his professorship in Johns Hopkins to become director of the new institution. During 1917 steady progress was made in campaigns against hookworm, malaria and yellow fever, in promoting better health administration, in securing reform in sanitary legislation, in persuading governments to increase their expenditure for preventive medicine, and in encouraging public health education. In China the foundation is promoting modern medical education and hospital administration. In September last the Chinese Minister of Education laid the corner stone of the Peking Union Medical College, which is being built in the Chinese capital. The program also includes a medical school and hospital at Shanghai, but the war has interrupted the prosecution of this scheme. The growth of the Rockefeller Institute for Medical Research has called for increasing sums for equipment and current expenses, and £400,000 was appropriated during 1917 as an addition to its endowment.—*British Medical Journal.*

SCIENTIFIC BOOKS

Fresh-water Biology. By HENRY BALDWIN WARD and GEORGE CHANDLER WHIPPLE, with the collaboration of a staff of specialists. New York, John Wiley & Sons. 1918. 8vo. 1111 pp., 1547 figures in text.

At last American students of fresh-water life are provided with a handbook and guide that will enable them to acquaint themselves with the forms of life found in their native lakes, ponds and streams. Ward and Whipple are the editors, and they themselves contribute five of the thirty-one chapters. Ward writes the general introduction and two chapters on parasitic worms, and one on Gasterotricha, and Whipple writes the concluding chapter on Technical and Sanitary Problems. There are two further introductory chapters, one by Shelford on conditions of existence, and an altogether excellent and practical chapter by Reighard on methods of collecting and photographing. The remaining chapters discuss the principal groups of aquatic organisms and are written by well-known American specialists in the several groups. All are prepared with evident care and with due regard for the needs of the general student and all are adequately illustrated.

Three of these chapters are for reading purposes only—the ones on bacteria by Jordan, on the higher plants by Pond and on aquatic vertebrates by Eigenmann. These are excellent summarized statements of the chief biological phenomena of these groups and are most interesting reading.

The volume is much more than a text-book for the remaining groups (to which 26 chapters are devoted): it is a handbook and guide. and a means of identification, and this is its peculiar merit. Each chapter gives, besides an introductory account of the group, an illustrated key, that is adequate for the determination of the forms and that is convenient and workable. No such set of keys has hitherto been available anywhere. The clear and copious illustrations are placed alongside the reading matter relating to them in the text, and are adequate for the interpretation of the characters used.

This book will at once take its place as the most indispensable reference work for students of freshwater biology; and it is likely to hold that place for a long time.

JAMES G. NEEDHAM

Equidæ of the Oligocene, Miocene and Pliocene of North America. By HENRY FAIRFIELD OSBORN. Memoirs of the American Museum of Natural History, Volume II., Part I., issued June 10, 1918.

AN extensive memoir of two hundred and seventeen quarto pages, illustrated by one hundred and seventy-three figures, and fifty-four plates reviews our knowledge, from a systematic standpoint, of the "Equidæ of the Oligocene, Miocene and Pliocene of North America."

The present revision of the fossil horses "is *iconographic* in the sense that all the original type figures of authors are reproduced in *facsimile,* and all unfigured types, especially those of Marsh, are now figured for the first time. . . ." The work is based largely on the collections at Yale and at the American Mu-

seum of Natural History, but a use was also made of type material in other collections.

Osborn's idea in presenting the matter in this form is that "the permanent data of systematic paleontology are the *type specimens*, determinate or indeterminate, the *type locality*, the *type geologic level*. Descriptions, figures, opinions, inferences, phylogenetic and other speculations are subject always to the fallibility of human observation and interpretation." These ideas of course are fundamental and apply to other phases of paleontology than the systematic portion.

A full discussion of the "Genesis and Evolution of Single Dental Characters" is given with abundant illustrations. This is followed by a review of "Geologic Horizons and Life Zones" appropriately illustrated with maps and tables.

The systematic portion discusses one hundred and forty-six species distributed among ten genera. Each species is carefully discussed and the type material illustrated. On turning the pages one is struck by the fragmentary nature of many of the species—but this is the condition throughout all fossil vertebrate groups. To some of the species more information has been added since their description but many of them stand to-day as they were originally described. Many species are known from very complete material.

The contribution is one of which American paleontologists may well be proud. Its permanent character is the careful collection and assembling of data on all species of fossil horses known from the Oligocene to the Pliocene of North America. The magnitude of the task is almost appalling in the amount of detailed work involved. The author tells us that this is a portion of the work done in connection with his "Monograph of the Equidæ" on which he has been working for the last eighteen years. A portion of the present work is due to the collaboration of Dr. W. D. Matthew to whom the author gives full credit.

The high standard assumed by the publications of the American Museum of Natural History twenty-five years ago is maintained in the present memoir. The typography and illustrations are excellent.

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SPECIAL ARTICLES

NOTE ON MEASURING THE RELATIVE RATES OF LIFE PROCESSES

THE development of quantitative methods in biology depends largely on finding means of measuring the speed of life processes. In most cases the absolute rate is of less importance than the relative rate (*e. g.*, the normal velocity compared with that observed under the influence of a reagent). Examination of the literature shows that the determination of relative rates is frequently made in a faulty manner, which could easily be avoided by a slight change of method.

We may illustrate this by supposing that the life process in question is a chemical one. The rate of a chemical reaction is expressed by its velocity constant. The simplest case is that in which a single substance, A, decomposes. The usual equation is[1]

$$K = \frac{1}{T} \log \left[\frac{A}{A - X} \right],$$

in which K is the velocity constant, T is time and $A - X$ is the amount remaining at any given time, T.

When the reaction is half completed the value of $A \div (A - X)$ is always 2, no matter what the original concentration of A. The time required to reach this stage of the reaction is inversely proportional to the value of K: for it is evident that if we double the value of K we must halve the value of T, provided the value of $A \div (A - X)$ remains 2, or any other constant value. Hence we see that no matter what stage of the reaction we choose (half completed, one fourth completed, etc.) the velocity constants are inversely pro-

[1] Natural logarithms give the true value of k, but common logarithms are frequently used: these multiply the value of k by .4343. For illustrations of the application of this equation to life processes see Osterhout, W. J. V., SCIENCE, N. S., 39: 544, 1914; *Jour. of Biol. Chem.*, 21: 585, 1917; *Proc. Nat. Acad. Sciences*, 4: 85, 1918.