mainly a book knowledge of the group he was monographing.

The section on Protozoa written by Marcus Hartog has a great deal of interesting matter, and the various physiological activities of the unicellular animals, such as digestion, secretion, etc., and the relations of nucleus to cytoplasm and the like, are considered in a broad and suggestive way. The fact that the treatment in all such matters is strongly colored by this author's often unique ideas is only to say that it was written by Professor Hartog, and, although always interesting and on the surface convincing, the generalizations can not always be accepted. We meet again the time-worn discussion on spontaneous generation (gotten up apparently to controvert Bastian's recent outburst), and on animals and plants, but we do not find sufficient emphasis on the more important modern features that are characteristic of the protozoa, such as the physiological importance of the life cycle and the morphological importance of chromidia and nucleus.

The section on sponges by I. B. J. Sollas is not as well written as the other sections and the meaning is frequently hidden in obscurity of the construction. The classification adopted is that of W. J. Sollas and Bütschli, Minchin and Maas are followed in assigning the Porifera to the division Parazoa, apart from the other metazoa and from the protozoa. Morphology and relationships of the spicules are carefully worked out, but we find very little on sponge development. This section is full of matters of popular interest, examples of which are afforded by the suggestion of the therapeutic value of the common house sponge on account of its iodine, and a popular description of the origin of flint.

The account of the Cœlenterata and Ctenophora by S. J. Hickson is little more than a list of families and can scarcely be described as interesting reading. The monotony of almost straight taxonomy is broken a bit by a discussion of corals and coral islands, but the work for the most part is devoid of general interest. With all the valuable and biologically interesting data afforded by the cœlenterates we feel that Professor Hickson has lost here an opportunity to present a readable account of one of the most fascinating groups of invertebrates.

E. W. MacBride has given a much more general account of the Echinodermata, although here, too, a wealth of biological facts has scarcely been touched, while details of structure fill page after page. The group is taken up somewhat differently than is customary in that the Asteroidea are regarded as the most primitive of the echinoderms, while the Holothuroidea are considered as a continuation of the same line of development that led to the Echinoidea. Unlike the other contributors, MacBride has given more embryology, although his account of the development of an echinoderm taken by itself is not full enough to give a clear picture to one unfamiliar with the complicated metamorphosis of these forms.

We do not see why the Echinodermata should be included with the above lower groups of invertebrates unless it is a characteristic devotion to the tradition of Cuvier's Radiata, or indeed, mere expediency. Certainly it seems poor logic to speak of echinoderms as intermediate between cœlenterates and higher invertebrates (page 428) and then to point out the probable common ancestry of Echinodermata and Vertebrata through dipleurula and tornaria larvæ (page 617).

The volume is beautifully gotten up and has a wealth of tables and keys of classification and is invaluable to the student of animal taxonomy although disappointing here in that it will not carry him into genera and species.

G. N. C.

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Comparative Neurology and Psychology for May contains three papers. The first, "Concerning the Intelligence of Raccoons," by Professor L. W. Cole, is based upon the study of thoroughly domesticated animals which were reared in captivity. They are found to be more docile than cats and able to form much more complex associations, though they are inferior to monkeys. They do not imitate their fellows, but learn various

acts from being put through them. The experiments indicate the presence of mental images. Miss Isabel McCracken, in studying "The Egg-laying Apparatus in the Silkworm (*Bombyx mori*) as a Reflex Apparatus," performed various operations on the nervous system to learn the localization of function in the egg-laying reflexes. The posterior abdominal ganglion is the controlling center and exhibits a high degree of independent activity. The vitality of the silkworm moth, as measured by length of life and capacity of the reproductive system to function, is not impaired by removal of the head. The exact influence upon the reproductive function of the cerebral, thoracic and the several abdominal ganglia was experimentally determined. "A Study of the Choroid Plexus," by Walter J. Meek, adds confirmatory evidence to the conclusion that the plexuses are concerned in the secretion of the cerebro-spinal fluid.

SOCIETIES AND ACADEMIES

THE ST. LOUIS CHEMICAL SOCIETY

At the meeting of the St. Louis Chemical Society, held June 10, three papers were presented on the general subject "The Fixation of Atmospheric Nitrogen."

1. "By Plants," J. Arthur Harris, of the Missouri Botanical Gardens.

2. "By Direct Oxidation," Carl Hambuechen.

3. "As Ammonia and Cyanides," Dr. F. W. Frerichs.

The speakers presented the general history of the several processes, and the methods employed, together with an account of the present status of the subject. Dr. F. W. Frerichs concluded that even if the Chilean sources of combined nitrogen should be exhausted within twenty-five years, and even if the low nitrogen content of mineral coal (about 2 per cent.) excluded this as a source of combined nitrogen, except in the few cases in which this nitrogen can be obtained as a by-product, still, chemistry will be quite able to supply all the combined nitrogen that shall be required.

C. J. Borgmeyer,
Corresponding Secretary

DISCUSSION AND CORRESPONDENCE

DR. EASTMAN'S RECENT PAPERS ON THE KINSHIP OF THE ARTHRODIRES[1]

Every one who labors with the time-honored problem of vertebrate descent must consider, sooner or later, the arthrodiran "fishes," for these, with forms similar but even more puzzling, were the most conspicuous and diversified of earliest chordates. They are first known in the upper Silurian, run their gamut of evolutional prosperity in the middle Devonian, and become extinct in the early Carboniferous: the earlier forms were small with tubercle-like teeth, the later, often of considerable size, with many types of dentition, tubercular, trenchant, or crushing. Unhappily, however, the various forms of arthrodires are known only imperfectly, and the fact that various writers have considered them as related to almost every and widely separated groups of living fishes is enough to indicate how little is known of their anatomy.

Among the latest contributions to this unsatisfactory theme are three papers by Dr. C. R. Eastman, and these contain such reactionary views as to the kinship of arthrodires that they merit a somewhat extended review. For, in the matter of vertebrate descent, there should, I think, be entered a friendly protest against Eastman's conclusions—all the more necessary on account of his deservedly high authority in matters of palæichthyology—and the reasons should be summarized for regarding his arguments inadequate. On the other hand, I do not believe that this is the place to support in detail a rival theory—it is rather to show the intricacy of the materials involved and the limitations to which our conclusions must be subject.

Eastman brings out in his papers three essential theses. He aims to demonstrate: (1) That arthrodires are specialized lung-fishes, principally on the evidence of dental plates and

[1] "Dipnoan Affinities of Arthrodires," *Am. Jour. Sci.*, Vol. XXI., February, 1906. "Structure and Relations of Mylostoma," *Bull. Mus. Comp. Zool.*, Vol. L., No. I., pp. 1–34, pls. 1–5, May, 1906. "Mylostomid Dentition," *ibid.*, Vol. L., No. 7, pp. 211–229, 1 pl., February, 1907.