when necessary. While this procedure is not objectionable for the practicing engineer to whom the further references frequently mean merely a refreshing of his memory in the matters concerned, it is not considered a wise practice for the student, and therefore the value of the book for classroom work is open to question. The student should always be cautioned against accepting and using formulas of whose validity he has not personally assured himself, and it is too much to expect him continually to refer to the indicated sources in which demonstrations may be found.

The book contains an excellent body of fundamental material covering principles of statics and stress analysis with much up-to-date information regarding dead and live loads, wind forces, earthquake forces and lateral pressures on walls for guidance in the preparation or checking of designs. It is a little unfortunate that in expressing the Theorem of Three Moments, equation (76), the author did not follow the procedure employed by Timoshenko and McCullough, to whose book he refers in a footnote. If the concentrated loads in the two spans are located by their respective distances from the nearer end support, the result is a much simplified expression. Strangely enough, however, most writers upon this subject have followed the same procedure as the author.

The design section of the book is more complete in the fields of timber and reinforced concrete than in that of structural steel. With the exception of the plate girder, very little attention is given to the design of steel members. Perhaps this is well. The steel specialist frequently needs to inform himself regarding details of timber construction, but the timber specialist would probably be wise not to attempt the design of steel structures because of the highly developed technical practice involved.

The material covered is carefully and attractively presented and has been selected with wise discrimination in view of its necessarily abbreviated character. The book is to be highly recommended for a place convenient of access upon the shelf of the practicing engineer.

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EMBRYOLOGY OF AN ECHIUROID WORM

The Embryology of the Echiuroid Worm Urechis caupo. By W. W. NEWBY. 219 pp. American Philosophical Society, Memoir XVI. $2.00.

THIS memoir deals with the development of an echiuroid worm from the time of fertilization until the larva undergoes its metamorphosis and assumes the adult form. It is one of the most complete and accurate studies which has been made in the case of any invertebrate. Furthermore, the clearness of style, the accuracy of the illustrations and the lack of bias in the evaluation of the work of others and in the formulation of general conclusions places this study on a high plane indeed.

The work comprises ten main sections of which six are concerned primarily with the problem of development. The first of these is a running account of the changes which ensue from the stage of fertilization to the assumption of the adult form. In this process the history of each cell is accurately traced to the 148 cell stage, which marks the beginning of gastrulation. Beyond this point there is a detailed description of the various body regions, their ciliation and the shifting of the embryonic areas and axes. There likewise is a complete account of the series of changes which transform the archenteron into the complicated digestive system of the adult. The ecto- and entomesoblast also are traced from their point of origin to where, in certain cases, they have attained their final form. In this connection it is demonstrated that the term "larval mesenchyme" is a misnomer. At no stage have its cells been found to degenerate, and, on the other hand, there are numerous instances, where, as functional muscle fibers, they extend from the esophagus and stomach to the body wall.

The development of the nervous system and entomesoblast involves the problem of the extent to which metameric segmentation exists in the echiuroids. The brain and ventral cord develop as in annelids, and after their union the cord develops twelve enlargements, which correspond to an equal number of rows of ectodermal glands. These enlargements or "segments" later subdivide irregularly to form from two to three secondary subdivisions. During this process the entomesoblasts have formed a pair of coelomic cavities whose subsequent fusion results in the single cavity of the adult. At no stage is there any indication of metamerism of the coelom or of any other structure of entomesoblastic origin. In other words, this is a case of pseudometamerism of the same general type as the duplication of the shell plates of chitons.

In the concluding sections the author reviews the developmental history of the flatworms, annelids, mollusks and echiuroids. All these are characterized by the spiral type of cleavage, all pass through a trochophore stage, and conceivably, therefore, all may be the descendants of an ancestral trochozoon. These fundamental resemblances, however, are largely obscured by later evolutionary changes which are of phyletic rank in all but the echiuroids. The author is convinced that this last-named group likewise is entitled to rank as a distinct phylum.

While this study will be of the highest value to the systematist and the student of normal development, it also will serve, to an equal degree, the needs of the experimentalist. Urechis, at all stages of growth, is

an unusually hardy organism, and in other respects it is especially favorable material for the study of vital phenomena. And equally important is the fact that henceforth the modifications produced by experimental methods may be analyzed in the light of normal development.

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REPORTS

TEN-YEAR RESEARCH PROGRAM OF THE VIRGINIA GEOLOGICAL SURVEY

WITH the appointment in 1929 of a new state geologist and of an assistant state geologist, a long-range program of field research by the Virginia Geological Survey was planned. The objectives of this program were chiefly three-fold: to obtain fundamental geologic data, mainly stratigraphic and structural, in a large part of the state which lacked detailed field mapping and studies; to study thoroughly the geologic relations of certain mineral resources; and to obtain as much data as possible upon the characteristics and uses of these resources.

The 40,262 square miles of land area in Virginia includes parts of five geologic or physical provinces—from the Atlantic coast westward into the Appalachian Plateaus. The fact that the 440-mile southern boundary is approximately transverse to the "grain" of the Appalachian Highlands and the Coastal Plain indicates the nature of the geologic problems to be studied. It should be noted also that the annual production value of the mineral resource industries in the state has, in general, ranked increasingly higher during the last two decades.

In planning the program, the wide range of uses of the field data was one controlling factor. The primary uses of technical data obviously would be by geologists and mining and industrial engineers. Much of the geologic data has had basic use in the planning of normal community and industrial development, and recently some have been very useful in national defense projects. Part of the program was planned for the distinct purpose of interpreting geology and mineral resources in a manner to be of use in the schools in the state and of interest and value to laymen.

The field research program was definitely started in 1930–1931, as certain appropriations became available. Its development over a decade can now be summarized. The emphasis in this brief summary is upon types of research projects that have been completed, or are nearing completion. More progress in research was made during the earlier part of the decade, despite the depression, because more funds were then available for field investigations. During this decade, 24 bulletins based on field research projects, having a total of about 3,000 octavo pages of text and about 775 half-tone illustrations and nine geologic maps in colors, were published. In the same period, almost 40 other field research projects have progressed to the stage where the manuscripts are on hand, or are being prepared, for publication as Survey reports. These projects cover many phases of the broad field of Virginia geology and its manifold economic applications.

It may be noted that at first in this decade two geologists constituted the regular technical staff of the Geological Survey and that another geologist was added a few years ago. Thus many of the research projects have necessarily been carried forward by other geologists—25 of them—who were from year to year employed seasonally. Some of these men were graduate students engaged in field research as a part of their work for Ph.D. degrees at various universities. In addition, eight geologists of the U. S. Geological Survey staff worked during this decade on cooperative projects in Virginia.

All this research by the State Geological Survey has been done as a division of the Virginia Conservation Commission, which was created in the reorganization of the state government by Governor Byrd in 1926.

Twenty projects were completed during the decade by the publication of reports in the regular bulletin series of the Survey. Projects in which basic geology predominates included Roanoke County with map[1] (34),[2] James River marble belt with map (39), Appalachian Valley geologic map with explantory text (42), Goochland County with map (48), Appalachian Valley geology (52, in press), Warrenton quadrangle in the northern Piedmont Upland and Triassic Lowland (54), and Draper Mountain area in Pulaski and Wythe counties (55). Industrial mineral (nonmetallic) projects were Coastal Plain sand and gravel (32), pegmatite deposits (33), kyanite deposits with map (38), Giles County marble prospects (40), and barite deposits (53). Metals included zinc and lead deposits with map (43) and gold (44). Ground-water projects comprised thermal springs with map (36), ground water of northern Virginia (41, preliminary summary, and 50, final report), and ground water in Shenandoah Valley (45). Educational, or more or less nontechnical publications for use in schools and by laymen, were: Virginia caverns (35), The Peninsula (37), mineral resources (47), and Russell County (49). In addition, two volumes of "Contributions to Virginia Geology" were published (46, with 13 papers, and 51,

[1] Map means geologic map in colors.
[2] Numbers in parentheses are serial numbers of published bulletins.