of chemistry, while the accuracy and completeness of the information provided are such that chemists themselves will find the book a useful addition to their reference libraries. Necessarily in a book of this scope, sections of information indispensable to one group of users will prove of little value to others. The inclusion of trade names may be invaluable for the industrialist but is scarcely warranted from the viewpoint of the researcher, considering the large amount of space that they require. Users in the latter group will, however, be pleased to find liberal references to reviews and texts where further information may be obtained, and frequently also to the original literature.

The third edition has been brought up to date (first volume to mid-1952, second to the end of 1952), and the additional information has been included without any increase in bulk over the preceding edition by resorting to the use of abbreviations. These, however, are not extensive and can be interpreted easily without repeated reference to the key provided. The excellent printing and format of the book remain unchanged, strict adherence to alphabetical listing of the items having been maintained. The encyclopedia is carefully cross-referenced, and location of the desired information is rapid and easy.

Although the coverage of less common chemical compounds is not as complete as in dictionaries and handbooks of more limited scope, *Chemie Lexikon* records a comprehensive range of substances related to all branches of chemistry and neighboring fields, such as foodstuffs, dyes, drugs, metallurgy, geology, and biology. Physical and chemical properties, preparative methods, uses, sources of supply, and in some cases prices are reported. Terms, reactions, theories, and laws are carefully explained. Information on modern chemical knowledge and practices, biographies of noted scientists, statistics on the chemical industry throughout the world, and a host of other subjects are covered. Descriptions of apparatus are usually accompanied by an illustration, and structural formulas of chemical compounds are given. The user with a limited knowledge of the German language will find no difficulty in understanding the clear and simple style of the author.

LEO C. VINING
Department of Microbiology, Rutgers University

Textbook of Physiology and Biochemistry. 2nd ed. George H. Bell, J. Norman Davidson, and Harold Scarborough. Livingstone, Edinburgh–London; Williams & Wilkins, Baltimore, Md., 1953. 1002 pp. Illus. + plates. $10.

This textbook first appeared in 1950 and has been well received in the British Isles, for whose medical and dental students it was written. Dr. Bell is professor of physiology in the University of St. Andrews, Dr. Davidson is professor of physiological chemistry in the University of Glasgow, and Dr. Scarborough is professor of medicine in the University of Wales. Coming from three different disciplines, these authors have produced a well-integrated volume, with a lucid style and straightforward argument, in which enough clinical material is incorporated to point the reader toward applications in the wards.

The second edition is somewhat longer than the first, but there has been little change in organization of the text and almost none in the illustrations. The figures are well chosen, many from classical sources, some newly drawn, and are reproduced with clarity, many appearing as halftones. References at the ends of chapters have been more than doubled, mainly by the inclusion of new papers and monographs published during the last 3 years. Nevertheless, the authors show a certain conservatism in their choice of material, and a number of recent advances have not been treated.

This book may be described as basically a text in physiology, with somewhat more than the usual attention paid to biochemistry. It is hardly adequate to serve the needs of the courses in biochemistry now given in American medical schools. It should be found acceptable as a text in some physiology courses, since the treatment is somewhat simpler than that used in most of the great tomes currently imposed upon American medical students, the majority of whom begin the study of the subject with very little background. The authors have certainly developed an interesting and easily read volume that should he helpful to many students, including seniors in arts and science schools who have had some previous training in the field.

WILLIAM R. AMBERSON
Department of Physiology, School of Medicine
University of Maryland, Baltimore

The Major Features of Evolution. George Gaylord Simpson. Columbia Univ. Press, New York, 1953. 434 pp. Illus. $7.50.

Dr. Simpson's new book is an outgrowth of his well-known earlier work, *Tempo and Mode in Evolution,* and contains the essential material of the earlier volume in a greatly expanded form. It is, therefore, the outstanding and, in fact, the only work that integrates the mass of paleontological data with the latest information from genetics to synthesize general principles about the course of evolution and the causal factors that underlie evolutionary change. For this reason, it should be on the must list for all scientists seriously interested in understanding evolution.

The book is built around the same basic topics as was *Tempo and Mode.* The same type of factual material is used for illustration—chiefly the fossil record of vertebrate animals, with some evidence from invertebrates. The data are again treated in a quantitative fashion, with statistical concepts playing a prominent role in the formulation of the general principles. The book is nevertheless free from statistical formulas and thus quite readable for those without much knowledge of statistics.

In this new work one finds a much larger body of factual material, and a fuller discussion of the ex-

amples presented. Some of these examples bring home Simpson's points with striking force; particularly illuminating is his analysis of changing evolutionary rates in the lungfishes, as deduced from the data of Westoll. Another improvement is the more logical arrangement of material. In *Tempo and Mode* there was a collection of ideas and facts about evolution only loosely connected with one another. The present work begins with a careful analysis of factual data on evolutionary rates, followed by a detailed consideration of the basis of variation, population, structure, selection, and adaptation and ends with a synthesis of the evidence presented in an account of evolutionary trends, chiefly on the level of the genus and higher categories. It thus builds up to the final climax in such a way that the reader becomes fully aware of the facts and reasoning back of Simpson's major conclusions.

The author devotes considerable space to discussing and refuting the arguments of those who disagree with the broad philosophy of evolution that he has adopted, namely, the Neo-Darwinian approach, which emphasizes selection of combinations of many small genetic differences as the dominant motivating force of evolution. The two opposing ideas that are attacked most persistently are the "mutationist" hypothesis, as presented by the geneticist Goldschmidt and the paleontologist Schindewolf, and the various versions of "orthogenesis," in the sense of evolutionary trends directed from within. The criticism of Schindewolf and Goldschmidt is based largely on different interpretations of the same paleontological data as those employed by Schindewolf, and in particular upon a more comprehensive and logical thread of argument. One example concerns the objection that the mutationists make to the Neo-Darwinian belief that higher categories, such as genera, families, and orders, arise through a continuation of the processes responsible for evolution on the level of species and subspecies. Both Goldschmidt and Schindewolf consider this unlikely, because the paleontological record shows that representatives of modern orders existed before organisms assigned to any modern family, and these in turn appeared before representatives of modern genera and species. Simpson points out the logical fallacy in this argument (p. 238):

> Now that the adaptive radiation is complete, we recognize the result as a family. . . . Looking backward from here, we consider that the family arose when its first species was differentiated. That species probably differed very little from its immediately ancestral species. . . . The family did not arise as such, but as a *species*. The family resulted from the whole radiation, and its first species is placed in it in retrospect.

On the subject of internally directed "orthogenesis," Simpson is equally logical and lucid. He illustrates the fact that the more we know about any particular fossil lineage, the more ramifications we find and the less it resembles a continuous series directed toward a single end-point. The evidence on the most famous of all fossil lineages, that of the horse, shows that it exhibits a large amount of irregularity and evolutionary opportunism. Many oft-repeated examples, that are supposed to demonstrate continued "orthogenesis" ending in the negation of selection and extinction owing to the inadaptive nature of the end-product, appear after Simpson's analysis, to be highly improbable or actually fictitious. Simpson proposes selectionist interpretations of such examples as the shellfish *Gryphaea,* the "Irish Elk" *Megaloceras,* and the labyrinthodont amphibians which are every bit as plausible as the nonselectionist, "orthogenetic" interpretations of these examples so often given in general books on evolution. One step forward made by Simpson is his emphasis on varying degrees of adaptation, and upon the fact that some species are broadly adapted and others narrowly adapted.

In the period between the writing of *Tempo and Mode* and that of the present book. Simpson has followed the recent trend of Neo-Darwinians in placing greater emphasis upon natural selection as the principal cause of evolutionary divergence, at the expense of such factors as drift and random fixation. The phenomenon of "quantum evolution," which he recognized in *Tempo and Mode* as a sequence of events responsible for the apparent sudden origin of many higher categories, was at that time believed to include an "inadaptive phase." In the present version, this phase is characterized merely as "narrowly adaptive," a concept more in keeping with evolutionary change as observed in living populations.

Although Simpson's viewpoint is basically Neo-Darwinian, he is not dogmatic or uncritical in maintaining this view. He recognizes the fact that the direction of mutation is not completely at random but depends upon the genetic and physiological nature of the organisms in which the mutations occur. The "randomness" of the mutational process exists only in relation to actual or potential adaptation to the external environment, or to any morphological trends that may be observed in the evolution of populations. In respect to the size of the effect produced by mutations, he cites several well-documented paleontological examples to show that certain changes of a major character appear to have evolved through the accumulation of many small mutational steps. He nevertheless recognizes the probability that single mutations with large effects have, from time to time, played an important role.

The style of writing in *The Major Features of Evolution* is in general far clearer than that of *Tempo and Mode.* The discussions in the earlier work were often so condensed that they had to be studied carefully before their meaning became clear. There are still some passages in the present work that are complex and somewhat obscure. These occur principally in the chapter on adaptation, where the reader is left with a feeling of the complexities of the adaptational processes in different organisms but without a clear concept of how they actually occur. Perhaps the greatest gap in modern evolutionary knowledge is our paucity of precise information on just how and why

certain characters are selected under a given set of environmental conditions. In any event, Simpson's numerous ideas deserve careful study by all scientists who wish to further our knowledge of evolution, either through the synthesis of available knowledge or through experiments designed and performed to increase this knowledge.

G. LEDYARD STEBBINS

Division of Genetics
Agricultural Experiment Station
College of Agriculture
University of California, Davis

Advances in Virus Research, Vol. I. Kenneth M. Smith and Max A. Lauffer, Eds. Academic Press, New York, 1953. 362 pp. Illus. $8.

It can hardly be said that this newcomer in the growing family of the "Advances" series fills any urgently felt need. Discussions of most areas of virus research have multiplied at a tremendous rate in the past few years, either as records of symposia or as reviews in various periodicals. Yet, *Advances in Virus Research* can make a real contribution by bringing together information from different areas of virology, and especially by encouraging the growth of the comparative approach.

The first volume contains generally sensible and occasionally authoritative material. What strikes the reader most forcibly is the uneven development of various areas. Epstein's opening article, a review limited to some well-known aspects of bacteriophage work, shows the enormous progress made possible by the use of strictly quantitative methods. Biological and biochemical aspects of phage research are, however, presented in a sketchy and somewhat confused manner. The two articles on plant viruses by Bennett and Black, both up-to-date and authoritative, serve to illustrate the urgent need for simple quantitative methods applicable to plant viruses. A host of challenging observations—for example, the joint transmission by insects of two viruses both needed for production of a disease—must await the availability of precise methods of study. The problem of "plant-and-insect" viruses, well presented by Black, is one of the most fascinating of biology and we must admire the patience and ingenuity required for work in this field.

The two papers that follow present an interesting contrast. Bergold's discussion of viruses that produce insect diseases shows, on the one hand, the need to complement the fine chemical and morphological observations (mainly the author's own) with precise work on virus growth and synthesis. Henle's article on influenza virus multiplication, a lengthy and somewhat overdetailed review, shows, on the other hand, the handicap of purely biological work on virus growth without close integration with biochemical analysis. It is almost inconceivable that even such basic information as the nucleic acid content and composition of influenza viruses should still be a matter of speculation.

"The focus of interest of this series [being] the virus, not the disease," as stated in the preface, Melnick's excellent review on poliomyelitis brings the reader a somewhat distressing realization of the primitive state of our knowledge concerning the biology and biochemistry of the agent of this most stubbornly investigated disease. Sharp's review of purification of animal viruses gives a useful compilation of recent advances in methodology. Markham's concluding article on nucleic acids, which unfortunately lacks the most recent information on desoxyribonucleic acid structure, is mainly valuable for the description of work on enzymatic degradation of ribonucleic acid.

As a whole this volume seems to suffer, not only from an apparent delay in publication, but also from the absence of an integrated plan. The suggestion might be made that the manuscripts for each future volume be submitted to a subeditor who, in an introductory article, would place the various contributions in some general perspective.

S. E. LURIA

Department of Bacteriology, University of Illinois

An Introduction to the Theory of Seismology, ed. 2. K. E. Bullen. Cambridge Univ. Press, New York, 1954. 296 pp. Illus. $6.50.

Dr. Bullen has changed the text but very little in this revised edition. A comparison between the 1947 and the present editions shows that many pages are identical. This is not a criticism, however, but rather a compliment to the author. His original exposition has met the test of the critics, and although little new has been added to his *Introduction,* either edition is a "must" for the shelves of any geophysical library.

In his introductory chapter, the author treats the history of seismology in a concise manner but does introduce most of the major personalities and projects that pertain to the development of this science. He provides a logical plan for developing his text and then follows this plan closely and explains his points clearly.

In the chapters on elasticity and the wave theories of both body and surface waves, Bullen provides an excellent position. Although he busies himself with the major phenomena, these are explained and proved both clearly and comprehensively. These chapters comprise the best section of the book.

This book does not propose to be a directive on station operation, and a critic is always trying to change the purpose of the author when he makes suggestions. The reader learns very little about station operation from this work, and it does not explain sufficiently the operation or characteristics of various types of instruments. Again, the technique of locating epicenters, the interpretation of seismograms, and so forth, is not sufficiently explained. For the student the material presented is insufficient, and for the teacher the material is superfluous. In some places, the author's quest for brevity has resulted in his being too brief. In Chapter xv, for example, in treating Fur-