the recognition of relative morphological values he would have prepared a work of signal utility. The student who uses the 'Grundriss' as his guide may acquire a fair knowledge of the empirical facts of embryology, but he will still have to learn the morphological interpretation of these facts and their relative importance. Meanwhile he will have profited by better, more available and more matter-of-fact descriptions of the anatomy of embryos than can be found in perhaps any other of the smaller text-books of embryology.

C. S. Minot.

Das Süsswasserplankton, Methode und Resultate der quantitativen Untersuchung. Von Dr. Carl Apstein, Kiel, Zool. Institut. Mit 113 Abbildungen. Kiel und Leipzig, Verlag von Lipsius & Tischer. 1896. 200 pp., 5 Tabellen.

To Dr. Apstein, of the school of planktologists at Kiel, is to be given the credit of applying the methods employed by Professor Hensen in his investigations in the Baltic and North seas, and on the '*National*' Expedition of 1889, to the quantitative investigation of the plankton of fresh water. His field of operations has been the lake region of Holstein. The book contains a full report of the results of the quantitative, and to some extent the qualitative, examination of more than 300 collections made in 15 different lakes during 1890–1895. A description is given of the apparatus, methods of collection, of determination of volume, and of enumeration of the constituent organisms or planktonts, if we adopt the term recently introduced by Schröter. There is, unfortunately, no adequate discussion of the margin of error which the methods involve. An annotated list of the important limnetic organisms is given with data on the seasonal distribution, abundance with dates of maximum and minimum occurrence and reproductive activity, with other facts of œcological import. Many of the forms are illustrated by reproductions from original microphotographs by the author. The microscope in the hands of the skillful operator reveals vastly more than the ordinary microphotograph records. For the purposes of scientific illustration of organisms of the plankton, and especially in such a book as this, it seems undesirable to substitute a method which rests upon the relative opacity of tissues simply, for one based upon the clear interpretation of the trained observer. One has only to contrast Dr. Apstein's best results in this line with the figures he reproduces from Hudson and Gosse, and Lauterborn, to appreciate the superiority of a carefully made drawing in conveying to the inquirer details of structure, and even such features as contour, proportion and natural position of parts. The book is not a manual of the limnetic fauna and flora, and the novice and casual student must still depend upon monographs and the widely scattered literature of the subject for aid in the determination of the planktonts. It is, however, an epitome of the subject, indispensable to every planktologist and a valuable aid to every student of fresh-water fauna.

Our author distinguishes active, passive and tycho-limnetic forms among the planktonts. With the latter he places *Difflugia*, whose presence in the open water is attributed to gas vacuoles, which cause it to rise from the bottom, its true habitat. *Difflugia* is a very abundant and important member of the plankton of our own great lakes, where it occurs in association with *Codonella*, *Dinobryon* and other typically limnetic forms. It also occurs in the Illinois river and its adjacent waters throughout a considerable part of the year, but in the open water and not upon the bottom. The conditions of the occurrence are such as to place it among the active members of the plankton rather than among those which owe their presence to the accidents of wind and current.

Following up the line of his earlier work, Apstein brings forward a long series of observations in proof of the equal horizontal distribution of the plankton in a body of water. In 80 catches the greatest departure from the mean was 22.8%, and the average departure but 5.52%. These hauls are distributed in short series of 2–5 parallel catches in various lakes, but the distance separating the successive collections is not given, and in no case has a lake been subjected to a larger number of examinations made upon the same day at frequent and regular distances throughout its whole extent. It seems

not improbable that such an examination would enlarge somewhat the variation in distribution as above given. Indeed, in another connection Apstein cites four catches made in Dobersdorfer See upon the same day, in which the variation from the mean is 100% or more, in three instances out of the four. This wide variation is, however, explained by our author as due to the presence of intervening sand bars in the lake. The results of counting individuals of various species in the plankton taken on the same day at different localities show a uniformity less marked than that indicated by the volumetric determination. There is no indication whatever of the presence in the plankton of 'swarms,' which Apstein defines as a local accumulation of animals of one species in one locality while the surrounding area is slightly, or not at all, peopled by it. This uniformity in the horizontal distribution is due to the similarity of the chemical constituents in the water, resulting in a uniform growth of the phyto-plankton and the zooplankton depending upon it. It is thus primarily a matter of food relations.

The vertical distribution of the plankton was determined by the subtraction process, and is subject to the error produced by the progressive clogging of the net. It seems very desirable that this problem be attacked by the pumping method. Apstein's results indicate the accumulation of the greater part of the plankton in the surface stratum of 0–2 meters, in which from $1\frac{1}{2}$ to 60 times as much plankton is found (per cubic meter) as is present in a similar volume in the water below a depth of 2 meters. In this particular his results are in harmony with those of Reighard, Ward, and Birge upon our own lakes. Most organisms prefer the surface waters, only a few rotifers and *Entomostraca* actively seeking the deeper and colder strata. The vertical distribution of many forms, especially among the phyto-plankton, is closely linked with the life cycle. The maximum numbers occur in surface waters, and as these decrease and resting stages appear, they seek the deeper water, to increase again and rise to the surface as the maximum returns.

Apstein still maintains that plankton-rich and plankton-poor waters are characterized by the predominance of the *Chroöcocaceæ* and *Dinobryon* respectively. Reighard has shown that these criteria cannot be adopted for Lake St. Clair, and later work is making it still more evident that waters may be rich or poor in plankton quite irrespective of the conditions attending such diversity in the lakes of Holstein. The suggestion that plankton-rich waters are occasioned by the abundance of water-fowl is of questionable value, though local data may seem to support it.

Only those familiar with the routine of plankton investigation can appreciate the vast amount of work which Apstein's book represents, though his results will command the attention of everyone interested in the œcological side of biology. The science of fresh-water planktology is still in its infancy; its methods are as yet imperfect, and its problems are so intricate that years of continuous investigation in a number of localities will be required to establish broad generalizations. Dr. Apstein has been a pioneer in the field, and the great value of his work lies in its exploratory character and in his suggestive mapping out of the problems of planktology.

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GEOLOGIC ATLAS OF THE UNITED STATES. FOLIO 25, LOUDON, TENNESSEE, 1896.

THE Loudon folio, recently published by the U. S. Geological Survey, represents that portion of the Appalachian province which is situated between the parallels 35° 30′ and 36° and the meridians 84° and 84° 30′. This area contains 968 square miles, divided between Blount, Monroe, Loudon, Knox, Roane and Morgan counties of Tennessee.

The folio consists of a topographic map, a geologic map, structure sections, stratigraphic sections, a map of the economic resources, and descriptive text. The author is Arthur Keith.

The text begins with a general description of the Appalachian province and points out the relations of this part to the others, with regard to its surface features. The local features of the drainage by the Tennessee river and its tributaries, Emory, Clinch, Tellico and Little Tennessee, follow next in description.