matic hydrolysis; odor of ammonia was observed after adding sodium carbonate; in the absence of buffers the *p*H changed from 7 to 8. Carbon dioxide was quantitatively measured by absorption by Ascarite on aeration; it was also qualitatively detected by the barium hydroxide test. Microcombustion of the C. P. biuret, obtained from Eimer and Amend, gave N, 34.86%, whereas $C_2N_3H_5O_2 \cdot H_2O$ gives N, 34.71%; the well-known biuret test was positive. Thus hydrolysis of biuret is definitely established; it occurred only in the presence of urease preparations as was shown by negative blanks. To establish that urease is responsible for this reaction the following experiments were performed. The ratio of ammonia produced in a 0.016 *M* solution of biuret to that in a 0.0019 *M* solution of urea by aliquot portions of a crude extract from jackbean meal was 1.5 at 20° and *p*H 7.0 in phosphate buffer. Crude extract from soya beans gave for this ratio 1.6. Crystalline enzyme prepared from jackbean meal by the method of Sumner and having a specific activity of 63,000 Sumner units gave a ratio of 1.6. On adding 10^{-4} *M* solution of Ag^+ to the enzyme its activity was reduced to that of the blank both for urea and biuret. In a solution containing 0.048 *M* of sodium sulfite and 0.013 *M* sodium bisulfite per liter in which the activity of urease toward urea is reduced[2] to one-fifth, the above ratio was still found to be 1.6. These ratios were reproducible to 10–15%. On adding to a 1.5% solution of urea 1.0% biuret the rate of production of ammonia by another preparation of crystalline enzyme (about 30,000 S. u. activity) was reduced by 11%. According to the data of Sumner, the production of ammonia is fastest in the 1.5% solution of urea, and thus the addition of biuret acted in the same manner as a further addition of urea, virtually eliminating the possibility that two different enzymes are responsible for the two reactions and showing that the two substrates compete for the same enzyme. The other experiments described above point in the same direction and we believe that hydrolytic activity of urease toward biuret has been established with a high degree of probability.

In 5×10^{-2} *M* solution of urea the production of ammonia is faster by a factor of 9 than in an equimolar solution of biuret. This is the partial explanation of the failure of Takeuchi[3] to detect hydrolysis of biuret by crude extracts from soya beans.

Preliminary determinations of both the ammonia and the carbon dioxide produced by urease in solutions of biuret indicate a ratio of 3:1, rather than 3:2, which would be obtained on complete hydrolysis, suggesting that some other products are being formed. The enzyme appears to become rapidly inactivated in hydrolyzing biuret, which suggests inhibition by some products of hydrolysis.

Urease occurs not uncommonly in living tissue and the need for elimination of urea from such tissue appears to be a weak justification for the presence of urease. The finding of another substrate toward which urease is active is therefore of interest as suggesting an additional biological reason for urease. We are therefore extending our experiments to derivatives of biuret and its homologs (carbonyl diurea, tetruret, etc.) as well as studying the mechanism of the biuret hydrolysis.

DEPARTMENT OF CHEMISTRY
HARVARD UNIVERSITY W. H. R. SHAW*
CAMBRIDGE, MASS. G. B. KISTIAKOWSKY†

RECEIVED NOVEMBER 23, 1949

(3) T. Takeuchi, *J. Coll. Agr., Tokyo, Imp. Univ.*, **1**, 1 (1909–1913).

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NEW BOOKS

Scientific and Technical Abbreviations, Signs and Symbols. By O. T. ZIMMERMAN, Ph.D., Professor of Chemical Engineering, University of New Hampshire, and IRVIN LAVINE, Ph.D., Formerly Professor of Chemical Engineering and Head of the Department, University of North Dakota. Industrial Research Service, Dover, N. H., 1948. xii + 476 pp. Illustrated. 14 × 22 cm. Price, $7.50.

In the days of Berzelius and Bunsen a scientist carried most of his science in his head and usually knew where to find the rest easily, but the time for abstract journals soon came, then science dictionaries, encyclopedias, monographs and special compilations such as the one here considered. Zimmerman and Lavine have done an extensive job of collecting the abbreviations, signs and symbols from A (aeronautics) to Z (zoology), with chemistry, physics, biology, botany, astronomy, mathematics, engineering, radio, electronics, hydrography, topography, meteorology, medicine, communications, machine and tool shopcraft, commerce, banking, military, navy, even plumbing and heating, in between, all well arranged by subjects and fields, in neat and readable tables. The sources drawn from are many, in particular the American Standards Association.

Any criteria of excellence or completeness are hard to establish; the reviewer could not find the kX. unit now substituting for Å. (A. U.), nor $[\alpha]^t_D$, nor MR_D, all of which are commonly used by chemists, nor O. R. C., B. R. T. or B. L. E. in the section devoted to railway terms. The authors discuss favorably in the Preface the growing practice of omitting periods after abbreviations. The

reviewer and most chemists have not succumbed to the infection as yet; there are points in its favor, superfluity of the period, and the space it fills, but equally as good or better arguments against. The space filled by the period is seldom responsible for an extra line, and the confusion produced, the décolleté appearance of the abbreviation, the difference between an abbreviation and a symbol, the secretarial problems involved in preparing uniform copy for publication, all these are effective *contra* points. Even the strong advocates cannot agree on how far to go and none of them are 100 per-cent-ers. The writers have succeeded quite well in their aim "to make available in one convenient volume the principal abbreviations, signs and symbols used in a number of scientific and technical fields."

ALLEN D. BLISS*

* Harvard University Ph.D. 1934.

High Molecular Weight Organic Compounds. Editors: R. E. BURK, Plastics Department, E. I. du Pont de Nemours & Company, Wilmington, Delaware, and OLIVER GRUMMITT, Morley Chemical Laboratory, Western Reserve University, Cleveland, Ohio. (Frontiers in Chemistry, Vol. VI.) Interscience Publishers Inc., 215 Fourth Avenue, New York 15, N. Y., 1949. 330 pp. Illustrated. 15.5 × 23.5. Price, $5.50.

The six review articles comprising this volume differ sufficiently from one another in both subject matter and type of treatment to defeat attempts at generalization. In the first contribution, "Polymerization in Suspension and Emulsion" (Hohenstein and Mark), an abundance of the new knowledge in this field is effectively integrated. This is not a comprehensive survey, however, but rather a presentation of the authors' interpretation of developments in the field prior to 1948. The next article, "Osmometry and Vicosity of Polymer Solutions" (Badgley and Mark), will probably appeal to a smaller audience. It is essentially an exposition designed for the non-specialist in these methods and is rather lacking in acuity and timeliness because no attempt has been made to relate the dependence of the reduced osmotic pressure and reduced specific viscosity on the concentration and newer theories now replace some of those discussed. The contribution, "Nature of Elastomers" (Fisher), is chiefly concerned with the determination of the structure of rubbers and the chemistry of vulcanization. Unhappily, a survey of the striking developments of the last decade is not to be found here; instead there is only a conservative evaluation of these topics as they appeared prior to World War II. The next two reviews—"Structure and Reactions of Proteins" (Edsall) and "Condensation Polymerization and Constitution Polymers" (Flory)—are models of judicious condensation. The field covered by the former has now become so vast that only a brief survey is possible within such a limited space. However, the survey is so designed as to bring the reader quickly to the most interesting frontiers. Of all the reviews in this volume, only the one on condensation polymers treats a subject that can be considered to have reached maturity and hence is ready for a definitive review rather than a progress report. This task is accomplished with skill by one whose endeavors have made possible the rapid development of this part of polymer science. The concluding article, "Physical and Chemical Structure of Phenoplasts" (Carswell), presents an interesting and concise digest of the status of our knowledge on the condensation products of phenols and aldehydes. The discussion serves to emphasize the contrast between the importance of the materials and the neglect of their scientific study.

The typography and binding are of the excellence expected from the Interscience Publishers. On the other hand, a regrettable lapse of time has occurred between the writing of most of the contributions and the appearance of the book. Finally one must note with disapproval the neglect of the editors, here as in some of the former volumes, to maintain a central theme for the volume as a whole. High Molecular Weight Organic Compounds is a field nearly as broad and diverse as Low Molecular Weight Organic Compounds and it is a rare person who will be greatly interested in all of the items in this collection.

PAUL DOTY*

* Harvard University Faculty 1948–.

Synthetische Methoden der organischen Chemie. Repertorium 2. By W. THEILHEIMER. S. Karger, Holbeinstrasse 22, Basel, Switzerland (New York), 1948. viii + 309 pp. 16 × 23.5 cm. Price, Sfr. 35.—.

The first volume of Theilheimer's collection, which had appeared in 1946, was received favorably by organic chemists as demonstrated, for instance, by the recent translation of the work into English. The second volume has now been published; in the foreword the author points out that this volume deals mainly with methods taken from Swiss, French and British publications of the years 1945 and 1946. The difficulties imposed by the war made it necessary to postpone consideration of American papers of that period until the publication of the third volume.

The reader will be pleased to note that the indexing system is more fully and lucidly illustrated in the volume at hand as compared with the first volume. Otherwise this reviewer has no comments to add to those made regarding the first volume beyond an expression of gratification at the successful continuation of the project.

HANS HEYMANN*

* Harvard University Ph.D. 1941; Faculty 1942–45, 1945–46.

Torchbearers of Chemistry. By HENRY MONMOUTH SMITH, formerly Professor of Inorganic Chemistry at Massachusetts Institute of Technology, with Bibliography of Biographies by RALPH E. OESPER. Academic Press, Inc., Publishers, 125 East 23rd Street, New York. N. Y., 1949. 276 pp. 18.5 × 26 cm. Price, $8.00.

The student of chemistry in the course of his usual pedestrian instruction is exposed to a vast array of chemical substances and chemical phenomena. If he is thoughtful and patient he also masters a host of deductions, generalizations and theories which help him to understand matter and its transformations.

It is unfortunate if the student in this study cannot marvel at the infinite variety and complexity of these substances and their interactions, and be thrilled by the power and beauty of many of these generalizations of his science and by the scope and insight of the intellects that first discerned and described them.

An appreciation of these aesthetic and emotional aspects of chemistry is best attained by a study of its history, and by this I mean not a mere chronological account of the growth of that science, but a study of the history of the individual discoveries of new and significant chemical phenomena and of new, wider and more powerful generalizations. This inevitably leads to the study of the activities and ideas of individual chemists.

For such a study, nothing is more helpful and inspiring than to be able to inspect pictures of the chemists in question and to consider how these men as shown in their portraits reacted to the problems or phenomena that they faced.

This collection of over two hundred pictures of the great chemists from Geber and Albertus Magnus down to Moses Gomberg and Gilbert Lewis is an unrivaled assemblage in one volume of the likenesses of many chemists. Professor Smith, with the aid of the Moore Fund established twenty years ago in memory of Professor Moore of the Massachusetts Institute of Technology, himself a gifted historian of chemistry, made this collection to adorn the corridors of the Chemical Laboratory at the Institute. Professor Smith has now reproduced these portraits in this

sumptuous volume and has inserted brief biographies of a few lines under each portrait. Professor Ralph E. Oesper has also contributed a useful Bibliography of Biographies, so that the reader, if he wishes, can refer to definitive accounts of the lives and achievements of the chemists here pictured.

These portraits are not only of individual interest. The two hundred of them viewed in succession make a remarkably powerful impression. *En masse* one cannot but be impressed by the keenness, power and human dignity that the portraits display. They make one feel rather pleased to be a chemist.

This volume should not only be of great value to teachers of chemistry but will afford pleasure and inspiration to all who are interested in chemistry itself or in chemistry as a preoccupation of the human intellect and spirit.

ARTHUR B. LAMB

The Practice of Research in the Chemical Industries. By R. H. GRIFFITH, Senior Research Chemist, North Thames Gas Board. Oxford University Press, 114 Fifth Avenue, New York 11, New York, 1949. vii + 184 pp. 14.5 × 22 cm. Price, $3.25.

In the introduction it is stated that "This book is an attempt to describe the functions, structure, and organization of a chemical research department attached to industry. It makes use of any published material which covers the subject, and is intended to indicate the directions in which existing laboratories might expand or modify their procedure, as well as to suggest the basis on which any new department might be established. Although primarily concerned with British conditions, attention is not restricted to this country, and much valuable information has been derived from American sources. . . . Its objective is to describe the way in which the work is actually done and to show the variety of activities involved in applied chemical research. It deals with organization and planning, not for their own sakes, but only so far as they can help in the output of original work. It includes, therefore, practical experimental methods and deals with the design, construction, and operation of new chemical plant. . . ."

"The material included in the book is intended to be of interest to those immediately concerned with industrial chemical research in any capacity, whether in its experimental, production, or management sides. It is also intended to give an indication to students or postgraduate research chemists, and perhaps to those who teach them, of the scope for applied research and of the opportunities which are available in industry for qualified men."

The chapters of the book are entitled: I. The Functions of the Research Department, II. The Research Staff, III. The Research Laboratory, IV. The Research Programme, V. Library Research, VI. Small-Scale Experimental Work, VII. Development Research, VIII. The Full-Scale Plant, IX. Operational Research, X. Records and Publications, XI. Welfare and Safety, XII. Costs and Profits, and XIII. Future Developments.

The reviewer will discuss the contents of the book in terms of principles and practices which are commonly used in industrial research laboratories of the United States. This may be unfair to the author, who states that the book is primarily concerned with British conditions, but it is felt that differences between practices in Great Britain and in the United States should be pointed out for the benefit of the American. Although there are a number of moderately large industrial research laboratories in England which in direction, operation, and results are fully comparable to those of the better laboratories in the United States, the total scale of industrial research does not approach that of the United States. Furthermore, the British Research Associations are attempting to carry out much of the technical work which is done in the United States by private industrial laboratories.

It is to be expected that any attempt to give in a small book a survey as comprehensive as that outlined in the introduction could not be completely successful. For those who are not experienced in the practice of industrial scientific research, it is useful to have available a broad summary of many of the important factors in its conduct, and this book does provide such a summary. However, the treatment of the individual elements of industrial research is in many cases necessarily superficial, and answers are not given to many of the questions which will occur to those who are actively engaged in experimentation or in the direction and management of an industrial research laboratory.

A fairly large proportion of the book is given to a discussion of functions and operations which are not usually considered in this country to be research, although in England they may be part of the laboratories' duties. In the United States, at least in the larger companies, much of the responsibility which is outlined in the chapters on "Development Research" and, in particular, "The Full-Scale Plant" is not assumed by the laboratory but by development and engineering groups which are directly under plant supervision. Further, the general field of "Operational Research" is usually considered to be a function not of the research laboratory but of an Industrial Engineering department. The reviewer is left with the impression that the research laboratory in England has so many duties connected with the manufacturing departments that the experimental work must suffer unless the laboratory staff is relatively large compared with that of other departments of the company.

There are a few differences of opinion and omissions which will occur to those familiar with the operation of industrial research laboratories in the United States. In the first chapter, there is a discussion of the extent and cost of research work, but the author does not come to grips with the basic problem of how these should be determined in any particular case.

The discussion in Chapter II, "The Research Staff," is generally good. In this country considerably less stress is placed upon continued scientific training of the laboratory staff. Only one brief paragraph is given to a discussion of the non-technical sections of the research department. The whole question of the management of a research laboratory is one which has occupied the attention of many research directors in the United States in the past few years; this very important subject is dismissed without comment.

The only serious omission in the chapter on "The Research Laboratory" is a description of the module principle of construction which is being widely used in the United States.

The chapter on "The Research Programme" includes not only a discussion of the selection of a program but many elements of research direction which are of importance. Some of the recommendations apply better to small or medium size laboratories than to large laboratories, but a number of excellent suggestions are made.

The chapter on "Small-Scale Experimental Work," particularly where concerned with supervision, is good. Some sections of the chapter will be of particular interest to the laboratory worker because they summarize principles of operation which a chemist should learn during his training. In the section dealing with reports, no mention is made of the conference system widely used in the United States for reporting the results of work and for following development programs.

Much of the chapter on "Development Research" is essentially a discussion of chemical engineering principles and is concerned more with advising the laboratory worker than with more fundamental problems of research direction and administration.

The chapter on "Costs and Profits" will be of little assistance to those who wish to develop a system for estimating costs and profits in an industrial laboratory. The chapter does not touch upon such matters as preparing the laboratory budget, systems of accounting, and salaries and wages, which are all-important in maintaining a smoothly operating environment for the productive staff of the laboratory, the scientists and technologists.

Chapters V, "Library Research," and X, "Records and Publications," indicate that the author has considerable interest in these subjects. The material of these chapters is useful and well presented, but some of the space devoted to it might have been better used to amplify other sections of the book on actual laboratory direction and administration.

Chapter XIII, "Future Developments," attempts to forecast the directions which the expansion of industrial research will take. The chapter is primarily concerned with future developments in England, which are necessarily conditioned by the present political system, the trend toward nationalized industries, the growth of Research Associations, and the present and predicted economic situation.

The book as a whole is well organized and clearly written. There is an adequate bibliography and index. Griffith's book should be interesting to those who wish to acquire a general background in research and development in chemical industries in Great Britain.

J. A. LEERMAKERS*

* Harvard University Post-doctorate Fellow, 1932–1934.

BOOKS RECEIVED

November 10, 1949–December 10, 1949

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