the preparation and impregnation of paper, the choice of solvent systems, converting substances to forms more suitable for chromatography (such as converting acids to hydroxamic acids), preparing samples for chromatography, and carrying out quantitative analyses. These two sections are detailed and represent a valuable compilation of frequently needed data. Finally, there are author and subject indexes (39½ pages, each with two columns of entries).

Volume 2, an important adjunct to volume 1, contains a minimum of explanatory text and 10,290 bibliographic entries, each with author, title or indication of the subject dealt with, and reference. These are also organized into two main divisions: a general part (56 pages) and the special part which comprises the bulk of the volume. The special part is divided into chapters which deal with particular types of compounds, some of which have been added since volume 1 was published. Most of the chapters are further subdivided. For example, the chapter on organic acids is subdivided into general reviews, lower fatty acids, higher fatty acids, aliphatic hydroxy acids, di- and tricarboxylic acids, keto acids, phenolic and other cyclic acids, glycerides and other esters of organic acids. Most of these subdivisions are further classified in terms of techniques and applications, which are themselves further subdivided. This careful, logical organization makes the information extraordinarily accessible down to very narrow requirements. The volume concludes with a complete author index and an alphabetical index of substances that have been chromatographed. The references in volume 2 comprise four times as many substances as are referred to in volume 1.

Both volumes are printed on good paper in a clear and readable style. The illustrations in volume 1 are excellently chosen, and the authors do not avoid epistemological considerations where these are appropriate—that is, where such considerations help the reader to understand the reasoning behind the method. For all of these reasons the editors and authors are to be congratulated on providing paper chromatographers, from beginners to experts, with a first-rate text and reference work. I recommend the two volumes most highly.

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## Quantitative Science

**Experimental Immunochemistry.** Elvin A. Kabat. With chapters by Manfred M. Mayer. Thomas, Springfield, Ill., ed. 2, 1961. xii + 905 pp. Illus. $26.50.

For those familiar with the 1948 edition of Kabat and Mayer, the publication of Kabat's new edition is an important event. Michael Heidelberger in the preview (an introduction) to the first edition predicted that *Experimental Immunochemistry* would be "more likely to gather acid spots and indicator stains on the laboratory table than to accumulate dust on the reference shelf," and I am prepared to produce the shreds of my second copy as the fulfillment of Heidelberger's prophesy.

Immunochemists and their forebears, immunologists, recognize that immunochemistry became a discipline in its own right through the brilliant and precise efforts of small groups of chemists and biologists to render quantitative an otherwise empirical science. The discipline, however, has evolved during the past decade into a bureaucracy, which even an author possessed of the breadth and clarity of Kabat finds impossible to treat fully in more than twice the linage of the first edition (900 two-column pages versus 550 single-column pages). Consequently, the author felt justified in omitting discussions of some newer offshoots of immunology, such as immunohistology and immunohematology, possibly because they do not as yet lend themselves to analysis by many of the precise quantitative methods with which the book is primarily concerned.

The original format has been preserved. There are four parts dealing with basic methodology and theory, applications, chemical and physical methods, and preparations. Several new chapters have been added to provide introductions to interim developments such as chromatography and measurements of radioactivity. Many chapters are greatly enlarged. The section on complement and complement fixation, by Mayer, is nearly three times more copious; it has new illustrations and tables. An excellent treatment of electrophoretic methods now includes discussions on the applications and limitations of various zone-electrophoresis techniques, including immunoelectrophoresis.

Gel-diffusion methods are now recognized among the most powerful tools available for analysis of complex antigen-antibody systems. They are treated extensively, but more from the theoretical than technical aspect. For the purposes of this book such a presentation is proper since the power and wide application of most techniques derive as much from their versatility as from their inherent physical or chemical qualifications. Because they are versatile, gel-diffusion methods have been modified in many ways by individual investigators to suit their particular problems.

The author's discretion in such matters demonstrates considerable insight into the basic questions which investigators pose for reference handbooks—for example: How can our results best be interpreted? Wherever appropriate, Kabat has provided theoretical and practical guideposts and danger signals in the application of physical and chemical methods to immunochemistry and in the use of immunochemical tools in approaches to biological or biochemical problems. In this respect *Experimental Immunochemistry* is not only an immunochemist's volume. It is a major contribution toward the advancement of the biochemistry of macromolecules, and it is to be highly recommended to all chemists and biologists whose fields are beginning to feel the impact of practical and theoretical immunochemistry.

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## Chloroplast

**The Life of the Green Plant.** Arthur W. Galston. Prentice-Hall, Englewood Cliffs, N.J., 1961. 116 pp. Illus. $2.95.

This concise, up-to-date summary of the fundamentals of plant physiology is chiefly designed for use in introductory courses in biology, but it should also be an ideal complement to more comprehensive texts used for beginning courses in plant physiology.

The sequence of topics is essentially the same as that in the larger text, *Principles of Plant Physiology,* by Galston and James Bonner. The most noticeable changes in content are the omission of the details of intermediary metabolism (which is to be expected, considering the audience for which this "Foundations of Modern Biology Series" is designed), the addition of a chapter on the green plant cell, and the emphasis on plant growth, differentiation,

and morphogenesis (comprising almost half the book). As those who have used the *Principles* will expect, the work is lucidly written and well organized. Illustrations are of high quality and in good taste.

I have only minor criticisms: for example, on page 37 it is not at all clear why it follows from the action spectrum of photosynthesis that carotenoids must be involved in the process, and on page 79 possibly too much emphasis is placed on the survival value of bud dormancy. In such a condensation very few of those persons associated with the major advances in a field can be mentioned; in this case it would have been wise to omit names entirely.

I suspect many students will consider careers in experimental botany as a result of using this volume.

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## $(C_{10}H_{13}O_3)_x$

**The Chemistry of Lignin**. Supplement volume. Covering the literature for the years 1949–1958. Fredrich Emil Brauns and Dorothy Alexandra Brauns. Academic Press, New York, 1960. x + 804 pp. Illus. $18.

Some idea of the effort expended on lignin research during the decade covered can be gained by noting that the size of this volume is almost identical to that of the first, which dealt with the entire earlier period beginning with the discovery of lignin in the 1830's. Workers in the lignin field who have long since abandoned attempts to keep abreast of the flood of pertinent literature will find the appearance of this supplement most welcome.

Although readers expecting to encounter progress in proportion to the volume of research may well be disillusioned, some will consider excessively pessimistic the authors' view that little progress has been made toward the elucidation of the structure of lignin. Recent evidence, much of which is admittedly indirect, has at least permitted presentation of a plausible diagram representing the main types of lignin "building stones" and the linkages between them. Such a concept seems to be gaining increasing acceptance, and this is a welcome change from the multitude of often-conflicting theories extant in 1952.

In other areas of lignin research, notably the problem of the lignin-carbohydrate bond (discussed here by J. W. T. Merewether) and the lignification process, very significant advances are reported. In recognition of this, for example, the chapter formerly entitled "Theories on the formation of lignin" now appears as "The biosynthesis of lignin."

Otherwise the plans of the volumes are virtually identical, although there have been considerable shifts of emphasis. The entire spectrum of lignin research has been scanned with such thoroughness and attention to detail that for many purposes reference to the original literature will be unnecessary. Especially gratifying in this respect are the frequent reproductions of tables, figures, and experimental procedures from Japanese, Soviet, and other journals not always readily accessible to American readers. As before, Brauns writes critically, exhibiting a profound knowledge of his subject, and he maintains a disinterested viewpoint even in areas where vigorous controversy has sometimes been in evidence.

The present volume, with its predecessor, can be regarded justifiably as the standard treatise on lignin in the English language, and it merits a place in the library of anyone seriously interested in the field.

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## Fatal Genes

**Developmental Genetics and Lethal Factors**. Ernst Hadorn. Translated by Ursula Mittwoch. Methuen, London; Wiley, New York, 1961. xviii + 355 pp. Illus. $8.50.

Biologists can only be grateful for an English version of this most valuable monograph on lethal factors, although one may wish that the time interval between the appearance of the original German edition (1955) and the appearance of the English translation (1961) had been shorter.

Lethals are defined as "Mendelian units which cause the death of an organism prior to the reproductive stage." They arise by mutation, probably in all organisms from virus to man. Since Ernst Hadorn has contributed perhaps more than any other person to their study, a painstaking and critical review from his pen of the now very extensive pertinent literature (the bibliography alone covers 32 pages) is very useful. Investigations made with lethals in *Drosophila*, mouse, and poultry are considered most fully, but other organisms, including plants and microorganisms, are by no means overlooked. Nor are human lethals neglected, although, of necessity, the coverage is here least comprehensive. A book as large as the present one would be needed to deal with lethal and semilethal hereditary diseases and malformations in man alone.

The bearing of the studies of lethal factors on the problems of developmental genetics is, as indicated by the title of the book, in the center of the author's attention. Brief descriptions of the occurrence of lethals in natural populations, of their economic importance, and of the possibilities of therapy's causing the otherwise lethal genotypes to produce viable individuals are nevertheless included. All in all, this is an indispensable book in any biological library.

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## Using Groups in Physics

**The Application of Group Theory in Physics**. G. Ya. Lyubarskii. Translated from the Russian by Stevan Dedijer. Pergamon, New York, 1960. ix + 380 pp. $10.

This English translation of a Russian work by G. Ya. Lyubarskii is a readable and quite complete discussion of the major applications that group theory finds in theoretical physics. The applications are discussed in sufficient detail to supply an interested reader with a working knowledge of the subject matter.

The book is very much slanted toward applications, and the early chapters, which discuss the general properties of groups and their representations, are quite sketchy. Complete descriptions of the properties and representations of groups of physical interest appear in the later chapters. Included in these discussions are the point groups, permutation groups, and space groups. Two entire chapters are devoted to the rotation groups in two and three dimensions, and another to the properties and