hombolepis and *Otomitla*) is attained in the latest members of the race with the least modified exoskeleton or when he notes that at the time the jaw elements become more simplified among the Teleostomes, a 'new vigor' is apparently infused into their race, marked by the outcrop of a varied series of families. By this means parallelisms have been largely evaded, but of these many interesting examples are cited, as the structures arising in the *Semionotids* and *Macrosemiids*, which are clearly interpretable as the result of similar physiological needs. And it was only after the closest scrutiny that the author was inclined to follow the lead of Prof. Cope in selecting fin structures as the most constant elements in comparison. The old tenets of classification, the characters of scales and even of vertebral axis, were found to be of decidedly minor importance, in the case of scales, as in *Eugnathus* and *Caturus* of not more than generic value. Throughout the volume phylogenetic views are seldom expressed definitely, for even the splendid series of forms which the author has been able to study has not convinced him, in the majority of cases, of more than probable kinships; thus we learn that the "origin of the Chondrostei is still entirely obscure," or that "it seems most reasonable in the present state of knowledge to place the Oligopleuridæ with the (Pholidophoridæ) near the base of the Isospondylic Series," or, again, that, "if speculation were permitted in seeking the direct ancestors of the Pycnodonts, it might be most profitable to turn toward the earliest Mesozoic fishes of the *Colobodus* type."

Mr. Smith Woodward regards his volume as acceptable 'merely as a convenient basis for further research, full of imperfections which each specialist will readily discover for himself.' But when one is familiar with the researches of its author, and knows, moreover, that the present volume embodies four years' diligent work, we may naturally expect that its sins, either of omission or commission, will not prove formidable. If criticism must be found one might be inclined to regret that the number of text figures, especially restorations, were not larger, although be it understood that from the obvious nature of the catalogue this number is already a goodly one. BASHFORD DEAN.

The Cyprinodonts. By S. GARMAN. Memoirs of the Museum of Comparative Zoölogy at Harvard College. Vol. XIX., No. 1, pp. 179, pls. XII. 1895.

The present monograph on the 'top minnows' has been based upon Mr. Garman's studies of the remarkable—possibly the most complete—collection of these forms, that of the Agassiz Museum at Harvard; and it is certainly one of the most valuable of recent contributions to the study of Fishes. It is important to the systematist, because there is scarcely a group of recent Teleostomes which has stood in greater need of critical revision, for the Cyprinodonts are not merely a large and scattered group, profusely and often very imperfectly described, but one whose species present a most confusing range in coloration, dentition and sexual characters.

One cannot help feeling that in the systematic portion of the work Mr. Garman's studies of the variation among members of each species have enabled him to interpret 'specific' differences with modern broadness, and that the order which has been drawn out of the tangle of synonymy (where a single form had, for example, been placed by various authors in as many as a half dozen 'genera') is one which will prove of permanent value. The monograph is one which, like that on the Discoboli, does fitting justice to its author's careful work; it might well be taken as a model of thoughtful preparation. The plates are admirable examples of the work of the artist and of the lithographer, and especially interesting are Pls. IX.–XII., which were drawn by Sonrel for the elder Agassiz.

The wide range in structural characters which the Cyprinodonts have evolved has been brought out clearly in the introductory portion of the monograph, but perhaps not as fully as many morphologists would desire. But the arrangement of the material with a view of sketching broadly the evolutional problems suggested by this group is certainly satisfactory. And there can be no doubt that many well-trained morphologists will here learn, for the first time, that sexual dimorphism—where the males or females of the same species will be either sinistral or dextral—may occur among

vertebrates. And on the evidence of cyprinodonts it must be admitted that several of the characters which have been almost universally regarded as stable landmarks in morphological studies should be given comparatively little definite importance. For in this group, ranking only as a *family*, oviparous and ovoviviparous forms have been evolved, together with a broad range in intromittent organs and in embryonic nutriment. So that, for example, we must admit that structures like the 'claspers' of sharks are of but little moment in separating the phylum of the elasmobranchs from that of the Dipnoan or of the Teleostome. In the morphological portion of his work Mr. Garman has directed especial attention to varietal changes, notably in the case of Fundulus heteroclitus, and to structural variation as shown principally in teeth, digestive tract, urinogenital system and vertebral column. Under the latter head he attributes the decrease in the number of vertebræ of fishes in general, in and toward the torrid zone, to the 'lessening of the comparative activity of the species,' due to an enlarged food supply and to a decreased need of nutriment, the decreased number is not, therefore, attributable to the direct action of temperature, as several writers appear to have inferred.

BASHFORD DEAN.

A NEW DETERMINATION OF THE RELATIVE DENSITIES OF OXYGEN AND HYDROGEN AND OF THE RATIO OF THEIR ATOMIC WEIGHTS.

To one familiar with the work of Prof. Morley on this subject it would seem that any one who wishes to add anything to our knowledge of the matter must be an experimenter of unusual ability, and must be willing to expend a very large amount of labor on his determinations. That Julius Thomsen, who has recently published the results of his experiments in this field,* is an experimenter of unusual ability every one will admit. That the results obtained can carry with them any considerable weight in comparison with those of Prof. Morley is very doubtful. It is, however, of very considerable interest to find that, by the use of comparatively simple apparatus and by methods differing in almost every detail, he has obtained results which are in fairly close agreement with those of Prof. Morley's elaborate researches.

The method employed for the determination of the ratio of the atomic weights consisted in the determination, first, of the ratio between the weight of a certain amount of aluminium and of the weight of hydrogen evolved by its solution in a strong solution of caustic potash, and, second, of the weight of oxygen required to burn the hydrogen evolved by the solution of a known weight of aluminium.

The density of hydrogen was determined by measuring over water saturated with hydrogen, the gas evolved by the solution of a known weight of aluminium. The density of oxygen was determined in a similar manner, the gas being evolved by the decomposition of potassium chlorate. The volume of gas measured was approximately one and one-half liters, while Prof. Morley measured a volume of hydrogen amounting to *forty-two* liters. The results obtained were:

Ratio of Atomic Weights	1:15.8690±0.0022
Density of hydrogen at 0°, 760 mm. and 45° Lat.	0:089947 ±0.000012
Density of oxygen "	1.42906

Prof. Morley's values were:

Ratio of Atomic Weights	1:15.879 ±0.00032
Density of hydrogen at 0°, 760 mm. and 45° Lat.	0.089873 ±0.0000027
Density of oxygen "	1.42900 ±0.000034

In discussing the result of his determination of the ratio of the atomic weights, Prof. Thomsen remarks that, as he has avoided the weighing and measuring of large volumes of gases, it is probable that his result is nearer the truth than that obtained by others, and that the uncertainty does not extend beyond the fourth decimal. He seems to have overlooked the fact that, in his syntheses of water, Prof. Morley weighed his hydrogen absorbed in paladium, and also weighed the water formed by its combination, and that, while he weighed the oxygen in gaseous form, the sum of the weights of oxygen and hydrogen agreed almost exactly with the weight of the water.

* Zeit. für Anorg. Chem. **11**, 14; and **12**, 1.