SCIENTIFIC BOOKS

A Text-book of Geology, in two parts. Part I., *Physical Geology*. By L. V. PIRSSON. Part II., *Historical Geology*. By CHARLES SCHUCHERT. John Wiley & Sons. 1915. Separately, Part I., $2.25; Part II., $2.75. Parts I. and II. bound in one volume, $4.00.

It is most fitting that this book, issued by two members of the Yale University Geological Department, should be "Dedicated to the memory of James Dwight Dana, Explorer, Geologist, Naturalist, Professor in Yale University"; to the man who first made this department so famous.

This book of 1,060 pages, with 522 illustrations and 40 plates, is divided into two parts. Part I., by Professor Pirsson, consists of 404 pages, and deals with physical geology. Part II., by Professor Schuchert, discusses historical geology and has 647 pages. It is an excellent plan to issue the parts separately, as well as combined. They are similar in size and binding to Bowman's "Forest Physiography" and Ries & Watson's "Engineering Geology." The binding is well done, the type is good, the illustrations are well produced and there are practically no typographic errors. The publishers and authors are to be congratulated upon this production.

Part I. is an excellent presentation of the fundamental facts and principles of physical geology. The subject is treated under two main captions, namely, Dynamical Geology and Structural Geology. In view of the statement made in the preface, that the author has attempted to produce a text-book which should have "a balance more even in the subject-matter composing it, than is to be found in available texts," the reader may question the space allotment assigned to the different chapters, as follows: Introduction, 5 pp.; General Considerations and Work of the Atmosphere, 22 pp.; Rain and Running Water, 42 pp.; Lakes and Interior Drainage, 10 pp.; The Ocean and Its Work, 27 pp.; Ice as a Geological Agency, 34 pp.; Underground Water, 17 pp.; The Geological Work of Organic Life, 23 pp. (is there such a thing as inorganic life?); Igneous Agencies, and Volcanoes and Hot Springs, 38 pp.; Movements of the Earth's Outer Shell, 23 pp. These chapters belong under Dynamical Geology. The structural side is treated in the remaining chapters: General Structure and Properties of the Earth, 11 pp.; Sedimentary Rocks, 39 pp.; Igneous Rocks, 21 pp.; Metamorphic Rocks, 18 pp.; Fractures and Faulting of Rocks, 17 pp.; Mountain Ranges, 31 pp.; and, Ore Deposits, 24 pp. Unless the reviewer is mistaken, he understands that the "balance" was obtained by averaging the space given to each subject by authors of older text-books of general geology.

In putting dynamical geology before structural geology the writer leads his readers from the known to the unknown. In many respects this is far more satisfactory for beginner's classes than the philosophical order according to which the masses operated upon by geologic forces should be described before considering the action of these forces.

An elementary text-book should excel, first and foremost, in the clearness of its exposition and in the choice of its illustrations. In both respects, "Physical Geology" is deserving of high praise. Almost without exception the language is lucid and concise, although we do read of "pouring dry dune sand from San Francisco" (p. 15). The half-tones are well chosen and excellently printed. With reference to the line diagrams perhaps a word of criticism may be said. Fig. 13 is incorrectly drawn; Figs. 74, 225, 227, 230 and 231 are misleading; and the perspective is faulty in Figs. 129 and 149. More uniformity might have been attained had the block diagrams been constructed either in perspective or in isometric projection, or, preferably, in cabinet projection. Thus, the blocks shown in Figs. 271, 272 and 273 might have been drawn in similar positions instead of being tilted at various angles.

There are a few places in the text where statements are misleading or incorrect. On p. 11 we find that, in a classification of work performed by the atmosphere, the chemical

destructive processes are designated *weathering,* as if there were no mechanical weathering, but this oversight is later corrected (p. 19) by the assertion that both mechanical and chemical processes fall under the head of weathering. Talus is described as having the coarser fragments above and the finer particles below (p. 22). As a matter of fact, true talus deposits, as distinguished from alluvial cones, are fine above and coarse below. "Bedrock" and "country rock" are defined as synonymous (p. 19). "Bedrock" should refer to solid rock in situ as distinguished from the unconsolidated superficial mantle rock. "Country rock" should be applied only to an older rock or rock complex, which has been invaded by younger veins or eruptive bodies. The distinction between base level and grade does not seem to be clearly brought out (p. 66). A *base level* is a *level* which controls the downward cutting of one or more streams. The control is such that each stream can reduce the inclination of its channel to a certain slope below which further downward cutting is impossible. This *slope* is *grade.* Only the lower end of such a graded stream can actually reach base level.

After all is said, these imperfections are of relatively minor importance, and they do not seriously detract from the usefulness of the volume *as a text-book.* If "Physical Geology" is also intended for a reference book—and such every elementary text-book should be with regard to the matter which it treats—its abbreviated table of contents and its incomplete index are to be deplored. In the table of contents should appear all the center and side headings employed in the text. Instead, merely chapter headings are given. Nothing described or referred to in the text should be omitted from the index. Yet coal, outwash plain, bedrock, country rock, etc., are not to be found. It is to be hoped that in a second edition the writer will correct these two grave defects.

Part II.—Professor Schuchert has given us a very readable, up-to-date book from the first chapter on "Matter and Organisms" to the last on "Earth History in Retrospect." It is unique in its method of treatment but with a uniqueness that appeals. The book consists of a series of lectures upon the principal events, physical and biologic, in the history of the earth. Each lecture or chapter deals with a single subject.

The ground is prepared for a clearer understanding upon the part of the reader by the first seven chapters, "Matter and Organisms"; "Evolution, the Constant Change of Living Things"; "Fossils, the Geologist's Time Markers"; "The Geological Time-table"; "The Lands and Their Life"; "Oceans, Their Deposits and Their Life"; "Seas, Their Nature and Deposits." There follow two chapters on the solar system, "Evolution of the Stars and the Solar System" and "Origin of the Solar System under the Planetesimal Hypothesis," the latter by Professor Barrell of Yale. In these chapters the planetesimal hypothesis of Chamberlin and Moulton is accepted as coordinating more known facts of the entire solar system than any other thus far propounded. The next chapter, "Primordial Geologic Time" applies this hypothesis more directly to the earth and its known rocks.

With the succeeding chapter begins the discussion of the history of the sedimentary rocks of the earth and their included organic remains, a consideration of the somewhat unstable continents and the ever encroaching oceans. The author, though in his research work advocating the uniform "ic" endings for the period names, very wisely in this undergraduate text-book uses the older endings, the endings used in the publications of the national surveys of the United States and Canada, of nearly all state surveys and by the majority of other geologists. There are three chapters devoted to the pre-Cambrian, "The Archeozoic Era" and "The Early and Late Proterozoic Sub-eras." Next is one on "The Paleozoic Era," in general, in which is briefly given the larger features of the North American continent during this era, especially a consideration of the more permanent land and water bodies. This includes a map (p. 577) giving the larger positive, or predominantly

rising areas, and the negative elements, the dominantly sinking areas, of the North American continent. The larger positive elements for the world are given in maps on pp. 462 and 463.

In the fifteen chapters devoted to the Paleozoic era, seven to the Mesozoic and four to the Cenozoic, the author reveals his familiarity with the geologic history of North America and its life, and here too he departs frequently from the older methods of presentation. At the first important occurrence of a group of organisms he discusses its zoology, evolution and in general its geologic occurrences, alluding but briefly to them later under the separate periods. For example, trilobites, brachiopods and all the mollusk classes are discussed between the chapters on the Cambrian and Ordovician. Fishes are given a chapter to themselves just before the Devonian discussion, and here are considered all subclasses, even though the dominant modern type of fish, the Teleostei, do not make their appearance until the Jurassic. There might be a difference of opinion as to the advisability of grouping the cœlenterates and echinoderms under the old name of "animals with a radial symmetry" and of discussing all classes of these together directly after the Ordovician.

After the general discussion of the Paleozoic one chapter is devoted to the Cambrian, one to "Trilobites" and one to "Shelled Animals." The Ordovician consumes one chapter, "Animals with a Radial Symmetry" and the "Silurian" each one. Then in succession are discussed "Fishes and the Ancestors of Vertebrates," "Devonian Time," "The Old Red," "Carboniferous of Older Geologists and the Mississippian Period," "Pennsylvanian-Permian Periods," "Rise of the Land Floras," a chapter on "Coal," and one on "The Earliest Land Vertebrates." While the discussion of coal is the best that has thus far appeared in a text-book on general geology, a brief consideration of the results of E. C. Jeffrey's work on the origin of coal and a view of one of his remarkable thin sections of coal would have added much to the completeness of the discussion.

The Mesozoic opens with a consideration of "The Triassic Period," which is followed by a chapter by Professor Lull on "Dinosaurs." Then follow in order "The Jurassic"; "Ammonites and Belemnites," a very brief chapter; "The Comanchian"; "Chalk"; "The Cretaceous Period and the Laramide Revolution." The four chapters of the Cenozoic are: "The Dawn of the Recent in Cenozoic Time"; "Evolution of Mammals and the Rise of Mentality" (including a discussion in greater detail of the evolution of the camels, horses and elephants); "Pleistocene" and "Man's Place in Nature," this last a 17-page discussion of man, biologic and geologic. The lectures close with a most concise and helpful fourteen-page summary chapter—"Earth History in Retrospect."

In the discussion of a period the author begins with a brief presentation of its occurrence in its earliest known areas, usually Europe. This is done by an account of the advances and retreats of the oceans and the mountain upheavals. Then follows a consideration of North America in greater detail, giving stratigraphic thicknesses and the paleogeography of the principal portions of the continent. This is followed by a synopsis of the life. The chapter is usually closed by a brief discussion of the climate and the economic products of sedimentary origin. The many figures illustrating the invertebrate life are commendably simplified for beginners by having their technical names banished to an appendix. Very seldom is the distribution of deposits throughout the world noted. We would thus not look to this book to find if Australia has Silurian deposits or China those of Mississippian age.

A pleasing innovation is the inclusion of the portraits of famous geologists. William Smith is given in the discussion of the Jurassic, the study of which in England led him to the discovery of the principles underlying historical geology. Lyell is given in the Cenozoic, Suess in the Cretaceous, Murchison in the Silurian and Sedgwick in the Ordovician. Of the North American workers Logan looks upon us from the pages of the Archeozoic, Hall

from the general Paleozoic discussion, William Dawson from the Devonian, Dana is given under the consideration of the permanency of continents and ocean basins, while Darwin, Wallace, Huxley and Lamarck are seen among the statements of evolution.

As was to be expected from one of the world's foremost paleogeographers not the least of the many excellent features of the book are the discussions of the past geography of the earth and the many original maps to illustrate it. There are usually several paleographic maps of North America for each period.

The book is so filled with interesting matter that it is difficult to pick out topics for special remark. It is, however, noteworthy that the text-book issuing from the university which saw the birth of Dana's "Manual of Geology" should advocate, though in a less rigid form than did Dana, the permanency of the oceanic and continental areas, the theory propounded by him. "Since the beginning of Paleozoic times the oceanic basins and the continental masses have been more or less permanent." This permanency is more flexible in the continental masses whose dominant movement is upward, for portions of these are at times invaded by the ocean or have parts of their masses faulted off into the oceanic basins.

The author's discussion of the early life of this globe must also be mentioned. "At the very base of the geologic record, in the Archeozoic," he says, "the rocks testify to a world with about the same physical environment as that of subsequent time." The presence of life in the marine waters at this time is shown by the carbonaceous shales and the large amount of graphite. No fossils are known. It is assumed that the Archeozoic was the "age of unicellular life," both plant and animal. By the close of this long era it is postulated that small multicellular plants and animals had also been evolved. Among the latter were morulæ, gastrulæ and planulæ, known at present as early embryonic stages in the development of existing animals. From the Proterozoic a small number of fossil species are known. These are "an abundance of marine algæ, some radiolarians and tubes and burrows made by annelids." The presence of annelids implies the existence of the more lowly organized sponges, cœlenterates and worms. So likewise the presence here of such other invertebrate phyla as the echinoderms, molluscoids, mollusks and arthropods is indicated by the highly evolved state of all these phyla at the opening of the Paleozoic. The author thus rejects Walcott's theory that the Proterozoic fossils thus far known are most probably non-marine and that in the at present unknown Proterozoic oceans developed the life which made so sudden an appearance in the lowest Paleozoic sediments. He agrees with Daly and Lane that the early marine waters had a different chemical content but objects that this alone could cause animals to so largely secrete chitinous, instead of calcareous skeletons, while the plant organisms, especially algæ, at the same time formed great thicknesses of limestone through their calcareous secretions.

As to the evolution of insects "it is thought that out of some Silurian or Devonian trilobite that habituated itself to the land-waters and became amphibious was derived the stem stock of insects."

That modern necessity, a good working index, is here well met. Only a few examples of oversight were noted. One was the failure to refer to the discussions of pre-Cambrian and late Paleozoic occurrences under the word glaciation. All references are to the Pleistocene.

An excellent generalization of the U. S. Geologic map, 14 by 17 inches, is inserted immediately before the index. It is thus easily accessible for reference without interfering with the usefulness of the index. It would be of still greater aid to the student if it had a blank base so that when unfolded the entire map would be visible though the back were closed. This would enable the map to be constantly before the student, no matter what part of the book he was reading. It is unfortunate that in the legend of this map the author uses the "ic" endings to the period names without

an explanation and substitutes for Paleogene used throughout the book for the lower Tertiary the term Eogenic.

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Modes of Research in Genetics. By RAYMOND PEARL, Biologist of the Maine Agricultural Experiment Station. The Macmillan Company. Pp. 182. Price $1.25.

In this book Professor Pearl has paused in the midst of his prolific and fruitful researches to put together in logical sequence around the central theme of methodology in genetics the substance of several of his recent papers and addresses.

There has been need enough for such a clear-cut analysis of the possibilities and limitations of the various methods now being utilized by workers in the expanding field of genetics and the author has performed this service most acceptably.

It is particularly gratifying to have a sane non-controversial evaluation of the much abused biometric method by one who is a past-master in biometry and is at the same time a biologist of notable attainment. It must be confessed that biometry of late years has rather needed a champion since non-mathematical biologists while admiring the magic of the biometrician, are often haunted with serious doubts about the value of the conclusions sometimes reached by this mode of investigation.

Although biometrics receives the most extended consideration of any method there is a comprehensive analysis of three other modes of research, namely, the Mendelian, the cytological and the embryological.

The next to the last, and the longest, chapter diverges into a somewhat technical treatment of the problem of inbreeding. Here the average lay reader is likely to ride through a tunnel with only intermittent glimpses of the light, but he is sure to emerge into broad daylight in the final chapter, which is upon "Genetics and Breeding," and feel well repaid for his journey. For any one engaged, or even interested, in genetic research Dr. Pearl's book will prove a most welcome and illuminating volume.

It is obvious that "Table III." on page 111 should read Table I. H. E. WALTER

An Introduction to the Study of Variable Stars. By CAROLINE E. FURNESS, Ph.D. Boston, Houghton Mifflin Company. 1915. Pp. 327. $1.75 net.

It is rather remarkable that no comprehensive work on variable stars had previously appeared in any language, though Hagen's extensive treatise, "Die veränderlichen Sterne," of which the first two parts have already been published, would soon have been completed had the war not delayed it. It is very timely in view of the great expansion in the past few years, not only in the observations of variable stars, but more especially in the deductions from their phenomena. Cosmic theories have drawn heavily on these phenomena, and seem likely to gain still more from further study.

Following the introductory chapter the work falls naturally into four divisions.

1. The equipment of the observer; maps, charts, catalogues: Chapters II. to V.

2. Photometry of variable stars; visual, photographic, photo-electric: Chapters VI. to VIII.

3. Reduction of the observations; light-scale, light-curves, elements and predictions: Chapters IX. to XI.

4. Deductions from these data; eclipsing and long-period variables, statistics, observing hints, tables: Chapters XII. to XV.

That the book is written from the standpoint of the teacher is well evidenced by the care taken to explain the fundamental ideas of each chapter. For example, the elements of spectrum analysis and radial velocity are given in considerable detail, a precaution very necessary to clarify the hazy ideas held by young students of spectroscopy. The principles underlying the photometric instruments are set forth in detail, especially the photo-electric appliances which have so recently entered the field of stellar photometry. A human interest is added by brief biographical sketches of some of the older great astron-