994g–h / **3**:1044e–g / **13**:411f–412e *passim* / 18:608h–609h passim
i.	The amino acid composition of proteins	**11**:1041d–h / **13**:405c–d / **15**:81f–84e	
ii.	Other general features of proteins: levels of structural organization, methods of study, physicochemical properties, conformation of globular forms, classification	**15**:84e–90c / **11**:1031f–1033a	**11**:1045h–1046e
b.	Special structure and function of proteins	**15**:90d–98g	

	articles	article sections	other references
i. Structural proteins; *e.g.*, collagen, muscle proteins, fibrinogen		**15**:90d–91h / **1**:301h–302b / **11**:877e–g	
ii. Albumins, globulins. and other soluble or conjugated proteins; *e.g.*, blood serum proteins, plant proteins, hemoglobins, hormones, antibodies		**15**:91h–98g / **2**:1021f–1022c	**2**:1114g–1115b / **14**:369d–g
4. The major carrier of chemical energy: ATP		**11**:1023a–e / **12**:627c–628h	
a. The mechanisms by which adenosine triphosphate (ATP) is synthesized from adenosine diphosphate (ADP) and inorganic phosphate		**11**:1035c–h / **12**:627f–628h	**11**:1027g–1028e / **14**:370d–373e *passim*
b. Utilization of ATP in biosynthesis		**11**:1037f–h / **12**:627e–f	
5. Nucleic acids	NUCLEIC ACID **13**:328–330	**10**:895b–d	**2**:995b–c
a. General features: nucleic acids as long chain compounds consisting of repeating structural units called nucleotides; types of nucleic acids		**13**:328e–g / **7**:985h–986f / **19**:164d–165c	**13**:330e–333h *passim*
b. Deoxyribonucleic acid (DNA): a major constituent of the hereditary material of calls		**13**:328g–329h / **7**:985d–h	**11**:1045a–e
c. Ribonucleic acid (RNA): a substance primarily associated with protein synthesis in cells		**13**:329h–330c	**11**:1045e–h / **19**:166a–c
6. Biological pigments and coloration	COLORATION, BIOLOGICAL **4**:911–929		
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		**4**:911g–913b	
b. The structural and biochemical bases for colour		**4**:913b–923g	
i. Structural colour: the effects of reflection, interference, and scattering and their reinforcement by the presence of pigment		**4**:913d–914c	
ii. Pigments; *e.g.*, carotenoids, quinones, flavonoids, porphyrins		**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
c. The adaptive value of biological coloration; *e.g.*, camouflage, advertising coloration		**4**:923g–929d	
7. Enzymes	ENZYME **6**:896–902	**3**:1004f–1005b	
a. Historical background and importance		**6**:896b–897d	
b. General properties: classification, chemical nature, coenzymes, and nature of catalysis		**6**:897d–898f / **15**:95d–96e	**13**:333f–g
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)		**6**:898f–901c / **2**:1031e–1032b	
d. Enzyme flexibility and allosteric control; *e.g.*, regulation of enzymatic activity		**6**:901d–902e	
8. Vitamins	VITAMIN **19**:488–493		**11**:835g–h
a. General characteristics of vitamins		**19**:488c–489d / **13**:405h–406e	**13**:419d–420d
i. Nomenclature and the biological significance of vitamins; *e.g.*, the regulation of metabolic reactions		**19**:488c–e	
ii. Sources of vitamins and vitamin requirements of living things		**19**:488f–h	**13**:420d–422a passim / 1:909d–f
iii. Results of vitamin deficiencies and the evolution of vitamin-dependent organisms		**19**:488h–489d / **2**:1135e–1136c / **13**:409d–411e	
b. Water-soluble vitamins (vitamin C and the B vitamins): properties, functions, and metabolism		**19**:489e–490f	**2**:1135g–h / **13**:409e–g / **13**:410f–411e
c. Lipid-soluble vitamin groups (the A, D, E, and K vitamins): properties, functions, and metabolism		**19**:490f–491h	**3**:23b–c / **13**:409g–410f
d. Vitamin-like substances: choline, myoinositol, para-aminobenzoic acid (PABA), carnitine, lipoic acid, and bioflavinoids		**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 specialattention 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
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		**11**:1025a–d / **11**:1048c–g	
C. The nitrogen cycle: the process of nitrogen fixation; the role of micro-organisms in nitrification and denitrification		**2**:1040f–1041d / **16**:1015g–1016a	**2**:572b–c / **13**:125a–b

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
A. The cell membrane: the barrier between the cell and its environment and between structures within the cell	MEMBRANE, BIOLOGICAL **11**:875–884		
1. The nature of membranes		**11**:876d–878e	**3**:1045d–f
a. Biochemical constituents of membranes		**11**:876d–877c	**2**:1016f–g
b. Properties of membranes; *e.g.*, electrical properties		**11**:877d–878e	**2**:998f–h
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		**11**:878f–879c	**3**:1045g–1046b
3. Movement of water across cell membranes: osmosis		**11**:879c–g / **2**:1122a–g / **7**:45e–46b	**2**:1114d–f / **4**:160h–161a
4. Movement of solutes through membranes in response to a concentration gradient		**11**:879h–881g	**5**:1043f–h
a. Methods of studying permeability: measurement of the rates of uptake or exit of solutes from cells		**11**:879h–880e	
b. Factors that influence permeability; *e.g.*, molecular size and electrical charge of the substance being transported; membrane structure		**11**:880e–h	
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		**11**:880h–881g	
5. Movement of solutes through membranes independent of concentration gradients		**11**:881h–884g / **14**:501c–e	**12**:970h–972g *passim*
a. Active transport: metabolically linked (*i.e.*, energy-requiring) transport across a membrane		**11**:881h–884e	

	articles	article sections	other references
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		**11**:884e–g	
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	BIOELECTRICITY **2**:998–1000	**6**:607e–609b	**12**:970a–974b passim
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**:998b–e	**3**:879e–f/**14**:364e–f
2. Factors required to establish a bioelectric potential: semipermeable membrane, potassium-ion gradient across the membrane, and energy		**2**:998f–999a/ **11**:877g–878e	
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		**2**:999a–f/ **12**:971g–972e	**3**:879f–880b
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)		**2**:999f–1000a/ **12**:972f–973b	
5. Effector organs and systems: bioelectric organs in fishes including eels, in endocrine systems, and in central nervous systems		**2**:1000a–h/ **12**:968e–970a	**11**:804a–d/**13**:761f–g/ **13**:764c–e
C. The nerve impulse: a unit of electrical information conducted along a nerve fibre (an extension of a nerve cell, or neuron)	NERVE IMPULSE **12**:968–975		**15**:159h–160c
1. The structure of the neuron		**12**:969a–970a/ **12**:977b–978f	**12**:996c–997g *passim*
2. Characteristics of artificially stimulated nerve fibres		**12**:970a–h	
a. Effects of stimulation; *e.g.*, all-or-none law, tetanus, refractory periods, latent addition		**12**:970a–e	**12**:624c–626d passim
b. Strength–duration curve		**12**:970e–h	
3. Nature of the nerve impulse		**12**:970h–973b/ **11**:877g–878e	**2**:998b–1000a passim
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		**12**:971b–e	
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		**12**:971g–972e	
c. Maintenance of ionic concentration gradients by the sodium pump, a mechanism by which sodium ions leave the cell and potassium ions enter it		**12**:972f–g	**11**:882f–883b
d. Accompanying phenomena; *e.g.*, liberation of heat, optical effects		**12**:972g–973b	
4. Transmission of the nerve impulse: the mechanism involved in transmitting impulses between cells; the synapse		**12**:973b–974b/ **12**:978f–979a/ **12**:1033f–1035d	
5. Study of the nerve impulse: the prediction of action potential events from voltage clamp data and from artificial and simplified membranes		**12**:974c–975a	**2**:1036b–c/ **12**:624c–625d passim
D. Muscle contraction: the conversion of chemical energy to work	MUSCLE CONTRACTION **12**:620–633		
1. Contractile or motile activity of some type as a characteristic of ail living things		**12**:620h–621g	
2. Striated, or skeletal, muscle in higher animals		**12**:621g–630c	
a. Structure and levels of organization: the whole muscle, the muscle fibre, the myofibril, and the myofilament		**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 1301

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.

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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 theorv: 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. Reproductivecells: 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	

	articles	article sections	other references
2. Living membranes; *e.g.*, as barriers, in transport, in the generation of electricity		**3**:1049e–1050c/ **11**:879c–884g	**1**:304f–g/**11**:877g–879c *passim*
3. Interplay of nucleus and cytoplasm: overall function of the nucleus in the production of messenger RNA; exchange between nucleus and cytoplasm		**3**:1050c–f	
4. Cell movement: ciliary, flagellar, and amoeboid		**11**:15h–16f/ **12**:621a–e/ **15**:125e–126b	**12**:976d–e
5. Cells in societies: extension of the cell concept for multicellular life		**3**:1050f–1051d	
D. The cell cycle: growth and division	**CELL** AND **CELL** DIVISION **3**:1051–1056	**15**:676f–677d	**2**:569f–570c
1. Cell growth: doubling of size, genetic replication, preparation for mitosis		**3**:1051e–1052d	**7**:986b–f/**8**:440g–444c passim/ **18**:440g–441g passim/ **19**:165f–166h *passim*
2. Mitosis: the separation of sister chromosomes to opposite poles of the mitotic apparatus, a spindle-shaped structure in the cytoplasm		**3**:1052d–1055f	**5**:626e–627c
a. Special structures in mitosis: the centrioles that define the poles and the kinetochores (centromeres), the points at which chromosomes attach to the poles		**3**:1052g–1053b	
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		**3**:1053b–1055a	
c. Telophase: restoration of the daughter nuclei		**3**:1055a–b	
d. Cytokinesis: division of the cell body		**3**:1055b–f	
3. Meiosis: reduction division that produces daughter cells with half the number of chromosomes of the parent cells		**3**:1055f–1056f	**7**:997e–998a
a. The events and significance of meiosis		**3**:1055f–1056b	
b. Differences between meiosis and mitosis		**3**:1056b–f	
E. Fertilization: the fusion of two different sex cells (gametes) to form the primary nucleus of an embryo (zygote nucleus)	**FERTILIZATION** **7**:254–257	**5**:625h–626d	
1. Characteristics of the mature egg: the egg surface and the egg coats		**7**:255d–f	**5**:625h–626c/**15**:711b–d
2. Events of fertilization: sperm–egg association, egg activation, and formation of the zygote nucleus		**7**:255g–257b/ **6**:743a–c	**5**:660f–661a
3. Biochemical analysis of the events of fertilization		**7**:257c–f	
4. Accessories to fertilization: mechanisms that aid in the union of gametes		**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	TISSUES AND FLUIDS, PLANT **18**:451–455		**12**:454f–g / **18**:690h–691e
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		
HOMEOSTASIS **8**:1014–1017		
1. The nature of homeostatic systems	**8**:1014d–1015d	
a. The concept of homeostasis	**8**:1014d–g	
b. The comparison and regulation of self-regulatory devices in mechanical and biological systems	**8**:1014g–1015b	**18**:328a–d
c. The pattern that identifies a homeostatic system and the limits of homeostatic regulation	**8**:1015b–d / **2**:1039d–e	**2**:570d–f / **14**:996h–998b passim
2. Survey of homeostatic processes	**8**:1015e–1017a	
a. Physiological homeostasis; *e.g.*, the balance of hormones, the composition of the blood	**8**:1015e–g / **7**:45g–46b / 7:429c–430b / **13**:724b–c	**1**:704f–g/**6**:800h–801f / **9**:664e–f
b. Genetical homeostasis: gene regulation and expression	**8**:1015h–1016b / **7**:990d–991c / **11**:429d–e / **11**:1046f–1048g	
c. Developmental homeostasis; *e.g.*, maturation, tissue growth, regeneration	**8**:1016b–d / **5**:647h–648e / **8**:443b–e	
d. Ecological homeostasis; *e.g.*, predator–prey relationships	**8**:1016d–f	**14**:831b–836a *passim*
e. Medical homeostasis: mental health and the response to disease	**8**:1016g–1017a / **5**:843d–844d	**11**:212c–f

	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

	articles	article sections	other references
iv. Mechanoreceptors and electroreceptors: pain receptors, position and interior stretch receptors, balance and motion receptors, and touch and pressure receptors	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
v. Sound receptors	SOUND RECEPTION **17**:39–51	**4**:1012b–e / **17**:30g–31e	**10**:899f / **13**:761d–f / **15**:734g–735c
2. Evolution of sensory systems; *e.g.*, specialized organs, information-processing structures		**16**:546g–547a	**18**:328a–c
3. Sensory information: interactions between adjacent sense cells and sensory neurons		**16**:547a–c	
C. Endocrine systems in animals	ENDOCRINE SYSTEMS **6**:839–849		
1. General features of hormonal coordination; *e.g.*, relationships between endocrine and neural regulation		**6**:839d–h / **8**:1074c–g	**6**:800c–801f / **13**:723g–h / **14**:439b–e
2. Vertebrate endocrine systems		**6**:839h–845f / **8**:1074h–1085f	
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		**6**:839h–841a / 8:1074a–f	**4**:912c–g
b. Structure and function; *e.g.*, neurosecretory systems, thyroid gland, ultimobranchial gland, gastrointestinal endocrine system		**6**:841a–845f / **7**:335g	**11**:409d–e / **18**:447c–h
3. Invertebrate endocrine systems; *e.g.*, insects, crustaceans, and annelid worms		**6**:845f–846g / **8**:1085f–1086f	**5**:316d–e / **5**:961d / **12**:981h–982a
4. Comparative, adaptive, and evolutionary aspects of endocrine systems; *e.g.*, the neurosecretory cell, hypothalamus-pituitary control systems		**6**:846h–849a / **8**:1074f–g / **8**:1077b–1078e / **12**:992e–h	
5. The human endocrine system **[see 422.F.]**			
D. Nervous systems in animals	NERVES AND NERVOUS SYSTEMS **12**:975–992	**13**:722f–g	
1. Comparison of chemical and nervous regulation: control mechanisms located between the stimulus and the response		**12**:975f–976b	**13**:723g–724a
2. Nervous coordination		**12**:976b–979a	
a. Intracellular coordination: general cytoplasmic responsiveness, or irritability, to a stimulus		**12**:976b–c	
b. Organelle systems: the channelling of responsiveness at the subcellular level within more complex protozoans		**12**:976d–e	
c. Nervous systems: the channelling of responsiveness at the cellular level within multicellular organisms		**12**:976f–979a	**17**:692f–693a / **14**:439a–b
i. The neuron, or nerve cell		**12**:977b–978f / **12**:969a–970a / **12**:996c–997g	**3**:1061e–f / **18**:446b–h
ii. The transmission of the nerve impulse and the synapse **[see 323.C.4.]**			
3. Invertebrate nervous systems: structure and function		**12**:979a–982a	
a. Theories of the evolutionary origin of the nervous system		**12**:979a–c	
b. Diffuse nervous systems: the nerve net of hydra and simple radial systems of other cnidarians (coelenterates)		**12**:979d–g	**4**:770g–h
c. Centralized nervous systems		**12**:979g–982a	**5**:315g–316a / **10**:739e–740a
i. Complex radial systems in echinoderms		**12**:979h	
ii. Simple bilateral systems as in flatworms		**12**:980a–b	
iii. Moderately cephalized systems as in annelid worms and simple mollusks		**12**:980b–g	**1**:934e–935a / **2**:1090g–1091a
iv. Complexly compartmentalized systems as in insects, spiders, and cephalopods such as squids		**12**:980g–982a / **9**:617d–618c	
4. Vertebrate nervous systems: structure and function		**12**:982a–992h	
a. The central nervous system		**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 1541

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 iayer, 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 422.1.9.]		
B. The body skeleton		
SKELETAL SYSTEMS **16**:818–830	**13**:722c	
1. The roles of the body skeleton: the major supportive function in ali 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 1541

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	REPRODUCTION **15**:676–679		
1. Levels of reproduction		**15**:676d–678f	
a. Molecular replication and reproduction		**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 (garnetophyte) 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

	articles	article sections	other references
e. Changes in tissue and cell morphology; *e.g.*, atrophy of tissues		1:303a–b	2:351h–352g *passim*
3. Aging as a loss of information: theories explaining the aging mechanism		1:303b–304a / 1:305b–f	
a. Aging of genetic information systems		1:303b–f / 1:305b–c	
b. Aging of the immunological systems; *e.g.*, age-related autoimmune disease		1:303f–g	
c. Aging of neural and endocrine systems; *e.g.*, decrease in hormone responsiveness		1:303h–304a	
4. Causes of aging		1:304a–g	10:913c–f
a. External environmental agents; *e.g.*, ionizing radiations, temperature		1:304a–f	
b. Internal environment: consequences of metabolism		1:304f–g	17:452g–h
5. The duration of life	LIFE-SPAN 10:911–915		
a. General background; *e.g.*, the significance of individual existence, having a definite beginning and end		10:911c–f / 14:830a–831b	5:645h–646a
b. Life-span in human beings: studies on longevity; actual versus possible life-span		10:911f–913a	1:306b–c
c. Life-span in subhuman animals: maximum and average longevity; environmental influences; patterns of survival		10:913b–914e / 1:300h–301f / 15:973b–e	1:930d–f / 4:430h–431a / 13:744f–g / 15:729e–g
d. Life-span in plants: the problem of defining age		10:914e–915g	5:6c–d / 13:728c–d / 14:502c–e
6. The ultimate effect of aging: death	DEATH 5:526–529		5:649d–f / 5:670d–671c *passim*
G. Specialized patterns of development			
1. Regeneration	REGENERATION, BIOLOGICAL 15:576–580		
a. The modes and significance of regeneration		15:576d–577d	8:441h–442b
b. The regeneration process		15:577d–578d	
c. The range of regenerative capability		15:578d–580e / 12:997f–g	1:302e–g / 5:646c–d / 12:978e–f
i. In protists and plants		15:578e–h	
ii. In invertebrates		15:578h–579h / 14:547d–f / 14:850b–d	1:930f–931a
iii. In vertebrates		15:579h–580c	5:846a–c
2. The healing processes and scar tissue formation		16:827f–828a / 19:1020a–e	3:27h–28d / 5:846a–d / 9:562h–563c
3. Aberrant development	MALFORMATION, BIOLOGICAL 11:378–380		2:1073a–1076e passim / 5:645d–f / 8:441g–h
a. Animal malformations		11:379a–380b / 6:749c–f	
b. Plant malformations		11:380b–h	
4. Twinning: multiple births		2:1148c–d / 6:748f–749a	
5. Development in vitro: cell and tissue cultures	TISSUE CULTURE 18:438–442	1:302g–303a / 3:1050g–1051d / 8:444a–c	19:169g–h
6. Development of transplanted tissues and organs [see 423.C.2.k.]			

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		8:818b–819e / 5:941e–h	
a. In domestic animals and cultivated plants; *e.g.*, pets, livestock, crops		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 1301

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. 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
A. Patterns of stereotyped response: unlearned behavioral reactions of organisms to some environmental stimulus	STEREOTYPED RESPONSE **17**:671–676		**12**:975f–h
1. Plant movements		**17**:672d–674g	
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)		**17**:672f–673f	**5**:664a–b
b. Nastic movements: movements whose direction is limited by the structure of the responding organ		**17**:673f–h	
c. Nutation: rhythmic or periodic movements exhibited by shoot apexes during growth		**17**:673h–674b	
d. Other autonomous movements: turgor movements, hydration movements, circadian rhythm, movements in insectivorous plants		**17**:674b–g	**12**:960b–e
2. Animal movements		**17**:674h–676b / **11**:23g–24a	**2**:804d–e / **12**:975f–977b *passim*
a. Reflex and reflex-like activities; *e.g.*, kineses, or velocity changes of an entire animal based on intensity of the stimulus		**17**:674h–675b	**9**:628h–629b / **12**:976g–h / **12**:1004a–f / **12**:1009b–d / **12**:1010f–g / **14**:438f–h
b. Taxes: oriented locomotory reactions in response to a stimulation		**17**:675b–676a	**3**:115c–d / **4**:177h–178b / **11**:23h–24a
c. Fixed action patterns and instinct	INSTINCT **9**:628–630	**17**:676b / **6**:760b–d	**7**:210h–211a / **12**:564e–f
i. Characteristics of instinctive behaviour: heritability, complexity of pattern, adaptive function, and stability under external change		**9**:628c–g / **2**:809e–810c	
ii. Varieties of instinctive behaviour: reflex activity, fixed action patterns, and modifiable action patterns		**9**:628g–630e	**5**:361a–g
iii. Modification of instinctive behaviour by experience		**2**:810e–811h / **2**:812c–g / **16**:945a–d	**4**:1018c–e
3. Photoperiodism: responses of organisms to relative length of light and dark periods	PHOTOPERIODISM **14**:352–353		
a. In plants: flowering, fruit-set and abscission, or the dropping of plant parts		**14**:352c–g / **5**:669e–671b / **16**:487c–f	
b. In animals: bird migration, reproduction		**14**:352g–353e	**12**:183g–184b / **15**:680b–d
B. Diverse conceptions of animal behaviour	BEHAVIOUR, ANIMAL **2**:804–814		
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		2:804a-e	**12**:975g–976b
2. Classification of behaviour		**2**:804f–805c	
a. Ways of classifying behaviour: by the immediate causation, by the similarity of evolutionary history, or by the similarity of function		**2**:804f–805a	
b. The influence of genetics and experience: classification according to the nature of the changes occurring during evolution or ontogeny; innate versus learned behaviour		**2**:805a–c	**14**:776b–c
3. Components of behaviour		**2**:805d–809d	
a. Fixed action patterns: behaviour that is independent of environmental stimuli for its form, although such stimuli may be responsible for its elicitation		**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
BEHAVIOUR, ANIMAL **2**:812–814		
	C. Hormonal and nervous control of behaviour	**2**:812g–813c/ **8**:1074c–f	**9**:629a–e/**12**:992g–h
	1. Interaction of endocrine and nervous systems	**2**:813d–814a/ **1**:298a–b	**2**:542g–h/**12**:183g–184b/ **15**:680c–e
	2. Hormonal influences on behaviour; *e.g.*, by sex hormones	**2**:814a–g/ **12**:975f–977b/ **15**:159c–160a	**2**:356b–d/ **6**:763d–766f passim/ **12**:982d–986f passim/ **15**:161c–h
	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	**12**:991f–992a	**15**:159g–160a
	a. The integrative capabilities and hierarchical organization of the nervous system	**10**:740a–g	**7**:91b–d/**11**:409e–f/ **12**:976h–977b/ **12**:990d–991f passim
	b. Relation of the complexity of the nervous system to behaviour		

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	
FEEDING BEHAVIOUR **7**:207–212	1. Food getting	

	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 1821

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 1891

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.

A. The extent of the biosphere

1. Preconditions of the biosphere: the Earth as an ideal medium for life
2. The levels of organization within the biosphere
   a. The biocycle: a collection of biotic realms [see 354]
   b. The ecosystem: a collection of integrated communities and their environment [see B., below]
   c. The community: a collection of interacting populations of two or more species [see 352.C.]
   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
BIOSPHERE **2**:1037–1044		
	2:1037h–1038a	
	2:1038b–f	
	2:1038f–1039g	**4**:1029e–1030g *passim* / **6**:282d–g
	2:1038f–1039a / **10**:894c–f	
	2:1039a–c / **14**:367e–h	**3**:824a–g *passim* / **4**:1031g–h
	2:1039d–e	**4**:727g–728c

	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
MICROCLIMATES **12**:114–121	**4**:722h–723d / **8**:281c–d	**1**:358g–360c *passim* / **7**:536e–537f *passim* / **10**:342f–343b
	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
	6:283g–284f	
	6:284g–285a	

d. Micro-environments: the local horizontal and vertical differences in limiting factors

3. Energy flow and nutrient cycling: processes that determine the nature and productivity of the ecosystem

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

5. Ecosystem development: comparison in energy flow between the early successional growth stage and the mature stages; relevance to land-use planning

6. Types of ecosystems
[see 354]

Section 352. The community: a collection of interacting populations

[for Part Three headnote see page 130
for Divisic 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
POPULATION, BIOLOGICAL **14**:824–838		
	14:826b–831b	**11**:404f–g

A. Properties of the species population

1. The study of populations
[see 10/34.B.6.]

2. The measurable characteristics of biological populations

	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	

articles	article sections	other references
i. Adverse environment; *e.g.*, drought, frost, nutritional deficiencies	**5**:886a–c	**1**:358g–360c *passim*
ii. Toxic chemicals; *e.g.*, herbicides, insecticides, pollutants	**5**:886d–f / **1**:360d–361b	
iii. Physical injury: *e.g.*, high winds, fire, insect and animal feeding	**5**:886f / **2**:1045f–1046c	**8**:280g–281c / **16**:420e–f
b. Infectious disease-causing agents	**5**:886g–894b	
i. Infection; *e.g.*, by viruses, mycoplasmas, bacteria, fungi	**5**:886g–892c / **16**:294g–295a / **16**:889c–d	**12**:763d–f
ii. Infestation; *e.g.*, by nematodes, parasitic seed plants, insects	**5**:892c–894b / **9**:610c–f	
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	**5**:894b–895f / **1**:354c–e	
C. Hazards to animals	DISEASES OF ANIMALS **5**:863–879	
1. General features of animal diseases: historical background, importance, and the role of ecology	**5**:864b–865h / **10**:823a–c	
2. Detection and diagnosis: the reactions of tissue to disease; methods of examination; tests as diagnostic aids	**5**:865h–874f	
3. Survey of animal diseases and disorders	**5**:874f–879g	**5**:965g–h
a. Infectious and noninfectious diseases	**5**:874f–875f / 8:1090e–f / **15**:120f–121b	**10**:1284h–1285a
i. Infectious diseases and interspecies competition: infection, infestation, and predation by other organisms	**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
ii. Noninfectious diseases and disorders; *e.g.*, nutritional deficiencies, hereditary conditions, congenital deformity, trauma	**1**:301f–303b / **5**:837f–838b / **11**:379a–380b / **14**:607h–616h / **19**:488g–489c / **19**:1018e–1019b	**13**:403f–406h passim
b. Zoonoses: human diseases acquired from or transmitted to any other vertebrate animal	**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
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	**5**:877d–879g	
4. Human diseases [see **423** and **424**]		

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	
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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.

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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
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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 2091

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

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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: Vertesszollos 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 2091

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 2091

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	GENETICS, HUMAN **7**:996–1010		**14**:839c–f
		7:996h–1002c	
a. Single-factor inheritance; *e.g.*, dominant gene traits, recessive traits, sex-linked inheritance, lethal genes		**7**:998c–1001d / **6**:1024g–1025c / **8**:1147a–e	**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 I **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 professionalizatmn 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 2091

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			
d. The immune response	IMMUNITY **9**:247–258	**5**:845e–846a / **9**:534g–535f	
i. General features of immunological mechanisms: nonspecific and specific immunity; evolution of the immunological responses		**9**:248b–249e / **18**:631c–f	**2**:1113h–1114c / **3**:770h–771a / **19**:170c–d
ii. The cellular basis of immunological responses: role of lymphocytes as the source of immunoglobulins synthesized in response to antigenic stimulus		**9**:249f–251b / **11**:210b–e	**6**:815g–h / **11**:213d–f
iii. Immunoglobulins (antibodies): substances that combat invading organisms or foreign proteins		**9**:251c–253d / **15**:97g–98g	
iv. Antigens: foreign substances such as toxins that evoke an immunological response if introduced into the body		**9**:253d–255a	
v. Interaction of antigens and antibodies: general and protective effects; activation of complement in blood		**9**:255a–256b / **2**:1143h–1144b	
vi. Manifestations of immunological reactions; *e.g.*, hypersensitivity, auto-immunity, immunosuppression		**9**:256b–258g / **1**:303f–g / **5**:854c–855a / **18**:631f–632b	**2**:1119c–g
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	

	articles	article sections	other references
2. Disposal of the dead	EMBALMING, BURIAL, AND CREMATION 6:735–741	11:581h–583b / 13:1051g–1052a	1:835h–836a
a. Embalming: history and practices		6:736c–737e / 5:535d–f	
b. Burial practices: modes of burial, cemeteries, cremation, and burial societies		6:737e–741f / 5:535f–537c / 14:985c–g	7:201d–e

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.

	articles	article sections	other references
A. The structures and functions of the cardiovascular system	CARDIO-VASCULAR SYSTEM, HUMAN 3:875–885		2:1125d–f / 3:886a–b
1. The heart: a muscular pump functioning to propel the blood into and through vessels		3:875h–881b	2:1125g–1127d *passim*
a. General description: shape and location; the pericardium, or enclosing sac; the four chambers of the heart; external grooves		3:875h–876g	
b. The mesodermal origin of the heart in the embryo and its development, including comparisons to the hearts of lower animals		3:876g–878a / 5:636d–638a	6:752c–e
c. Structure and function of parts of the heart: characteristics of the atrioventricular and semilunar valves, the heart wall, and the coronary arteries		3:878a–879b / 12:630d–g	
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		3:881b–885f / 2:1109e–f	2:1128f–1133d *passim*
a. Structure: the walls of the arteries and veins; the transition from artery to capillary and from capillary to vein; the venous valves		3:881c–h	
b. The various vessel systems		3:881h–885f	7:52c–g / 10:1269e–f / 12:1008a–b / 15:766c–d
i. Arteries: the pulmonary circuit; the aorta and its principal branches; the pulse		3:881h–883f	10:258h
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		3:883f–885b	
iii. Capillaries: characteristics including their structure and function		3:885b–d	2:1130f–1131f *passim* / 11:212c–f
iv. Fetal circulation		3:885d–f / 6:751h–752e	

	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 /	
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 epididyrnus, 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	**5**:841h–843a / **7**:69a–b	**5**:837d–e / **8**:687d–689d *passim*
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**:843a–846g / **8**:1016g–1017a	**5**:684g–685a
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**:846h–847g / **3**:900c–f / **2**:1139g–1140b	**3**:891b–e / **12**:1037b–d
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**:847g–862g / **5**:874f–875f	**5**:837e–838e *passim*
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**: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**:897f–g / **2**:1144e–f / **3**:29h–30b / **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.

	articles	article sections	other references
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	SHOCK, PHYSIOLOGICAL **16**:699–702	**17**:816h–817h	
a. Types of shock and their recognition		**16**:699d–701d	
i. Shock owing to inadequate blood volume; *e.g.*, hemorrhage, burns, dehydration		**16**:699d–f	**3**:521a–d/**5**:561c–e
ii. Shock owing to inadequate cardiac output; *e.g.*, cardiogenic shock, pulmonary embolus, cardiac tamponade		**16**:699f–h	**3**:894b–h *passim*
iii. Shock owing to increased circulatory capacity; *e.g.*, infection, drugs, endocrine causes		**16**:700a–e/ 1:608c–e	
iv. Refractory and irreversible shock		**16**:700e–701a	
v. Identification of the causes of shock		**16**:701b–d	
b. Management, prognosis, and salient features of shock		**16**:701d–702d	**3**:523b–e
2. Metabolic diseases and disorders	METABOLISM, DISEASES OF 11:1049–1060	**3**:24e–26a	
a. Metabolic disturbances caused by nutritional deficiencies or by liver, kidney, and endocrine diseases		**11**:1049a–f/ **13**:409d–412a	
b. Inborn errors of metabolism		**11**:1049f–1060h/ **12**:1044f–1045e	**5**:850b–d/**8**:1147b–e/ **13**:415a–c
i. General features		**11**:1049f–1051e	
ii. Disturbances in amino acid metabolism		**11**:1051e–1056g/ 5:18g–h	
iii. Disturbances in carbohydrate metabolism		**11**:1056g–1058a/ **12**:1045c–e	**12**:634h–635b
iv. Disturbances in lipid metabolism		**11**:1058a–1059b/ **12**:1044h–1045c	
v. Disturbances in mucopolysaccharide metabolism		**11**:1059b–c/ **5**:19c–d	
vi. Disturbances in purine and pyrimidine metabolism		**11**:1059d–1060a	
vii. Miscellaneous disturbances		**11**:1060b–h	
3. Nutritional diseases: disorders related to nutritional deficiencies and excesses	NUTRITIONAL DISEASES AND DISORDERS **13**:408–417	**5**:860e–861a/ **11**:1049a–d	**5**:856a–b
a. Caused by deficiencies		**13**:408g–413h/ **2**:1135e–1136c/ **4**:223g–224a/ **5**:860f–861a/ **7**:503b–f/ **19**:488h–489c	**2**:1136h–1137c/**3**:24h–25b
b. Caused by overconsumption		**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	

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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

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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
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a. Diseases of the arteries		**3**:897h–899f	**5**:862c–e
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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	
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3. Significance of enlargement of accessible lymph nodes		**11**:216a–d	

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E. The symptoms, diagnosis, and treatment of diseases of the respiratory system and of breathing disorders	RESPIRATORY SYSTEM DISEASES **15**:767–778	**1**:308h–309b / **4**:224a–e / **18**:283h–284a	**5**:689h–690d
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b. Morphological classification of respiratory disease		**15**:767h–768f	
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2. Infectious diseases of the respiratory system		**15**:770c–772c	**4**:224a–c / **9**:543c–e / **14**:979g–980b
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b. Bacterial diseases; *e.g.*, bacterial pneumonia, pulmonary tuberculosis		**15**:771b–772c	**1**:609b–d / **5**:857g–858a / **9**:550d–f / **9**:550h–551e
3. Allergic lung diseases; *e.g.*, asthma, hay fever, farmer's lung		**15**:772d–773d / **1**:608e–g	**4**:224c–d
4. Bronchopulmonary diseases		**15**:773d–777f / **18**:630g–631a	
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b. Generalized nonobstructive lung disease		**15**:775a–e	
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d. Congenital and developmental abnormalities		**15**:776d–f	
e. Other causes; *e.g.*, circulatory disorders, lung cancer		**15**:776f–777f	**3**:767d–e
5. Diseases of the nonpulmonary structures		**15**:777f–778b	
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6. Disorders in the dynamics of respiration	RESPIRATION, DISORDERS OF **15**:745–747	**9**:531a–c	**9**:529c–d
a. Basic disorders of respiration: asphyxiation, altitude sickness, anemia, and carbon monoxide poisoning		**15**:745d–746h / **15**:769f–h	**2**:1116d–h / **2**:1134d–1135a *passim*
b. Special situations affecting respiration: swimming and diving; abnormalities of respiratory rhythm; space exploration		**15**:746h–747f / **1**:142h–143f	**4**:1043c–d / **4**:1045a–f
F. The symptoms, diagnosis, and treatment of diseases of the digestive system and of digestive disorders	DIGESTIVE SYSTEM DISEASES **5**:796–804	**4**:223c–g / **14**:980b–c / **18**:284a–d	**2**:1075a–c / **3**:767f–768a
1. Of the mouth, pharynx, and associated structures; *e.g.*, mouth lesions, nutritional deficiencies, tonsillitis		**5**:796f–797h	**17**:490h–492a passim
2. Of the esophagus; *e.g.*, inflammation strictures, esophagogastric junction disturbances		**5**:797h–799a	
3. Of the stomach and duodenum; *e.g.*, peptic ulceration, gastric cancer		**5**:799a–800c	
4. Of the small intestine and appendix; *e.g.*, intestinal obstruction, appendicitis		**5**:800c–h	
5. Of the large intestine; *e.g.*, diverticulitis, dysentery, hemorrhoids		**5**:800h–802d	**9**:553e–g
6. Of the digestive glands; *e.g.*, cirrhosis of the liver, gallstones, pancreatitis		**5**:802d–804a / **10**:1270h–1274h / **18**:630f–g	**9**:555b–d / **9**:555g–h / **11**:1049e–f
7. Disorders in the digestion and absorption of foods; *e.g.*, heartburn, nausea, diarrhea	DIGESTION, DISORDERS OF **5**:768–771		**12**:1004d–f / **14**:973d–g
G. The symptoms, diagnosis, and treatment of diseases of the endocrine system and of endocrine disorders	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
1. Of the pituitary		**3**:818d–820d	**12**:1043g–h / **12**:1005h–1006a
a. The anterior pituitary; *e.g.*, acromegaly		**6**:818d–820a	**15**:698e–f

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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	
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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
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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*
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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
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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

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3. Infections; *e.g.*, syphilis, puerperal infection, prostatitis		**15**:699g–700f	**3**:891f–g / **9**:543e–g / **12**:1053g–1054a
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3. Of the urinary tract: ureters, bladder, and urethra		**7**:59h–60e	**4**:226c / 7:42h–43b
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d. Ionizing radiation injury to bone		**3**:26c–e	**15**:388h–389a
e. Infectious disease of bone: osteomyelitis		**3**:26e–27a	**19**:1019b–1020a *passim*
f. Fractures		**3**:27a–28g	**4**:1043e–1044f passim / **19**:1019a–b
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b. Types of muscle disease; *e.g.*, Gushing's syndrome, muscular dystrophy, muscle rupture		**12**:634e–636c/ **12**:1056e–1057f	**9**:555e–f
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2. Neurological manifestations secondary to other diseases, neurochemical disorders, and development defects		**12**:1043f–1045h/ **2**:353c–e	**2**:1074g–h
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5. Disorders of the central nervous system		**12**:1047h–1052e	**1**:307b–c/**1**:439b–441b *passim*/**11**:888a–c/ **17**:489c–490d
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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 2171

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

	articles	article sections	other references
1. Vaccination and immunization		**9**:544g–546c	**9**:549g–h / **11**:833g–835b *passim*
2. The quarantine and isolation of infected victims	QUARANTINE AND ISOLATION **15**:326–327	**9**:546c–g	**8**:694g–695f *passim*
3. Destruction of infectious agent or carrier; *e.g.*, aseptic and antiseptic precautions, control of disease carriers, disinfection		**2**:572g–573c / **9**:546g–548a	**1**:995d–998e *passim* / **15**:970h–971a / **18**:57c–e *passim*
4. The use of therapeutic agents and prophylactic medication		**1**:986a–987e / **4**:189e–192e	
5. The prevention and control of epidemics		**5**:865e–h	**9**:549f / **15**:770e–f
I. Industrial and social medicine			
1. Industrial and occupational medicine; *e.g.*, industrial physicians, nurses, first aid rooms; commercial aviation medicine	INDUSTRIAL MEDICINE **9**:528–532		**8**:696g–697e *passim*
a. Aims and functions of occupational health services		**9**:528d–g / **11**:846d–847a	**14**:622d–g
b. Specific occupational exposures; *e.g.*, chemicals, mechanical factors, radiation		**9**:528h–530g	**5**:1136g–1137a / **9**:537c–538a
c. Some representative occupational diseases; *e.g.*, asbestosis, lead poisoning, anthrax		**9**:530g–532a / **15**:775e–776b	**9**:555h–556b
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	HEALTH AND SAFETY LAWS **8**:693–700	**5**:1052a–b	**2**:1069c–f / **11**:911g–912c / **18**:467d–f
a. The development of health and safety laws to 1800: the correlation between religious and hygienic objectives; early governmental control of health standards		**8**:694c–695g / **15**:202f–203b	**4**:517a–e
b. Reforms in the 19th century: systems of social insurance; regulations of working conditions; rudimentary child labour laws; proposals for national public health schemes		**8**:695g–696g / **3**:274c–h / **15**:203b–204d	**3**:267b–e / **6**:236d–e / **11**:846d–e / **16**:925a–d
c. The legal evolution of industrial medicine: tort liability in industrial accidents; workmen's compensation insurance		**8**:696g–697e / **9**:649b–h / **10**:572d–h / **11**:846d–847a / **19**:752h–753h	**16**:137e–138b / **18**:524g–525a / **18**:528c–d
d. Public welfare in the 20th century: unemployment compensation, public assistance, social security, and compulsory national health (illness and disability) insurance		**8**:697e–698d / **15**:204d–208g	**16**:925d–e / **19**:743h–754e *passim*
e. Modern health and safety legislation		**8**:698d–700d	**1**:449e–g
i. Legal prohibitions on the adulteration of foods, drugs, and cosmetics		**8**:698d–g / **5**:199b–h / **7**:489b–g	**5**:101c–e
ii. Industrial safety regulations: inspection of hazardous or high-risk industrial, mining, and construction sites; fire prevention control; traffic regulation		**8**:698h–699c / **7**:314a–315c / **11**:846d–847a / **18**:572e–573g / **18**:1082b–1084a	**12**:251g–h
iii. International programs regulating public health and safety: child and women's labour laws; the transportation and use of radioactive materials; air pollution control		**8**:699c–700d / 15:204f–205b	**5**:49c–h / **5**:58e–61c *passim* / **5**:189b–c
J. The economics of health and disease	HEALTH AND DISEASE, ECONOMICS OF **8**:689–693		
1. The cost of medical care		**8**:689g–692a	
a. Problems of financing health services: the right to receive public medical care; the history of national health services		**8**:690b–691b / **8**:1114h–1115d / **19**:749c–750e	
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		8:691b–692a / **19**:750e–751a	1 1:842c–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**:1hlh–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 2411

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			
I. 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			
a. Determinants and effects of educational experiences		**5**:268h–269b / **6**:413b–414d	**19**:912h–913g *passim* / **19**:1092d–h
b. Determinants and effects of career and occupational choices and of success and satisfaction in one's vocation and with one's work		**2**:11f–h / **6**:413f–414a	**19**:913g–915a passim

	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	

	articles	article sections	other references
F. The perception of space	SPACE PERCEPTION 17:378–381		
1. The nature of space perception: man's orientation to his environment		17:378a–379e	9:242e–f
2. Perception of depth and distance: gross tactual-kinesthetic, eye muscle, visual, and auditory cues		17:379f–380d / 7:112a–116a	10:747h–748c / 14:41c–d
3. Interrelations among the senses		17:380d–381d	
a. Perceptual constancies: "corrections to conform to reality"		17:380h–381a / 14:43h–44b	
b. Path recognition: navigation in space		17:381b–d / 7:112a–113b	
4. Social and interpersonal aspects of space perception: territorial behaviour, reason in perception, and nativistic and empiricistic considerations		17:381d–f / 14:44b–h	
G. The perception of movement	PERCEPTION OF MOVEMENT 14:45–46		14:42g–43a
1. Visual cues for perceiving self-motion and motion of objects		14:45b–46a	17:381b–d
a. The role of eye movements: saccadic and pursuit movements		14:45c–e / 7:98c–100b	5:1130g–1131b
b. Special visual phenomena in motion perception; *e.g.*, relative movement, movement aftereffect, flicker-fusion frequency, stroboscopic effect, movement in depth		14:45f–46a	7:100b–116a passim / 14:41f–42a / 17:379g–380d
2. Nonvisual cues: auditory, kinesthetic, and vestibular cues		14:46b–e	16:550f–551h passim / 17:379f–381e
H. Perceptual illusions and hallucinations	ILLUSIONS AND HALLUCINATIONS 9:240–247		5:919f–g
1. Types of illusory experience		9:240h–244a / 14:43a–g	17:378h–379b
a. Stimulus-distortion illusions		9:241b–e / 10:748e–g	11:889h–890d
b. Perceiver-distortion illusions		9:241e–242f / 10:747g–748d	7:112a–116a *passim* / 18:423e–424a
c. Successive contrast illusions: the influence of a "fading trace" on subsequent perceptions		9:242f–g	
d. Tactual illusions		9:242h–243a	16:549h–550b
e. Anchor effect: perceptual thresholds and colour, weight, olfactory, and loudness illusions		9:243a–e	
f. Intersensory effects: synesthesia; intersensory rivalry and facilitation		9:243e–g	
g. Illusions of psychiatric significance		9:243g–244a	
2. Hallucinations		9:244a–247c	18:854e–g
a. Neurological factors in hallucinations		9:244c–245b	
b. Types of hallucinatory experience		9:245b–247c	
i. Direct brain stimulation		9:245b–c	
ii. Hallucinations associated with sleep and dreaming		9:245c–g / 16:881h–882c	5:1010h–1014c *passim* / 16:879g–880a
iii. Excessive excitation, sensory deprivation, and loss of sleep		9:245g–246b	16:880e–h
iv. Hypnotic states		9:246b–d	9:136b–137f passim
v. Sensory defects		9:246d–e	16:881e–f
vi. Psychological factors: various "mental sets" conducive to hallucination		9:246e–g	4:548g–549b / 16:882d–e
vii. Chemical factors: effects of taking drugs		9:246g–247c / 5:1055e–1056e / 14:200a–g / 16:882e–g	8:557g–559a *passim*

	articles	article sections	other references
I. Theories of parapsychological phenomena	**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, vocai, 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.

	articles	article sections	other references
A. General activation level			
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

	articles	article sections	other references
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		**9**:679e–f / **4**:1057b–1058b / **12**:224g–225d	**11**:76d–e
6. The measurement of intelligence [see B., above]			
E. The distribution of intelligence [see also A.2., above]	INTELLIGENCE, DISTRIBUTION OF **9**:672–677		
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		**9**:672h–673d	**11**:738f–739a
2. Retardation		**9**:673d–675b	
a. Different levels of retardation and their prevalence		**9**:673d–674a / **6**:431e–f	**7**:1004b–e
b. Causes of retardation: sociocultural and medical causes		**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
c. Social adjustments of the retarded; special programs for their aid		**9**:674g–675b / **6**:434a–e	
3. The gifted		**9**:675c–676c	
a. Different levels of superior endowment and their prevalence		**9**:675c–h / **11**:890f–891a	
b. Social adjustment of the gifted		**9**:675h–676c	
4. Group differences in intelligence: the measurement and interpretation of differences in age, socio-economic class, race, sex, and other factors		**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 2411

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*

	articles	article sections	other references
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		**10**:749f–751d	
3. Factors affecting improvements in psychomotor skills: practice, feedback, task complexity, work and rest distribution, motive-incentive conditions, environmental situations, and inhibitory factors		**10**:751d–752h / **10**:747c–g / **10**:756h–758b / **16**:544c–545c	**12**:564d–e
4. Group differences in psychomotor performance and learning; *e.g.*, age, sex, race, personal characteristics, intelligence		**10**:753a–754d	
C. Perceptual learning [see also 342.B.]	LEARNING, PERCEPTUAL **10**:746–748	**14**:40g–42a	**17**:901g–h / **18**:421g–423c passim
I. The process of perceptual learning: diverse definitions and theories		**10**:746h–747c	
2. Factors influencing perceptual learning: practice; assumptions concerning the environment and sensory experience		**10**:747c–748d / **9**:241e–242f / **14**:281g–282c	
3. Adaptation: perceptual learning that results from exposure to contradictory sensory data		**10**:748e–g / **9**:241b–e	**15**:160h–161a
D. Conceptual learning	CONCEPT FORMATION **4**:1062–1064		
1. The nature of concept formation		**4**:1062b–e / **6**:943h–944g / **18**:352b–e	**8**:1152g–1153c / **15**:162h–163b / **18**:355h–356a
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		**4**:1062e–1063d / **10**:740d–g	
3. Conceptual behaviour: stages of development in the young; the influence of instruction; concept formation in adults		**4**:1063e–1064a	
4. Language in relation to concept formation		4:1064a–c / **6**:943h–946b	**1**:800g–801c / **6**:929h–931b passim / **18**:352e–f
5. Concept formation in nonhuman animals and in machines		**4**:1064c–f / **10**:738c / **10**:740g–h	
E. Retention and forgetting of learned habits and content	MEMORY: RETENTION AND FORGETTING **11**:891–894	**10**:758g–759c	
1. The adaptive role of remembering and forgetting		**11**:891b–d	
2. The experimental measurement of retention factors: recall, recognition, and learning		**11**:891d–892c / **10**:738d–739d	**10**:750e–g
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		**11**:892c–893c / **10**:738d–g / **15**:162c–h	**4**:1062g–h / **8**:1141g–h / **10**:758g–759b / **15**:42a–d / **18**:600d–f
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		**11**:893c–894c / **11**:886d–g	
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		**11**:894c–h	**11**:886h–888c *passim* / **11**:889b–890f passim / **14**:126b–c
6. Abnormalities of memory with special attention to	MEMORY, ABNORMALITIES OF **11**:886–891	**9**:136g–137b / 15:168e–h	
a. Amnesia		**11**:886h–889h	
b. Paramnesia and confabulation: errors and illusions of memory		**11**:889h–890f	
c. Hypermnesia: enhancement of memory		**11**:890f–891a / **11**:894e–g	

	articles	article sections	other references
F. The higher thought processes			
1. The psychology of higher thought processes	THOUGHT PROCESSES, THEORIES OF 18:352–354	6:766g–768d / 8:1137b–f / 8:1140c–1142d / 12:224e–229c	13:1101a–c
a. The range of psychological activities involved in thinking: diverse definitions of thinking		18:352b–e / 18:354f–355a	
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		18:352e–353b	8:1140e–h
c. Thought processes: diverse theories concerning the sequence of thought processes		18:353b–354b / 4:1062a–e / 8:1140h–1142d	
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		2:361a–f / 12:225d–226f / 18:354b–e	8:1142d–1143h *passim* / 12:563g–564c
2. The role of language in the higher thought processes [see 442.A.]			
3. Meaning [see 442.B.4.]			
4. Types of thinking	THOUGHT PROCESSES, TYPES OF 18:354–358	8:1140h–1142d	18:353b–354b
a. Realistic thinking: types of thought determined by goal-directed activities		18:355a–357c	1:151h–154h *passim*
i. Convergent thinking: processes that utilize a person's abilities to assemble and organize information; *e.g.*, judging, conceptualizing		18:355a–356a	
ii. Problem solving: processes utilized in exploring and organizing resources to reach a goal; *e.g.*, trial and error, insight, inductive and deductive reasoning		18:356a–f / 11:72h–73g	11:28b–29g *passim* / 15:147c–g
iii. Divergent thinking: processes that lead to the production of new information or previously undiscovered solutions; *e.g.*, creative thinking		18:356f–357a	
b. Autistic thinking: types of thought processes determined by subjective emotional–motivational impulses		18:357d–358g	
i. Free association: verbal responses that reflect aroused emotional impulses		18:357d–f	
ii. Fantasy: well-organized sequences of thinking in which sensory imagery prevails		18:357f–h	
iii. Dreaming: diverse views concerning the significance of autistic thinking during sleep		18:357h–358c / 5:1012a–c / 9:245d–g	
iv. Pathological thinking: general patterns or categories of thought displayed by persons with behaviour disorders, neuroses, or psychoses		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 2411

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:llf–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–compulsivereactions		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 ***Macropsdia***
(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 2631

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	COMMUNICATION **4**:1005–1010		
1. The analysis of communication		**4**:1005a–g	
2. Theoretical models of communication		**4**:1005g–1007b / **17**:477h–478a	**7**:77a–b
a. Linear-quantitative models: systems using the concepts of noise, message, channel, feedback, and control		**4**:1005g–1006d / **13**:632h–633e	**9**:574f–580f *passim*
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**:1006e–f	
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.l.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	ENCYCLO-PAEDIA **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		**16**:126c–f	**4**:1008b–1009a *passim*
a. Attitudes toward language: taboos in language usage; myths that ascribe a divine origin to language; views concerning the interdependence of language and thought		**10**:643c–644d	**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	**8**:393d–395g *passim* / **12**:796h–797a / **15**:629d–g / **15**:863f–866g *passim*
c. The use of language as a political instrument		**15**:36g–37b	
3. The complex nature of language structure and composition		**10**:644d–645e	
4. The diverse forms of language		**10**:645f–648d	
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: the 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 study of language factors that reflect distribution patterns, settlement boundaries, and the cultural development of people		**10**:1011h–1012b / **5**:699c–700c	

	articles	article sections	other references
e. Computational linguistics: the use of computers in linguistic research		**10**:1012b–c	
f. Mathematical linguistics: the study of linguistic statistical data and the construction of mathematical models of language components		**10**:1012d–e / **2**:502c–503g / **8**:270b–c	
g. Stylistics, semantics, and applied linguistics: the analysis of language by the literary critic, the philosopher, and the educator		**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
E. The classification of language	LANGUAGES OF THE WORLD **10**:662–672	**10**:660d–661b	
1. The methodology of language classification: typological and genetic classification; the use of geographical comparisons and contrasts		**10**:662h–663d / **10**:661h–662f	**1**:220e–f / **8**:590g–h / **10**:663d–671b *passim*
2. Languages spoken in Europe and areas of European colonization		**10**:663d–664f	**17**:388c–f
a. Indo-European languages	INDO-EUROPEAN LANGUAGES **9**:431–438	**10**:663f–664b / **8**:392e–h	**3**:1018b–d / **6**:1063d–f / **11**:935c–d
i. Indo-Iranian languages [see E.3.a.i., below]			
ii. Celtic languages	CELTIC LANGUAGES **3**:1064–1068		**1**:625g–626a / **18**:873g–h
iii. Italic languages [see E.6.c., below]			
iv. Romance languages	ROMANCE LANGUAGES **15**:1025–1044		1:624f–627c passim / **17**:388c–e
v. Greek language	GREEK LANGUAGE **8**:392–398	**1**:623e–624c	
vi. Baltic languages	BALTIC LANGUAGES **2**:660–664		**9**:431g–h
vii. Slavic languages	SLAVIC LANGUAGES **16**:866–873	1:624c–f	**2**:661a–e / **9**:431g–h
viii. Germanic languages	GERMANIC LANGUAGES **8**:15–30		**1**:625b–e / **8**:54g–55a
ix. English language	ENGLISH LANGUAGE **6**:874–886	**8**:20e–g	**18**:873h–874b
x. Albanian language	ALBANIAN LANGUAGE **1**:422–423		
xi. Armenian language	ARMENIAN LANGUAGE **2**:23–24		
xii. Tocharian language [see E.6.e., below]			
b. Non-Indo-European languages			
i. Uralic languages	URALIC LANGUAGES **18**:1022–1032	**10**:664b–c	
ii. Basque language	BASQUE LANGUAGE **2**:762–764		
3. Languages of Asia and Oceania		**10**:664f–669f	**17**:223d–h
a. Languages of Asia		**10**:664f–669a	**2**:176h–177d / **4**:270g–273a / **9**:285c–286g / **13**:897c–h
i. Indo-Iranian languages	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
i. The problem of food supply: special difficulties facing the developing countries		**7**:362d–e/ **7**:498c–499d	
ii. Attempts to increase the production and utilization of food supplies: the quest for new sources of food protein	FOOD, NEW SOURCES AND PRODUCTS **7**:481–484	**1**:365c–366f/ **7**:499e–504b	
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 2731

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 **12**: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 rhe 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 appliedon 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
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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
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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 MODFRNIZATION **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 socioculturalforms**
[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[w]"—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
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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.

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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-sciencemodel: 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.l.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 modem 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 modem 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 modem 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. Gerneinschaft 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 modem 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 Europead 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
A. Social differentiation and stratification	SOCIAL DIFFERENTIATION AND STRATIFICATION **16**:953–959		**3**:904h–905b / **7**:22f–g / **15**:609h–610b
1. The concepts of differentiation and stratification: distinctions and interrelationships		**16**:953d–g / **10**:753c–e	
2. The process of social differentiation: factors producing social, economic, and cultural differences; concomitant inequalities		**16**:953h–956d / **10**:753a–c	
a. Biological factors		**16**:953h–955c	
i. Sex differentiation: physical and psychological factors that contribute to differences between the sexes; popular conceptions; scientific studies		**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
ii. Age differentiation: attitudes toward age groups in various societies		**16**:954c–f / **13**:546g–552c / **19**:1090g–1091a	**8**:475e–f / **16**:28e–f
iii. Racial differentiation: historical and political influences		**16**:954f–955a / **8**:1149h–1150d / **13**:468h–469b / **15**:355f–356c	**9**:676f–677a / **12**:264c–f
iv. Intellectual differentiation: its role in stratification		**16**:955a–c / **7**:162a–b / **9**:676c–677f / **10**:1046f–1047f	**8**:1148d–1149a
b. Social and cultural factors: differentiation among civilizations, nations, and types of societies; differentiation within societies		**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
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

	articles	article sections	other references
d. The relation of the individual to society: the effects of differentiation and stratification		**16**:958g–959a / **2**:105e–109b / **19**:1096b–1097d	**18**:926h–928a
B. Varieties of social stratification and social mobility	SOCIAL CLASS AND MOBILITY **16**:946–953		
1. The concept of social class: problems of definition; the relation of social class to other concepts—*e.g.*, caste, status, elites		**16**:946c–947a / **12**:263c–264f / **16**:956h–958a	**4**:1092f–h / **8**:1156e–g / **16**:953f–g
2. Theories of social class: divergent conceptions of the importance of classes in social structures and of the nature of class relationships		**16**:947b–948g / **16**:955g–956d / **16**:956h–958a	**10**:71h–73a
a. Classical, neoclassical, and other pre-Marxian theories of social class		**16**:947b–f	
b. The Marxian theory of social structure: the mode of production as the determinant of social class		**16**:947f–948a / **11**:555a–556d / **16**:966c–f	**16**:956h–957a
c. Various post-Marxian theories of social classes and social conflict		**16**:948a–g / **16**:957b–958a / **16**:992d–g	
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		**16**:948g–950g / **5**:267h–268a / **5**:272e–h	**9**:674e–g / **9**:864d–h / **14**:938g–939b / **17**:514a–d
4. Social mobility: the upward or downward movement of individuals, families, or groups between different sectors of society		**16**:950h–952f / **9**:502h–503b	**9**:525b–f / **12**:264c–265e *passim* / **16**:958b–f / **17**:130f–g / **18**:11d–e
a. The nature of social mobility		**16**:950h–951f	**16**:958b–d
b. The determinants of social mobility: intelligence; education; degree of "openness" of the system; rate and quality of social change; population changes		**16**:951f–952c	**2**:194a / **9**:364b–d / **12**:264c–f / **16**:958d–f
c. The consequences of social mobility: positive and negative aspects		**16**:952d–f	
5. The idea of a classless society: approximations to an equality of conditions		**16**:952f–953a / **1**:808a–809g / **12**:264f–265e / **17**:314a–c	**11**:556a–c
6. Social immobility: slavery, serfdom, and forced labour	SLAVERY, SERFDOM, AND FORCED LABOUR **16**:853–865		
a. Forms of involuntary servitude		**16**:853g–855g	
b. Servitude and slavery from antiquity to the late 19th century		**16**:855g–863b / **4**:513a–d	**8**:474b–c
i. Slavery in the ancient Near East, Greece, and Rome		**16**:855g–857f	**5**:369g–h / **11**:972b–c / **18**:29g–h
ii. Servitude in ancient India, China, and Japan		**16**:857g–858g	**10**:60h–61a
iii. Servitude in the Muslim world		**16**:858g–859b / **11**:399d–401a	**9**:366d–e / **13**:780c–d
iv. European servitude from the Middle Ages through the late 19th century		**16**:859b–860e / **7**:650c–g / **12**:147d–g	**16**:58h–59d
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		**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*
c. Servitude in the late 19th and 20th centuries		**16**:863b–865e / **17**:291g–293f	
i. International efforts to suppress slavery and forced labour		**16**:863b–g	**8**:1184b–1185e *passim*
ii. Forced labour in modern states; *e.g.*, the Third Reich, the Soviet Union		**16**:863g–864f	
iii. Contemporary efforts to reduce forced labour		**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
A. The nature and forms of collective behaviour	COLLECTIVE BEHAVIOUR **4**:842–853		
1. Elementary collective behaviour		**4**:842f–844d	
a. Milling: agitated aimless movement		**4**:842g–843a	
b. Rumour		**4**:843b–844b	**15**:211h–213c *passim*
c. General social unrest: conditions of widespread milling and rumour		**4**:844b–d	
2. Major forms of collective behaviour		**4**:844d–851a	
a. Responses to disaster: the disaster cycle		**4**:844d–845d	
b. Collective obsessions; *e.g.*, fads, contagions, crazes, deviant epidemics		**4**:845d–846e/ **13**:282g–283a/ **16**:166g–167a	**15**:211d–e
c. Active and expressive crowds		**4**:846e–848d	
d. Panic		**4**:848d–849b	
e. Publics and masses		**4**:849c–e	**4**:1009b–h/**15**:211c–h
f. Social movements [see also D., below]		**4**:849e–851a/ 1:809g–812b/ **13**:282d–g/ **13**:849g–850a/ **16**:974c–980a	**15**:787a–791b *passim*
3. Theories of collective behaviour		**4**:851a–852a/ **16**:976a–f	**15**:787c–e/ **16**:974b–975c *passim*
a. Individual motivation theories: frustration and alienation		**4**:851c–e/ **16**:978d–f	**1**:575e–576b/**19**:1096g–1097d
b. Interaction theories: contagion and convergence		**4**:851e–h/ **16**:978d–f	
c. Social change theories: collective behaviour as normal in periods of social change		**4**:851h–852a/ **16**:974d–e/ **16**:978g–979a/ **16**:992d–g	
4. Effects of collective behaviour		**4**:852b–h/ **16**:979b–g	
5. Attempts to control collective behaviour		**4**:852h–853b/ **8**:462e–463e/ **14**:669e–670a	
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			
a. Methods and materials of urban planning and redevelopment	URBAN DESIGN **18**:1053–1073		
i. Historical practices, to the Renaissance		**18**:1065d–1073a	
ii. Modern practices		**18**:1053f–1065d	
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 ciimatic 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*)

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COMTE, AUGUSTE **4**:1058
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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.

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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 growtn 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. Westera-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
ii. Controls on advertising and labelling of products: regulation of weight and price labelling		**5**:102a–h	**15**:43h–44c/**19**:731a–735c *passim*
iii. Controls on sales methods: the elimination of deceptive sales practices		**5**:102h–103b	**18**:560c–g
b. The consumer movement: the development of private consumer organizations in various countries; consumerism as a grass roots movement		**5**:103b–104b/ **5**:187a–b	

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
A. Markets as an economic institution in a mixed economy	MARKETS **11**:511–515		
1. Markets classified by reference to competition and monopoly	MONOPOLY AND COMPETITION **12**:376–380	**5**:152h–153d/ **6**:268h–270a/ **15**:216h–217f	**6**:266e–g/**13**:1071a–c
a. Purely competitive markets as distinguished from markets of imperfect competition: monopoly, oligopoly, and monopolistic competition		**11**:511f–g/ **12**:376d–377c/ **5**:185a–f/ **6**:271f–272a/ **11**:508d–f	**18**:932d–e/**18**:976c–d
b. Influences affecting the behaviour of sellers under various competitive conditions		**12**:377c–378h/ **10**:847a–g	
c. The concept of workable competition		**12**:378h–379d	
d. Government regulation of monopolistic practices		**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
2. Major types of markets		**11**:511c–g	
a. Markets for primary commodities; *e.g.*, raw materials, food crops, minerals, wool, fur	COMMODITY TRADE, INTERNATIONAL **4**:994–997	**11**:511d–e	
i. The operation of primary commodity markets: trading for primary commodities to be delivered at a future time	FUTURES **7**:816–818	**4**:994f–995h/ **7**:178c–f/ **14**:1000h–1001d	
ii. Efforts to stabilize prices in international commodity trade through action by individual countries or by international cooperation		**4**:995h–997f	**18**:669e–g
b. Markets for manufactured goods		**11**:511f–g/ **11**:508d–f	
c. Markets for money and capital: the market for short-term loans; the securities market		**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

	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 3111

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 or' 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	PRODUCTION, THEORY OF 15:19–22	**9**:523h–524b / **18**:553a–554h	
1. Analysis of costs and output in the short run: the production function; substitution; the relationship of marginal cost to market price; marginal product		**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 distributionof 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	WEALTH AND INCOME, DISTRIBUTION OF **19**:673–680	**3**:441f–g / **5**:106c–107d	
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 difference 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 3111

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 *Micropzdia)*

BAGEHOT, WALTER **2**:583
BENTHAM, JEREMY **2**:837
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MALTHUS, THOMAS ROBERT **11**:394
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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 321

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 modem 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 modem 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
b. The state as a creation of man: the state as conventional			**6**:891f–892a / **6**:892e–g
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
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Section 542. Political institutions: the structure, branches, and offices of government

[for Part Five headnote see page 283
for Division IV headnote see page 3321

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 modem dictatorship; the modem 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

	articles	article sections	other references
4. The judiciary: the branch of government primarily responsible for the adjudication and interpretation of laws [see also 552.F.1.]		**14**:723a–c / **5**:90d–93a / **5**:220b–226c	**17**:350f–351a / **18**:938a–c
a. The organization of various types of courts: civil and criminal trial courts, courts of appeal, and courts of last resort		**5**:222g–224d / **5**:279h–281a / **9**:734c–736c / **17**:1087a–g	**3**:140h–141c / **17**:314g–315h
b. Single and multiple jurisdictions: juridical systems in unitary and federal states		**5**:224b–d / **10**:782g–783c	**7**:606b–e
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		**5**:224f–225h / **9**:734d–h	**7**:606c–d
e. Responsibilities of judges; their rights, privileges, and immunities		**5**:95f–96b / **5**:220f–222f	**10**:717e–g / **15**:10g–11c / **18**:938a–c
f. Areas of judicial autonomy: the extent of judicial responsibility, authority, and influence		**1**:95g–96a / **5**:90d–91a / **5**:220b–222b	**14**:669b–c
g. Areas of judicial overlap: the role of the judiciary in legislative and executive functions		1:92e–95a / **5**:222c–f / **17**:316e–317b / **17**:1087a–g	**11**:537b–d
C. Public administration: the planning, organization, and coordination of governmental bureaucratic operations	PUBLIC ADMINISTRATION **15**:183–186	**1**:92b–e / **3**:487g–491a / **14**:725h–726b	
1. Development of public administration systems	BUREAUCRACY **3**:484–496	**15**:183c–186g / **4**:667e–g / **12**:156e–157h	**4**:311f–312c / **13**:780g–781c
a. From the 17th through the mid-19th century		**3**:486a–487g	**4**:667g–668g / **15**:183c–184b / **16**:58f–h
b. Late 19th- and 20th-century development of civil service as the personnel branch of public administration	CIVIL SERVICE **4**:667–673	**15**:184b–186d	
i. Recruitment and appointment of civil service personnel by the spoils system and the merit system		**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
ii. Organization of civil service departments		**4**:671e–673e / **15**:201b–202a	**14**:726a–b
c. Modern bureaucratic chains of command: various theories of bureaucratic policy and organizational methods		**3**:491b–496f / **4**:670f–673e / **15**:184g–186g / 1:92b–e / **1**:1022d–1023f	
2. Judicial and legislative controls exercised over public administrative agencies		**1**:91e–95a / **4**:671e–673e / **5**:222c–e	**5**:91b–c / **5**:95e–f
3. The organization of public administrative units with special attention *to*		**1**:91b–e	**6**:772h–773c / **14**:722e–h
a. Units organized as commissions or committees; *e.g.*, regulatory and investigatory commissions		**15**:218f–219c	**6**:634f–635c / **16**:450b–d
b. Units organized as governmental corporations		**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. Types of governmental functions: the ways in which political power is exercised	POLITICAL SYSTEMS **14**:723–726	**10**:847h–848b	
1. Internal and external security functions of government: the self-preservation of the state		**14**:723f–724d	
a. External security functions: maintaining the security of the state in relation to other states		**14**:724b–d / **2**:17h–18a / **9**:682a–686d	**9**:781g–782a
b. Internal security functions: maintaining domestic peace and order; providing facilities and procedures for the cohesion of the whole social process		**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. The conduct of foreign relations: the function of government in relation to other sovereign states, its own dependencies, and international organizations **[see 544.A. and 544.B.]**			
3. Supervisory functions of government: the resolution of conflicts through mediation and the adjudication of suits **[see also 552.F.1.a. and 552.F.3.]**		**14**:723a–c / **14**:724d–f / **5**:220c–e / **15**:217f–218e	**1**:1074h–1076a *passim* / **2**:410h–411b
4. Regulatory functions of government: the establishment and active enforcement of standards		**14**:724f–725d	**18**:934f–935b
a. Control or influence over production, distribution, and consumption		**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. Regulation of labour: working conditions, wages, and standards of safety		**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. Control of prices and incomes **[see also 536.C.3.c.]**		**3**:539e–540b / **6**:261a–e / **7**:326d–328d	**2**:709c–e / **17**:1084h–1085a
d. Regulation of transportation: allocation of routes and setting of safety standards		**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. Control over, or influence on, oral and written communication; *e.g.*, censorship, licensing	CENSORSHIP **3**:1083–1090	**2**:114a–115c / **6**:784a–c	**4**:1009c–e / **13**:297f–h / **14**:725a–b / **16**:271h–272b
i. Historical development of censorship laws		**3**:1083e–1087a	**2**:463b–c / **2**:464a–b / **5**:153e–g / **6**:889d–f / **15**:226d–g / **16**:59e–h
ii. Modern methods of censorship; legal and philosophical objections to censorship		**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. Protection of the political and social rights of individuals		**5**:92c–93a / **6**:533f–534h	**9**:749e
g. Population control: immigration and emigration regulations; birth control programs, maternity benefits, family allowances		**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. The use of subsidies and tariffs; *e.g.*, to regulate trade, encourage domestic industry, secure a favourable balance of payments		**17**:753g–755d / **17**:1067e–1069d / **18**:555f–557b	**5**:378a–379a
i. Regulation of weights and measures		**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	**9**:737d–740b passim
c. Proceeds from public-owned and /or public-operated enterprises [see also 535.B.5.b.ii.]		**14**:886f–890f / **15**:198c–202a	
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
	14:726d–727b / **7**:649d–650c / **10**:74d–g	
	14:727b–e / **5**:94h–96h	
	14:727f–728c	**4**:644b–650b *passim*
	5:96b–e	
	5:96h–97e / **6**:532c–d / **13**:849g–851b	**14**:714b–g
	8:359e–360b / **13**:851b–e	**14**:714g–715d
REVOLUTION, POLITICAL **15**:787–791	**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*

a. Unstable political systems: economic, social, legal, and military crises as causes of revolutions

b. Stable political systems: governments responsive to economic and social innovations

c. Problems of political change: shifts in the nature of the polity, the structure of the political system, and governmental policy

2. Methods of changing the form of government

a. Peaceful changes; *e.g.*, by electoral process (plebiscite), by constitutional mandate

b. Violent changes

i. Revolution: the overthrow of a foreign governing pnwer; civil war
[see also **544.B.1.f.**]

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 modem 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
INTERNATIONAL RELATIONS, THEORIES OF **9**:778–785		
	9:779d–780e / **9**:745a–h	
	9:779e–f / **14**:707f–708a / **15**:1108g–1109d	
	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
	4:902d–e	**6**:496f–500a passim / **13**:169a–170g

A. The politics of international relations

1. Various types of relationships among political regimes

a. The imperial system: the relationship between imperial power and colonial dependency

i. The establishment and maintenance of colonies

ii. The establishment and maintenance of protectorates and dependencies

	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.*, eccnomic, 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

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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. Modem 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]			

	articles	article sections	other references
c. Social and moral consequences of war: the effect of warfare on a people's values		**8**:1184h–1185a	**19**:556g–577g *passim* / **9**:756d–f
d. Other consequences of war; *e.g.*, legal, demographic, cultural consequences		**19**:554e–556g / **19**:966c–d	**8**:1187b–c / **8**:1188d–e / **12**:186h–187a
5. Armed forces: military organizations designed for conquest or defense	**ARMED FORCES** **2**:8–22		
a. The role of the armed forces in suppressing foreign or domestic enemies		**2**:8h–9f / **2**:17e–18a	**14**:724a–c
b. Military bureaucracy: the hierarchical nature of rank and authority; the growth of specialist services		**2**:9g–11f / 2:12a–e / **2**:12h–13g	
c. The makeup of the professional soldier: the "military mind"		**2**:11f–12h / **2**:13h–14a / **2**:15c–f	
d. The military community: the life-style of the officer as compared to that of the enlisted man		**2**:12e–14b / **2**:19e–h	
e. Problems of recruiting, mobilizing, and financing an army; the maintenance of moral commitment among the troops		**2**:14c–15h / **8**:462c–e	
f. Various types of soldiers		**2**:15b–17e	**18**:939a–b
i. The professional soldier: the officer corps and the noncommissioned career soldier		**2**:10e–12h / **2**:13h–14b / **2**:17b–e / **2**:19h–20c	
ii. The volunteer soldier: the militiaman; the national guardsman or reservist		**2**:15f–h	**19**:602h–603a
iii. The conscripted, or drafted, soldier		**2**:15h–17b	**7**:719e–721a
iv. The mercenary, or hired, soldier		**2**:17b–e	
v. The religious crusader or member of a paramilitary religious order			**5**:303f–h / **12**:338e–339c
vi. The guerrilla fighter: The irregular or national liberation organization soldier [see B.1.f.i., above]			
g. Historical development of organized military forces		**2**:18b–20d	
i. In the ancient world		**2**:18c–e / **8**:339e–340b / **19**:573g–575h	**4**:306a–c / **6**:323c–e / **15**:1101g–1102a
ii. During the Middle Ages: the feudal army		**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
iii. From the 16th through the 18th century: the development of royal and standing armies		**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*
iv. In the 19th and 20th centuries: the development of national armies		**2**:19h–20d / **2**:22d–f	**4**:293f–294f / **19**:579d–582e passim
h. The military establishment and society		**2**:20e–22f	
i. The relationship between the civilian and military sectors of society: the politicization of the armed forces; the militarization of politics		**2**:20e–21g / **8**:460b–462b / **12**:195a–d	**11**:603b–c
ii. The military coup d'etat: military intervention into and takeover of civilian governments		**2**:21g–22c	**1**:205h–206b / **3**:151f–g / **4**:369h–370a / **8**:321e–322d / **10**:83b–84g / **14**:717f–718c
iii. The problem of the military-industrial complex		**2**:21a–b / **2**:22d–e	**19**:546b–e
i. Establishment and maintenance of various branches of the armed forces			
i. Ground forces		**17**:1019e–1025a / **19**:573g–575h	
ii. Air forces		**1**:383c–391h / **7**:401d–403a / **7**:404c–405d / **12**:894a–c / **12**:894g–895d / **19**:585e–586g	**11**:81d–f

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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

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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	

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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

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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

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for Division V headnote see page 3521

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. Islamic 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 innational 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

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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	

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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

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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

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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	
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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
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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	

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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	

	articles	article sections	other references
iii. Reinvestment of company earnings			5:185h–186a / 7:300h–301b
e. Trends in laws governing mergers and consolidations: employee participation [see also 534.H.2.c.]		3:535d–536d / 7:301d–h	
f. Laws governing the liquidation of insolvent business and nonbusiness estates: the law of bankruptcy	BANKRUPTCY, LAWS CONCERNING 2:694–699	7:301h–302a	
4. Laws regulating relationships between employers and employees	LABOUR LAW 10:570–574		
a. Historical development of labour law		10:570f–571c / 19:935d–h	10:695a–696c / 18:564d–570g *passim* / 18:976f–977b
b. The scope and nature of labour law: the use and treatment of the labour force		10:571c–573h / 8:1184f–g	
i. Individual employer–employee and collective employment relationships: wages and other remuneration; hours and conditions of work		10:571e–572d / 1:1021b–e / 10:564c–e / 17:318d–g	
ii. Health, safety, and welfare of workers: workmen's compensation, unemployment insurance, and social security benefits		10:572d–h / 9:649b–h / 19:746a–749c / 19:751d–752b / 19:752h–753h	16:137e–138b / 18:524g–525a / 18:528c–d
iii. Trade unions and labour–management relations: administration of labour contract provisions		10:572h–573d / 1:1076c–1077a / 9:510e–512b / 10:564e–567g	6:773b–c / 18:563f–570g *passim*
c. Comparison of labour law in various legal systems		10:573d–h / 18:564d–570g	2:410h–411c
d. Effects of political factors on labour law		10:574a–h / 1:810c–g / 4:671e–672e	
5. Laws governing commercial transportation			
a. Laws regulating the carriage of goods	CARRIAGE OF GOODS, LAW OF 3:960–965		
i. Historical development of laws of commercial transportation		3:960b–g	
ii. Contract and tort liabilities of common or contract carriers in various legal systems		3:960g–962a / 1:398e–399c / 11:502c–h	
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]		3:962a–965h / 11:501d–502c	4:989h–990e / 17:708g–709f / 17:710f–711d
b. Laws regulating the transportation of goods and passengers at sea: marine salvage and insurance doctrines	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
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	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
E. Civil procedural law	PROCEDURAL LAW 15:4–14		
1. Historical growth of civil'procedural law		15:5b–6f / 4:998h–999b / 4:1036c–f / 17:314f–316e / 18:524b–f	8:765h–766d
a. Development of civil procedure in Roman and medieval European law		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	

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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.

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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 2831

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
A. Philosophies of education		
EDUCATION, PHILOSOPHY OF **6**:408–412		
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 3711

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	

	articles	article sections	other references
B. History of education: philosophies, practices, and institutions	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 Islamic 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. Islamic 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 Ftnelon		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 modem 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 ***Macropzdia***
(Additional biographical entries may also be found in the *Micropædia*)

ARISTOTLE 1:1162
COMENIUS, JOHN AMOS 4:967
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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.

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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.

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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
A. General theories and conceptions of art		
ART, PHILOSOPHY OF **2**:40–56		
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, 6291**			
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 3831

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., belowl			

	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

	articles	article sections	other references
C. The training and work of the artist	ARTS, PRACTICE AND PROFESSION OF THE **2**:93–102	**2**:105e–109b	
1. The preparation of the artist: methods of training		**2**:93e–97a	
a. Training by systems of apprenticeship		**2**:93g–94b / **2**:96b–c	**1**:1018c–1019h *passim*
b. Training in formal educational institutions: development, curricula, and teaching methods		**2**:94b–96e / **15**:800b–802d	
i. Specialized academies, schools, institutes, or studios		**2**:94b–95e / **2**:95g–96e / **6**:351g–352a	
ii. General schools and colleges: the arts in higher education		**2**:95e–f / **2**:96a–b / **18**:216g–217a	
c. Training by the study of other artists and of life: the self-taught artist		**2**:96f–g	**7**:470f–472b passim
2. Art as a vocation: conditions of work in the arts		**2**:97a–102e / **2**:106f–109b / **13**:296g–297h	**1**:108h–109a
a. The economic rewards of the arts **[see B., above]**			
b. The social and intellectual status of the artist		**2**:97b–100b / **2**:105e–106f / **10**:1047d–g	**12**:719c–e / **12**:742h–743a / **14**:807f–h / **19**:175d–f / **19**:380a–b
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"		**2**:100h–101e / **2**:106f–109b	
d. Functions and effects of societies and institutions for the arts; *e.g.*, guilds and unions, honorary societies		**2**:101f–h / **2**:102a–b / **6**:351g–352a	
3. Professionalism and amateurism in the arts		**2**:102c–e / **14**:1032c–d	**12**:652h–653a
a. Diverse conceptions of the distinctions between the professional and the amateur artist		**2**:93b–c	1:232g–h / **2**:107g–108a / **19**:175d–f
b. The economic and social limitations on professionalism or on full-time participation in the arts			**2**:100b–h passim / **2**:106e–f
c. The range of amateur activity in the arts		2:102c–e / **8**:974e–976c / **14**:315h–316c	**7**:471c–476e passim
d. The influences of the amateur on the development, the preservation, and the dissemination of the arts		**2**:102e / **8**:973h–974b / **14**:316d–318e	**12**:553h–555a *passim*
D. The preservation and dissemination of works of art		**2**:120c–122b / **2**:133d–134f	
1. The role of institutions		**1**:691g–692f	**2**:56g–64b *passim* / **2**:145e–f / **7**:609e–610c / **8**:67f–h / **18**:943d–944a
a. Libraries and archives	LIBRARY **10**:856–866	**12**:510d–g	**2**:978b–980b passim / **10**:867c–875f passim / **15**:229a
b. Museums and galleries	MUSEUM **12**:649–661	**14**:326g–h	**2**:120e–121b / **9**:1112e–g
c. Producing associations: the preservation of works of art by performance		**13**:593c–f / **18**:258d–259g	**12**:742h–743b
2. The role of writing and notation		**4**:455e–456f / **12**:742a–b / **18**:189e–190c	**2**:120d–e / **12**:732h–738b passim
3. The role of industry and commerce		**12**:494g–496b	**13**:296g–h / **18**:943a–d
4. The role of mechanical and electronic media			**10**:872f–874a *passim* / **14**:802d–803h passim / **18**:944a–f
a. Printing, photography, motion pictures, and recording		**12**:510b–h	**12**:691f–695f passim / **14**:306d–326h *passim* / **14**:1051h–1052d / **15**:224d–235g passim
b. Television and radio	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.

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622. Theatre 400
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625. Dance 414
626. Architecture, garden and landscape design, and urban design 417
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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	

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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 NO 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 Islamic peoples	ISLĀMIC PEOPLES, ARTS OF **9**:977–982	**9**:952c–954a	

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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	

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Section **623. Motion** pictures

[for Part Six headnote see page 383
for Division II headnote see page 3931

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 ***Macropzdia***
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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. Woodwindinstruments; *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, modem 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 Islamic 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

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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, modem, 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 modem 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		
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		
DANCE, ART OF **5**:451–456		
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	

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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 uvon 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 7331**		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-Islamic 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	ISLAMIC 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

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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	ISLAMIC PEOPLES, ARTS OF **9**:982–1010	**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

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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 subiect 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			
a. Kinds of drawing determined by subject matter; *e.g.*, portraits, landscapes, figure compositions, still lifes		**5**:1003h–1007b	
b. Kinds of drawing determined by special uses [for aspects of drawing related to writing, see 629.C.4.]		**5**:1003d–h	
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. Printrnaking **[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-Islamic 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
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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	
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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		
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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	
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c. The painting of Southeast Asian peoples	SOUTHEAST ASIAN PEOPLES, ARTS OF **17**:250–273	**17**:230g–233g	
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ii. Of Thai and Laotian peoples		**17**:255h–259a	
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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		
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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		
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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	
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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 Islamic, 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
4. Glass	GLASS, HISTORY OF **8**:181–196	**12**:463h–464h	**17**:566h–576d passim / **19**:318b–c
5. Metals	METALWORK **11**:1092–1118	**7**:782f–783a / **10**:164e–g / **10**:165e–h / **16**:425c–e	**11**:1061b–1063e / **19**:317a–f
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	

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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.*, cloisonnk, champlevk, painted enamels	ENAMELWORK **6**:773–779	**10**:165h–166b	
b. Lacquerwork; *e.g.*, carved lacquer, inlaid lacquer, laque burgautke	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

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ii. Ancient Near Eastern: Mesopotamian, Syro-Palestinian, pre-Islamic 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
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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
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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
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f. Arts of decoration and functional design of Islamic peoples	ISLAMIC 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

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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	
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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**:181h–182h / **11**:1117e–1118c / **14**:928f–930a	**2**:761h–762a
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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.

Developtnent 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.

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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 technalogy: 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/ 4:1006h–1007h/ **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**:517f–g/**15**:112d–g/ **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.

	articles	article sections	other references
A. Stages in the development of human labour	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.

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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		
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
ENERGY SOURCES **6**:854–858		

	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			

	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 MISSILESYSTEMS **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	THERMO-ELECTRIC 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	MAGNETO-HYDRODYNAMIC 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

C. Machine tools: stationary power-driven machines for shaping and forming parts made of metal or other materials

1. History and characteristics of machine tools
2. Operation of metal-cutting tools
3. Basic machine tools: turning machines, shapers and planers, drilling machines, milling machines, grinding machines, power saws, and presses
4. Modifications of basic machines; *e.g.*, turret lathes, production millers
5. Special-purpose machines; *e.g.*, gear-cutting machines, broaching machines
6. Recent innovations
   a. Automatic control of machine tools: application of tracer techniques and numerical control
   b. Chipless methods of removing metal; *e.g.*, plasma arc machining, laser-beam machining

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
MACHINE TOOLS 11:259–265	**11:621c–e**	
	11:260b–f	
	11:260g–261f	
	11:261f–262h/ 3:952f–953a	
	11:262h–263f	
	11:263g–264b	**1:16b–f/11:239e–h**
	11:264c–265c	
	11:264c–g/ 1:140a–b	**2:508g–509a**
	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 measuremenr; *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
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 CHARAGTERIZATION **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, 2241	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 rnicrometeorology 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. Modem 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 PRODC'CTION 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 4371

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.

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732. Technology of the major industries 469
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734. Transportation technology 477
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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
A. Technology of agriculture	AGRICULTURE, TECHNOLOGY OF 1:347–366		
1. Farm management	FARM MANAGEMENT 7:177–181	1:316b–317b	1:323f–g *passim*
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 modem 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:**172**g–184c/ 17:**1055**h–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.1**	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:**406**d–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 7351			

	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 7341			
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.1**]		**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; modem 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.]			

	articles	article sections	other references
F. Air transportation	TRANSPORTATION, AIR 18:633–648		
1. Aircraft: configurations, fight 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.1]			
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 fights		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	OFFICE **MACHINES**	13:509–515	
1. Writing and reproducing machines		13:510b–512b	
a. Typewriters [see E.2., below]			

	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; modem 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 7.1	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 the mechanical devices; contributions of Hollerith and 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		17:57e–58e	
a. Microphones and amplifiers		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.1]	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.1]	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		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 4621

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	ARMOUR **2**:27–30		
a. Body armour		**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 4621

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 7341			
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 4621

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		

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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.

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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.

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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

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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
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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

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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-disciplineand 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
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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
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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:**10**b–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. Modem 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 modem 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 5111	**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.1**		
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, Levi-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**:101la–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. Toternism: 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 5171

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.

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
A. Religions of the ancient Near Eastern peoples			
1. Characteristics of the ancient Near Eastern religions	NEAR EASTERN RELIGIONS, ANCIENT **12**:916–921	10:303a–d	**12**:914h–915c
a. The creation of religious literature: myths, liturgies, wisdom literature		**12**:918b–f	
b. The sacrality of natural forces: the view that the universe is divinely created and ordered; a multiplicity of gods		**12**:918f–919a/ **13**:951c–e	**5**:1066e–g/**14**:787b–c
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"		**12**:919a–h/ **12**:921b–f/ **5**:226g–227a	**15**:641h–642b/ **16**:118e–122e *passim*/ **18**:219b–c
d. Myth as the basic mode of religious thought: the importance of etiological myths, and their relation to ritual		**12**:919h–920b	**11**:1008a–c/**19**:1014c–d
e. The use of magic, witchcraft, divination, prophecy, astrology, or exorcism		**12**:920b–c/ 2:220f–221c/ **15**:63a–f	**11**:298f–g/**19**:897g–898a
f. Seasonal patterns of rituals and festivals: vegetation and fertility rites		**12**:920c–921a	12:778f–783a passim
2. Mesopotamian religions	MESOPOTAMIAN RELIGIONS **11**:1001–1006		
a. Historical development of the religious beliefs and practices of the Sumerians and Akkadians		**11**:1002h–1003c	
b. Religious literature and mythology	MESOPOTAMIAN RELIGIOUS LITERATURE AND MYTHOLOGY **11**:1007–1012	**11**:1003d–f/ **6**:908c–f/ 10:1088b–e	**6**:920f–921b
c. The Mesopotamian world view: gods and demons; beliefs about the origin of the universe and about the nature and destiny of man		**11**:1003g–1004g	**6**:74e–g
d. Practices and institutions: sacred times and places		**11**:1004g–1006b/ **18**:219d–e	**7**:199h–200b/**11**:971h–972b/ **14**:951d–e
e. Magic, divination, astrology, and witchcraft		**11**:1006b–e/ **2**:220f–221a	**15**:63b–d/**17**:1009a–d
f. Religious art and iconography		**11**:1006e–f	**19**:259c–h
3. Egyptian religion	EGYPTIAN RELIGION **6**:503–509		19:249b–c
a. Historical developments from the late Neolithic Period to the Hellenistic Age		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 Islam		1:1057f–h	**9**:927d–f
b. Polytheistic beliefs: the deities of the pre-Islamic 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.1.1]		**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 Mazda (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-Islamic 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 8271			
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

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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 Rgveda	**8**:909g–910e	**3**:984b–h/**9**:347e–g
b. The religion of the later Vedas and ***Brdhmanas***	**8**:910f–h	14:101la–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 8241	**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 *mārga*s: 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	
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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, mandalas, *liṅga*s, and *yoni*s		**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 Islam		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
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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. Islamic 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

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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
A. History of Buddhism	BUDDHISM, HISTORY OF **3**:403–413		
1. The cultural context: its background in Hinduism; its geographical, ethnic, and cultural base [see also 8231]		**3**:404b–g	**8**:911d–h
2. The founding of Buddhism: the life, work, and teachings of Siddhārtha Gautama, 6th–5th century BC		**3**:404g–405d/ **3**:375c–e/ **9**:317a–g	**3**:369d–373e/**9**:349e–g
3. Developments in India, 6th century BC–12th century AD		**3**:405d–407h/ **3**:391d–g	**3**:415g–416a/**17**:173d–175b
a. Early Buddhist councils and the development of schisms between Theravādins and Mahāyānists		**3**:405h–406g/ **3**:1083g–h/ **6**:319f–h/ **9**:322f–323a	
b. Expansion and later decline of Buddhism in India		**3**:406h–407h	**2**:205c–g/**8**:914f–h/ **9**:352b–f/**9**:356d–f/ **9**:360b–f
4. Buddhism in Central Asia and China [see also **825.A.1**]		**3**:407h–409c	**3**:416b–c
a. Developments in Central Asian kingdoms		**3**:407h–408b/ **12**:373g–374b	**3**:1137c–1138b
b. Developments in China		**3**:408b–409c/ **4**:319a–g/ **4**:328b–e/ **4**:418b–g	**4**:344a–c/**4**:423b–c/ **6**:321g–322b
5. Buddhism in Korea and Japan [see also 825.D. and E.]		**3**:409d–410h	
a. Developments in Korea		3:409d–f	**10**:531b–f

	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 Pali 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: Nirvana		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 arhatship; 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), vihdra (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 (mandala)		**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

	articles	article sections	other references
i. Confucianism today: its current demographic and social aspects		4:1103f–g	
2. Confucian Classics	CONFUCIAN TEXTS, CLASSICAL 4:1104–1107	4:1094e–g	
a. Divination and poetic texts: **I** *Ching, Shih Ching*		4:1105c–h	
b. Basic texts on Confucius and Mencius: *Lun yŭ, Hsiao Ching, Meng-tzu*		4:1105h–1106d	
c. History texts: *Shu Ching, Ch'un Ch'iu,* commentaries on the *Ch'un Ch'iu*		**4**:1106d–1107a	
d. Ritual texts: *Li chi* and other texts		4:1107a–g	
3. Confucianism as a religion and as a philosophy	CONFUCIANISM 4:1091–1099		
a. Beliefs and doctrines: the concept of Tao as a way of action, the ideal relationships between the individual and society		4:1097e–1098g	**10**:532f–533a/**11**:898a–d/ 16:163h–164b
b. The place of Confucianism in Chinese culture: its influence on the visual arts and on literature		**4**:1098g–1099b/ **4**:1107g–h	**1**:160g–161a/**15**:643f–g/ **17**:1043d–e
c. The relation of Confucianism to non-Chinese religions and philosophical schools, especially Buddhism, Shintō, Islām, and Christianity		**4**:1099b–e/ **3**:398e–399a/ **4**:1102h–1103b/ **10**:101h–102a/ **10**:105c–106d	**4**:1102h–1103b
C. Taoism			
1. History of Taoism	TAOISM, HISTORY OF 17:1044–1050		17:1051a–c
a. Origin and early developments: the first evidence of the teachings of *Lao-tzu* and *Chuang-tzu, c.* 4th–3rd century BC		17:1045f–1046b	**4**:416f–417a/**4**:584d–585c/ 10:679f–680e/**17**:1051e–f
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		**17**:1046b–g/ **4**:317f–318c/ **4**:417h–418b/ **17**:1052b–1053e	
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		**17**:1046h–1049g/ **4**:318c–319a/ **17**:1038g–1039a/ **17**:1053e–1054c	
d. Developments under the T'ang, Sung, and later dynasties: internal developments; the role of alchemy; syncretistic tendencies		**17**:1049g–1050f/ **17**:1054c–e	
e. The later development of philosophical and religious Taoism, from the 14th century to the present time		17:1050f–g/ 17:1042e–f	
2. Taoist literature	TAOIST LITERATURE 17:1051–1055		
a. Texts of speculative Taoism; *e.g.*, the *Tao-te Ching, Chuang-tzu*		**17**:1051e–1052e/ 17:1036h–1038c/ 17:1045f–1046b	
b. The literature of Taoist esoterism; *e.g.*, hagiography, doctrinal texts		17:1052e–1054e	**10**:1053h–1054a
3. Taoism as a religion and as a philosophy	TAOISM 17:1034–1044		
a. Basic concepts of Taoism: philosophical, ethical, and ritual approaches to the understanding of the integral unity of mankind and the natural order		17:1035b–1036f/ 17:1044g–1045c	
b. Doctrines of philosophical Taoism: the teachings of Lao-tzu, Chuang-tzu, and later teachers		**17**:1036g–1039a	
c. Beliefs and practices of religious Taoism: techniques for attaining longevity; priestly and monastic institutions		**17**:1039b–1042c/ **1**:432d–433a/ **17**:1052g–1054e	**17**:1048b–d
d. Folk Taoism and other variations in belief and practice: the deities of the popular pantheon; magical rituals and exorcism rites; secret societies		**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 Shinto; 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 Shinto, Sect Shinto, 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. Shinto: the Way of the Gods	SHINTŌ **16**:671–676	**10**:111b–f	
a. History of Shinto [see E.2., above]			
b. Characteristics of primitive Shinto: 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:**100**d–f/**16**:675h–676c
8. Place of Japanese religion in world religion		**10**:115a–c/ **16**:672c–e	

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(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
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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 Islam, 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.1**]		**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.c. 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**:11lb–h
4. The medieval era: the European and Islamic 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–Islamic 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 modem era, from c. mid-18th century: developments in modem 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. Qumran 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/ 16:11lf–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.l	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; Hasidism; 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 Islam		**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	

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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
CHRISTIANITY BEFORE THE SCHISM OF 1054 **4**:533–545		
A. History of Christianity before the schism of 1054		
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.l	**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.l	**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]	4:536h–537e/ 13:960e–f/ 13:1078f–1079c	**1**:199f–200g/**4**:460a–c/ **4**:493d–g
PAPACY **13**:955–956		
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
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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

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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

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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-Islamic setting in Arabia; the origin of Islam in the life and teachings of the Prophet Muhammad; the foundations of the Islamic community; and the early expansion of Islam beyond Arabia. It goes on to the development of Islamic religion, culture, and society during the first centuries of the caliphate of the ʿAbbāsids, from the 8th to 11tb century. It next deals with the Middle Ages of Islam, from the 11th to the 18th century, covering such topics as the emergence of independent dynasties in the Muslim West; developments in Islamic theology, philosophy, and mysticism; the further expansion of Islam 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.

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; Islamic law; Islāmic theology and philosophy; Islamic mysticism; and Islamic myth and legend.

The outline of subject C deals first with basic Islamic beliefs and doctrines—doctrines concerning God, the universe, and man; doctrines concerning Satan and other intermediate beings, powers, or principles; doctrines concerning Muhammad 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 Islamic 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 Islamic 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.

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A. History of Islam		
ISLĀM, HISTORY OF **9**:926–937		
1. The pre-Islamic setting in Arabia [see also 822.A.6.]	**9**:927d–f/ 1:1043a–1046e/ 1:1057h–1059g	
2. The origin of Islam in the life and teachings of the Prophet Muhammad, the Messenger of Allāh, 6th–7th century AD	**9**:927g–928e/ **3**:624a–625a/ **8**:536f–g/ **15**:343d–f	**1**:1046g–1047a/ **12**:606b–609b/**15**:66e–g
3. The foundations of the Islamic community and the early expansion of Islam beyond Arabia, 7th and 8th century	**9**:928e–929h/ **8**:536h–537b/ **9**:938e–f/ **11**:990h–991h	**1**:1047a–f/**4**:580e–581a/ **9**:852d–853a/**13**:110a–c
a. The caliphate of the Companions, or the first four caliphs (successors)	**9**:928f–929d/ **3**:625a–626h/ **9**:958e–g	**1**:573f–h/**4**:580e–581a
b. The caliphate of the Umayyads	**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
4. The development of Islamic religion, culture, and society during the first centuries of the caliphate of the 'Abbasids, 8th–11th century	**9**:929h–930h/ **9**:959c–961a/ **9**:987b–988d/ **9**:1018e–1021a	**1**:1047g–1048b
a. The relation of the caliphate to the religious community	**9**:929h–930c/ **3**:635a–639a	**11**:991h–992g
b. The development and consolidation of Sunnite law and theology	**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
c. Challenges to and disruption of the unity of the community: the role of the Shīʿah and other sectarian movements	**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
5. The Middle Ages of Islam: developments in theology, law, and culture, 11th–18th century	**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 Islamic 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 Sufism, Islamic 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 Islam 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 Islam, 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 Safavids 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. Islam in the modem world, 18th–20th century		**9**:936d–937e	
a. The development of reform movements: rigorous puritan groups, anti-Sufi trends, attempts to renew Shī'ism 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. Islam 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 Islam [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 Hadith: the oral tradition	ḤADĪTH **8**:536–538		
3. Islamic law: Shari'an and *figh*	ISLĀMIC LAW **9**:938–942	**5**:733c–e/ **9**:920f–921d	1:18c–e/**1**:368e–g
4. Islamic theology and philosophy: philosophic and anti-philosophic trends in Islam; the major schools of Islamic 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 Islamic beliefs and doctrines	ISLĀMIC MYTH AND LEGEND **9**:949–952		

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C. Beliefs, practices, and institutions of Islam	ISLAM 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 Islam: the orthodox community and its variations		9:915b–918e	
a. Khārijism: the doctrines of the Kharijis and Ibadis		9:915b–d	9:852d–g
b. Mu'tazilism: 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 Sunni 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 Islamic origin, now considered non-Islamic; *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 Islam: 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 Shari'ah: 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 Islam		9:921d–h/ 4:591a–b	
f. Educational institutions		9:921h–922e/ 6:339d–340c	15:645g–646b
g. Folk Islam: 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 Islamic contexts		**9**:924f–925g/ **9**:936d–937e	**1**:829d–e/**9**:820b–h
6. The relation of Islam 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

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Section 829. Other religions and religious movements in the modern world

[for Part Eight headnote see page 501
for Division II headnote see page 5171

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 Islamic 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 Islam, 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 Islam			
1. The Baha'i faith	**BAHĀ'Ī** FAITH **2**:587–589		
2. The Druze religion	**DRUZES** 5:1060–1062		
3. The Nation of Islam, 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
UR **18**:1021–1022	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	**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
IRAN, HISTORY OF 9:831	2. Early Elam (Iran): cultural ties and political and military interaction with Mesopotamia	**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
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**:463d–465b/ 6:508d–e/ **19**:249d–g	**1**:326e–g/**11**:895b–d
2. The Old Kingdom (c. 2686–2160 BC) and the First Intermediate Period (*c.* 2160–*c.* 2040 BC)		**6**:465b–469b	**8**:853a–856d *passim*
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, 17861567 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 Halafian 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; Kamares 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)	EGYPT, HISTORY OF 6:471–479		11:896c–f
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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	6:473g–475d	1:402a–403d/6:508e–g/ 19:254d–255c
b. The 19th and 20th dynasties (1320–1085 BC): political shift to the north; new construction; foreign policies		6:475d–477d	
i. Reassertion of Egyptian power: campaigns against the Hittites and Libyans; succession disputes		6:475d–476b	1:819a–c/12:488f–489b/ 15:501g–503b
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		6:476c–477d/ 17:941a–e	
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		6:477d–479a/ 19:255c–256f	16:119a–121a *passim*
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			12:914b–d
a. The Hittite Empire (c. 1525–1190 BC)		1:818c–819e	
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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		**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**
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		**17:942a–h/** 1:619f–620c/ 1:621b–g	
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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)		**11:981b–982g**	
4. The Elamite kingdom and its struggle with Babylonia in the 13th and 12th centuries BC		**9:831e–h**	**11:981h–982a**
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 amval of the Greeks	AEGEAN CIVILIZATIONS **1:119–122**		**5:252g–253a**
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		**1:119g–121a/ 1:822h–823e/ 8:392g–393b**	**8:393e–f/14:898f–g**
b. The end of the Bronze Age in the Aegean: destruction of Mycenaean centres; invasion from the north and the coming of the Greeks		**1:121a–e**	
c. The people of the Bronze Age Aegean: physical types, dress, society, economy, warfare, religion, and arts		**1:121f–122h/ 19:275e–277g**	
F. The era of the new states of Southwest Asia: the beginning of the Iron Age (c. 1050–700 BC)			
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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	BABYLON 2:554–556	**11:981h–982g**	**9:831g–h**

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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
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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		
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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	

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d. The Kingdom of the Medes in Iran (c. 700–550 BC) and the establishment of the Achaemenid Persian Empire		9:832f–833h	
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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
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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
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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
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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
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3. Armenia: client status under the Iranian empires of Rome in the period dominated by the Arsacids		**18**:1041g–1042b	
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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

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3. Pre-Islāmic South Arabia: the kingdoms of Ma'in, Saba', Qataban, 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		
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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		
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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	

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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
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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
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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

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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

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Division II. Peoples and civilizations of medieval Europe, North Africa, and Southwest Asia

[for Part Nine headnote *see page 5631*

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 Islamic 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 Islamic 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 5631*

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 Volkerwanderung (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 fight 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 Islam 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
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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
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f. Justinian's successors (565–610): relations with the barbarians and with the Persians; revolt of the army		3:555g–556d	
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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		
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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 Pfemysl 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 Pfemysl 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 Bfetislav (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 Arpád 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	

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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 'Abbasid 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 ʿAbbāsids, 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 'Abbasid caliphate and with economic, social, and cultural life under the ʿAbbāsids. It goes on to the eclipse of the ʿAbbāsids 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 Biiyid dynasty in Iran and Iraq; and other states in eastern Arabia, eastern Turkistan, Afghanistan, and northwestern India.

	articles	article sections	other references
A.	The rise and spread of Islam and the Arab Empire to the end of the Umayyad dynasty (AD 622–750)		
	CALIPHATE, EMPIRE OF THE **3**:623–635		
1.	Introduction to Islamic history: the historical sources; historiographic problems	3:600e–h/ **4**:580e–581b/ **13**:155f–h	**9**:912b–e/**9**:927d–f/ **17**:980g–981c
2.	Islām and Arab expansion in the 7th century	**3**:624a–626h/ 1:1046f–1047e	13:156a–b
a.	The life and career of Muhammad and the rise of Islām; the doctrine of the jihad (holy war)	**3**:624b–625a/ 8:536b–f/ 9:927g–928f	1:1046g–1047a/**9**:912e–f/ **9**:914g–h/**12**:606b–609b
b.	Muslim expansion outside Arabia under the four Patriarchal Caliphs (632–661)	**3**:625a–626h/ **9**:851g–853a	1:1047a–e/**18**:792h–793b
i.	Abū Bakr (632–634) and 'Umar I (634–644): the tribe of Quraysh; divisions among the followers of Muhammad; the conquest of Iraq and the Sāsānid (Persian) Empire and the Byzantine territories of Jordan, Palestine, Syria, and Egypt	**3**:625a–626b/ 9:851e–g/ **11**:990f–991b	**6**:487f–488c/**9**:928f–929d/ **17**:951h–952a
ii.	ʿUthmān (644–656) and ʿAlī (656–661): expeditions into North Africa, Armenia, and Persia; social and religious grievances; civil unrest; the origins of Shīʿism	**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.	The Umayyad caliphate (661–750)	**3**:626h–635a	**6**:488c–g/**9**:929d–h/ **13**:156a–c
a.	The consolidation of the caliphate (661–684) under Muʿāwiyah I and his successors: westward orientation of the caliphate and its capital at Damascus; growing opposition to the Umayyads	**3**:626h–628a	**1**:1047e–f/**11**:991c–e/ **12**:605c–g/**17**:952b
b.	The zenith of Umayyad power with the advent of the Marwānids: 'Abd al-Malik (685–705) and al-Walid (705–715); suppression of revolts; new conquests	**3**:628b–630a/ **17**:414a–f	**1**:5d–6a/**11**:991f–h
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 ʿAbbāsid revolt	**3**:630a–632b	
d.	Umayyad government and society	**3**:632b–635a	

	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 Abii 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 Cordoba	CÓRDOBA 5:171–172	17:414f–416g	17:407g–408a
i. Foundation of the independent amirate by 'Abd ar-Raḥmān I (756–788): defeat of the Franks at Roncevalles (778); political and cultural splendour in the reign of 'Abd ar-Raḥmān II; defeat of the muwallads		7:414f–415f	
ii. The Umayyad caliphate under 'Abd ar-Raḥmān an-Nāṣir III: relations with Arabs, Berbers, and the Christian states in Spain; conquest of Morocco by his successors; the *ṭā'ifas* 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 Idrisids 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 Biiyid 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 'an-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 Macropedia
(Additional biographical entries may also be found in the Micropedia)

'ABD AL-MALIK IBN MARWĀN 1:5
'ABD AR-RAḤMĀN III AN-NĀṢIR 1:7
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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
MIDDLE AGES (*c.* 395–1500) 12:142–164		
A. The medieval western European revival, and the economy, society, and culture of Western Christendom in the High Middle Ages	**12**:143h–164a	
1. Society, economy, and culture		
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.*, Lubeck); 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	

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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	
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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

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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	
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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
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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 Mamliiks 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.

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BOHEMOND I, PRINCE OF ANTIOCH 2:1201
CARPINI, GIOVANNI DA PIAN DEL 3:956
DANDOLO, ENRICO 5:480
HUNYADI, JÁNOS 9:53
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IVAN III THE GREAT, OF RUSSIA 9:1178
MEHMED II 11:859
MICHAEL VIII PALAEOLOGUS 12:96
NIẒĀM AL-MULK 13:135
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STEFAN DUŠAN 17:664

Division III. Peoples and traditional civilizations of East, Central, South, and Southeast Asia

[for Part Nine headnote see page 5631

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–

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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 5951

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
	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
CHINA, HISTORY OF 4:297–307		
	4:297g–301e	
	4:297h–298e	
	4:298e–h	
	4:298h–299h	**8**:1052e–f
	4:299b–d	
	4:299d–h	**19**:177b–c
	4:299h–301e	**19**:177c–e
	4:301e–307c	**9**:727a–g
	4:301e–302a/ **4**:411f–413d	1:327h–328d
AN-YANG 1:1009–1010	4:302a–303c/ **3**:608d–609b/ 19:177f–179e	**4**:415c–d/**4**:422e–f

A. Introduction: the character and achievements of Chinese civilization; the geography and ethnography of China; archaeological and documentary historical sources; historiographic problems

B. The emergence of traditional Chinese civilization

1. The prehistoric period
   a. The Paleolithic and Mesolithic stages in North China: industries in the Ordos region; rnicrolithic tools
   b. The Neolithic stage: pebble tools and domesticated animals; "Mongolian Neolithic"
   c. The Yang-shao Painted Pottery culture
      i. Stratigraphy: villages of Hsi-yin-ts'un and Yang-shao-ts'un; pottery styles
      ii. Painted pottery styles; sites in Kansu; ornamental designs; stone implements
   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
2. The beginnings of the Chinese civilization: the early dynasties
   a. Origins of the Chinese people and culture: legends and cultural centres; the Hsia dynasty (c. 2205–c. 1766 BC)
   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

	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)

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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-yiieh		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 Yuan 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 Yuan 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 Yiian-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
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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.

	articles	article sections	other references
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	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
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		**9**:597b–f	**4**:313g–314e/**12**:370e–h
2. The Manchurian tribes: attempts at unification; fluctuating relations with the Chinese until the advent of the Mongols	MANCHURIA, HISTORY OF **11**:435–436		
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)		**11**:435c–g	
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		**11**:435g–436d/ **4**:335a–336h	
3. Development of West and East Turkistan to c. 1750	TURKISTAN, HISTORY OF **18**:792–798	9:597g–598h/ 3:407h–408b	**4**:321c–d/**4**:323g–324a
a. West Turkistan: the early empires; Muslim rule; the Chagatai khans and Timurids; the Uzbek and Kazakh khanates		**9**:600b–c/ **9**:601d–e/ **18**:792c–796c	**1**:174c–d/**4**:325g–h
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)		**9**:598c–h/ **18**:797f–798a	**11**:444d–e/**12**:370g–371d
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)			**11**:435g–436d/**12**:370h–371d
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	AFGHANISTAN, HISTORY OF **1**:172–174		
C. The Mongol Empire and its successor states	MONGOLS **12**:370–374		
1. The establishment of a united Mongol Empire in Central, eastern, and western Asia by Genghis Khan and his successors (1206–60)		**12**:371d–373b/ **1**:173h–174b/ **9**:857c–d	**10**:541h–542c/**18**:793g–h
a. The rise of Genghis Khan: his military and political organization, tactics, and conquests		**12**:371d–372d/ **4**:341d–f	**7**:1014c–1015g/**9**:599b–c
b. The division of his empire among his sons: further expansion under Ögödei Khan; Mangu (Mongke) Khan's friendly relations with Western Christendom		**12**:372d–373b	**4**:341f–g
2. The Mongol successor states		**12**:372d–374b	
a. The completion of the conquest of China (1260–79) and the foundation of the Yüan dynasty by Kublai Khan		**12**:373a–d/ **4**:341g–343h	**9**:599d–f/**10**:542c–f
b. The Chagatai khanate (*ulus*) of Turkistan in the 13th and 14th centuries		**18**:793h–794c	
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	SAMARKAND **16**:204		**7**:893b–e/**9**:599h–600a/ 9:858c–f/**9**:934a–c/ **16**:43g–44a/**18**:424e–425c/ 18:794c–g
d. The Iranian Il Khans (1258–1335): the Golden Horde (later Kipchak empire) in southern Russia and its successor states (1240–1783)		**9**:857d–858d/ **16**:42g–44a	**1**:478h–479b/**9**:599d–600a/ 12:372f–373a/**18**:795g–796c
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		**12**:373d–374h	**4**:355c–e/**18**:380a–b

	articles	article sections	other references
D. Tibet and Nepal to c. 1750			
1. Tibet to c. 1750	TIBET, HISTORY OF 18:378–381		
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		18:378d–379f/ 3:410h–411c	3:416c–e
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		18:379g–380d/ 3:1123d–g/ 3:1141c–1143a	
c. Rule by the Dge-lugs-pa (Yellow Hat) monastic order; unification of Tibet (1642); Tibet under Chinese overlordship (1720)		18:380e–381f	
2. Nepal to c. 1750: rule by Indian princely families; influence of Hinduism; relations with China and Tibet	NEPAL, HISTORY OF 12:957	3:1140a–1141b	
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		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 5951

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, aad Silla) and their interactions (c. 57 BC–AD 668); the unification of Korea under Silla control (668–918); and the Koryd 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).

	articles	article sections	other references
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		4:573e–574a	10:34e–45f/10:516e–520c/ 10:522d–523h
B. Early Japan	JAPAN, HISTORY OF 10:57–64	6:342c–e	
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		10:57d–59b/ 16:671h–672b	14:926e–f/19:216f–217h
2. The ancient period: unification of Japan under the Yamato court and subsequent governments (c. 250–710)		10:59c–61b/ 12:680b–681g	
a. The rise and fall of the Yamato court: relations with Korea; internal power struggles; introduction of Buddhism		10:59d–h	19:217h–219e
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		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 Hbgen (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 Hbjb family from 1199: the Jōkyū War (1221); Hbjb 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 cohsolidation 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 Shinto 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 Tempo 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 (Koguryd, 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 Koryd 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.

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

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

1. Late Stone Age hunters and Neolithic settlement in Baluchistan and the Indus Valley; first settlements east of the Indus
2. Indus civilization (c. 2300–c. 1750 BC): social, economic, and cultural developments
   a. Development of urban centres; *e.g.*, Mohenjo-daro, Harappā, Kalibangan, Lothal
   b. Developments in agriculture, animal husbandry, metalwork and pottery, transportation, and trade
   c. Developments in languages, religion, and the visual arts
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
   a. Early Ganges cultures to c. 1200 BC: social organization and religious development
   b. Later Ganges cultures to c. 600 BC: development of the caste system and emergence of Brahmin, Kṣatriya, Vaiśya, and Śiidra castes
4. Pre-Mauryan states (*c.* 600–150 BC): development of political and economic systems; Taxila as a cultural centre
   a. The early development of Buddhism and Jainism; growth of Magadhan ascendancy
   b. Invasion of Alexander the Great (327 BC) and establishment of Greek settlements
5. Development of the Mauryan Empire (c. 321–185 BC): the capital at Pāṭaliputra (Patna)
   a. Establishment of the empire by Candragupta Maurya (c. 321–c. 297 BC) and consolidation by Aśoka (*c.* 265–238 BC)
   b. Mauryan economic, social, and administrative developments; evolution of the concept of the state
6. The rise of small kingdoms in the north (150 BC–AD 300): Indo-Greek and Asian rulers; various local republics and kingdoms (Śunga, Kaliṅga, Andhra)
7. South Indian civilizations to AD 300

articles	article sections	other references
	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
INDIAN SUBCONTINENT, HISTORY OF THE **9**:336–357		
	9:336d–339a	
	9:339a–344e/ **6**:319b–e	
	9:340c–341g	
	9:341g–343b	**1**:329d–f
	9:343b–344a/ **8**:908c–909f	**1**:622f–g/**5**:990b–f/ **17**:184h–185c
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
	9:345e–346f	
	9:346f–348c/ **8**:910f–911e/ **16**:857g–858a	
TAXILA **17**:1082–1083	**9**:348e–350e	**1**:329g–h/**17**:135a–e
	9:349e–350b/ **3**:404b–405h/ **6**:319f–h	**3**:369d–373e/**3**:415g–416a/ **8**:911e–h/**11**:347d–348b
	9:350b–e/ **9**:353c–e/ **8**:375d–376a/ **8**:380c–e	**1**:471b–f
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
	9:350e–351d	**2**:205f–g
	9:351d–353b	
	9:353b–354f	**9**:315e–g
	9:354f–357b	

	articles	article sections	other references
a. Development of guilds, banking systems, and extensive maritime trade with the West		9:356a–d	
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		**9**:354f–356a/ **9**:356d–357b	**3**:406c–f/**17**:173h–174d
C. North India, the Deccan, and South India (AD 300–750)	INDIAN SUBCONTINENT, HISTORY OF THE **9**:357–361	**11**:823h–824g	**1**:622g–623e
1. The Guptas of North India (AD 320–540): expansion and administration of territory; invasions by the Hanas (*c.* mid-5th century); successor states to the Guptas		**9**:357e–358h/ **6**:319h–320c/ **8**:912e–913c	**3**:407a–d/**8**:913g–914c
2. Various kingdoms of the Deccan: the Vākāṭaka dynasty, the Viṣṇukuṇḍins, the Cālukyas, and the Rāṣṭrakūṭas		**9**:358h–359g	
3. The Pallavas in South India: developments in religious art and architecture, literature, and science		**9**:359g–361a/ **4**:2f–g	
D. North India (750–1200), the Deccan, and South India (750–c. 1330): new dynasties and centres of power	INDIAN SUBCONTINENT, HISTORY OF THE 9:361–365		
1. The tripartite struggle in North India; the Rājput kingdoms; Turkish control in Ghazna from 998		**9**:361a–362h	
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		**9**:362h–363e	
3. Social, economic, and cultural developments; *e.g.*, feudalism and economic decentralization, partial social mobility, growth of Tantrism, literature and the visual arts		**9**:363e–365d/ **3**:407d–h/ **8**:891h–893b/ **8**:914d–h/ 17:175b–183g	**15**:499e–500a/**17**:197f–198d
E. Ceylon from the prehistoric period to the end of the Classical Age (AD 1200)	CEYLON, HISTORY OF 4:1–3		
1. Prehistoric settlements in Ceylon; colonization by Indo-Aryan tribes in the 5th century BC; conversion to Buddhism (*c.* 3rd century BC)		4:1a–2e	**3**:411e–g
2. Ceylon in the Classical Age (c. 200 BC–AD 1200): the Polonnaruva dynasties; growth of Sinhalese political institutions; social and agricultural developments		**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 5951

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 Bahmani 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 Bahmani 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
A. North India under Muslim hegemony (c. 1200–1526)	INDIAN SUBCONTINENT, HISTORY OF THE	**9**:365–370	
1. The completion of the Ghurid conquest; the Delhi sultanate (1206–1526): the military and administrative policies of the five dynasties		**9**:365e–369e	
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 Khalji 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.*, Islamic 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 Bahmani dynasty and the five Deccan sultanates		**9**:370f–374b	
a. The Bahmani 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, Bidar, 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), Shah 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

articles	article sections	other references
	9:385b–386g	3:587b–c/4:742c–e

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

INDIAN SUBCONTINENT, HISTORY OF THE 9:386–392		
	9:386h–388g	2:373c–e/16:812a–e

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

	9:386c–g/ 9:388h–390b	

E. Ceylon from *c.* 1200 to the arrival of the Portuguese (1505)

CEYLON, HISTORY OF 4:3–5		
	4:3g–5d	

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

	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 5951

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 Nan-chao 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 Islam 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 documentaw historical sources: historiographic problems

B. Mainland Southeast Asia to c. 1600

	articles	article sections	other references
1. Burma from the Anyathian culture (5000 BC–AD 1600)	BURMA, HISTORY OF **3**:510–512		**3**:412c–d
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		**3**:510d–511a/ **17**:253c–g	
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)		**3**:511b–512b	
c. The city kingdom of Pagan (849–1287): the influence of Theravāda Buddhism; Pagan as a cultural centre; destruction by the Mongols (1287)	PAGAN **13**:860–861	**3**:511f–512b/ **17**:253g–255h	
d. Burma from c. 1300 to c. 1600: reunification and expansion		**3**:512c–f	**17**:234e–g
2. The Thai people and the kingdom of Siam to *c.* 1500	SIAM AND THAILAND, HISTORY OF **16**:718–720		
a. The origins and settlement of the Thais: the kingdom of Nanchao in Yunnan (8th century AD)		**16**:718d–h/ **17**:255h–256c	
b. Establishment of Thai power at Sukhothai (c. 1220): social and cultural developments		**16**:718h–719f/ **17**:256d–h	**3**:412d–e/**14**:928d–e
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)		16:719f–720f/ **17**:256h–258e	
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)	LAOS, HISTORY OF **10**:677		
3. Cambodia from the prehistoric period to c. 1500	CAMBODIA, HISTORY OF **3**:681–686		
a. Prehistoric peoples in Cambodia; mythological origins of kingdom of Funan (c. AD 100) and the influence of Indian culture		**3**:681g–682f	19:121e–h
b. Emergence of the state of Chenla and its dominance (c. 598) over Funan		**3**:682f–683b	**17**:259e–260a
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	ANGKOR **1**:885–886	**3**:683b–685c	**17**:260a–262f
d. Jayavarman VII (1181–c. 1218) and the re-establishment and extension of Khmer authority		**3**:685c–f	**10**:118h–119e/**17**:262f–263b
e. Decline of the Angkor kingdom after 1220; introduction of Theravāda Buddhism; Thai invasions (1369 and 1389) and fall of city of Angkor (1444)		**3**:685f–686e	**1**:886d
4. Vietnam from the prehistoric period to *c.* 1615	VIETNAM, HISTORY OF **19**:120–124		
a. The legendary and historical origins of the Vietnamese people; the influence of Chinese rule (from 111 BC) on Vietnamese society		**19**:120b–121e	
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)		**19**:121e–h/ **17**:263c–264b	**3**:412e–h
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		**19**:121h–124g/ **17**:264b–e	
5. Malaya to the 16th century AD	MALAYA, HISTORY OF **11**:365–366		
a. Rise of Indianized states and their role in the formation of Malaya: the advent of Islam and the rise of the sultanate of Malacca (*c.* 1400–1511)		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 Singhasari empire of Kertanagara and the royal cult
5. The Majapahit empire in eastern Java (1319–89): religious and cultural developments
6. The spread of Islam in Indonesia: the rise of Muslim states in Sumatra and Java (*c.* late 13th century); conflicts between Islam 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
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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
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KERTANAGARA **10**:435
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MINAMOTO YORIMMO **12**:221
MUHAMMAD IBN TUGHLUQ **12**:610
NURHACHI **13**:392
ODA NOBUNAGA **13**:505
OU-YANG HSIU **13**:796
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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)		
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	**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		**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 Islamic revolutions in the western Sudan: spiritual and military leadership of Sīdī Mukhtar (d. 1811) and Usman dan Fodio (d. 1817); the Fulani and Hausa *jihāds* (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

WEST AFRICA, HISTORY OF **19**:760–765

TIMBUKTU **18**:409

WEST AFRICA, HISTORY OF **19**:765–777

	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 'Alwah; 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 'Alwah as the last Christian barrier until its conquest (c. 1500)		13:110a–e	
3. The rise of the Funj (c. 1500); the spread of Islam		13:110f–111d	
4. The Egyptian occupation from 1820 to 1885: the administration of Muhammad 'Ali 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 6101

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 6101

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 Micropcedia)

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 SULTAN 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.

	articles	article sections	other references
A. Introduction: the character and achievements of Andean civilization; the geography and ethnography of the Andean region; archaeological and documentary historical sources; historiographic problems		1:839h–843d/ 1:847b–848d/ 1:688b–691f/ **9**:259b–d/ 17:105g–h/ 17:119a–g	**14**:993d–g/**17**:94b–f
B. Pre-Inca cultures and states	ANDEAN CIVILIZATION, HISTORY OF 1:839–847		**9**:259d–g
1. Late Preceramic (c. 3500–c. 1800 BC) cultures: development of agriculture		1:840h–841f	**1**:855b–c/**17**:118b–c
2. Initial (*c.* 1800–c. 1000 BC) and Early Horizon, or Chavin and Paracas (c. 1000–c. 200 BC), cultures in Peru: development of textiles, pottery, and ceremonial architecture		**1**:841f–843d	
3. Early Intermediate (Florescent, or Classic) Period (c. 200 BC–*c.* AD 600): metallurgy, pottery, and textile production in the Nazca and Moche cultures		**1**:843e–845a	**14**:929f–g
4. Middle Horizon Period (*c.* AD 600–c. 1000): the Huari and Tiahuanaco cultures: urban settlements; cultural decline after c. AD 800		**1**:845a–g	
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		**1**:845g–847a	**1**:688d–690e
C. The empire of the Incas (c. 1400–c. 1540)	ANDEAN CIVILIZATION, HISTORY OF 1:847–854		
1. The origins and development of the Inca Empire		**1**:848a–851f	
a. The autochthonic mythical origins of the Inca dynasty; establishment of the Cuzco Valley settlement (c. 1400)		1:848a–d	1:662a–c
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)		**1**:848d–h	**9**:259h–260a
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		**1**:848h–850a	**17**:118c–e
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		**1**:850a–d	**1**:690e–691f/**3**:9h–10a
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		**1**:850d–851c	
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		1:851c–f/ 10:639b–g	4:882a–c/**6**:291a–b/ **14**:488a–d/**17**:120b–d
2. Incan government, society, and culture		**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 6151

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 Yucatin 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 Ocos 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. Teotihuacan cultural and urban development; ceremonial architecture and pottery; the Zapotecs at Monte Alban		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 Teotihuacan 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 Yucatan 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 Yucatan Peninsula (c. 900–c. 1200): secular and religious institutions; art and architecture; the legend of Quetzalcoatl; 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 Yucatan 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 5631

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 Islamic 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.

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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
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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		
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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
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ii. Investigations of man and his institutions: Locke, Hume, Diderot and the Encyclopkdie, 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

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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

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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 6181

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 I1 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

ʿAlawī dynasty (1659–1830). The history of Iran begins with the rise of the Shiʿite Safavid 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 Shīʿite and Sunni 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.

	articles	article sections	other references
A. The Christian states of eastern Europe			
1. Poland–Lithuania (1492–1795): gradual weakening of the monarchy; decline and dismemberment of the state	POLAND, HISTORY OF 14:642–647		
a. The Golden Age of the Polish–Lithuanian empire (1492–1572)		**14**:642c–643g	
i. Foreign relations: Ottoman invasions; Russian invasion of Lithuania; alliance with Turks (1533) and re-establishment of Polish security; renewed Russian aggression		**14**:642d–h/ **16**:46e–g	**13**:783c–d/**16**:48c–e
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		**14**:642h–643g/ **10**:1145f–1146a	
b. Establishment of the royal republic (1572–1648)		**14**:643g–645b	
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		**14**:643g–644c/ **18**:336a–b	
ii. Wiadysiaw IV Vasa (1632–48): the Cossack revolt; economic prosperity; increased power of the nobility; effect of the Counter-Reformation		**14**:644c–645b	
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		**14**:645b–f	**10**:238d–239c
d. The Saxonian era, the Russian Protectorate, and the partitions of Poland among Russia, Prussia, and Austria		**14**:645g–647g	**2**:672e–f/**6**:1098h–1099c/ **16**:54c
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)		**14**:645g–646c/ **8**:96g–97a	**8**:96a–b
ii. The reign of Stanisław II August Poniatowski (1764–95): the Confederation of Bar; reform; the partitions of Poland (1772, 1793, and 1795)		**14**:646d–647g	**6**:1098h–1099c/ **10**:534h–535d
2. Hungary: the Jagiellon kings (1490–1526) and the partition period (1526–1699)	HUNGARY, HISTORY OF **9**:33–35		
a. The peasant revolt (1514); defeat by the Ottoman Turks at Battle of Mohacs (1526)		**9**:33h–34a	**13**:778h–779e/**17**:784f–785a
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		**9**:34b–f	
3. Emergence of the Russian Empire (*c.* 1500–1796)	RUSSIA AND THE SOVIET UNION, HISTORY OF **16**:45–57	**6**:156g–158b	**6**:600g–601d
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)		**16**:45d–47e	**9**:1179d–1180g
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		**16**:47f–49g/ **10**:1161g–1162b/ **18**:336a–b/ **18**:339h–340a	**6**:157e–f/**13**:101e–102d
c. The beginning of westernization and further expansion under Peter I the Great (1689–1725): the Petrine state		**16**:49g–53g	**6**:157f–158b/**14**:158b–160g

	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 Islamic 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; Suleyman 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 'Alawi 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 Shi'ite Safavid 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 Safavids		**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 Shi'ite and Sunni 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	

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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 Napoleon 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

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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 6181

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 Not th 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.

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Section 965. Development of the United States and Canada from 1763 to 1920

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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.

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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 6181

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 Juarez 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 Rio 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).*

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	

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 (1*802–03)* 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 (1*810–25);* the establishment of the independent Empire of Brazil (1*822)*

	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 Bolivar (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 Rio 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 Martin'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 Martin's withdrawal and assumption of control by Simon Bolivar; 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); Iturbide'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 Iturbide (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. Juarez 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 Juarez' 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 Diaz dictatorship (1876–1911)		12:83h–85e	
a. Diaz' 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 Diaz' re-election (1909); armed revolt, Diaz' 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 Obregon; 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; Rio 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 Paez (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 Guzman Blanco (1870–88)		19:68h–69d	
c. Political instability to 1892; Crespo's regime (1892–96); the Castro (1899–1908) and Gomez (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 Garcia 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; Leguia'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 I860		**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 Rio 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 Rio 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. Pa'raguay 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 Rodriguez Francia's dictatorship (1814–40); encouragement of foreign trade during Carlos Antonio Lopez' dictatorship (1841–62)		**13**:990e–g	
c. Francisco Solano Lopez' 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	

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CLIVE, ROBERT 4:741
CURZON, LORD 5:374
DALHOUSIE, JAMES RAMSAY, 1ST MARQUESS OF 5:438
GANDHI, MAHATMA 7:874
HASTINGS, WARREN 8:665
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Section 969. Southeast Asia under the influence of European imperialism to c. 1920

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for Division VI headnote see page 6181

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	

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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 6181

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**, HISTORY OF **4**:358–366		
1.		**4**:358c–361b	**4**:1102h–1103b
a.		**4**:358c–359g	
i.		**4**:358c–359a	**4**:898a–d/**10**:1015d–f
ii.		**4**:359a–g	
b.		**4**:359a–361b	**9**:44a–g/**10**:970h–971a/ **18**:730d–f
2.		**4**:361b–366d	**4**:31d–h/**4**:1103b–c/ **10**:1057h–1058c/ **14**:924f–925c
a.		**4**:361b–362b	**10**:971b–c
i.		**4**:361c–f	**4**:898d–g
ii.		**4**:361g–362b	
b.		**4**:362b–363f	**10**:80f–81a/**10**:971c–e/ **11**:437b–e/**12**:374h–375b/ **16**:66c–e/**18**:798b–c
c.		**4**:363f–364g/ **18**:982e–g	**4**:898g–899a/**6**:387f–388b/ **10**:382b–g/**10**:971e–f
d.		**4**:364g–366d	
i.		**4**:365c–g	**4**:194d–f/**11**:437e–f/ **17**:810e–811b
ii.		**4**:365g–366d	
B.	**JAPAN**, HISTORY OF **10**:78–81		
1.		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

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HUNG HSIU-CH'ÜAN **9**:43
II NAOSUKE **9**:234
ITŌ HIROBUMI **9**:1175
K'ANG YU-WEI **10**:381
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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 6181

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 Muhammad 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 Agha Mohammad Khan 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

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USMAN DAN FODIO **18**:1100
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Division VII. The world since 1920

[for Part Nine headnote see page 5631

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.**

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972. Europe since *c.* 1920 666
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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 in the postwar period: the Cold War from 1945 to 1957	INTERNATIONAL RELATIONS (1945 TO *c.* 1970) **9**:751–764		

	articles	article sections	other references
1. The aftermath of war (1945–53)		**9**:752h–756d	19:555c–556d
a. Postwar plans and conferences: formation of the United Nations		**9**:752h–754a/ 8:1185f–1187b/ 18:894a–895a	**8**:1188f–1189a
b. Developments in postwar Europe		**9**:754a–756d	**19**:569a–d
i. Allied occupation and partition of Germany; the Soviet Union's conflicts with the Western Allies; the Marshall Plan for European economic recovery (1947); the Truman Doctrine (1947) and the growth of U.S. influence in western Europe, Greece, Turkey, and Iran; the formation of NATO (1949)		**9**:754a–755h/ **2**:478h–479f/ 6:249c–250d/ 8:121f–123c	**2**:637d–g/**11**:159g–h/ **13**:792a–b/**18**:725g–h/ **18**:993e–h/**19**:551b–f/ **19**:555f–h
ii. The Soviet Union's reduction of the eastern European countries to satellite status; Soviet failure to win control of Greece, Turkey, and Iran; Soviet development of atomic weapons (1949)		**9**:755f–756b/ **2**:636h–638c/ **2**:1197g–1198d/ **16**:82g–83b	**8**:125a–e/**14**:653g–654b
c. Developments in postwar East Asia: U.S. occupation and reorganization of Japan (1945–51); Civil War (1945–49) in China and establishment of the People's Republic of China (1949); Chinese diplomatic isolation and xenophobia; the Korean War (1950–53)		**9**:758d–759f/ **4**:375h–378f/ **10**:86e–89b/ **10**:513b–514c	**4**:390a–c/**4**:393c–g/**16**:83b–d/ **18**:994g–h/**19**:555h–556b
2. Military standoff between Communist and Western powers in the later 1950s: the United Nations as an international forum; international espionage; tensions within the Soviet bloc		**9**:761e–762e/ **9**:763a–764c	**16**:84c–h/ **18**:897d–898c *passim*/ **19**:569d–f
3. Developments in the Third World: breakup of European colonial empires and emergence of independent states in Asia and Africa; problems of economic underdevelopment and social dislocations; pressures of East–West rivalry		**9**:756d–758c/ **3**:279b–c/ **4**:903d–905e/ **12**:852g–853e	**3**:305a–306g *passim*/ **14**:816f–g
a. Emergence of independent India and Pakistan amid conflict; Philippine and Indonesian independence		**9**:757g–758c/ **6**:252a–h/ **9**:421f–423e/ **9**:489a–490c/ **14**:244b–e	**4**:904b–c/**9**:757g–758c
b. The French Indochina War to 1954; the Geneva Agreements of 1954 and civil wars in Vietnam, Laos, and Cambodia		**9**:759f–760e/ **10**:678c–e/ **19**:128h–129g	**3**:688d–f/**7**:678a–c
c. Nationalist movements in Algeria, Morocco, Tunisia, Egypt, and other Arab states: Israeli statehood (1948) and conflicts with the Arab states; the Western Powers and crises over Suez (1956) and in Lebanon (1958), Syria (1957), and Iran (1952–53); U.S. and Soviet influences in the Middle East		**9**:760e–761e/ **9**:762f–763a/ **6**:499e–500a/ **17**:960e–961h	**2**:837a–e/**9**:757d–e/ **9**:1059c–e/**13**:114f–h/ **13**:164g–166a/**13**:168a–c
d. Independence movements and socialism in the British, Belgian, and French colonies in sub-Saharan Africa: clashes between white settlers and black nationalists		**9**:757e–g/ 3:1098a–e/ 3:1099b–1011c/ **6**:102d–103b/ **19**:782f–785f	4:904f–h/ 17:295a–298g *passim*
e. Problems of economic development and sociopolitical change in the underdeveloped countries of Asia, Africa, and Latin America: native bourgeoisie and links with the capitalist world		9:756g–757c/ **4**:904h–905e/ **6**:208f–210e/ **6**:251e–253g/ **6**:261h–263e	
D. International relations since 1957	INTERNATIONAL RELATIONS (1945 to c. 1970) **9**:764–778		
1. Continued scientific and military rivalry between the U.S. and the Soviet Union: crises over atmospheric testing of nuclear weapons; problems of the continued arms race and spread of nuclear weapons technology; competition in the space race		**9**:764d–768a/ **11**:83f–85h/ **12**:896f–897g/ **15**:934h–935b/ 18:52g–53f/ 19:570e–571c	**16**:85a–d/**16**:88b–e/ **18**:996e–f/**19**:551f–553d/ **19**:569f–570c/ **19**:601a–602a ***passim***
2. Continued tension between the Soviet Union and other Communist countries in eastern Europe; the Sino-Soviet conflict and the growth of the influence of the People's Republic of China in the international Communist movement; extension of Chinese power into Tibet (1959), and conflicts with India		**9**:768b–773h/ **4**:1024h–1025d	**4**:395f–396d/**9**:424f–425b/ **16**:85d–g/**16**:87f–88b/ **18**:382e–g

	articles	article sections	other references
3. U.S. involvement in the Vietnam War and other U.S.-Southeast Asian relations; the role of Australia and New Zealand in the Southwest Pacific		9:767e–g/ 19:130a–131b	**2**:423g–h/**3**:688h–689c/ **10**:678h–679d/**13**:55c–e/ **16**:88c–e/**18**:997f–998a/ **18**:999d–g
4. The growth of Japanese economic power and influence in Asia, Europe, and the U.S.		**2**:703h–704e/ 5:187g–189a/ **10**:90e–91c	**6**:251c–d
5. Continued hostilities in the Middle East: renewed Arab–Israeli warfare and the extension of U.S.–Soviet rivalry into the conflict		9:775g–778a	6:500f–g/ **17**:961h–965b *passim*
6. Expansion of black African independence movements and continued resistance from white-governed African countries		9:767b–e/ 6:103b–109c	1:208a–209e/ **17**:295a–298g *passim*
7. Economic and political developments in western Europe: formation of the European Economic Community; tensions within NATO; French assertion of independence and leadership in Europe; attempts at rapprochement with Warsaw Pact powers; ambivalent role of Britain in Europe and the Commonwealth of Nations		**9**:773h–775g/ **5**:381c–383b/ **18**:557b–d	**3**:747c–748a/**11**:159h–160b
8. Socialist movements and social, economic, and political crises in Latin America		**9**:765g–767a/ **5**:383b–f	**3**:12f–h/**3**:148g–151e *passim*/ **3**:1113e–1114a/ **3**:1117f–1118d/ **4**:258d–259b/**4**:876g–877d/ **5**:357h–358h/**6**:292f–293b/ **14**:136a–f/**19**:70c–f
9. The functions of economic development and trade in international relations: the rise of an international economic system; the Common Market		9:777f–778c/ **4**:904h–905e/ 5:378e–379a/ **5**:381b–385c/ **6**:250d–251e/ **6**:253g–254a	7:32b–35a *passim*

Section 972. Europe since c. 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 6621

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*

	articles	article sections	other references
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; the Labour government under Wilson (1964–70); Conservative government under Heath after 1970; entrance into the Common Market (1973); developments in Scotland and Wales		3:279d–282e/ 3:305g–306g/ **5**:385b–c/ **9**:421f–423e	4:599g–600f/**18**:876a–893a
b. Developments in Ireland since c. 1920		**3**:292c–294a	
i. Division of Ireland and establishment of the Irish Free State and Northern Ireland (1922); the Cosgrove and De Valera governments; neutrality in World War II; entrance into the Common Market (1973); postwar domestic politics		**3**:292c–293f	**5**:624d–625a/**9**:884c–889a
ii. Northern Ireland since 1922: growing antagonism between Roman Catholics and Protestants; economic stagnation; continuing violence		**3**:293g–294a	**13**:237e–g/**13**:238g–242f
2. France since 1920	FRANCE, HISTORY OF 7:672–680		
a. From 1920 to the end of World War II		**7**:672e–677b	
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		**7**:672e–674e	**6**:177c–h
ii. Social, cultural, and economic developments under the Third Republic		**7**:674e–676a	**6**:379f–g
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)		**7**:676b–677b	**14**:153a–c/ **19**:980f–1007d *passim*/ **19**:1010c–e
b. The postwar period		**7**:677c–680c	
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		**7**:677c–678f/ **9**:759f–760e/ **19**:129b–g	**6**:379h–380d/**8**:982f–983a/ **13**:164g–166a
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		**7**:678f–680c/ **4**:650c–651c	**3**:748a–f/**5**:89e–f/ **7**:592c–611a/**7**:963g–965f/ **9**:774f–775d
3. Germany since 1920	GERMANY, HISTORY OF **8**:116–125		
a. From 1920 to the end of World War II		**8**:116e–121f/ **7**:185h–186d	**2**:850b–d
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		**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
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)		**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*
b. The postwar period		**8**:121f–125g	
i. Germany after World War II (1945–49): occupation by the Allies; partition between west and east zones		**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		**16**:334g–336h	
i. Finland: liberation from Russia (1918); parliamentary government; agrarian reform; growth of political parties; language problems; foreign policy and activities during World War 11; domestic and foreign policies in the postwar period		16:334g–336c	7:303h–309h
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**:336d–h	**9**:172h–175d
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		**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
8. Switzerland since 1920: Swiss neutrality in World War 11; immigration and economic policies		**17**:887b–f	**17**:875c–878f
B. Eastern and central Europe			
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
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Section 973. **The United States and Canada since** 1920

[for Part Nine headnote see page 563
for Division VII headnote see page 6621

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.

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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.

	articles	article sections	other references
A. Mexico since 1920	MEXICO, HISTORY OF 12:86–89		
1. Obregon's coup and Carranza's execution (1920); land reforms during Obregon's (1920–24) and Calles' (1924–28) regimes; rule by Calles' National Revolutionary Party (1928–34)		12:86b–e	3:874f–h
2. Cardenas' 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)		**12:86f–87b**	**3:874h–875c**
3. Mexico during World War II: economic and military cooperation with the United States; wartime industrialization		**12:87b–e**	
4. Mexico since 1945		**12:87e–89a**	
a. Economic and social development: the Party of Institutionalized Revolution and peaceful presidential successions; female suffrage (1958); foreign trade and industrialization		**12:87e–88c/ 3:319d–f**	**3:875c–e**
b. Urbanization and educational advancements; relations with the U.S. and other countries; social and economic planning in the 1970s		**12:88c–89a**	**12:72a–77c**
B. Central America and the Caribbean since c. 1920			
1. The Central American republics since c. 1920	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		3:1111d–h	8:456c–458e
b. Honduras since 1920: political unrest in the 1920s; Carias Andino's dictatorship (1932–49); administrations of Gálvez (1949–54), Lozano Diaz (1954–56), Villeda Morales (1957–63), Lopez 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 Sanchez Hernandez 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		

	articles	article sections	other references
a. Abortive attempts at democratic government amid renewed military dictatorships (1935–58); the Acción Democratica party's economic reforms		19:69h–70c	
b. Social and economic development during administrations of Betancourt (1959–64), Leoni (1964–69), and Caldera (from 1969)		**19**:70c–f	**19**:65h–67e
2. Colombia since 1930	COLOMBIA, HISTORY OF **4**:876–877		
a. Liberal Party rule (1930–46): social and land reforms during López' administrations (1934–38 and 1942–45)		4:876a–c	
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		**4**:876c–g	
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		**4**:876g–877d	**4**:870d–874g
D. Ecuador, Peru, and Bolivia since c. 1930			
1. Ecuador since 1925	ECUADOR, HISTORY OF 6:292–293		
a. Economic development and participation in World War II; loss of territory to Peru (1942)		**6**:292d–f	
b. Various administrations of Velasco Ibarra and other presidents after 1945; social and economic problems of the 1970s		**6**:292f–293b	**6**:287h–290f
2. Peru since 1930	PERU, HISTORY OF **14**:135–136		
a. The overthrow of Leguia (1930); Sanchez Cerro's administration (1931–33); the Aprista uprising and Sanchez Cerro's assassination; Benavides' administration (1933–39), social reforms, and the outlawing of the Apristas		14:135d–g	
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); Odria's military dictatorship (1948–56) and suppression of Apristas		**14**:135g–136a	
c. Re-legalization of Apristas and economic prosperity during Prado's second term (1956–62); military seizure of power (1962); social reforms of Belaunde-Terry's administration (1963–68); military rule after 1968; economic nationalism		**14**:136a–f	**10**:976g–979e/**14**:131d–133b
3. Bolivia since 1930	BOLIVIA, HISTORY OF **3**:11–12		
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		**3**:11h–12b	
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)		**3**:12b–d	
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		**3**:12d–h	**3**:6h–9d
E. Chile since 1920	CHILE, HISTORY OF **4**:257–259		
1. Chile from 1920 to 1938			

	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 Ibafiez del Campo (1927–31)		4:257c–e	
b. Economic crises during the 1930s: brief return to civilian rule under Montero Rodriguez; 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 Rios (1942–46): agrarian reforms; Chilean neutrality until 1942; economic prosperity		4:257f–h	
b. Gonzalez 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 Rodriguez (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 resurgence of Peronista forces; return of Perón (1973)		1:1150b–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

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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

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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.

	articles	article sections	other references
A. China since 1912	CHINA, HISTORY OF 4:366–402		
1. The development of the republic (1912–20)		**4**:366h–368g	**12**:375a–c
a. Early power struggles: Chinese involvement in World War I		4:366h–368d/ **19**:960a–c	
i. Japanese gains in the early part of the war: Yuan Shih-k'ai's attempts to become emperor		4:367c–g	10:81d–e/**19**:1098d–g
ii. Conflict over entry into the war; formation of a rival southern government; changes brought about by the war		**4**:367g–368d	**17**:811c–d
b. Modernization and the growth of nationalism: emergence of a new intelligentsia; riots and protests		**4**:368d–g	**4**:194d–g/**6**:388b–f/ **9**:66g–67c/**10**:1058c–g/ **11**:465g–466b
2. The interwar years (1920–37)		**4**:368h–372h	**4**:457c–f
a. The beginnings of a national revolution: the Kuomintang; the Chinese Communist Party; cooperation between the two parties		**4**:368h–369f	**4**:194g–195a/**11**:466b–e
b. Reactions to warlords and foreigners: militarism in China; the continued presence of foreign interests; reorganization of the Kuomintang		**4**:369f–370g	**10**:1014b–c/**17**:811d–f
c. Struggles within the two-party coalition: influence of Soviet Russia		**4**:370h–372a	
i. Outbreak of clashes with foreigners: Kuomintang opposition to the radicals		**4**:370h–371c	
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		**4**:371c–372a	**11**:466f–h
d. The Nationalist government from 1928 to 1937: Chiang Kai-shek's attempts to eliminate the Communists		**4**:372a–h	**4**:206d–h
i. Attempts at economic reform and failure in agriculture; educational reform; economic competition with the Japanese in Manchuria		**3**:372b–d	**6**:388f–389b/**11**:437g–438a
ii. Renewal of Japanese aggression: war between the Communists and Nationalists; the Long March; formation of the United Front against Japan		**4**:372d–h/ **11**:438a–e/ **19**:973e–g	**10**:84h–85c/**10**:1014c–e/ **11**:466h–467c
3. The war against Japan (1937–45)		**4**:372h–375h	**12**:375e–g
a. Communist–Nationalist cooperation in the early stages of the war; renewed conflict between the two groups		**4**:373a–374a	**11**:467c–468a
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		**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, detnocracy, and livelihood		**4**:380h–382g	**17**:811f–g
c. The political ideas of Chiang Kai-shek: idealization of Chinese tradition; the pattern of moral and social reconstruction		**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; reduction in Soviet influence		**4**:390a–391a/ **10**:513g–h	**11**:468a–e
ii. The transition to socialism (1953–57): rural collectivization; urban nationalization; foreign policy		**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; emphasis upon the history of the revolutionary struggle; China as a nuclear power		**4**:395b–396h/ **16**:85d–h	
iii. The Great Proletarian Cultural Revolution (1965–68): attacks on cultural leaders and party members; resistance to Peking; steps to end disruptions and end the Cultural Revolution		**4**:396h–399d	**4**:294a–295e/**6**:390a–e/ **10**:1014g–h/**11**:469b–e
iv. Reconstruction (1968–71): 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**:399d–400f	**11**:469e–f
d. International relations after the Cultural Revolution: UN representation (1971); rapprochement with the U.S. and Japan (1972)		**4**:402a–f	**18**:999c–e/**9**:773f–h
6. The Nationalist government on Taiwan since 1949: initial repression and consolidation; leadership of Chiang Kai-shek; alliance with the U.S. and economic growth; loss of UN representation (1971); Taiwanese separatism		**4**:400g–402a	**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 advent of terrorism; 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

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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 11-sung; industrialization; relations with the Soviet Union and the People's Republic of China		**10**:515f–516b	**10**:520a–522d

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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 6621

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.

articles	article sections	other references
A. India, Pakistan, Ceylon, Tibet, and Nepal since 1920		
INDIAN SUBCONTINENT, HISTORY OF THE 9:418–428		
1. India since c. 1920: nationalism and the decline of the raj	9:418d–423e	
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	9:418d–420d	3:53b–e/7:876h–877f/ 8:918h–919d/12:944g–945d/ 13:850b–g/13:1070d–g
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	9:420d–423e	3:53e–f/7:877f–878a/ 12:945d–h
2. India since 1947	9:423f–426b	
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	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
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	9:424f–426b	4:395f–g/10:30e–g/12:946c–f
3. Pakistan (1947–71); Pakistan and Bangladesh since 1971	9:426c–428f	13:899a–905b
a. National consolidation (1947–51) under Jinnah and Liaquat Ali Khan: economic and political instability	9:426c–427b	10:224f–g
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	9:427c–428f	2:692d–694a/6:404e–g/ 9:771c–d
4. Ceylon since 1920 (Sri Lanka after 1972)		
CEYLON, HISTORY OF 4:8–9		
a. Nationalism and the demand for constitutional reform (1920–31); the 1931 constitution; effect of World War II	4:8g–9a	
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)	4:9b–g	6:404b–d/17:521f–525c
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	18:381h–382g	18:374d–378c

	articles	article sections	other references
6. Nepal: British withdrawal (1947) and revival of Nepalese royal control under Tribhuvan (1951–55) and Mahendra (1955–72); domestic politics		**12**:957h–958b	**12**:953h–956g
B. Mainland Southeast Asia since 1920			
1. Burma since 1920	BURMA, HISTORY OF **3**:514–515		
a. Emergence of Burmese nationalism and the British response (1920–37); limited constitutional government (1937–42); the Japanese occupation (1942–45)		**3**:514f–515c/ 19:1009f–1010b	19:1005d–e
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		**3**:515c–g	**3**:504b–510a/**6**:403h–404b
2. Malaya and Singapore since 1920	MALAYA, HISTORY OF **11**:367–368		
a. British economic policies in Malaya; Japanese occupation (1941–45); British return to power (1945) and progress toward self-government		**11**:367c–368c	
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		**11**:368c–e	**6**:404d–e/**10**:640g–641a/ **10**:772d–h/**11**:376d–377b/ **11**:378e/**16**:784d–f/ **16**:786c–789a
3. Thailand since 1920	SIAM AND THAILAND, HISTORY OF **16**:722–723		**6**:405c–d
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		**16**:722f–723a	
b. Loss of wartime gains and political instability; military government (1957–63); growth of U.S. military presence since 1965		**16**:723a–c	**18**:202b–205e
4. Indochina since 1920: emergence of independent states and continued strife	VIETNAM, HISTORY OF **19**:127–131		**6**:405d–g
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		19:127a–129b/ 10:678c–d	**3**:688b–d/**7**:678a–c/ **8**:981h–982d
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		**19**:129b–130a/ **9**:759f–760e	**8**:982e–983a/**10**:678d–f
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)		**19**:130a–131b/ **19**:596a–597a	**9**:767e–g/**18**:997f–998a/ **19**:138b–e/**19**:140a–144f
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)		**19**:130f–131b	**8**:628g–h/**8**:983b–f/ **19**:131f–h/**19**:132e–138a
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	LAOS, HISTORY OF 10:678–679		**10**:674a–676h

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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

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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 and economic development since 1945: the treatment of Aborigines; European immigration; Labor Party government to 1949 and Liberal–Country coalition governments (1949–72); return to Labor government control (1972); relations with the U.S. and influence in Southwest Pacific and Asia		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

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PACIFIC ISLANDS 13:826
PACIFIC ISLANDS, TRUST TERRITORY OF THE 13:831
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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 Atatiirk. 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.

	articles	article sections	other references
A. Turkey since 1919; Cyprus since 1920	OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE 13:790–795		
1. The War of Independence (1919–23) and the development of the Turkish nation under the leadership of Mustafa Kemal Atatiirk		13:790f–791c	2:256e–257e
2. Ataturk's one-party government: secularization; social and economic reforms		13:791c–h	2:257b–d
3. Turkey since 1938: World War II and the postwar period; the republic since 1961		13:792a–795e	
a. Wartime neutrality until alignment (1945) with the Allies: postwar problems with the Soviet Union; political developments		13:792a–f	
b. Turkey under the Democrats (1950–60): economic growth and political repression		13:792f–793b	
c. The army coup (1960) and political, economic, and social developments: foreign policy		13:793c–795e	18:786c–791e
4. Cyprus since 1920: British administration to 1960; the Republic of Cyprus; political disunity over the *énosis* question	CYPRUS, HISTORY OF 5:408–409		5:403c–405g
B. Development of the Arab states and Israel in Southwest Asia and Egypt	SYRIA AND PALESTINE, HISTORY OF 17:955–965		
1. The Arab lands of Southwest Asia under the mandate system		17:955g–960g	
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)		17:956h–957h/ 17:959a–960a	5:448d–e
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)		11:995d–997f	
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)		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; the Chehab (1958–64) and Helou regimes (1964–70); the economy; foreign relations		**17**:962e–963g	**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		**17**:961b–962e	**17**:923b–926a
c. 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
d. 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**:960a–961b/ **17**:963h–965b	
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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 Britnnnicn 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 discipiines 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.

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II. Mathematics 699
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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.

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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.

articles	article sections	other references
A. History of logic		
LOGIC, HISTORY OF **11**:56–72		
1. Ancient logic	**11**:57c–60e	**6**:526g–527c *passim*/ **16**:1004d–e
a. Precursors of ancient logic: contributions of the Sophists, Socrates, and Plato to theories of language and the axiomatic method	**11**:57c–g	
b. Aristotle and the logic of predicates: theories of the structure of language; theories of opposition and conversion; development of syllogistic and modal logic	**11**:57g–59c/ **1**:1155f–1156c/ **17**:890f–g	**1**:1167a–g
c. Later developments in the logic of predicates: contributions of Theophrastus and Galen	**11**:59c–f	
d. Founding of the logic of propositions: contributions of Theophrastus and the Megarians; Stoic logic	**11**:59f–60d	1:1156d–e/ 17:698d–699e *passim*
2. Medieval logic	**11**:60f–62e	10:1175b–e/ **14**:257b–261a *passim*
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	**11**:60f–61b/ **9**:1021a–1022d	1:1156e–1159h *passim*/ 16:352g–357a *passim*
b. Medieval theories of language and their relation to the development of logic: the theory of categorematic and syncategorematic terms; the theory of supposition	**11**:61b–e/ 15:801b–c	
c. Medieval developments in formal logic: the logic of medicates. of propositions. and of modal expressions: logical fallacies and paradoxes	**11**:61f–62e	
3. Modern logic from the Renaissance to the 20th century	**11**:64a–69a	**1**:801e–g
a. Logic in the Renaissance: the influence of Neoplatonism and of the rise of the naturai sciences; the logics of Petrus Ramus and of Port-Royal	**11**:64a–d	**2**:565a–e
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	**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** 6941

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. Teniporal 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
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LEŚNIEWSKI, STANISLAW **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-

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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.1.1]		**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; modem 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. Hert, 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.

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
A. Set theory		
1. Origins of set theory and the definitions of a set and a set element, or member		
SET THEORY 16:569–575	**11**:53b–54b	
	16:569b–d	
2. Introduction to set theory		
a. Fundamental set concepts	**16**:569d–571d	**11**:53b–f
i. Operations on sets; *e.g.*, union of sets, intersection of sets	**16**:569d–570c	
ii. Logical relations between sets; *e.g.*, "is a subset of," "is in one-to-one correspondence with"	**16**:569e–g	
b. Essential features of Cantorian set theory	**16**:569g–570c	
i. The principles of extension and abstraction: definition of a set by enumeration or by description of its members	**16**:570c–571d	
ii. The concept of equivalent sets	**16**:570c–f	
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	**16**:570f–g	
	16:570h–571d/ **1**:776c–f/ **11**:632a–633a	**11**:68f–69a
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.]	**16**:571d–575a	**11**:53f–54b/**11**:71c–g
a. Postulates of axiomatic set theory: the Zermelo–Fraenkel axioms; the von Neumann–Bernays–Godel axioms	**16**:571e–574b	
b. Limitations of axiomatic set theory: failure of attempts to prove the consistency of axiomatic set theory; Gödel's theorem	**16**:574b–e	
c. The present status of axiomatic set theory: profound changes in axiomatic set theory as a result of recent discoveries	**16**:574f–575a	
B. Algebra		
1. Arithmetic		
ARITHMETIC **1**:1171–1178		
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	**1**:1171g–1172h	**1**:499d–h
b. Theory of divisors: extension of natural number concepts to non-integers; fractions resulting from the binary operation of division	**1**:1172h–1174h/ **1**:774b–775c	
i. The fundamental theorem of arithmetic: rational numbers comprising the integers and fractions; operations with fractions	**1**:1173b–1174a/ **1**:774f–g	
ii. Irrational numbers: numbers that cannot be expressed as rational fractions	**1**:1174b–h/ **1**:774h–775c	
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.]	**1**:1174h–1176e	
d. Arithmetic calculation with decimals: binary operations with decimals; divisibility rules; calculation of square, cube, and higher roots	**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 rth 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 Schlafli, 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. Combinatonal 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/ I: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: nth-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, Schrodinger'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 eauations, 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 eauations: 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 Mobius 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 Konigsberg 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: Mi 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 Poincare 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.1		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.1		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-differenceequations		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-differenceequations		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	

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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	

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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	
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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
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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	

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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 auantum 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.1		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	

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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

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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
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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

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	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
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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	
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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

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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 7251

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.

	articles	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

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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	

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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

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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.l		**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 rnicropaleontology; 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 7251

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		
A. Development of the biological sciences	**2**:1016g–1020b/ **4**:684f–685a	
1. Origin and early development of biological ideas	**2**:1016h–1017c	**14**:115d–e
a. Early views of life and living things; *e.g.*, Assyria, Babylonia, Egypt, China, India	**2**:1017c–1018f	**1**:1168e–g/**3**:66a–c/**4**:684f–h/ **7**:849f–h/**14**:572c–g/ **19**:1163h
b. Biology in the Greco-Roman world: theories about man and the origin of life; Aristotelian concepts of classification, reproduction, [illegible], and descent; [illegible] initial [illegible] discoveries	**2**:1018f–1019c	
c. Biology in the Middle Ages: the influence of Arabian biologists; the development of botany and zoology as separate disciplines; further discoveries in anatomy	2:1019c–1020b	**4**:684h–685a/ **8**:131b–132a *passim*/ **10**:816c–f/ **19**:94d–95c *passim*
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	2:1020b–1025c	
2. Developments in the biological sciences in the 17th, 18th, and 19th centuries	**2**:1020b–1023c	
a. Biology in the 17th and 18th centuries	**2**:1020c–d	**8**:662a–c/**11**:388d–389e
i. The discovery of the circulation of blood	**2**:1020d–f	
ii. The establishment of scientific societies	**2**:1020f–1021h/ **12**:127g–128d	**3**:66e–f/**3**:1058e–g/ **10**:773b–g/**12**:109f
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.

A. History of medicine

articles	article sections	other references
MEDICINE, HISTORY OF 11:823–840		5:684c–685a
1. Early medicine: Western medicine before 1800; Oriental medicine before ***c.*** 1900	**11**:823c–831d	**14**:607b–g
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.

	articles	article sections	other references
A. Development of the social sciences	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:**1041**c–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		
1. Emergence of the technological sciences		18:19g–20e	
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		**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
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. Islamic 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:llb–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 Islamic 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

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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

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Division V. Philosophy

[for **Part Ten** headnote **see page** 6941

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 rhese 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.

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10/52. History of philosophy 767
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Section 10/51. The nature and the divisions of philosophy

[for **Part Ten** headnote **see page** 6941

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

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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**:610b–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

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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		
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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
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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	

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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*
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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

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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*/ 11:375h–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 3551		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
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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

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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
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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	

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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 7601

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 Islamic 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, Jbdo, 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 Nirvana 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 Vedanta: 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 Islamic 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, Jbdo (Pure Land), and Nichiren sects; tendencies in Shintb 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 Shinto; 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. Islamic philosophy	ISLÂMIC 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 philosophical school and 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	
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A.F.Sh. Arthur Frank Shore. *Assistant Keeper, Department of Egyptian Antiquities, British Museum, London. Author of* Portrait Painting from Roman Egypt.
VISUAL ARTS, WESTERN *(in part)*

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. Andre 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. *Charles Seymour Professor of History, Yale University. 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 Science Programs; Head Psychophysiology Department, Naval Aerospace Medical Institute, Department of the Navy, 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.
NORTH AMERICAN PLATEAU INDIANS

A.G.C. André George Corhet. *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. *Metropolitan Editor,* The New York Times. *Co-author of* O'Neill.
O'NEILL, EUGENE *(in part)*

A.G.H. A. Gordon Hammer. *Professor of Applied Psychology, University of New South Wales, Sydney, Australia. Author of* Elementary Matrix Algebra for Psychologists and Social Scientists.
HYPNOSIS *(in part)*

A.G.Ha. Rev. Adalbert G. Hamman. *Professor at Patristic Institute, Rome. Editor,* Patrologiae Latinae Supplementum. *Author of* La Priere; La Vie quotidienne des premiers chrétiens; *and others.*
PRAYER

A.Gi. Alexander Gillies. *Emeritus Professor of German Language and Literature, University of Leeds, England. Honorary Life Member, Modern Humanities Research Association. 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 *and others.*
WILLIAM I THE SILENT, PRINCE OF ORANGE

A.G.L. Andrew George Lehmann. *Professor of French, University of Warwick, Coventry, England. Author of* Sainte-Beuve: A Portrait of the Critic: The Symbolist Aesthetic in France.
SAINTE-BEUVE, CHARLES-AUGUSTIN

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MONOTREMATA

Ag.M. Agnes Mongan. *Curator of Drawings, Fogg Art Museum, Horvard 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. *Lecturer in Inorganic Chemistry, Queen Mary College, University of London. 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; President of the Catholic University of Nijmegen, The Netherlands. Author of* From Atomos to Atom *and others.*
ATOMISM

A.Gn. Alfonz Gspan. *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, the State University, New Brunswick, New Jersey. Translation editor of* Glass-Ceramics and Photo-Sitalls.
CERAMICS, INDUSTRIAL

A.G.W. A. Geoffrey Woodhead. *Fellow of Corpus Christi College, Cambridge; Lecturer in Classics, University of Cambridge. Member, Institute for Advanced Study, Princeton, New Jersey, 1968–72. Author of* The Greeks in the West; The Study of Greek Inscriptions; *and others.*
CHRONOLOGY *(in part)*
SYRACUSE

A.G. y B. Antonio Garcia 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 peninsula Iberica *and others.*
SPAIN, HISTORY OF *(in part)*

A.H. Anthony Hallam. *University Lecturer in Geology, University of Oxford. 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 of Greek, University of Liverpool. Editor of* The Cambridge History of Later Greek and Eariy Mediaeval Philosophy; *translator of* Plotinus.
PLATONISM AND NEOPLATONISM
PLOTINUS

A.H.Ao. Anselm H. Amadio. *Staff Writer, Philosophy and Religion,* Encyclopaedia Britannica, *Chicago, 1970–73. Lecturer in Philosophy and the History of Religion, Holy Cross College, Canon City, Colorado, 1959–65.*
ARISTOTLE
PALAMAS, SAINT GREGORY

A.H.B. Addeke Hendrik Boerma. *Director General, Food and Agriculture Organization of the United Nations, Rome.*
FOOD SUPPLY OF THE WORLD

A.H.C. Arthur Herbert Cook. *Director, Brewing Industry Research Foundation, Nutfield, England. 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* Sterne's Comedy of Moral Sentiments; *co-editor of* The Winged Skull: Papers from the Laurence Sterne Bicentenary Conference.
STERNE, LAURENCE

A.He. Antony Hewish. *Reader in Radioastronomy, University of Cambridge; Fellow of Churchill College, Cambridge. Co-author and editor of* Seeing Beyond the Visible.
PULSAR

A.H.E. Archie H. Easton. *Professor of Civil and Mechanical Engineering; Director,*

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TRUCKS AND BUSES

A.H.F. 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,* Food and Drink Weekly, *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. *Fellow of Clare College, Cambridge; Lecturer in Ancient History, University of Cambridge. Author of* Republican Rome; *editor of* Oxford Text of Livy, *Vol. V.*
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 Specialisr 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. *Head Librarian, Johannesburg Public Library. Director, Africana Museum, Johannesburg. Author of* Pictorial History of Johannesburg.
JOHANNESBURG

A.H.St. Alan Howard Stratford. *Partner, Alan Stratford and Associates (air transport consultants), Maidenhead, 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

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 paleontology and stratigraphy who contributed to the preparation of Silurian correlation charts for many parts of the world.*
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.** *Associate Physicist, Argonne National Laboratory, Argonne, Illinois.*
NEUTRON

A.J.H. Arlen J. Hansen. *Associate 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, Pennsylvania State University, University Park. 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. Honorary Director, Beaverbrook Library, London. 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 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 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. *Director of Studies, Royal Institute of International Affairs, London, 1925–55. Research Professor Emeritus of International History, University of London. Author of* A Study of History *and many others.*
CAESAR, JULIUS
TIME *(in part)*

A.J.V. Alan John **Villiers.** *Free-lance writer. 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. Assistant Professor of 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 in the Jerusalem Archbishopric. Bye Fellow of Gonville and Caius College, University of Cambridge. Author of* Counsels in Contemporary Islam *andothers.*
ḤADĪTH

A.K.Ca. Alan K. Campbell. *Dean, Maxwell Graduate School of Citizenship and Public Affairs, Syracuse University, New York. Author of* The States and the Urban Crisis.
NEW YORK (STATE)

A.K.Ch. **Abdel** Kader Cbanderli. *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 other classic works on the art of South and Southeast Asia.*
METALWORK *(in part)*

A.K.H. A. Kent Hieatt. *Professor of English, University of Western Ontario, London. Author of* Short Time's Endless Monument: The Symbolism of the Numbers in Edmund Spenser's Epithalamion; *co-editor of Spenser's* Selected Poetry.
SPENSER, EDMUND

A.Kn. Arthur Knight. *Professor of Cinema, University of Southern California, Los Angeles. Contributing Editor (Films),* The Saturday Review. *Author of* The Liveliest Art; The Hollywood Style.
CHAPLIN, CHARLIE

A.K.N. A.K. Narain. *Professor of History and Indian 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. *Associate Director of the Solar Division, Kitt Peak National Observatory, Tucson, Arizona.*
SUN *(in part)*

A.K.Pa. Andrew K. Pawley. *Associate 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 Linguistics, University of Chicago. Author of* Speaking of Siva *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. *Consultant, Regional Planning Consultation. 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 Surrealisme au cinema; 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* L'histoire du Maghreb.
MOROCCO

A.L. al-S.M. **Afaf** Lutfi **al-Sayyid Marsot.** *Associate 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, Australia. Author of* Studies in Indian History and Culture *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 Laboratory; 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; *author of numerous articles on Antarctic oceanography.*
DRAKE PASSAGE

Al.Ge. Alan Gewirth. *Professor of Philosophy, University of Chicago. Author of* Marsilius of Padua and Medieval Political Philosophy.
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 Economic 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, Stanford Research Institute, Menlo Park, California. Investigator of cavern development through experimental and theoretical studies. Editor of* Cave Studies.
CAVES AND CAVE SYSTEMS

A.L.La. Arthur Lon Labanauskas. *Research Editor, Science,* Encyclopædia Britannica, *Chicago.*
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. Editor of* Folk Song in England *and others.*
POPULAR MUSIC

A.L.M. **Akinlawon Ladipo Mabogunje.** *Professor of Geography; Dean, Faculty of Social Sciences, University of Ibadan, Nigeria. Member, United Narions Research Institute for Social Development. 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, 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* The Profintern: Communism and World Labor.
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 frangaise *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.** *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)*

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VISUAL ARTS, WESTERN *(in part)*

A.M.B. Alfred M. **Beeton.** *Professor of Zoology; Associate Director, Center for Great*

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GREAT LAKES
GREAT SALT LAKE

A.M.-C. **Arturo Morales-Carrión.** *Director, Historical Research Centre, University of Puerto Rico, Rio Piedras. Author of* Puerto Rico and the Non-Hispanic Caribbean.
PUERTO RICO

A.M.C.L. Agnes M.C. **Latham.** *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. *Head, Department of Cultural and Social Sciences, Scientific Film Institute, Göttingen, West Germany. Author of* Studien zur Ethnogenese bei den Mangbetu.
AFRICAN PEOPLES, ARTS OF *(in parr)*

A.M.G. Alan M. Gaines. *Assistant Professor of Geochemistry, University of Pennsylvania, Philadelphia.*
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 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. *Lecturer 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)*

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PRIPET MARSHES

A.M.Ma. Abraham M. Max. *Professor of Mechanical Engineering; Chairman, Department of 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* Mirovoyi 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, Laboratory of Molecular Embryology, National Research Council, 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 parr)*

A.M.Q. Anthony M. **Quinton.** *Lecturer in Philosophy, University of Oxford; Fellow of New College, Oxford. Author ofnumerous articles in pkilosophicaljournals; editor of* Political Philosophy.
EMPIRICISM

A.M.Sl. Axel Mose **Sløk.** *Academic Secretary, Department of Economics and Statistics, Danish Employers' Confederatiort, Copenhagen. Vice Chairman, Danish Council of International Development Cooperation. Co-author and editor of* The Danish Legislation 1968–1971.
DENMARK

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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. *Professor of Japanese History of Education, University of Tokyo. Author of* The Formation of the Modern Textbook System.
EDUCATION, HISTORY OF *(in part)*

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ARABIAN SEA

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NOVEL

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MALRAUX, ANDRÉ

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SOUTH AFRICA *(in part)*

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ALPINE FOLK CULTURES

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WHITMAN, WALT

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DANDOLO, ENRICO

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TRINIDAD AND TOBAGO *(in part)*

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MASHRIQ, CULTURES OF THE

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ISLĀMIC MYSTICISM
ISLĀMIC MYTH AND LEGEND
ISLĀMIC PEOPLES, ARTS OF *(in part)*
JALĀL AD-DĪN AR RŪMĪ

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CARRIAGE OF GOODS, LAW OF
PROPERTY, LAW OF

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CARLYLE, THOMAS
SCOTT, SIR WALTER

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KARA SEA *(in part)*
LAPTEV SEA *(in part)*

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CENOZOIC ERA

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ABRAHAM

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DNEPR RIVER
DNESTR RIVER
DVINA RIVER, WESTERN

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RIO DE JANEIRO (STATE)

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BEAUFORT SEA
BERING SEA AND STRAIT

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AMUR RIVER
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EUROPEAN LAW, MEDIEVAL

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PROPERTY TAX (*in part*)

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CAMPING

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BRAMANTE, DONATO

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OILS, FATS, AND WAXES *(in part)*

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PEPYS, SAMUEL

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THEMISTOCLES

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CROCE, BENEDETTO

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BELGIUM

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JUDAISM, HISTORY OF *(in part)*

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DAMASCUS
SYRIA *(in part)*

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SCHOPENHAUER, ARTHUR

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HARMONY

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STRAUSS, RICHARD

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HETEROCYCLIC COMPOUNDS

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COMMON LAW

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DISEASES OF PLANTS (*in part*)

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GUINEA, GULF OF

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LASER AND MASER

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WEBER, MAX

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EDWARD IV OF ENGLAND
HENRY VII OF ENGLAND

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IGNEOUS ROCKS, EXTRUSIVE

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NUMERICAL ANALYSIS (*in part*)

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CRAIG, EDWARD GORDON

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CAMBRIAN PERIOD

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SHORTHAND

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BLOOD CIRCULATION, HUMAN

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Reviewer: LITERATURE, WESTERN *(in part)*

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AMAZON RAIN FOREST

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CENTRAL AMERICAN STATES, HISTORY OF *(in part)*

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BRITAIN AND IRELAND, HISTORY OF *(in part)*
COBDEN, RICHARD

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CARTIER-BRESSON, HENRI

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WEED CONTROL

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RAMEAU, JEAN-PHILIPPE

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SOAPS AND DETERGENTS

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AŚOKA

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FABLE, PARABLE, AND ALLEGORY (*in part*)

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TRUMAN, HARRY S.

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ISLĀMIC PEOPLES, ARTS OF (*in part*)

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GRACCHI, THE

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ARGENTINA

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AARON

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FAIDHERBE, LOUIS

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UNITED STATES, HISTORY OF THE *(in part)*

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MUNCH, EDVARD

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FELLINI, FEDERICO

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POLLUTION CONTROL *(in part)*

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PAŠIĆ, NIKOLA

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SIMPSON, GEORGE GAYLORD

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CHEMICAL INDUSTRY

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PARTICLES, SUBATOMIC *(in part)*

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ANGIOSPERM

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ELIOT, T.S.

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TURKEY *(in part)*

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PISA
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RAVENNA

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BERGSON, HENRI *(in part)*

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CONTRACTS, LAW OF

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AFRICAN PEOPLES, ARTS OF *(in part)*

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TILLICH, PAUL

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CORACIIFORMES

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MAURITIUS

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ASCETICISM
EASTERN CHRISTIANITY, INDEPENDENT CHURCHES OF

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UNITED NATIONS *(in part)*

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FISHING, COMMERCIAL

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ARMOUR

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EDDINGTON, SIR ARTHUR STANLEY

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POGONOPHORA

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VISUAL ARTS, WESTERN *(in part)*

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BALKHASH, LAKE

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BALTIC STATES, HISTORY OF THE

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MUSICAL CRITICISM

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SAND SHEETS AND SAND DUNES

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ARTIODACTYLA

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THUCYDIDES

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SCORPAENIFORMES

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ACTON, LORD

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MATHEMATICS, HISTORY OF *(in part)*

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PHILOSOPHY, HISTORY OF WESTERN *(in part)*

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HORSE

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ZINC PRODUCTS AND PRODUCTION

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DICTIONARY

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OPTIMIZATION, MATHEMATICAL THEORY OF *(in part)*

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EPIC

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ANALYSIS, FOURIER *(in part)*

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ASQUITH, H. H.
DISRAELI, BENJAMIN
LLOYD GEORGE, DAVID

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ARKANSAS

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KARA-KUM DESERT

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IRRIGATION AND DRAINAGE

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CLAIR, RENÉ

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IDAHO

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COPYRIGHT LAW

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HEALTH AND DISEASE, ECONOMICS OF

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TARIFFS *(in part)*

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LADOGA, LAKE
ONEGA, LAKE

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RATIONALISM

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MAGNETISM

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SHANGHAI
SHANSI
SHANTUNG
TIENTSIN
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THAR DESERT *(in part)*

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GUNNERY *(in part)*

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BULLFIGHTING

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CIVIL SERVICE *(in part)*

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ATLANTIC OCEAN *(in part)*

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DISNEY, WALT

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RAY, RAMMOHAN

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RED SEA *(in part)*

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AUSTEN, JANE

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BOATING AND YACHTING *(in part)*

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GALVANI, LUIGI

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EZEKIEL

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ATHENS *(in part)*
DUBLIN
EDINBURGH
FLORENCE
ISTANBUL
LISBON
LONDON
MADRID
MARSEILLE
NAPLES
PARIS
ROME *(in part)*
THAMES RIVER
VENICE
VIENNA

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BILLIARD GAMES

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FERMI, ENRICO

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ASTRONOMY AND ASTROPHYSICS

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OTTO, RUDOLF

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PHOTOGRAPHY, ART OF

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GREEK LANGUAGE *(in part)*

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GALAXY, THE

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HIGHER EDUCATION

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RHODE ISLAND

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COMBINATORICS AND COMBINATORIAL GEOMETRY *(in part)*

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SOUTH ASIAN PEOPLES, ARTS OF *(in part)*

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O'NEILL, EUGENE *(in part)*

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MEMPHIS (EGYPT)

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JAZZ

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BEGONIALES

B.G.Sa. Bernard G. Saunders. *Associate Editor, Physics,* Encyclopædia Britannica, *Chicago, 1970–73.*
MAGNETIC RESONANCE *(in part)*

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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EVERGLADES

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PETROLEUM AND GAS EXTRACTION

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KOREA, HISTORY OF *(in part)*

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REFRIGERATION EQUIPMENT

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ELEMENTS, GEOCHEMICAL DISTRIBUTION OF

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MESOZOA

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NORTH AFRICA, HISTORY OF *(in part)*

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DAIRYING AND DAIRY PRODUCTS

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DEVELOPMENT, ANIMAL

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AIR LAW

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LAGOS

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SONATA

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SENSORIMOTOR SKILLS

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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; Director, Institute of Optics, University of Rochester, New York. Author of* Physical Optics Notebook.
OPTICS, PRINCIPLES OF *(in part)*

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MEMORY: RETENTION AND FORGETTING

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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.*
BLACKSTONE, SIR WILLIAM

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SAUDI ARABIA

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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.

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FĀṬIMIDS

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CHEMICAL SEPARATIONS AND PURIFICATIONS

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PROPAGANDA

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FABALES

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ARCHIMEDES
EUCLID

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ICELAND *(in part)*

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METALWORK (*in part*)

B.M.H. Bernice Margaret Hamilton. *Senior Lecturer in Politics; Provost of Alcuin College, University of York, Heslington, England. Author of* Political Thought in 16th-Century Spain.
VITORIA, FRANCISCO DE

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P'YŎNGYANG
VIETNAM, NORTH

B.M.M. Barbara Mary Middlehurst. *Associate Editor, Astronomy,* Encyclopædia Britannica, *Chicago, 1968–72. Co-editor of* Moon, Meteorites and Comets.
TIDES (*in part*)

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LITERATURE, WESTERN: *Swedish (in part);*
STRINDBERG, AUGUST

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CIVILIZATION AND CULTURAL EVOLUTION

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FOLK MUSIC

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TRACK-AND-FIELD SPORTS

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PATNA AND PĀṬALIPUTRA
TAXILA

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JEWISH PEOPLES, ARTS OF (*in part*)

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CONSTANTS, PHYSICAL

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NOVA SCOTIA
PRINCE EDWARD ISLAND

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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*)

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GANDHI, MAHATMA

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GREEK CIVILIZATION, ANCIENT (*in part*)

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CHRISTIAN SCIENCE
MORMONISM

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LITERATURE, WESTERN: *Icelandic (in part)*

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CHONDROSTEI (*in part*)

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CYPRUS, HISTORY OF (*in part*)

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TELEPHONE AND TELECOMMUNICATIONS SYSTEMS (*in part*)

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PLASMA STATE

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MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

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NATURAL GAS (*in part*)

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LACTATION, HUMAN

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PHYSIOLOGY

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UNITED KINGDOM

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BIOCHEMISTRY (*in part*)

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KOLMOGOROV, A.N.

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METALWORK (*in part*)

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TYLOR, SIR EDWARD BURNETT

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ARNOLD, MATTHEW
BUTLER, SAMUEL
LITERATURE, WESTERN: *English; 19th century*
WORDSWORTH, WILLIAM

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METEOROLOGICAL MEASUREMENT

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CECIL, WILLIAM, LORD BURGHLEY

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LITERATURE, EAST ASIAN (*in part*)

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ROBERT I THE BRUCE, OF SCOTLAND

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POISONOUS ANIMALS AND PLANTS

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CONFECTIONERY AND CANDY PRODUCTION (*in part*)

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METAPHYSICS (*in part*)

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MAIMONIDES, MOSES

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COMET

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THOREAU, HENRY DAVID

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ATLANTIC OCEAN (*in part*)

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SENEGAL

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SOIL ORGANISM

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SENSORY RECEPTION

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ANTISEPTIC AND GERMICIDE

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FOCH, FERDINAND

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DEÁK, FERENC
HUNGARY, HISTORY OF
KOSSUTH, LAJOS

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INTERNATIONAL RELATIONS, THEORIES OF

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LAGOONS

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CALENDAR *(in part)*
COPERNICUS
HIPPARCHUS
PTOLEMY
RUSSELL, HENRY NORRIS

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NUMBER THEORY *(in part)*

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RADIATION, BIOLOGICAL EFFECTS OF

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LITERATURE, WESTERN: *Greek*

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MUTATION

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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)*

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KALAHARI (DESERT) *(in part)*

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EULER, LEONHARD
FERMAT, PIERRE DE

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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)*

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BRASÍLIA

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EARTH, GEOLOGICAL HISTORY OF

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PIPERALES

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HUXLEY FAMILY

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HEMICHORDATA

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METALWORK *(in part)*

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SULFUR PRODUCTS AND PRODUCTION

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FORTIFICATIONS *(in part)*

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MASONRY CONSTRUCTION

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ANALYSIS, FUNCTIONAL *(in part)*

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SAN MARINO

C.C. Claude Cahen. *Professor of Islāmic History, University of Paris. Author of* La Syrie du nord a l'époque des croisades *and others.*
ALP-ARSLAN
SYRIA AND PALESTINE, HISTORY OF *(in part)*

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EARTH SCIENCES
UNIFORMITARIANISM

C.C.B. Charles Calvert Bayley. *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 Plankta.
CTENOPHORA

C.Ce. Charles Cestre (d. *1959). Professor of American Literature and Civilization, University of Paris, 1917–42. Author of* Histoire de la littérature americaine *and others.*
POE, EDGAR ALLAN *(in part)*

C.Ch. Charles Chadwick. *Professor of French, University of Aberdeen, Scotland. Author of* Mallarme, sa pensée dans sa poesie; Symbolism.
MALLARMÉ, STÉPHANE

C.Ck. Cecily Clark. *Editor of* The Peterborough Chronicle *1070–1*154.
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 Miller. *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

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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 Dail Eireann (lower house of the Irish Parliament), Dublin. Author of* Parnell and His Party.
PARNELL, CHARLES STEWART

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SHIP DESIGN AND CONSTRUCTION *(in part)*

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CORNALES
GERANIALES

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EPICUREANISM
EPICURUS

C.D.C. Charles D. Calnan. *Professor of Dermatology, Institute of Dermatology, University of London. Editor, Transactions of St. John's Hospital Dermatological Society and "Contact Dermatitis Newsletter."*
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, the XIVth, XVth, XVIth Centuries.
SLUTER, CLAUS

C.De. Charles **Dédéyan.** *Professor and Head, Department of Comparative Literature, University of Paris. 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 Paraiba, João Pessoa.*
PARAÍBA

C.D.G. C. David Gutsche. *Professor and Chairman, Department 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.

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JUNGLES AND RAIN FORESTS *(in part)*

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HENRY V OF ENGLAND

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MOUNTAINEERING *(in part)*

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TOKUGAWA IEYASU

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CALIPHATE, EMPIRE OF THE

C.E.B.B. Charles Edmond Bradlaugh Banner. *Principal Curator, Conservatory and Botanical Garden, Geneva. Author of* Index Hepaticarum.
EBENALES *(in part)*

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ORE DEPOSITS

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RIDING AND HORSEMANSHIP

C.E.Ca. **Concepción** E. Castaiieda. *Associate Professor of Geography, Millikin University, Decatur, Illinois. Professor of Geography, University of Havana, 1960–62.*
SÃO FRANCISCO RIVER

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DISEASES OF ANIMALS

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ENGLISH CHANNEL

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VARIATIONS, MUSICAL

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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

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COLONIALISM *(c. 1450–c. 1970) (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

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ATHEISM

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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 VI.
UGARIT

C.Fe. **Cyrille** Felteau. *Editorial and News Writer of* La Presse, *Montreal.*
MONTREAL

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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

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BORROMINI, FRANCESCO

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PUBLIC UTILITIES, U.S.

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EARTHQUAKES

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FINLAND
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)*

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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)*

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COLOMBIA

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CANCER

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SEYCHELLES (*in part*)

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ONCOPOD

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ALABAMA

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CARNAP, RUDOLF

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KANSAS

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BAHRAIN
SYRIA *(in part)*

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PEISISTRATUS

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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.*
JAURÉS, JEAN

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CHEMICAL ENGINEERING

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MICROCLIMATES

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PACIFIC OCEAN

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ORCHIDALES

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MONTGOLFIER, JACQUES-ÉTIENNE AND JOSEPH-MICHEL

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NEAR EASTERN RELIGIONS, ANCIENT
SOLOMON

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DYESTUFFS AND PIGMENTS

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BRIDGE
CARDS AND CARD GAMES

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WRIGHT, ORVILLE AND WILBUR

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FURNITURE INDUSTRY

C.H.Ho. Cyrus Henry Hoy. *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 I1 Duce; *and others.*
MUSSOLINI, BENITO

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CALENDAR (*in part*)

C.H.L. Clarence H. **Lorig.** *Consultant, Battelle Memorial Institute, Columbus, Ohio; Assistant Director, 1947–65. Author of* Copper as an Alloying Element in Steel and Cast Iron.
METALLURGY

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CREATION, MYTHS AND DOCTRINES OF

C.H.P. Clifford **Hillhouse** Pope. *Science writer. Curator, Division of Reptiles and Amphibians, Field Museum of Natural History, Chicago, 1941–53. Author of* The Reptile World; Turtles of the United States and Canada; *and others.*
CHELONIA

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LITERATURE, WESTERN: *Hebrew*

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CAVENDISH, HENRY

C.H.T. Charles Henri Toupet. *Assistant 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*)

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DEVELOPMENT, BIOLOGICAL

C.H.Wi. Charles Henry Wilson. *Professor of Modern History, University of Cambridge; Fellow of Jesus College, Cambridge. Author of* The Dutch Republic and the Civilization of the Seventeenth Century; *editor of* Cambridge Economic History of Europe.
ECONOMIC HISTORY SINCE 1500 *(in part)*
MAURICE OF NASSAU, PRINCE OF ORANGE

C.I. Charles Issawi. *Ragnar Nurkse Professor of Economics, Columbia 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.** *Professor of Botany, University of Texas at Austin. Author of* Introductory Mycology.
MYCOTA

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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 Movsvēs Dasxurançi's* The History of the Caucasian Albanians *and others.*
URARTU AND ARMENIA, HISTORY OF (*in part*)

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AMPHIBIA

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ARACHNIDA (*in part*)

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SHERIDAN, RICHARD BRINSLEY

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AQUEDUCT

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FALCONRY (*in part*)

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COMPUTERS

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FALKLAND ISLANDS AND DEPENDENCIES

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MELANESIAN CULTURES

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SIRENIA (*in part*)

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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*)

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BLOOD, HUMAN

C.L.Cl. C.L. Cline. *Ashbel H. Smith Professor of English, University of Texas at Austin. Author of* Byron, Shelley, and Their Pisan Circle; *editor of* The Letters of George Meredith.
MEREDITH, GEORGE

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FENCING

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KOREA, NORTH
KOREA, SOUTH
SEOUL

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ANALYSIS, FOURIER (*in part*)

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PROPERTY TAX (*in part*)

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HU SHIH

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HUMBOLDT, ALEXANDER VON

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JONSON, BEN
MARLOWE, CHRISTOPHER

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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. Edrtor of* Melanchthon on Christian Doctrine *and others.*
MELANCHTHON, PHILIPP

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GHIBERTI, LORENZO

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MESOPOTAMIA AND IRAQ, HISTORY OF (*in part*)

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VIRGINIA

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HAITI, HISTORY OF
TRINIDAD AND TOBAGO (*in part*)

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PENNSYLVANIA

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TISSUES AND FLUIDS, PLANT (*in part*)

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CANALS AND INLAND WATERWAYS (*in part*)

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MORSE, SAMUEL F.B.

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BONIFACE, SAINT

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BODY CAVITIES AND MEMBRANES, HUMAN (*in part*)

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ADAMS, HENRY

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CHILDHOOD DISEASES (*in part*)

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NINGSIA HUI
SINKIANG UIGHUR
TSINGHAI

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JEFFERSON, THOMAS

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SOUTH ASIAN PEOPLES, ARTS OF (*in part*)

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CHU HSI

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DIESEL, RUDOLF

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CHINA, HISTORY OF (*in part*)

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RHODES, CECIL

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BIVALVIA

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OCEANS AND SEAS (*in part*)

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GUNNERY (*in part*)
MOLTKE, HELMUTH VON
WARFARE, CONDUCT OF (*in part*)

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MOTIVATION

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GARRICK, DAVID

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IONOSPHERE

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CHINA, HISTORY OF *(in part)*
YUNG-LO

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BOTSWANA
LESOTHO
SWAZILAND

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EDUCATION, SOCIAL ASPECTS OF

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ATHERINIFORMES
ELOPIFORMES

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URUGUAY *(in part)*

C.Pe. Chaim Perelman. *Professor of Logic and Ethics, Free University of Brussels. Author of* Rhttorique et philosophie.
RHETORIC *(in part)*

C.Pf. Carl Pfaffmann. *Vice President; Professor of Psychology, Rockefeller University, New York City. Editor of* Olfaction and Taste III.
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

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RURAL SOCIETY, CONTEMPORARY

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FRENCH POLYNESIA *(in part)*

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BOMBAY
HARYANA
HIMACHAL PRADESH
MEGHALAYA

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GENGHIS KHAN
KUBLAI KHAN

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TEA PRODUCTION

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NERVOUS SYSTEM, HUMAN *(in part)*

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CHEMICAL COMPOUNDS, ORGANIC

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ENERGY SOURCES

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AUSTRALIA *(in part)*
WEATHERING

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SOUTH ASIAN PEOPLES, ARTS OF *(in part)*

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PUCCINI, GIACOMO

C.S.B. Cyril S. Belshaw. *Professor and Head, Department of Anthropology and Sociology, University of British Columbia, Vancouver. Internationally known scholar in areas of social change and economics. Author of* Traditional Exchange and Modern Markets *and others.*
ECONOMIC SYSTEMS, PRIMITIVE

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POPULATIONS, HUMAN

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EASTERN RITE CHURCHES

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CHINA *(in part)*
HONG KONG

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WILSON, WOODROW

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NORTH AMERICAN GREAT BASIN INDIANS *(in part)*

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ALKALINE-EARTH METALS AND THEIR COMPOUNDS

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NATIVE ELEMENTS

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GRÜNEWALD, MATTHIAS
HOLBEIN, HANS, THE YOUNGER

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MERCURY
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NERVOUS SYSTEM, HUMAN *(in part)*

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CHINA, HISTORY OF *(in part)*

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KWANGTUNG *(in part)*

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THEOSOPHY

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GENTIANALES

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CHAMPLAIN, SAMUEL DE

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RADICALS, FREE

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LOW COUNTRIES, HISTORY OF *(in part)*

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PHYSIOGRAPHIC EFFECTS OF MAN

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ASIA *(in part)*

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STRAFFORD, THOMAS WENTWORTH, 1ST EARL OF

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SACRED KINGSHIP

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STAHL, GEORG ERNST

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BURKE, EDMUND

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JACKSON, "STONEWALL"

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CALLIGRAPHY *(in part)*

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INNER MONGOLIA
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CHINA, HISTORY OF *(in part)*

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LYSENKO, TROFIM DENISOVICH

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LOGIC, HISTORY OF

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ELEMENTARY AND SECONDARY EDUCATION

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ALBERTA *(in part)*

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ENLIGHTENMENT

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ARABIAN DESERT

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POLITICAL SYSTEMS

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INFORMATION PROCESSING *(in part)*

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EXCRETORY SYSTEM DISEASES

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AQUATIC ECOSYSTEM
LAKES AND LAKE SYSTEMS *(in part)*

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EAST AFRICA, HISTORY OF

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LITERATURE, WESTERN: *Russian; 18th, 19th century, 20th (in part)*

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NEW GUINEA, TRUST TERRITORY OF

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CALLIGRAPHY *(in part)*

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PATEL, VALLABHBHAI JHAVERBHAI

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ELECTRON TUBE

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KUWAIT

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CHRYSOSTOM, SAINT JOHN

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MILTON, JOHN

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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HUNG-WU

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TOOL AND DIE MAKING

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ATLANTIC OCEAN *(in part)*

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HERZL, THEODOR

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CENTRAL AMERICAN AND NORTHERN ANDEAN CULTURES

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RUGBY

D.B.O.S. Douglas B.O. Savile. *Principal Mycologist, Plant Research Institute, Canada Department of Agriculture, Ottawa. Author of* Arctic Adaptations in Plants.
ARCTIC ISLANDS

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STIEGLITZ, ALFRED

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SILICA MINERALS

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URODELA

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GAUGUIN, PAUL

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MARKETING AND MERCHANDISING

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MEASUREMENT, PSYCHOLOGICAL

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LOUVOIS, FRANÇOIS-MICHEL LE TELLIER, MARQUIS DE

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SHOSTAKOVICH, DMITRY

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LA SALLE, ROBERT CAVELIER, SIEUR DE

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STATISTICS *(in part)*

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DEHYDRATION

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BUILDING CONSTRUCTION *(in part)*

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MACARTHUR, DOUGLAS

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MANILA

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CHINA, HISTORY OF *(in part)*
SHENSI
SSU-MA CH'IEN
T'ANG HSÜAN TSUNG

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DEGAS, EDGAR

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ALPHABETS

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BURNS, ROBERT
STEVENSON, ROBERT LOUIS

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PUSHKIN, ALEKSANDR

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CLOCKS, WATCHES, AND SUNDIALS

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NORTH AMERICAN GREAT BASIN INDIANS *(in part)*

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PACIFIC ISLANDS, TRUST TERRITORY OF THE

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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YEATS, WILLIAM BUTLER

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STATE, THE

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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THOUGHT PROCESSES, THEORIES OF

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LIGHT, ABERRATION OF

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AEROSPACE MEDICINE

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HALE, SIR MATTHEW

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ENZYME

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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: A Great Life in Brief; *editor of* Garibaldi.
GARIBALDI, GIUSEPPE

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ASTROLOGY

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ORCHESTRATION AND INSTRUMENTATION

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ARITHMETIC *(in part)*
MATHEMATICS, HISTORY OF *(in part)*

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MELVILLE, HERMAN

DeW.C.R. **DeWitt** C. Reddick. *Professor of Journalism and Education, University of Texas, Austin; Dean, School of Communication, 1967–69.*
TEXAS

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SLEEP

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ADDISON, JOSEPH

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BIBLICAL LITERATURE (*in part*)

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SINUS

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COUPERIN FAMILY

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WEALTH AND INCOME, DISTRIBUTION OF

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TAINE, HIPPOLYTE

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LITERATURE, WESTERN: *German; 17th Century*

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MICHAEL VIII PALAEOLOGUS

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SOLAR SYSTEM

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INTERNATIONAL EDUCATIONAL RELATIONS

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SONAR

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ROPES AND CABLES

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THACKERAY, WILLIAM MAKEPEACE

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CHEMICAL COMPOUNDS, INORGANIC

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UNITED STATES, HISTORY OF THE *(in part)*

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CARPENTARIA, GULF OF
CORAL ISLANDS, CORAL REEFS, AND ATOLLS
EYRE, LAKE
GREAT BARRIER REEF

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INTERNATIONAL RELATIONS *(1945–c.1970) (in part)*

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LAUD, WILLIAM

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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. *Lecturer in Fine Art; Head, Department of History of Art, University of Aberdeen, Scotland. Author of* English Neoclassical Art; Visual Arts, Taste and Criticism; Winckelmann.
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. *Associate 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 Niger Research Centre in Social Sciences, Niamey, Niger. Author of "Tradition orale et recherche historique en Afrique,"* Journal of World History (UNESCO).
NIGER

D.J.B. D. Joseph Bodin. *Assistant Superintendent, Fontaine Modular Strucrures, Inc., Northampton, 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; Head, Department of Geography and Geology, University of Hong Kong. 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. Author of* American Federalism: A View from the States *and others.*
FEDERALISM

D.J.G. Douglas James Guthrie, M.D. *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 and Head, Department of Biochemistry, University of Arizona, Tucson. Author of* Lipide Chemistry.
LIPID *(in part)*

D.J.M.H. David J.M. Higgins. *Associate Professor of English, Monmouth College, West Long Branch, New Jersey. Author of* Portrait of Emily Dickinson.
DICKINSON, EMILY

D.J.R. **Donald J. Reish.** *Professor of Biology, California State College, 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.** *Director, Institute of Judicial Administration, New York City. Professor of Law, New York University, New York City. Author of* **Judicial Administration: The American Experience** *and others.*
COURTS AND THE JUDICIARY *(in part)*

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DOMESTICATION, PLANT AND ANIMAL

D.Ke. **Donald Keene.** *Professor of Japanese, Columbia University. Translator into English of many of the great literary works in Japanese; and editor of* **Anthology of Japanese Literature; Modern Japanese Literature.**
LITERATURE, EAST ASIAN *(in part)*

D.Ko. **Dimiter Konstantinov Kossev.** *Academician-Secretary, Department of History and Pedagogics, Bulgarian Academy of Sciences, Sofia. Formerly rector, University of Sofia. Author of* **Concise History of Bulgaria.**
BULGARIA
SOFIA

D.Le. **(Mary) Domenica Legge.** *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, Orthopedic Surgeon, Southeast Metropolitan Regional Hospital Board, U.K. Author of* **Synopsis of Orthopaedic Surgery.**
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.** *Director, Edward Grey Institute of Field Ornithology, University of Oxford. Author of* **Natural Regulation of Animal Numbers** *and others.*
POPULATION, BIOLOGICAL

D.L.Le. **David L. Lewis.** *Associate Professor of History, Federal City College, Washington, D.C. Author of* **King: A Critical Biography.**
KING, MARTIN LUTHER, JR.

D.L.M. **David Livingstone Mueller.** *Associate 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 and Supervisor, Division of Echinoderms, Smithsonian Institution, Washington, D.C. Contributor to* **Physiology of Echinodermata.**
ECHINODERMATA

D.L.S. **David Llewelyn Snellgrove.** *Reader in Tibetan, School of Oriental and African Studies, 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.** *Head of the Subdepartment of Sedimentary Facies, Institute of Geology and Paleontology, Georg August Utziversity 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.** *Assistant Professor of Integrated Studies; Associate Curator, University Museum, University of Colorado, Boulder.*
MAMMALIA *(in part)*

D.M.Ar. **Denis Midgley Arnold.** *Professor of Music, University of Nottingham, England. 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 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, 1957–65. Author of* **From Rooke to Nelson: 101 Eventful Years in Gibraltar.**
GIBRALTAR

D.M.Ea. **David Magarey Earl.** *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 other books.*
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.** *Physicist, Kitt Peak National Observatory, Tucson, Arizona.*
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.** *Lecturer in History of Science, University of Durham, England. Author of* **Atoms and Elements.**
ARRHENIUS, SVANTE AUGUST

D.M.Ke. **David M. Kunzle.** *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; The Byzantine Family of Kantakouzenos;** *and others.*
BYZANTINE EMPIRE *(in part)*

D.M.P. **Dorothy M. Pickles.** *Writer and broadcaster. Instructor, London School of Economics and Political Science. Author of* **The Fifth French Republic** *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.** *Associate 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. Author of numerous papers on analytical and carbohydrate chemistry; 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. *Professor of Music, North Texas State University, Denton. Author of* Bruckner-Mahler-Schoenberg; *editor of* Arnold Schoenberg: Style and Idea.
SCHOENBERG, ARNOLD

D.N. da C. Décio Neves da Cunha. *Director of the Faculty of Philosophy, Science, and Letters, University of Espírito Santo, Vitdria, 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. *Professor of Geography, University of South Carolina, Columbia.*
SOUTH CAROLINA

D.O.D.W. David O.D. Wurfel. *Associate 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.O1. Daria Olivier. *Writer and hisrorian. Book reviewer,* Reforme. *Author of* Alexandre I^er^ *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* Eleutherios Venizelos *and others.*
VENIZÉLOS, ELEUTHÉRIOS

D.P.C. Douglas Parodé Capper. *Commander, Royal Navy. 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 Director of Research Engineering, 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 College. Author of* The Wolof of Senegambia.
WESTERN SUDAN, CULTURES OF THE

D.P.K. Daniel P. Kunene. *Associate 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. *Associate 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. *Associate Professor of History, University of Missouri, Columbia. Author of* The Early Life of Robert M. La Follette.
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. *Reader in Modern English History, University of Kent at Canterbury, England. Author of* Cobden and Bright: A Victorian Political Partnership *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. *Professor of Near Eastern Studies, 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. *Professor of Physics, University of Massachusetts, Amherst. Author of* Testing and Taming of Nuclear Weapons.
NUCLEUS, ATOMIC

D.R.M. Donald R. Morris. *Deputy Administrator for International Affairs, National Aeronautics and Space Administration. 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, University of Chicago; Dean, Graduate Library School, 1963–72. 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 ALLIFD SPORTS (*in part*)

D.S.B. Daniel Stephen Barker. *Associate 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. Consultant Physician, Bethlem Royal Hospital and Maudsley Hospital, and Institute of Psychiatry of the University of London. Author of* Psychiatry Today; Psychiatry for Students; *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

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LITERATURE, WESTERN: *Slovene* (*in part*)

D.S.H.W.N. Davidson S.H.W. Nicol. *Director, United Nations Institute for Training and Research, New York City. High Commissioner for the Republic of Sierra Leone to Great Britain, 1971–72. 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. *Professor of Altaic Studies and of History; Chairman, Department of Uralic and Altaic Studies, Indiana University, Bloomington. Author of* Introduction *a* l'étude de l'Eurasie Centrale; Inner Asia.
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. *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. *Leroy B. Williams Professor of History and Political Science, Harvard University. Editor of* The Rise of Capitalism; *contributor to vol. 6 of* The Cambridge Economic History of Europe.
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* a *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.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. *Emeritus Secretary, Metropolitan Museum of Art, New York; 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. *University Reader in Theoretrcal 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. 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. *Chairman, Department of Physiology, McGill University. Physician, Royal Victoria Hospital, Montreal. 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. *Musicologist. Music Presentation Editor, British Broadcasting Corporation, London. 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; Honorary Fellow of Newnham College, Cambridge. Honorary Fellow of St. Hilda's College, University of Oxford. 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, AT-

D.W.C. David W. Crabb. *Associate Professor of Anthropology, Princeton University. Author of* E. Roid Bantu Languages of Ogoja (Eastern Nigeria).
AFRICAN LANGUAGES *(in part)*

D.We. Donald Weinstein. *Professor of History, State University of Rutgers, 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.** *Professor of Systems Ecology; Director, Desert Biome, Ecology Center, Utah State University, Logan.*
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.** *Director, Institute of Historical Research, Human Sciences Research Council, Pretoria, South Africa. 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 in Classics, University of Cambridge, 1959–69. Author of* The Greek Tragic Poets; A Commentary on Aristotle's Poetics.
LITERATURE, WESTERN: *Ancient Greek*

D.W.M. D.W. Maurer. *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 numerous articles and papers on slang.*
SLANG *(in part)*

D.Wo. Douglas Woodruff. *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.** *Professor of Religion, 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. Author of* Tudor Church Music.
CHORAL MUSIC
PALESTRINA

D.W.T. Donald W. Tinkle. *Professor of Zoology; Curator, Museum of Zoology, University of Michigan, Ann Arbor. Author of* The Life and Demography of the Side-blotched Lizard.
SPECIES AND SPECIATION

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COALS

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LUTHER, MARTIN

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GOYA, FRANCISCO DE
VELÁZQUEZ, DIEGO

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CORREGGIO

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SULLA, LUCIUS CORNELIUS

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MAECENAS, GAIUS
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BIBLIOGRAPHY
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HARDY, THOMAS

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BRUEGEL, PIETER, THE ELDER

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ORGANOMETALLIC COMPOUNDS *(in part)*

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MENDELEYEV, DMITRY IVANOVICH

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HEILUNGKIANG
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KÁRMÁN, THEODORE VON

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OCEANIA, HISTORY OF

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SHELLEY, PERCY BYSSHE

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BURTON, SIR RICHARD

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UNITED STATES, HISTORY OF THE (*in part*)

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VARVED DEPOSITS

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HEADACHE

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IBN GABIROL

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CARACALLA

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ISLAM

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AFGHANISTAN, HISTORY OF (*in part*)
INDIAN SUBCONTINENT, HISTORY OF THE (*in part*)

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GLASS PRODUCTS AND PRODUCTION

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NEHRU, JAWAHARLAL

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BONHOEFFER, DIETRICH

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JOSEPH II, EMPEROR

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LITERATURE, WESTERN: *French; (20th century)*

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HESIOD

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VEBLEN, THORSTEIN

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ALKALI METALS AND THEIR COMPOUNDS

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CRANACH, LUCAS, THE ELDER

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OCEANS, DEVELOPMENT OF

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YAMAGATA ARITOMO

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DE KOONING, WILLEM
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POLITICAL POWER

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DAVY, SIR HUMPHRY

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ALEXANDER VI, POPE
PAUL III, POPE

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ARIOSTO, LUDOVICO
BRUNO, GIORDANO
LITERATURE, WESTERN: *Italian; Medieval (in part); Renaissance (in part)*
TASSO, TORQUATO

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BRACHIOPODA

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CARBONIUM IONS *(in part)*

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CHAMBERLAIN, JOSEPH
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GESNER, CONRAD

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LIVINGSTONE, DAVID

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OPTIMIZATION, MATHEMATICAL THEORY OF *(in part)*

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GLUCK, CHRISTOPH

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DARWIN, CHARLES
EVOLUTION
OWEN, SIR RICHARD

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DEWEY, JOHN

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MUSIC, ART OF

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VESPASIAN

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LOGIC, FORMAL

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CONGO RIVER

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MEKONG RIVER

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CLAY, HENRY

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ALTAIC LANGUAGES

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COKE, SIR EDWARD

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GERMANY, FEDERAL REPUBLIC OF *(in part)*

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VELD

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MATHEMATICS, HISTORY OF *(in part)*

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ETNA (MOUNT)
VESUVIUS (MOUNT)

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URUGUAY *(in part)*

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BAIKAL, LAKE

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WATTEAU, ANTOINE

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PRIMULALES

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HAMILTON, SIR WILLIAM ROWAN
LAPLACE, PIERRE-SIMON, MARQUIS DE
POINCARÉ, HENRI

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RADAR

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CASIMIR III THE GREAT, OF POLAND
CASIMIR IV OF POLAND
JOHN III SOBIESKI, OF POLAND
WŁADYSŁAW II JAGIELLO AND JADWIGA

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HARVEY, WILLIAM

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GENTZ, FRIEDRICH VON

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CALHOUN, JOHN C.

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SALLUST

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OSLER, SIR WILLIAM

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AMERICAN INDIAN PEOPLES, ARTS OF (*in part*)
FOLK DANCE

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ARECALES

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SAGA

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HOLSTEIN, FRIEDRICH VON

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SOUND RECORDING AND REPRODUCING *(in part)*

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VISUAL ARTS, WESTERN *(in part)*

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SPRINGS AND WELLS *(in part)*

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HAMBURG

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CHINESE MYTHOLOGY

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GIORGIONE
GRECO, EL
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VISUAL ARTS, WESTERN *(in part)*

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CHEMICAL KINETICS, PRINCIPLES OF

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ELBE RIVER
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MEXICO, HISTORY OF

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POSITIVISM AND LOGICAL EMPIRICISM

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PROPERTY TAX *(in part)*

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AALTO, ALVAR
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X-RAY SOURCES, ASTRONOMICAL

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RAFFLES, SIR THOMAS STAMFORD

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CHINA, HISTORY OF *(in part)*

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GORING, HERMANN *(in part)*

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ION-EXCHANGE REACTIONS

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CROCODILIA

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BUDDHIST MYSTICISM
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Reviewer: LITERATURE, WESTERN *(in part)*

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BIBLICAL LITERATURE *(in part)*

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CHURCHILL, SIR WINSTON

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CALDER, ALEXANDER

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ROEBLING, JOHN AUGUSTUS AND WASHINGTON AUGUSTUS

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ZÜRICH

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GOEBBELS, JOSEPH

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BERNINI, GIAN LORENZO

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FAGALES

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PUNIC WARS *(in part)*
SCIPIO AEMILIANUS
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HAWTHORNE, NATHANIEL

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STEINMETZ, CHARLES PROTEUS

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FOX, GEORGE

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MADAGASCAR, HISTORY OF

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KANTIANISM

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PARAPSYCHOLOGICAL PHENOMENA, THEORIES OF

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BERLIN

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BALZAC, HONORÉ DE

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EDUCATION, HISTORY OF *(in part)*

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GERMAN DEMOCRATIC REPUBLIC *(in part)*
LEIPZIG

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CARNIVORA

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GREEK LAW

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DOMINICAN REPUBLIC, HISTORY OF THE

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FASCISM
NATIONALISM

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JURY *(in part)*

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SOLID STATE OF MATTER *(in part)*

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SAVIGNY, FRIEDRICH KARL VON

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DANCE, WESTERN

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GREGORY I, SAINT AND POPE
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AUSTIN, JOHN

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CHILDHOOD DISEASES

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MONDRIAN, PIET

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DOBZHANSKY, THEODOSIUS

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FORESTRY

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NORTH AFRICA, HISTORY OF (*in part*)

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EYCK, JAN AND HUBERT VAN
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PAIN, THEORIES OF

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JAMES, WILLIAM

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LIEBIG, JUSTUS VON
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DEATH AND GIFT TAXES

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BEUST, FRIEDRICH VON

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VOLLEYBALL

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NANSEN, FRIDTJOF

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ANTIGONUS II GONATAS
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ALBUQUERQUE, AFONSO DE
COVILHÃ PÊRO DA
DIAS, BARTOLOMEU
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JOHN II OF PORTUGAL
MANUEL I OF PORTUGAL
PORTUGAL, HISTORY OF

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JACKSON, ANDREW
UNITED STATES, HISTORY OF THE *(in part)*

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OPERA

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ROTTERDAM

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CHEMORECEPTION

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BARNUM, P.T.

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RELIGION, PHILOSOPHY OF

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SOVIET UNION *(in part)*

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BLANQUI, AUGUSTE

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PLATYHELMINTHES

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LOS ANGELES

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MEDITERRANEAN FOLK CULTURES, WESTERN *(in part)*

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POPE, ALEXANDER

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HABER, FRITZ

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TOUSSAINT-LOUVERTURE

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EISENSTEIN, SERGEY
RAY, SATYAJIT

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MOLLUSCA

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VISTULA RIVER

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COMENIUS, JOHN AMOS

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RUSKIN, JOHN

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STEEL PRODUCTION

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INSECTIVORA

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CONSTANTINE THE GREAT

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TAYLOR, FREDERICK WINSLOW

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SPAIN, HISTORY OF *(in part)*

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RICHARDSON, HENRY HOBSON

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SCHOLASTICISM

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BONAVENTURE, SAINT

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WAR, THEORY OF

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NAPIER, JOHN

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FINANCE, BUSINESS

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HURRICANES AND TYPHOONS
MONSOONS

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ALBERTI, LEON BATTISTA

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DAM

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NUCLEAR FISSION

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FIBRES, MAN-MADE

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GIBBS, J. WILLARD

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NESTORIUS

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EUROPE, ANCIENT

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LEO X, POPE

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PARACELSUS

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PIUS II, POPE
NICHOLAS V, POPE

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NAPOLEON
TALLEYRAND

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HILLEL
JOHANAN BEN ZAKKAI

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POLLEN STRATIGRAPHY

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CHINA, HISTORY OF *(in part)*

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BRANCHIOPODA
ESTUARIES *(in part)*

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OCEANIAN PEOPLES, ARTS OF *(in part)*

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WELFARE AND SECURITY PROGRAMS

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WALES

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IRANIAN CULTURES

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SURINAM

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COORDINATION COMPOUNDS

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UNITED NATIONS *(in part)*

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DAUDET, ALPHONSE

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MASS SPECTROMETRY

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IRVING FAMILY

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NEGRO CHURCHES (IN THE UNITED STATES)

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HUYGENS, CHRISTIAAN

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DEVELOPMENT, PLANT

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BOHEMOND I, PRINCE OF ANTIOCH *(in part)*

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IMMUNITY

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HARBOURS AND SEA WORKS

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THERMODYNAMICS, PRINCIPLES OF *(in part)*

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WALPOLE, ROBERT

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MAGNESIUM PRODUCTS AND PRODUCTION

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DISEASE, HUMAN *(in part)*

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TEETH AND GUMS, HUMAN

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FRANCE, HISTORY OF *(in part)*

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ENGINEERING, MILITARY

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ADVENTISTS
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RICCI, MATTEO

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PETRARCH
PIRANDELLO, LUIGI

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CHUANG-TZU

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OKAVANGO RIVER
ORANGE RIVER

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LITERATURE, WESTERN: *French; Medieval (in part)*

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LITERATURE, WESTERN: *English; (20th Century)*

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HORTICULTURE

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TIME *(in part)*

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BYRD, WILLIAM

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FREDERICK HENRY, PRINCE OF ORANGE
OLDENBARNEVELT, JOHAN VAN

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SILICATE MINERALS

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MARY
ROMAN CATHOLICISM, HISTORY OF *(in part)*

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BÖHME, JAKOB

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MICHELET, JULES

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RICARDO, DAVID

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POLLUTION CONTROL *(in part)*

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PERU, HISTORY OF

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EDWARD III OF ENGLAND
ISABELLA I THE CATHOLIC, OF CASTILE

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SCIENCE, HISTORY OF

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HOOKER, RICHARD

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MEASUREMENT, PRINCIPLES AND INSTRUMENTS OF

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BRYOZOA
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CYCLONES AND ANTICYCLONES

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EUSEBIUS OF CAESAREA

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LITERATURE, WESTERN: *Canadian in French*

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MÜLLER, JOHANNES PETER

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JONES, INIGO
WREN, SIR CHRISTOPHER

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GEORGE III OF GREAT BRITAIN

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CHINA, HISTORY OF *(in part)*

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STRIGIFORMES

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HOLINESS CHURCHES
PENTECOSTAL CHURCHES

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VAN DYCK, SIR ANTHONY

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BLANC, LOUIS
MAKAT, JEAN-PAUL
THIERS, ADOLPHE

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NUCLEOTIDES
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SMALL ARMS, MILITARY
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HEALING CULTS
HELLENISTIC RELIGIONS

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APTERYGOTE
NEUROPTERAN
TRICHOPTERA

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POUSSIN, NICOLAS

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ACCRA
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WILDE, OSCAR

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KOREA, HISTORY OF (*in part*)

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PRODUCTION AND CONSUMPTION, GOVERNMENT'S ROLE IN

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BRAHMS, JOHANNES
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SALES AND EXCISE TAXES

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LOGIC, PHILOSOPHY OF

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GERMANY, HISTORY OF (*in part*)

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SRI LANKA (CEYLON)

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URBAN DESIGN *(in part)*

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SAN FRANCISCO

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BRAGG, SIR LAWRENCE
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BOATING AND YACHTING *(in part)*

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JAPAN, HISTORY OF *(in part)*

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BACON, FRANCIS

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PIŁSUDSKI, JÓZEF KLEMENS

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DANA, JAMES DWIGHT

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MINAMOTO YORITOMO

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AGRICULTURE, HISTORY OF *(in part)*

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MANSFIELD, WILLIAM MURRAY, 1ST EARL OF

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CORPORATION, BUSINESS *(in part)*

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SOUTH AMERICAN NOMAD CULTURES

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CHINA *(in part)*

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MEMBRANE, BIOLOGICAL *(in part)*

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LITERATURE, ART OF

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KOREA, HISTORY OF *(in part)*

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BAYERN

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ALUMINUM PRODUCTS AND PRODUCTION

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RANJIT SINGH
SIKHISM

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JORDAN

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ANALYTIC AND LINGUISTIC PHILOSOPHY

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HAUPTMANN, GERHART

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PESTALOZZI, JOHANN HEINRICH

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WHALE *(in part)*

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ANDAMAN SEA

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SYRIA AND PALESTINE, HISTORY OF *(in part)*

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BIBLICAL LITERATURE *(in part)*

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LAHORE *(in part)*

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BALANCHINE, GEORGE
FOKINE, MICHEL
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OTTO I THE GREAT, EMPEROR

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PHILOSOPHY, HISTORY OF WESTERN *(in part)*

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SPACE PERCEPTION *(in part)*

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SPRINGS AND WELLS *(in part)*

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DELHI *(in part)*

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LITERATURE, WESTERN: *French; Renaissance*

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MYTH AND MYTHOLOGY

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PAPER AND PAPER PRODUCTION

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EMERSON, RALPH WALDO

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ORGANS AND ORGAN SYSTEMS, ANIMAL *(in part)*

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LIEBKNECHT, WILHELM AND KARL

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AUTOMOBILE *(in part)*

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MANN, HORACE

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LOMONOSOV, MIKHAIL VASILYEVICH

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BYRON, LORD

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PHOTOGRAPHY, TECHNOLOGY OF

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BECQUEREL, HENRI

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BEGONIALES *(in part)*
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CARAVAGGIO

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MALFORMATION, BIOLOGICAL *(in part)*
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CHINA, HISTORY OF *(in part)*

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ESTE, HOUSE OF

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WELLS, H.G.

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CRYPTOLOGY

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GRIMM BROTHERS

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JAMES, HENRY

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SAINT LAWRENCE, GULF OF
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HUNYADI, JÁNOS
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CURZON, LORD

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ANGELS AND DEMONS
BIBLICAL LITERATURE *(in part)*
CHRISTIAN MYTH AND LEGEND
CLEMENT OF ALEXANDRIA, SAINT
FEAST AND FESTIVAL

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KOCH, ROBERT

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RUSH, BENJAMIN

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GULF STREAM
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ARMSTRONG, EDWIN H.

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HELMHOLTZ, HERMANN VON

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MESOPOTAMIA AND IRAQ, HISTORY OF *(in part)*

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KAUNDA, KENNETH

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GODDARD, ROBERT HUTCHINGS *(in part)*

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EDUCATION, HISTORY OF *(in part)*

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MODES, MUSICAL

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TOGO

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WORK, ORGANIZATION OF

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AUDEN, W.H.

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EUROPEAN ATLANTIC COAST, FOLK CULTURES OF THE

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CONODONTS

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QUINTILIAN

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GEORGIAN SOVIET SOCIALIST REPUBLIC

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HYMENOPTERA

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CARRACCI
RUBENS, PETER PAUL

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GODDARD, ROBERT HUTCHINGS *(in part)*

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AUSTRALIA, HISTORY OF

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SIPHONAPTERA *(in part)*

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BAFFIN BAY
BARENTS SEA
GREENLAND SEA
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GASEOUS STATE

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JANSEN, CORNELIUS OTTO

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NILE RIVER

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INFORMATION PROCESSING *(in part)*

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MAGELLAN, FERDINAND

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COLUMBIA ICEFIELD
FUNDY, BAY OF

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NINEVEH

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SOIL MECHANICS, APPLICATIONS OF

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BLOOD DISEASES

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ATMOSPHERE

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SADE, MARQUIS DE

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ORISSA

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RETICULOENDOTHELIAL SYSTEM, HUMAN

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DRESS *(in part)*
URARTU AND ARMENIA, HISTORY OF *(in part)*

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BREMEN

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POLICE

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M.Pl. Maurice Platnauer. *Honorary Fellow of Brasenose College, University of Oxford; Principal of Brasenose College,* 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, *2 vols.; co-editor of* The Diaries of Lord Lugard.
LUGARD, LORD

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GOBI (DESERT)
TAKLA MAKAN DESERT

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GLADSTONE, WILLIAM EWART

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SAINT-JUST, LOUIS DE

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GUSTAVUS II ADOLPHUS, OF SWEDEN
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PORIFERA

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TSIOLKOVSKY, KONSTANTIN EDUARDOVICH

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ANGELICO, FRA

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TAXATION (*in part*)

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TELEPHONE AND TELECOMMUNICATIONS SYSTEMS *(in part)*

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LITERATURE, WESTERN: *Ancient Egyptian*
THEBES (EGYPT)
THUTMOSE III

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AFGHANISTAN

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AEGEAN CIVILIZATIONS

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DAIGO II
FUJIWARA FAMILY

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EDUCATION, HISTORY OF (*in part*)

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ORGANS AND ORGAN SYSTEMS, ANIMAL (*in part*)

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UGANDA

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ISLÂMIC THEOLOGY AND PHILOSOPHY

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JUNG, CARL *(in part)*

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HUS, JAN

M.S.S. Mark S. Slobin. *Assistant Professor of Music, Wesleyan University, Middletown, Connecticut. Author of several articles on the music of Central Asia.*
CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

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TAOISM, HISTORY OF
TAOIST LITERATURE

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MA YÜAN
VISUAL ARTS, EAST ASIAN *(in part)*

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OIL SHALES

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AUTOMATION
MASS PRODUCTION

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TUNIS
TUNISIA *(in part)*

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ALEXANDER III OF RUSSIA

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NAGOYA

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ADEN, GULF OF

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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

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JAPAN, SEA OF
YELLOW SEA

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LIBYA

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NEW YORK (CITY)

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BELGRADE

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LITERATURE, WESTERN: *South African in English*

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HAGUE, THE *(in part)*

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FRANCIS I OF FRANCE

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CRUSADES

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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)*

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CLAUDE LORRAIN

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GAINSBOROUGH, THOMAS

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OLD AGE, SOCIAL ASPECTS OF *(in part)*

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CIVIL LAW *(in part)*
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INHERITANCE

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ALISMALES

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SA'ADIA BEN JOSEPH

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SUBSIDIES

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BRAHMAPUTRA RIVER
GANGES RIVER
INDUS RIVER

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EXISTENTIALISM

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BALUCHISTAN
SIND

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MUSCLE CONTRACTION *(in part)*

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GEOMETRY, ANALYTIC AND TRIGONOMETRIC *(in part)*

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CAUCASUS MOUNTAINS *(in part)*

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SOUTH ASIAN PEOPLES, ARTS OF *(in part)*

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POMPADOUR, MADAME DE

N.A.M. Norman A. Malcolm. *Susan Linn Sage Professor of Philosophy, Cornell University, Ithacn, New York. Author of* Ludwig Wittgenstein: *A* Memoir.
WITTGENSTEIN, LUDWIG

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INTERNATIONAL LANGUAGE

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FABLE, PARABLE, AND ALLEGORY *(in part)*

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IVAN IV THE TERRIBLE, OF RUSSIA

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ARCTIC OCEAN

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WILLIAM III OF GREAT BRITAIN

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REPRODUCTIVE SYSTEM DISEASES *(in part)*

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ACARINA

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BOURGUIBA, HABIB
CALENDAR *(in part)*
CHRONOLOGY *(in part)*

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NORTH AFRICA, HISTORY OF *(in part)*

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MINNESOTA

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DIGESTION, HUMAN
DIGESTIVE SYSTEM, HUMAN

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EUPHORBIALES
RUTALES

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SUBMARINE

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LITERATURE, WESTERN: *English; Medieval (in part)*

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ALEPPO

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IOWA

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FRUITS AND FRUIT FARMING

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GREY, CHARLES GREY, 2ND EARL
PEEL, SIR ROBERT

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EXPLOSIVES

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GRECO-PERSIAN WARS
PELOPONNESIAN WAR
XENOPHON

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MUSIC, THEATRICAL

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REPRODUCTIVE BEHAVIOUR

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ARTS, STYLE IN THE
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JAPANESE LANGUAGE

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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PLEKHANOV, GEORGY VALENTINOVICH

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ISAIAH

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KOSCIUSZKO, TADEUSZ

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ANATOLIA, ANCIENT *(in part)*
TIGRIS-EUPHRATES RIVER SYSTEM
VISUAL ARTS, WESTERN *(in part)*

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KONOE FUMIMARO

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BIOLOGICAL SCIENCES *(in part)*

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SOUTHERN AFRICA, HISTORY OF

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AVICENNA

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MONGOLIAN PEOPLE'S REPUBLIC *(in part)*

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KENYA
NAIROBI

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the Roman World; The Political Background of the New Testament; *and others.*
CLEOPATRA
HEROD I THE GREAT
JERUSALEM (*in part*)
JULIAN THE APOSTATE

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STIMULANT

S.H.St. S. Henry Steinberg (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

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MONGOLIAN PEOPLE'S REPUBLIC (*in part*)

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FISH
TELEOSTEI

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AURORAS

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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 and Chairman, Department 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

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EAST AFRICAN LAKES
EAST AFRICAN MOUNTAINS
VIRUNGA MOUNTAINS

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OTTOMAN EMPIRE AND TURKEY, HISTORY OF THE (*in part*)

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OFFICE MACHINES

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ŌSAKA-KŌBE METROPOLITAN AREA
TOKYO-YOKOHAMA METROPOLITAN AREA

S.K.G. Sisir Kumar **Ghose.** *Professor of English, Visva-Bharati, Santiniketan, India. Author of* Mystics and Society *and others.*
MYSTICISM

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CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)

S.Kö. Stephan Korner. *Professor of Philosophy, University of Bristol, England, and Yale University. Author of* Conceptual Thinking; Categorical Frameworks; *and others.*
CLASSIFICATION THEORY

S.K.S. Sylvester K. Stevens. *Executive Director, Pennsylvania Historical and Museum Commission, Harrisburg. Author of* Pennsylvania: Birthplace of a Nation *and others.*
PHILADELPHIA

S.L. Steffen **Linvald.** *Director of Copenhagen City Museum. Author of* Kobenhavnske Gadenavne i fortio og Nutid.
COPENHAGEN

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BLOOD GROUPS

S.L.D. S. Lawrence **Dingman.** *Lecturer in Earth Sciences, Dartmouth College, Hanover, New Hampshire.*
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*)

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THERMIONIC DEVICES

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SILVER PRODUCTS AND PRODUCTION

S.M. Sonia Moore. *Founder and President, American Center for Stanislavski Theatre Art, Inc., New York City. Author of* Training an Actor: The Stanislavski System in Class; The Stanislavski System.
STANISLAVSKY, KONSTANTIN

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PERCUSSION INSTRUMENTS

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IRRAWADDY RIVER

S.McD. Sheila D. **McDonough.** *Associate 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. **Ćirković.** *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. *Editor,* 20 Mule Team Magazine. *Associate of the British Museum (Natural History). Author of* The Prehistory of East Africa *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 Health Development; Fellow of the Center for Human Growth and Development, University of Michigan, Ann Arbor. Author of* Human Races.
RACES OF MANKIND

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FOOD, QUALITY CONTROL OF

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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

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SKELETAL SYSTEMS (*in part*)

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MĀHĀRASHTRA

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SECURITIES TRADING

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SIERRA LEONE (*in part*)

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EDUCATION, HISTORY OF (*in part*)

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KIRGIZ SOVIET SOCIALIST REPUBLIC

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YALU RIVER

So.T. Sol Tax. *Professor of Anthropology, University of Chicago. Director, Center for the Study of Man, Smithsonian Institution,*

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BOAS, FRANZ

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ENGLISH LANGUAGE

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THAR DESERT *(in part)*

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HIMALAYAN MOUNTAIN RANGES
TRIPURA

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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

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TRADEMARK LAW

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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

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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; Head, Contemporary China Institute, School of Oriental and African Studies, University of London. Author of* Mao Tse-tung; The Political Thought of Mao Tse-tung.
MAO TSE-TUNG

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FOOD, NEW SOURCES AND PRODUCTS

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SULFIDE MINERALS

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LIVER, HUMAN

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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)*

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BRITAIN, ANCIENT

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CHILE

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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

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DIFFERENTIAL EQUATIONS *(in part)*

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CHRISTIAN MYSTICISM

S.St. Sewell Stokes. *Author and dramatist. Author of* Isadora: An Intimate Portrait *and others.*
DUNCAN, ISADORA

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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

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CHINESE LAW

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METALWORK *(in part)*

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JUDAISM, HISTORY OF *(in part)*

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LAWRENCE, T.E.
SHAW, GEORGE BERNARD

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OPARIN, ALEKSANDR IVANOVICH

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CARDIOVASCULAR SYSTEM, HUMAN

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ZINC GROUP ELEMENTS AND THEIR COMPOUNDS

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SEMICONDUCTOR DEVICES *(in part)*

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WARFARE, CONDUCT OF *(in part)*

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LITERATURE, EAST ASIAN *(in part)*

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TSENG KUO-FAN

S.Z. Sir Solly Zuckerman. *Secretary, Zoological Society of London. Author of* Functional Affinities of Man, Monkeys and Apes.
ZOOLOGICAL GARDEN

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BA'AL SHEM TOV *(in part)*
JEWISH RELIGIOUS YEAR
LURIA, ISAAC BEN SOLOMON *(in part)*

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EDWARDS, JONATHAN

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PEST CONTROL

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SOCIAL CLASS AND MOBILITY
SOCIAL DIFFERENTIATION AND STRATIFICATION

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NORTH MEXICAN INDIAN CULTURES

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FISHING, SPORT *(in part)*

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PHTHIRAPTERA

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SIGILLOGRAPHY *(in part)*

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JUPITER

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ANDEAN CIVILIZATION, HISTORY OF *(in part)*

T.Cr. Rev. Theodore Crowley, O.F.M. *Professor of Scholasric Philosophy, Queen's University of Belfast, Northern Ireland. Author of* Roger Bacon: The Problem of the Soul in his Philosophical Commentaries.
BACON, ROGER

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EISENHOWER, DWIGHT D.

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RAILROADS AND LOCOMOTIVES

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IRAN, HISTORY OF *(in part)*

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GENE *(in part)*
HEREDITY

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FERDINAND II THE CATHOLIC, OF ARAGON

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KOREAN RELIGION

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GERMFREE LIFE

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RUTHERFORD, LORD

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CAUCASIAN LANGUAGES *(in part)*

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HUME, DAVID

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MESO-AMERICAN INDIAN LANGUAGES

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MAYO FAMILY

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GUINEA

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HUNGARY *(in part)*

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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

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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

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CONNECTIVE TISSUE DISEASES *(in part)*

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EGYPT, HISTORY OF *(in part)*

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HANOI

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HOMEOSTASIS

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AURANGZEB
BĀBUR
CLIVE, ROBERT
INDIAN SUBCONTINENT, HISTORY OF THE *(in part)*

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STRINGED INSTRUMENTS

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TELEVISION *(in part)*

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EDUCATION, HISTORY OF *(in part)*

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ARGENTINA, HISTORY OF

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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

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Author of Aku-Aku: The Secret of Easter Island; The Kon-Tiki Expedition; *and others.*
EASTER ISLAND

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TORONTO

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AESTHETICS *(in part)*
ARTS, CLASSIFICATION OF THE

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USMAN DAN FODIO

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FRANKLIN, BENJAMIN

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CAUCASIAN LANGUAGES *(in part)*

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IBN AL-'ARABĪ

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EKMAN, VAGN WALFRID

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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

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MESOPOTAMIAN RELIGIONS
MESOPOTAMIAN RELIGIOUS LITERATURE AND MYTHOLOGY

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TARIFFS *(in part)*

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CALLIGRAPHY *(in part)*
PUNCTUATION

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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*

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CONTROL SYSTEMS

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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

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BELL, ALEXANDER GRAHAM

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ECONOMIC HISTORY SINCE 1500 *(in part)*

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UNITED STATES OF AMERICA *(in part)*

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'ABD AL-MALIK IBN MARWĀN
'ABD AR-RAHMAN III AN-NĀṢIR

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LITERATURE, WESTERN: *Hungarian (in part)*

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TOYOTOMI HIDEYOSHI

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RANGOON

T.K.Z. Tatyana Konstantinovna Zakharova. *Senior Science Editor,* Sovietskaya Entsyklopediya *(publishing house).*
PAMIR MOUNTAIN AREA *(in part)*

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ARCHIMEDES *(in part)*

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CENTRAL AMERICAN STATES, HISTORY OF *(in part)*

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NERVES AND NERVOUS SYSTEMS

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UNIDENTIFIED FLYING OBJECTS

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PERMAFROST

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BRAZIL *(in part)*
URUGUAY *(in part)*

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CRETACEOUS PERIOD

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HEGEL, GEORG WILHELM FRIEDRICH

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CARBON GROUP ELEMENTS AND THEIR COMPOUNDS

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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

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EARTH, MAGNETIC FIELD OF

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FRANCE, HISTORY OF *(in part)*

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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, Higher Education Authority, Dublin. Editor of* Genealogical Tracts *I.*
PATRICK, SAINT

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RHETORIC (*in part*)

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ELECTRIC POWER

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CALENDAR (*in part*)

T.P.M. Terence Patrick Morris. *Professor of Sociology, London School of Economics and Political Science, University of London. Author of* The Criminal Area: A Study in Social Ecology.
PUNISHMENT

T.Po. Tom Pocock. *Defense Correspondent and Special Correspondent,* Evening Standard, *London. Author of* Nelson and His World *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 Wiewir; Wij Mensen; *and others.*
MONOTHEISM
PROVIDENCE, RELIGIOUS DOCTRINES AND MYTHS OF

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STEEL CONSTRUCTION

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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

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JAPAN, HISTORY OF (*in part*)

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HERODOTUS

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GLASS, HISTORY OF (*in part*)

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ENDOCRINE SYSTEM DISEASES AND DISORDERS

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GERMANY, HISTORY OF (*in part*)

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RESEARCH AND DEVELOPMENT, INDUSTRIAL

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SHAKESPEARE, WILLIAM (*in part*)

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JAPAN, HISTORY OF (*in part*)

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CH'EN TU-HSIU

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RIVERS AND RIVER SYSTEMS (*in part*)

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CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)
SARMATIANS
SCYTHIANS

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CENTRAL ASIAN PEOPLES, ARTS OF (*in part*)
TIBET (*in part*)

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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

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CUCURBITALES

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SUGAR PRODUCTION

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LITERATURE, EAST ASIAN (*in part*)

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OKHOTSK, SEA OF

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EARTH, FIGURE OF

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DUALISM, RELIGIOUS

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MASACCIO

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AFRICAN PEOPLES, ARTS OF (*in part*)

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CONTINENTAL DRIFT

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BOCCACCIO, GIOVANNI

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CAVOUR, COUNT

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FRANKFURT AM MAIN

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COMMERCIAL TRANSACTIONS, LAW OF

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VALLA, LORENZO

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JAINISM
MAHĀVĪRA

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LICHEN

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ISSYK-KUL, LAKE

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ICELAND *(in part)*

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ZAPATA, EMILIANO

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BOLIVIA

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

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YUGOSLAVIA

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CONTINENTS, DEVELOPMENT OF

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LUXEMBOURG *(in part)*

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GEMSTONES

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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

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TURKMEN SOVIET SOCIALIST REPUBLIC

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

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WATER RESOURCES *(in part)*

V.E.I. Verity Elizabeth Irvine. *Writer and researcher.*
SYRIA AND PALESTINE, HISTORY OF *(in part)*

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PHOSPHORITES

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INDIAN OCEAN

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KAZAKH SOVIET SOCIALIST REPUBLIC

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HALOGEN ELEMENTS AND THEIR COMPOUNDS

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INDIAN OCEAN *(in part)*

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MECHANICS, CELESTIAL

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RACHMANINOFF, SERGEY

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SALT RANGE *(in part)*

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ALGAE

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BALTIC LANGUAGES

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BAYEZID II
SÜLEYMAN I THE MAGNIFICENT

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ESTONIAN SOVIET SOCIALIST REPUBLIC *(in part)*

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WOMEN, STATUS OF

V.Ka. Vytautas Kavolis. *Professor of Sociology; Chairman, Department of Sociology—Anthropology, 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.** *Professor of Philosophy, Johns Hopkins University, Baltimore. Author of* Understanding Whitehead.
WHITEHEAD, ALFRED NORTH

V.L.S. Victor L. Streeter. *Professor of Hydraulics, University of Michigan, Ann Arbor. Author of* Fluid Mechanics.
MECHANICS, FLUID

V.L.S.P.R. Vaddiparti Lova **Surya** Prakasa Rao. *Professor and Chairman, Department of Human Geography, Delhi School of Economics, University of Delhi, India.*
DELHI *(in part)*

V.L.T. Victor-Lucien **Tapié.** *Member, Academy of Moral and Political Sciences, Institute of France, Paris. Emeritus Professor of Modern History, University of Paris-IV. Author of* La France de Louis XIII et de Richelieu *and others.*
COLBERT, JEAN–BAPTISTE

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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

V.M.S. **Vasily** Mikhaylovich Sinitsyn. *Head, Laboratory of Paleography; Dean, Department of Geology, Leningrad A.A. Zhdanov State University.*
KUNLUN MOUNTAINS

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SOVIET UNION *(in part)*

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PITT, WILLIAM, THE ELDER

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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

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BLACK SEA *(in part)*

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VERLAINE, PAUL

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BEACHES
GULFS AND BAYS

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ADVERTISING

V.R.L. Val R. Lorwin. *Professor of History, University of Oregon, Eugene.*
UNITED NATIONS *(in part)*

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KERALA

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MATHEMATICS, HISTORY OF *(in part)*

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ROMANIA

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STRATIGRAPHIC BOUNDARIES

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HYDROLOGIC CYCLE
HYDROLOGIC SCIENCES

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ALGIRDAS

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LITERATURE, WESTERN: *Estonian*

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SLAVIC LANGUAGES

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DOMESTICATION, PLANT AND ANIMAL *(in part)*

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SOVIET UNION *(in part)*

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LERMONTOV, MIKHAIL

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INCA RELIGION

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ARAL SEA

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LITERATURE, WESTERN: *Serbian*

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SKELETAL SYSTEM, HUMAN

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LITERATURE, WESTERN: *American; 20th Century (in part)*

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NEW MEXICO

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ATROPHY

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JUGLANDALES

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METALS, THEORY OF

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SUKARNO

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VIVALDI, ANTONIO

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CARICATURE, CARTOON, AND COMIC STRIP *(in part)*

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CIRRIPEDIA

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PIUS XII, POPE

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BUDDHA

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ADMINISTRATIVE LAW
CITY GOVERNMENT

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SIDNEY, SIR PHILIP

W.A.S. W.A. Swanberg. *Free-lance writer. Author of* Dreiser *and others.*
DREISER, THEODORE

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VEGETABLES AND VEGETABLE FARMING

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INTERNATIONAL RELATIONS *(1945–c.* 1970) *(in part)*

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GYROSCOPE *(in part)*

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DIAGNOSIS

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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. I).*
IRAQ *(in part)*
SUEZ CANAL

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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 of* Automation and Mechanisation in the Instrument Industry.
ROBOT DEVICES

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PHENOMENOLOGY *(in part)*

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ROCKS, PHYSICAL PROPERTIES OF

W.Bl. Warren Blanding. *Executive Vice President, Marketing Publications Inc., Washington, D.C. Author of* Profit Opportunities in Physical Distribution *and others.*
STORAGE AND WAREHOUSING

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POLICE TECHNOLOGY

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HUTTON, JAMES

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PLANCK, MAX

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DISEASE

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DREAMS

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INDO-EUROPEAN LANGUAGES

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CERVANTES, MIGUEL DE
LITERATURE, WESTERN: *Spanish* and *Portuguese (in part)*

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TUNISIA *(in part)*

W.C.Da. William C. Davis, **Jr.** *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 behaviour, anatomy, and systematics of fishes.*
PERCIFORMES *(in part)*

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TIRPITZ, ALFRED VON

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ATTENTION *(in part)*

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STAGING AND STAGE DESIGN *(in part)*

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VIRUS

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MONET, CLAUDE

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BOTANY

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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

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SARTRE, JEAN-PAUL

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HOBBIES

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HOSPITAL

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AGRICULTURE, HISTORY OF *(in part)*

W.E. William Epstein. *Professor of Psychology, University of Wisconsin, Madison. Author of* Varieties of Perceptual Learning.
LEARNING, PERCEPTUAL

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CONRAD, JOSEPH
FIELDING, HENRY
SMOLLETT, TOBIAS

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ANURA

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LEO III THE ISAURIAN

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BACH, JOHANN SEBASTIAN *(in part)*

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COMPASS *(in part)*

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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

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TYPOGRAPHY *(in part)*

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MIRÓ, JOAN

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MILITARY LAW

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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

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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)*

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PARAGUAY RIVER

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SANTA CATARINA

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SIAM AND THAILAND, HISTORY OF

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MUSCLE SYSTEMS

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INDUSTRIAL AND ORGANIZATIONAL RELATIONS

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NIEDERSACHSEN *(in part)*

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ROSSETTI FAMILY

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TERENCE

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TELEMANN, GEORG PHILIPP

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CANALETTO

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EUROPE

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ASCHELMINTHES

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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

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LA ROCHEFOUCAULD
LITERATURE, WESTERN: *French; 17th century*
MOLIÈRE

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LUDENDORFF, ERICH
ROMMEL, ERWIN

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ARABIAN RELIGIONS

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ZONE MELTING

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SHOCK, PHYSIOLOGICAL

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MEMBRANE, BIOLOGICAL *(in part)*

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INFLAMMATION

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DRUG PROBLEMS

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PALEOGRAPHY

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ATTENTION *(in part)*

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CHRONOLOGY *(in part)*

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WORSHIP

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FORTIFICATIONS *(in part)*

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PHARMACOLOGICAL CULTS

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CYPRIAN, SAINT

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RHYNCHOCEPHALIA

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PHILIP THE MAGNANIMOUS, LANDGRAVE OF HESSE

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PAVLOV, IVAN PETROVICH

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EADS, JAMES BUCHANAN
EVANS, OLIVER

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PHOTORECEPTION

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UNIVERSE, STRUCTURE AND PROPERTIES OF

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NĀNAK

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BALKANS, HISTORY OF THE *(in part)*

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TIDES *(in part)*

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NEW ZEALAND, HISTORY OF

W.H.P.R. William H.P. Robertson. *Editor,* The Thoroughbred Record; *Chairman, Record Publishing Company, Inc., Lexington, Kentucky. Author of* History of Thoroughbred Racing in America.
HORSE RACING *(in part)*

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INSTINCT
LEARNING, ANIMAL

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ENGLAND

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FERRITES

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METAPHYSICS *(in part)*

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FERN

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GEOCHEMICAL EQUILIBRIA AT LOW TEMPERATURES AND PRESSURES *(in part)*

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GERMANIC LANGUAGES *(in part)*

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LASSALLE, FERDINAND

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HUNTING, SPORT *(in part)*

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WAVE MOTION

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UTILITY AND VALUE, ECONOMIC

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ITALY AND SICILY, HISTORY OF *(in part)*

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JEROME, SAINT

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CARTIER, JACQUES
FRONTENAC, COMTE DE

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NUCLEAR WEAPONS

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SCORPIONIDA

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Adhbmar, Jean. J.Ad.
Adkins, Dorothy C. D.C.A.
Adler, John H. J.H.A.
Ado, Yuei 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.
Ahlstrom, Gosta 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, Hblene. 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-Carrie, Rene. 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.
Almagia, Roberto. Ro.A.
Alpert, Barbara Anne. B.A.A.
Al-Shahi, Ahmed S. A.Al-Sh.
Alston, (Arthur) Rex. R.Al.
Alvariño, Angeles. A.Al.
Amadio, Anselm H. A.H.Ao.
Amaral, Ilidio Melo Peres do. I.M.P. do A.
Amber, John Thomas. J.T.A.
Amengual, Barthblemy. 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, Zoltan. 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.
Arsenyeva, 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.
Bakarid, Vladimir. V.Ba.
Baker, Carl G. C.G.B.
Baker, Sir John Fleetwood. J.F.Br.
Baker, Philip S. P.S.B.
Baker, Samuel John Kenneth. S.J.K.B.
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.
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, 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 Rene 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. Andre. 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. C.W.B.
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.
Belayev, Dmitri Konstantinovich. D.K.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.
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.
Benitez, 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. F.J.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-Mery, 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, 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.
Blankston, 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.
Bonham-Carter, Graeme F. G.B.-C.
Bonilla, Jose. 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, Saville. 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, H. 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. 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. 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 (H.M.H.). 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, Jose 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 Maria. 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, Wilbert K. W.K.C.
Cartwright, Frederick F. F.F.C.
Cartwright, Janet M. J.M.Ca.
Carvalho, Jose 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-Leon. 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.
Cirković, 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, 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, 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 (A.W.). 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. J.Co.
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 Pre. M. Du P.C.
Copp, J. Terry. J.T.C.
Corbet, Andre 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, Rene. 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 Clark. 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, Mary R. M.R.D.
Day, Michael H. M.H.D.
Dayal, P. P.D.
Dayen, Leonid Abramovich. L.A.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 Vleeshauwer, Herman Jean. H.J. de V.
De Vries, Johan G.W. J.G.W. De V.
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, Gerard. 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.
Dolger, 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, Rent. 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.
Dyakonov, Fedor Vasileyvich. F.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. 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, Irenaus. 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, Joaquin de. J. de E.
Enyedi, Gyorgy. G.En.
Epperson, Gordon. G.E.
Epstein, Joseph. J.Ep.
Epstein, William. W.E.
Erb, Donald James. D.Er.
Erh, Hubert Joseph. H.J.Er.
Erhen, Walter. W.Er.
Erdens, Antonia Dta. 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 N. 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.
Fermin Gomez, 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 Gonpalves. M.G.F.
Feuer, Lewis S. L.S.F.
Fieandt, Kai V.J. von. K.V.J.v.F.
Fiegenbaum, Jay W. J.W.F.
Field, Andrew. A.Fi.
Fielder, Gilbert. G.Fi.
Fielding, Raymond E. R.E.Fi.
Figueiredo, Jose 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, 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.
Foldi, Tamás. T.F.
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.
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, 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, Hennann. 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.
Gadol, Joan Kelly. J.Ga.
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.G.
Gantt, W. Horsley. W.H.G.
Garavito, Clemente. C.Ga.
García y Bellido, Antonio. A.G. y B.
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 Petrovitch. 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, Sisir Kumar. 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, Rt. Hon. Patrick Chrestien. 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.J.Ha.
Hagiwara Takahiro. H.To.

Hahn, Boe-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.
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 W. K.Hä.
Hauser, Philip M. P.M.H.
Havard, C(yril) William H(olmes). 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, 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-Rene. P.Hi.
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.
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-Rotislav. M.-R.Ho.
Hogetsu, Keigo. K.Ho.
Hogg, Helen Sawyer. H.S.H.
Hohl, Reinhold D. Re.H.
Holder, 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.
Horowitz, David J. D.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-yuan. 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.
Hubscher, 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, G.E. G.E.H.
Hughes, Graham McK. G.McK.H.
Huizing, Peter J. P.Hu.
Hultkrautz, Åke Gunnar Birger. A.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, (S.) 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.Ic.
Ichiye, Takashi. T.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.
İnalcik, 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-Jurgen. 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.
Isnard, 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
Iz, Fahir. F.I.
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.
Jaffe, Michael. Mi.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.
Jarvinen, 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.
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.
Keenan, 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.
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, 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.
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.X.
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.
Knauth, Josefina Vazquez de. J.V. de K.
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.
Kohler, 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.
Konig, Most Rev. Franz Cardinal. F.K.
Kopanev, German Viktorovich. G.V.K.
Kopytoff, Igor. I.Ko.
Korab, Harry Edward. H.E.K.
Korkala, Pekka Yrjö. P.Y.K.
Korn, Walter. W.Ko.
Kornberg, Hans L. H.L.K.
Korner, 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 Ann Weichery. 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.
Kuhner, 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.
Kurten, 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, Leo F. L.F.L.
Lardner, Rex. R.La.
Laroui, Abdallah. A.La.
Lasker, Gabriel W(ard). G.W.L.
Lasko, Peter Erik. P.E.L.
Lassen, Erik. Er.L.
Lasserre, Franpois. 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, Henry P. H.P.L.
Launay, Michel C. M.C.L.
Lauwerys, Joseph Albert. J.A.L.
Laver, James. Ja.L.
Lavondks, 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.
Lechkne, 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) Domenica. 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, Bmce Sween. B.S.L.
Lima, José Lourenpo 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.
Lindstrom, Maurits. M.L.
Link, Arthur Stanley. A.S.L.
Linvald, Steffen. S.L.
Lippold, Adolf. A.Lip.
Lisitsin, Aleksandr Petrovich. A.P.L.
Lissens, Rene 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.
Llewellyn, 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.
Loewe, Michael Arthur Nathan. M.Lo.
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.
Liiling, 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, Jose. 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.McK.
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.
Marques, 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., Jr. 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. W.P.Mn.
Massevitch, Alla Genrikhovna. A.G.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, Bjorn. 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.
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.
Meysak, Nikolay Alekseyevich. N.Me.
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, Elberf John. E.J.M.
Mincy, Elizabeth Gard. E.G.My.
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, Jurgen 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. F1.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, Amtlia Nogueira. A.A.Mo.
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.
Muhlmann, Wilhelm Emil. W.E.Mü.
Mukerji, S.N. S.N.M.
Mulholland, J. Derral. J.D.Mu.
Miiller, Claudius Cornelius. C.C.M.
Miiller, Edith A. E.A.M.
Muller, Joachim. J.Mu.
Miiller-Brockmann, Josef. J.M.-Br.
Muller-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.
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, M. 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 Flavia. 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.
Norlund, 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, Zoe. 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.O1.
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.
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.
Padclford, 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.
Pallottino, Massimo. M.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, Andre. 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, Giinter. G.Pa.
Passmore, Reginald. R.Pa.
Pastor, José M.F. J.M.F.P.
Pasutin, Ingrid Margareta. I.M.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, Giinther. Gü.P.
Pauck, Wilhelm. W.P.
Paul, George M. G.M.P.
Pauling, Linus C. L.C.P.
Pavelic, 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.
Pelissier, René. R.P.
Pelissier, 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, Regine. 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. C.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.
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, Rene 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.
Poyov, 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.
Pozdnyak, Pavel Ivanovich. P.I.P.
Pozo Velez, 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, Zainolabedin. 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.
Riche, 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.
Rodevand, Oivind. Oi.R.
Rodgers, Harry Brian. H.B.Ro.
Rodgers, Jack D. J.D.Ro.
Rodnan, Gerald P. G.P.R.
Rodolfo, Kelvin S. K.S.R.
Rodriguez-Monegal, Emir. E.R.-M.
Roe, (Owen) Michael. Mi.R.
Roey, Jan L.R. Van. J.V.R.
Rogers, C. Ambrose. C.A.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 Kiibler-. 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.
Rouze, 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.
Saez, Emilio. E.Sa.
Sagan, Carl (Edward). C.Sn.
Saggs, Henry W.F. H.W.F.S.
Sági, Márton. Má.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.
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.
Sepulveda Gonzblez, 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.
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.
Sloan, 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, Carol D. C.D.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, Quach-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.
Tapie, 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.-E.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, J. Eric S. 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.
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. 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.
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Paul B. Moore. *Professor of Mineralogy and Crystallography, University of Chicago.*

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Hans Arnold Albert Panofsky. *Evan Pugh Research Professor of Atmospheric Sciences, Pennsylvania State University, University Park.*

Kenneth Macaulay Papnorth. *Brigadier (retired). Chief Survey Officer, Ordnance Survey, N.Ire., 1949–57.*

Ralph Brazelton Peck. *Professor of Foundation Engineering, University of Illinois, Urbana.*

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Sir Graham Sutton. *Vice President, University College of Wales, Aberystwyth. Director General, Meteorological Office, London, 1953–65.*

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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.*

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Part Three. Life on Earth

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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 Instrtution, 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 wrirer 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. *Free-lance writer on botany. Teaching Assistant, Department of Botany, University of Maryland, College Park.*

L.C. Dunn. *Emeritus Professor of Zoology; Senior Research Associate in Biological Sciences, 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 and Head, Departntent of Biology, Western Michigan University, Kalamazoo.*

Marie Louise Goodnight. *Free-lance wrirer. 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.*

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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.*

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Turner Harcourt Hopper. *Former Chief, Oilseed Crops Laboratory, Southern Utilization Research and Development Division, New Orleans.*

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Clark Hubbs. *Professor of Zoology, University of Texas at Austin.*

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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.*

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Leonard Harrison Mattbews. *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 Biology, 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.*

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Alfred S. Romer. *Alexander Agassiz Professor Emeritus of Zoology, Harvard University.*

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Herbert Holdsworth Ross. *Professor of Entomology, University of Georgia, Athens.*

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Norman Taylor (d. *1967). Assistant Curator, New York Botanical Garden, 1905–11. Author of* Guide **to Garden Flowers** *and others.*

John W. Thieret. *Professor of Biology, University of Southwestern Louisiana, Lafayette.*

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.*

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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.*

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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.*

Rohert 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 Barrou. *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.*

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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. *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 Cornmissioner, Eastern College Athletic Conference.*

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Donald E. Cassels, M.D. *Professor of Pediatrics, University of Chicago.*

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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. *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 Sywdicate.*

Helen Aird Dickie, M.D. *Professor of Medicine, University of Wisconsin, Madison.*

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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.*

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James Russell Eckman. *Senior Consultant, Section of Publications, Mayo Clinic, Rochester, Minn.*

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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.*

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Douglas James Guthrie, M.D. *Medical Historian. Lecturer on the History of Medicine, University of Edinburgh, 1945–56.*

Ward Campbell Halstead (d. **1969**). *Professor, Departments of Psychology and Medicine, Uriiversity of Chicago, 1946–69.*

Eric P. Hamp. *Professor of Indo-European Linguistics; 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.*

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 Psycltology,*

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Ford Hutchinson. *Free-lance writer.*

Jacques Andre 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.*

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George Alexander Kelly (d. 1967). *Professor of Psychology, Brandeis University, Waltharn, Mass., 1965–67.*

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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.*

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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.*

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Raymond G. Kuhlen (d. 1967). *Professor of Psychology, Syracuse University, N.Y.*

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George E. Lardner (deceased). *Associate Editor, Bell-McClure Syndicate, Inc., New York City.*

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Joseph **Colville** Lincoln. *Author of* Soaring for Diamonds.

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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.

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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.*

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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.*

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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 Healtlt, 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 Aeronautics and Space Administration Manned Spacecraft Center, Houston, Texas, 1964–70.*

Cecil Wilson Plant. *Honorary Secretary, International Water Polo Board.*

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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.*

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Charles De Visscher. *Honorary President of the Institute of International Law. Judge, Internatiorzal Court of Justice, 1945–52.*

Sir Claud Humphrey Meredith Waldock. *Chichele Professor of Public International Law, University of Oxford, 1947–72.*

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William Thomas Wells. *Queen's Counsel. Member of Parliament for Walsall, Eng., 1945–55; Walsall North, 1955– . General Staff Oficer, 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.*

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Sir John Wyndham Pope-Hennessy. *Director and Secretary, Victoria and Albert Museum, London; Keeper, Department of Architecture and Sculpture, 1954–66.*

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 Raiue. *Poet andscholar. 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, Eug.*

Charles Martin Robertson. *Lincoln Professor of Classical Archaeology and Art, University of Oxford.*

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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; Groves Dictionary of Music.

Kaarlo Salo. *Attaché for Press and Cultural Affairs, Finnish Embassy, London.*

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Alexander Mackie Scott. *Senior Lecturer in Scottish Literature, University of Glasgow.*

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Arthur J(ames) M(arshall) Smith. *Professor of English, Michigan State University, East Lansing.*

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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.*

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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.*

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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.*

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Anthony Thwaite. *Poet and critic. Literary Editor,* **New Statesman,** *London. Author of* **Contemporary English Poetry** *and others.*

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Arlin Turner. *Professor of American Literature, Duke University, Durham, N.C.*

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Frank Walker (d. 1962). *Musicologist and broadcaster.*

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Francis William Wentworth-Sheilds (d. *1969). Artist. Principal Lecturer, Department of Printing and Graphic Design, Twickenham College of Technology, Middlesex, Eng., 1966–69.*

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Nelson Hitchcock Budd. *Fortner 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.*

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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.**

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Gordon Maskew Fair (d. *1970). Abbott and James Lawrence Professor of Engineering. Gordon McKay Professor of Sanitary Engineering, Harvard University.*

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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.*

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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, *Shefield, 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.*

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John Forrest Hayward. *Associate Director, Sotheby and Company, London. Deputy Keeper, Victoria and Albert Museum, London, 1946–65. Author of* Huguenot Silver in England *and others.*

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John B. Heffernan. *Rear Admiral, U.S. Navy (retired). Secretary, Naval Historical Foundation, Washington, D.C. Director of Naval History, Navy Department, 1946–56.*

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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.*

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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 Kiichemann. *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.*

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James Charles Moran. *Editor,* Graphic Technology *(London).*

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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.*

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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.*

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L.T.C. Rolt. *Free-lance writer. 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.*

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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.*

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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.*

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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,* Encyclopaedia Britannica, *Chicago, 1959–66.*

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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

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Charles Joseph Adams. *Professor and Director, Institute of Islamic Studies, McGill University, Montreal.*

Rev. Joseph **Denis** Agius, O.S.B. *Monk of Downside Abbey, Eng.*

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Kurt Aland. *Professor of Church History, University of Miinster, 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.*

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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 Cltancellor, Jewish Theological Seminary of America, New York City.*

Donald Attwater. *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.*

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Count Michael de la Bedoyere. *Editor of* Search *newsletter, 1965–68.*

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Rev. Maurice **Bévenot,** S.J. *Professor of Ecclesiology, Heythrop College, University of London.*

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Arthur Stanley Bolster, Jr. *Professor of Education, Harvard University.*

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Rev. James Patrick Brodrick, S.J. *Author of* Origin of the Jesuits *and others.*

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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.*

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William Reginald Ward. *Professor of Modern History, University of Durham, Eng.*

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Saul S. Weinberg. *Professor of Classical Archaeology, University of Missouri, Columbia.*

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Delwin Brown. *Associate Professor of Philosophy and Religion, Anderson College, Ind.*

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William R. Eckhardt. *Free-lance writer on mathematics.*

Dorothy Mary Emmet. *Emeritus Professor of Philosophy, Victoria University of Manchester.*

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Sir T. Malcolm Knox. *Principal, University of St. Andrews, Scot., 1953–66; Professor of Moral Philosophy, 1936–53.*

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Richard Holbrook Brown. *Director, Committee on the Study of History, Hampshire College, Amherst, Mass., and the Newberry Library, Chicago.*

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Raul **d'Eça.** *Lecturer on Latin-American affairs. Assistant Career Planning Oficer, U.S. Information Agency, 1959–61. Branch Public Affairs Oficer, Recife and Belo Horizonte, Braz., Office of International Information and Cultural Affairs, 1947–58.*

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