ions to move is one of considerable interest, but the excitation of nerve itself may perhaps be more profitably studied using real cathodes, since more is known about the way in which they function. However, it is conceivable that once one has the mechanism of excitation of nerve worked out, it may be possible to work backward and to piece together the intermediate processes occurring in the visual organ.

JAMES H. BARTLETT

Department of Physics
University of Illinois
Urbana

Reference

1. WALD, G., and BROWN, P. K. *Science*, **113**, 474 (1951).

Book Reviews

The American Illustrated Medical Dictionary, 22nd ed. W. A. Newman Dorland, Ed. Philadelphia-London: Saunders, 1951. 1736 pp. $10.00.

As science makes advances new terms are constantly being added. The job of keeping a medical dictionary up to date is difficult and complicated, and such a book requires numerous revisions and editions. Saunders medical dictionary, now in its twenty-second edition, has long served as an authority in its field, and this latest edition, published on its fiftieth anniversary, maintains its previously high standards of excellence. New terms are covered adequately, and old terms have been retained and elaborated upon in a satisfactory manner.

The volume is in a new typography and format, characterized by many illustrations to keep abreast of modern findings and changes in nomenclature.

Among new features in the book the editor has included a valuable preliminary article on the fundamentals of medical etymology and a table of modern drugs and dosages. He and the publishers are to be congratulated on this new edition; its excellence should assure continued publication for the next fifty years.

ALLEN E. HENKIN

Washington, D. C.

The Computation of Elements of Eclipsing Binary Systems. Zdeněk Kopal. Cambridge, Mass.: Harvard College Observatory, 1950. 181 pp. $5.00, $4.00 paper.

Eclipsing variables make it possible to study many properties of the stars which would otherwise be almost, or completely, closed to our investigation. Almost all our reliable information about their diameters and densities comes from this source, and under favorable circumstances it becomes possible to enter analytically the otherwise inaccessible interior, and find the internal concentration of density.

Modern photoelectric methods make observation of the light of an eclipsing system a simple matter—for the expert—with an accuracy approaching one part in a thousand. From such observations, covering the whole period, and showing fully the effects of the eclipse of each star by the other, a remarkable amount of knowledge may be derived.

Analytically, the theory that deduces the size and brightness of the stars, the orbital inclination, etc., is surprisingly complicated. Even the simplest case (two spherical stars and a circular orbit) can be solved only with the aid of extensive numerical tables of special functions. With their aid a precise solution is usually possible, but there remain cases in which a solution is indeterminate without additional information. In the more complex cases, when the stars are close together, distorted by tidal forces, and heated on the facing sides by each other's radiation, a fair approximation may be reached by a theory, first suggested nearly forty years ago, that assumes the components to be similar ellipsoids. Methods for improving this solution to any desired degree with the aid of very extensive expansions in series were later developed by Dr. Kopal. Still more complications, such as the presence of streams of gas escaping from the stars, or of bright patches on their surfaces, sometimes occur, but are not yet amenable to theory. Eclipsing systems, therefore, are as interesting to the mathematician as to the astrophysicist.

The present work supplements the author's earlier volume, *An Introduction to the Study of Eclipsing Variables,* published in 1946, and deals with methods for the numerical solution of the various forms presented by the problem. Though no numerical examples are given, the presentation of theory and practical procedure is complete and lucid. The specific treatment is highly technical (as it should be) and comment on its details may well be left to reviewers in professional journals.

It appears more to the point to note certain differences in the manner of discussing even such recondite matters when seen from different angles. These are primarily differences of taste and preference and all the more interesting because of the traditional impossibility of resolving the dispute.

Dr. Kopal's approach is that of a fairly pure mathematician who feels strongly the element of uncertainty and of personal idiosyncrasy involved in the use of a freehand curve drawn to represent the observations. He prefers to make even the first of the successive approximations required in the solution by a discussion of all the relevant observations by least-squares—even though it is clearly recognized that the first approximation must ordinarily start with such

inaccurate estimated values that its results will be considerably (though less) in error—and to use this first result as a basis for a second least-squares solution, and so on until this iterative process converges to the true value. Most other workers (including the reviewer) believe that it is more profitable to make these preliminary adjustments by graphical methods, and test them by plotting the light curves derived from them against the points representing the observations. Both agree that a definitive adjustment should be made by least-squares *after* the "perturbations" due to the deviations of the figure of the components from the ellipsoidal form (and many others) have been calculated and applied.

It should be emphasized that this question is not one of truth versus error; it involves one of Mark Twain's "differences of opinion that make horse races."

A detailed description of the methods of the other school is already partly published, and the observer and computer may then bet on either side.

HENRY NORRIS RUSSELL
Princeton University Observatory

A Source Book in Animal Biology. Thomas S. Hall, Ed. New York–London: McGraw-Hill, 1951. 716 pp. $10.00.

Biologists of every variety stand indebted to the editor, the publisher, and the American Philosophical Association for their respective parts in preparing and publishing this volume, the sixth in a notable series. The book has two primary purposes. The first is to increase the general availability of the classics in zoology. The second is to enable students to trace the development of thought and knowledge in the major fields of biological investigation. Both purposes are well carried out.

The 120-odd selections are organized under 8 main headings: "Cellular Biology," "The Origin and Development of the Individual," "Physiology," "Pathology," "The Basis of Animal Behavior," "Evolution and Heredity," "Zoögeography" (three selections only), and a catchall category, "The Organization of Animal Life." The value of the compilation is greatly augmented for students by the introductions provided for each selection. These are masterpieces of deft condensation, clear, informative, and to the point.

Obviously this is not a book to be read from cover to cover and returned to the library, but rather one to live with. It will provide a continuing source of profit, and enjoyment as well, for years to come. One is tempted to paraphrase a remark which the great English mathematician Cayley made about his field.

> It is difficult to give an idea of the vast extent of modern mathematics. The word ''extent'' is not the right one. . . . I mean a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail.

Beginning with da Vinci, Hall has assembled the pith and substance of the work of all the leading and many of the lesser biologists whose work lay primarily with animals, a truly immense undertaking. Here are key passages from Bonnet and Claude Bernard, Descartes and Darwin, Hooke and Huxley, Malthus and Metschnikoff, Vesalius, Verworn, and dozens of others. Some selections were especially translated.

The only real problem arises from the necessary limitations in size for a single volume, coupled with the immense wealth of biological literature. A companion volume seems the only answer for those who would like Ross as well as Manson and Smith, Dzierzon as well as Fabre, Owen and Gegenbaur as well as Oken and Haeckel, or de Maupertuis as well as La Mettrie. The editor must have been faced with many difficult choices. The present reviewer believes he has maintained a representative balance with only one or two exceptions. When mystics like Bergson and Driesch receive 8 pages each, it seems a pity to have excluded Jacques Loeb completely.

In an age when the value of firsthand knowledge of sources and even of laboratory experience is being challenged by the lovers of dogma, this volume is doubly welcome. Biological knowledge presented on a single flat plane without any historical depth tends to be brittle no matter how brilliantly illuminated. This book will make for wisdom.

GAIRDNER B. MOMENT
Department of Biology
Goucher College

The Topology of Fibre Bundles. Norman Steenrod. Princeton, N. J.: Princeton Univ. Press, 1951. 224 pp. $5.00.

This book is an excellent technical exposition of the subject of fiber bundles—a subject which has been developed over the past 15 years with no previous attempt at a systematic organization. It is primarily of interest to the specialist in topology, although Part I presupposes only a modest knowledge of point set theory. Parts II and III require more extensive preparation of the reader.

The concept of a fiber bundle developed from the study of differential geometry, where it has its most important applications. It is a generalization of the notion of product space allowing twisting "in the large." In analogy to the graphs in the product space there are the cross sections in the fiber bundle. This has proved to be an adequate concept for the study of certain subjects, such as tensor fields on manifolds, for which the simpler concept of product space was quite inadequate.

J. H. ROBERTS
Department of Mathematics
Duke University