own efforts, Mrs. Whiting has devoted considerable time and attention in preparation of material for courses and in instructing individual students, thus relieving other members of the department.

My "Program for Teaching and Research in Biological Science at the University of Maine," which was submitted to you after President Little's departure, was worked out with much care and approved by several eminent biologists at the university. It was, however, negatived by the administration in points essential both to efficient teaching and to research, despite the fact that the present budget allowance was ample to cover all expenses involved.

I assure you that I am leaving Maine with no feeling of resentment, but with the hope that a more constructive policy will be pursued in the future.

Very truly yours,

(*Signed*) P. W. WHITING

SCIENTIFIC BOOKS

Textbook of Comparative Physiology. By CHARLES GARDNER ROGERS. McGraw-Hill Book Co., New York. 1927. List price, $5.50.

To state that Professor Rogers's book is new and different from others tells little; yet even this feeble remark may attract attention to the work among the books of the year. The present writer is not a physiologist, but he feels moved to say something about the book for the benefit of his non-physiological brethren. Professional physiologists will soon be familiar with it; zoologists and botanists working in other fields need to have it brought to their notice.

A few of the chapter headings may be listed: II. Solutions, III. Diffusions and Osmosis, V. Properties of Protoplasm, VII. General Phenomena of Life, X. Blood as an Oxygen Carrier, XIII. Circulatory Mechanisms, XVIII. Catalytic Actions of Animals, XXII. Nutrition of Different Animal Groups, XXVI. Physiology of Movement. These rather familiar titles, most of which are found in all physiologies, suggest the general scope of the work and yet they do not give any intimation of the freshness of treatment and the breadth of outlook which our author brings to us. In his hands, physiology becomes functional biology, the real science of life.

Dr. Rogers compassionately spares us the multitude of algebraic formulae and soul-corrupting graphs now so popular. He is teaching physiology, not mathematics, physics and chemistry. He gives clear pictures of life processes in general and offers a wealth of information about the physiology of invertebrates not obtainable in our usual books of reference. He presents his material in logical and interesting form with no apparent bias for pet theories. If an outsider might presume a suggestion, it would be that in future editions the introductory part to each chapter be somewhat amplified or that a rather "popular" summary be placed at the close of each chapter.

Every young zoologist and botanist (and some of the older ones, too) could profit by knowing the book and making use of it.

FRANCIS RAMALEY

UNIVERSITY OF COLORADO

Ice Ages, Recent and Ancient. By A. P. COLEMAN. New York: The Macmillan Co., 1926. pp. 296, 51 figs., 8 maps.

IT is the stroke of the master pen. Only mastery could produce so complete, frank, simple and obviously trustworthy an account of the Ice Ages of the earth. Many accounts of personal experience enliven the style of the book. As an introduction to the work of ancient glaciers, the activities of living glaciers are sketched with a few well-chosen examples. The Pleistocene glaciation is treated only briefly, since "the work is not intended to take up the Pleistocene in great detail, but rather to outline its extent, to describe its mode of operation and to study particularly such features as will throw light on more ancient and therefore less completely recorded glaciations." The drift, the extent, the centers of radiation and the interglacial periods are discussed both for North America and abroad. One interesting point in North America is that the Cordilleran sheet was formed first and was followed in succession by the Keewatin and then the Labradorian sheets. It is inferred by the reviewer that this applies to the last of the Pleistocene sheets. It would be of great interest to know whether this succession holds for the earlier of the Pleistocene invasions. Doubtless data are not available to answer this question, for the author makes no mention of it. Four interglacial periods are recognized near the drift-margin in North America, while at least one is distinguished in Canada near Toronto and Moose River. Likewise three warm interglacial periods are accepted in the Alps and in Denmark, while studies of the interglacial climates have led to the conclusion that the ice in Europe, as well as in North America, was completely removed at least once during the Pleistocene.

Ancient ice ages are beautifully described. Eocene and Jurassic tillites in North America are discussed. In all the periods of the Paleozoic era, glaciation is either strongly inferred or is proved. Of these the world-wide Permo-Carboniferous glaciation, the greatest in the history of the earth, receives its due consideration. Chapters on the Talchir tillite of India, the Dwyka of South Africa, the Squantum of North America and the tillites and interglacial deposits of

South America and Australia are very impressive. They leave no doubt in the reader's mind of the magnitude and certainty of the refrigeration. Continental ice sheets of Silurian age are known in Alaska. The Varanger Fiord tillites of northern Norway have been recently correlated with the Ordovician. Widespread Ordovician glacial conglomerate is also recognized in Gaspé. Early Cambrian or late pre-Cambrian tillites are described from the Yangtzi Canyon in China, from southern Norway, from several places in North America, from Africa and from Australia, placing this ice age as equal in magnitude to that of the Pleistocene.

The widespread Gowganda tillite of Huronian age in Canada is convincingly described as of glacial origin. And beds of similar age, probably of glacial origin, are cited from several other parts of the world. Conglomerates strikingly like tillites are discussed from the Timiskamian and Keewatin rocks of Canada, though metamorphism has rendered their sure reference to glacial origin uncertain.

The effects of glacial periods on both plants and animals, treated rather fully, makes a very suggestive contribution to the study of organic evolution.

Defects in all existing theories of the cause of ice ages are pointed out. But the author confesses he is unable to propose something better. In his opinion the solution must come from general and local causes in a combination of astronomic, geologic and atmospheric conditions.

Photographs are numerous and in general very good, though many of them lack a scale. The book is of great importance not only to the glacial geologist, but to the historical geologist, the paleontologist and the paleobotanist as well.

PAUL MACCLINTOCK

UNIVERSITY OF CHICAGO

SPECIAL ARTICLES

THE NATURE OF THE "INORGANIC PHOSPHATE" IN VOLUNTARY MUSCLE

SOME months ago we[1] described a colorimetric phosphate method, the special feature of which is the use of a very active agent (aminonaphtholsulfonic acid) for converting the phosphomolybdic acid to its blue reduction product. When we first made use of this method for the determination of inorganic phosphate in protein-free muscle filtrates, shortly after the details had been worked out, we found a marked delay in color production. The time required to reach a constant reading was about thirty minutes, whereas ordinarily the full color (relative to the standard) has developed within four minutes or less. This peculiar behavior appeared to indicate that muscle contains either some substance capable of retarding the color reaction or else a very unstable (presumably organic) compound which liberates o-phosphoric acid while the color is developing. While the course of the color development in muscle filtrates turned out to be quite different from anything which we had seen in testing out the method in the presence of known interfering substances, it is impossible to rely on this point as a means of distinguishing between the two alternatives. Ferric salts, for example, also behave in a way that is unique. A mixture of inorganic phosphate and ferric chloride certainly does not contain a highly unstable organic phosphorus compound, and the delayed color reaction found with muscle filtrates therefore does not constitute conclusive proof of the existence of such a substance in the muscles.

Further study of the course of color development nevertheless did bring out some interesting and suggestive points, notably the fact that the delay is hardly any more pronounced with 10 cc of muscle filtrate, for example, than with 5 cc or less. Every interfering substance which we investigated in the course of our work on the phosphate method, on the other hand, shows a much more marked effect when the phosphorus content of the sample is increased. Although these facts have been in our possession now for more than a year, we have until this time refrained from placing them on record, inasmuch as the phenomena observed could not with any certainty be ascribed to the presence of an organic compound of phosphoric acid until the compound had been isolated, or at least until the organic radicle had been identified. Both these things have now been done, although the isolated substance has not yet been obtained in the pure state, and the outcome appears likely to throw light on a field of biochemistry never before suspected of being in any way related to phosphoric acid.

Muscle filtrates from which all the inorganic phosphate has been removed (by precipitation with barium, silver, etc.), as well as material which has been still further purified, show the same delay in the production of the color. These facts, together with the knowledge that the delayed reaction really is associated with the hydrolysis of an organic compound of phosphoric acid, give real significance to the quantitative data which we have meanwhile been accumulating. Some of these data will now be presented before we proceed to a discussion of the nature of the substance.

The method which we have used for the determination of this unstable form of phosphorus (which we shall for the present designate as "labile phosphorus")

[1] C. H. Fiske and Y. Subbarow, *J. Biol. Chem.*, Vol. 66 (375)—1925.