tion may be called to those discrepancies by a coadjutor more recently from the schools, nevertheless the breadth of his experience assures the more mature man that his judgment is not at fault and it is experience that is of value in the end.

In conclusion, a word may be pardoned concerning a matter which has received more or less attention of late from the public press, namely, the treatment of reservoir water with copper sulphate for the purpose of destroying suspended organisms. No doubt whatever exists that a sufficiency of the salt will destroy aquatic life, and the amount required to dispose of such as produce objectionable taste and smell is certainly very small.

What the public are anxious about, however, is whether or not the salts of copper are to be classed with those of lead as cumulative poisons. Unfortunately, the answer to that question is not very satisfactory at the present moment. We do not possess as much light upon the point as we should wish.

Copper is eliminated by the liver and kidneys, and some hold that there is a tendency towards an accumulation of the metal in the liver, and that 'elimination is only complete when eliminating organs are sound.' This appears reasonable. On the other hand, we should be reminded that the use of copper sulphate for preventing algal growth is but occasional, and that no necessity is at hand for asking the people to constantly use a water treated with the salt.

A dose of the chemical is administered to the reservoir water; the objectionable plants are killed thereby and no further dosing is required during a considerable interval of time. Let it be noted, therefore, that the amount of copper used is minute, that all of it does not remain in solution, and that its use is not continuous.

As to the employment of copper sulphate for the killing of pathogenic bacteria the case is quite different. Under such conditions the amount of the sulphate required has to be greatly increased, and, what is still more objectionable, its addition to the water supply must be constant, because of the continual presence of the organisms which require removal. It may well be urged that the use of a 'disinfected' water supply would be opposed by the average citizen upon pretty much the same ground that he would object to the use of embalmed beef.

Some modification of the copper process for the killing of disease germs may yet be suggested which will excite the prejudice in the popular mind against 'chemicals' to no greater degree than does the employment of alum in mechanical filtration, but that day is scarcely here as yet. Let it not be forgotten, however, that its use for removal of those algal growths which have given us so much trouble in the past is to be encouraged, and that the authors of the process are deserving of much praise for their contribution to the growing field of 'water supply.'

W. P. MASON.

SCIENTIFIC BOOKS.

A NEW INTRODUCTION TO THE STUDY OF FISHES.

I.

A FULL fourth of a century had passed since the publication of a general work in English* on systematic ichthyology before a new one appeared to take its place. It was in 1880 that 'An Introduction to the Study of Fishes by Albert C. L. G. Günther' appeared. That work, however, by no means represented the condition of science at the time of its issue, and was replete with errors as well as anachronisms of all kinds. Its author was

* E. Perrier's corresponding portions of his French work (Traité de Zoologie) were mostly published less than a year before (1903), and, if put in the same typographical dress, would cover nearly two fifths more space.

then the custodian of the fish collection of the British Museum as well as 'keeper of the zoological department.' His successor as custodian of the fishes, Dr. George A. Boulenger, is one of the authors of a new work covering practically the same ground as Dr. Günther's. The new work labors under the disadvantage of having no real descriptive title-page. On a bastard title-page it is designated as 'The Cambridge Natural History—Volume VII.,' and on the true title-page it has the following legends apportioned and punctuated as here represented.

HEMICHORDATA
By S. F. Harmer, [etc.].
ASCIDIANS AND AMPHIOXUS
By W. A. Herdman, [etc.].
FISHES (Exclusive of the Systematic Account of Teleostei)
By T. W. Bridge, [etc.].
FISHES (Systematic Account of the Teleostei)
By G. A. Boulenger, [etc.].
London
Macmillan and Co., Limited
New York: The Macmillan Company
1904

We are thus compelled to refer to it as the Cambridge Natural History, Volume VII.

The new work, in line with modern concepts respecting the vertebrates or chordates, includes not only the lower types of the vertebrates of the old naturalists, but also the Hemichordata and Urochordata or Tunicates. The old class of fishes of the 'Introduction' is replaced by the three classes for more than a generation past adopted in America, that is, the 'Cephalochordata' (Leptocardians), the 'Cyclostomata' (Marsipobranchs) and the 'Pisces' (Teleostomes or fishes proper).

It may be noted that the names Hemichordata, Urochordata and Cephalochordata are given as terms of subphyla and not as class names. The constituents of the first, for Dr. Harmer, are the 'orders' Enteropneusta, Pterobranchia and Phoronidea, each of which has been considered by some as a class, or, at least, far removed from the others; the second is universally known as the class of Tunicates or Ascidians, the third as the class Leptocardians. The three subphyla thus named are succeeded by another subphylum—'IV. Craniata,' which is divided into two classes: 'Class Cyclostomata,' generally called Marsipobranchs or Myzonts, and 'Class Pisces,' including the Selachians and true fishes, or Teleostomes.

II.

The three 'orders' aggregated as 'Hemichordata' can not be considered to have been proved beyond all cavil either to be closely related or to be true Chordata. The student may find a summary of the arguments respecting the 'affinities of the Hemichordata' at the end of the chapter on the group (pp. 30–32). It is not long since almost all the known species of Enteropneusta were supposed to be referable to one genus—*Balanoglossus*. Now they are distributed among three families and the oldest of them appears under the guise of Ptychoderidæ.

III.

The 'Urochordata' or Tunicata have been elaborated in excellent style by the eminent monographer of the 'class' (Professor Herdman), who has long been known in connection with those animals. In spite of the many different changes and systems that have been proposed by others while he has been actively engaged on the group, he retains practically unchanged the system he employed in the Encyclopædia Britannica (1888) and the *Journal of the Linnæan Society* (1891). It is noteworthy, too, that the name *Cynthia* is still kept, although there is a well-known genus of Fabricius (1808) so termed long before Savigny's genus (1827) was established. That the retention was deliberate and in spite of the facts is evident from a note to the same in the *Journal of the Linnæan Society* (23, 576), where the substitute '*Halocynthia*, Verrill, is [declared to be] merely a synonym.'

IV.

The main structural features of the 'Cephalochordata' are passed under review in an able manner and the latest sources of information made use of. The classification is derived by Professor Herdman from Mr. Walter Tattersall; that author is evidently

well informed, but his logical faculty and taxonomic tact will be disputed by some at least.

The 'sixteen species' recognized are grouped under two genera—*Branchiostoma*, 'having biserial gonads and symmetrical metapleura' and *Asymmetron* 'with uniserial (right) gonads and asymmetrical metapleura.' One of the species referred to *Branchiostoma* is the *B. pelagicum*. According to the original describer 'buccal tentacles are absent,' and this statement has been corroborated by all subsequent observers; the last examiner of the species (G. H. Parker, in November, 1904) had an 'exceptionally well preserved specimen' and could 'confirm the statement of most previous writers that oral cirri are absent.' Parker was also, like C. F. Cooper, 'unable to find any evidence of branchial apparatus.' Furthermore, the gonads, though in two rows, 'are often so closely pressed together near the median plane that they there seem to form a single median row.' Surely a species distinguished by such trenchant characters and also distinguished by its pelagic life is entitled to distinction from all its fellows! Owen and the old naturalists generally considered the development of the mouth as 'a longitudinal fissure with subrigid cirri on each side' to be an *ordinal* character of the '*Cirrostomi*' named for *Branchiostoma*. Unquestionably the character is of *generic* value at least, and the form differing so decidedly from it may be ranked not only as the type of a distinct genus (*Amphioxides*), but distinct family (Amphioxididæ). The details of the oral structure, however, remain to be made known.

A flagrant violation of a principle of nomenclature adopted by all learned societies may next be noticed. The name *Asymmetron* has been adopted for all the species 'with uniserial gonads.' Now, *Asymmetron* was not named till 1893, and long before (1876) Peters had named a genus *Epigonichthys* for a species which is believed by the author to be congeneric with *Asymmetron*. If such were the case, the prior name, *Epigonichthys*, should of course have been used for the genus. As a matter of fact, however, some naturalists at least will adopt the names *Epigonichthys* and *Asymmetron*, as well as *Paramphioxus*, for special species or groups of species thrown together in *Asymmetron*. It may be added that the fact that Peters did not appreciate the proper generic characters is not a necessary corollary of the question at issue; he gave the name in connection with an undoubted species and tried to define it.

V.

The 'Craniata,' or rather the pisciform craniates, of course are the chief subjects of the volume, the 'craniata' being equivalent to all the vertebrates of the old naturalists before the recognition of the Branchiostomids. These are considered under two classes, (1) the Cyclostomata and (2) the Pisces. The former, and of the latter the Elasmobranchii or Selachians, and the Ganoids of the Müllerian system, have been treated by Professor Bridge; the Teleosts are summarized by Dr. Boulenger. The elaborate chapters on the anatomical systems and organs are also by Professor Bridge.

On the whole, the chapters on anatomy and physiology are apt and as full as could be reasonably expected in a volume of the series for which it was prepared. That on 'the skeleton' (Chapter VIII.), however, is insufficient in view of the extreme importance of the various osseous elements in the determination of the relationships of all fishes. All the non-teleost fishes might be lost and their loss made good, numerically, by the discoveries of a single year, yet all the space that is devoted to the skeletology of a teleost fish is less than ten pages (pp. 205, 211–216, 237, 240, 246); the species selected, the trout, is also not typical, a far better representative being the one chosen very many years ago by Cuvier and retained by Günther—the perch. The nomenclature of the bones is that current for a number of years past in Europe. Long ago, however, Sagemehl expressed doubt whether a single bone of the fish's skull was really a homologue of any in the terrestrial vertebrates. We fully share in that doubt, or rather belief, but for the present may retain the time-honored names derived from mammalian anatomy for the fish's bones. We can

not, however, do so for the elements of the shoulder-girdle; the bones of the trout for which the names scapula and coracoid have been used (p. 240) can not possibly be the homologues of the bones so called in the mammals. The fish bones only became developed as independent bones in those fishes which had originated from a holostean stock and when later specialization in a direction toward the Acanthopterygian type had supervened. To call such bones scapula and coracoid is to inculcate a most misleading concept of piscine morphology and development.

Attention may be called to another statement whose ambiguity will mislead. It is said (p. 252) that 'in some of the wrasses (*Labrus*), the inferior [pharyngeal] teeth are opposed to superior teeth on the upper pharyngeal bones'; experiments show that this sentence may be interpreted to mean that teeth on the superior pharyngeals are exceptional, whereas they are there, as a rule, not only in all Labrids, but in Acanthopterygian and many other fishes. Professor Bridge doubtless knows better, but has been unhappy in the use of words.

Another phase that may perplex the student is the frequent incongruity between the names of fishes referred to in the anatomical chapters and those adopted in the systematic portion of the work, such as *Mesoprion* (p. 235) for *Lutjanus* (p. 663), *Lutodeira* (p. 256) for *Chanos* (p. 294), *Rhombus* (p. 275) for *Psetta* (p. 687), and the like. Such are simple enough, but there are some names which Professor Bridge evidently introduced without knowing what forms were involved. In one place (p. 262), the statement is made that "ciliated epithelium has been found in the intestine of a few species (*e. g., Rhombus aculeatus* and *Syngnathus acus*)." The *Rhombus* here is by no means the same as the *Rhombus* elsewhere, but the *Stromateus aculeatus*. In a second place (p. 275), it is said that 'in *Labrus labrax* there are about sixty' pyloric cæca: now no *Labrus* nor labrid has any cæca and the bass (*Labrax* of Cuvier) has only about five; consequently some other explanation must be found.* Perhaps the statement was based on some hexagrammid, called by Pallas *Labrax,* which has numerous cæca. In a third place (p. 357), we are told that 'stridulating sounds may also be produced by the friction of the upper and lower pharyngeal teeth, as in a species of mackerel (*Scomber brachyurus*)'; there is no mackerel so named, but the fish meant is the 'common horse mackerel (*Caranx trachurus*)' whose relatives are mentioned elsewhere by Professor Bridge (p. 363) as 'horse mackerels (*Caranx hippos*),' and which represent a peculiar family —the Carangidæ (p. 677).

In 'An Introduction to the Study of Fishes' (p. 177), the law was dogmatically declared that 'with regard to size, it appears that *in all* teleosteous fishes the female is larger than the male; in many cyprinodonts the male may be only one sixth or even less of the bulk of the female.' In 'The Cambridge Natural History' (p. 413) it is correctly stated that, 'as a rule, in fishes females are more numerous than males, and *generally* they are larger, but to both statements there are notable exceptions.' It is noteworthy that in the very family of Cyprinodonts of which the males were declared to be very much smaller than the females, there is at least one notable exception in the case of the genus *Mollienisia* (*Mollienia?*), whose males are much larger than the females. Furthermore, the males contrast with the females in brilliant coloration and especially in the greatly expanded dorsal fin. Some other fishes whose males are larger than the females belong to the families Callionymidæ, Gobiesocidæ, Labridæ, Gobiidæ, etc.

In almost all cases, so far as known, the larger size of the male is coordinated with brilliancy of coloration or some other secondary character. In short, the rule seems to be that when the males are brilliantly colored or have other marked secondary characters they are larger than the females.

"The only examples of viviparous fishes,"

* Neither the origin nor cause of the strange confusion of names of two unrelated genera into factitious species has been indicated by Professor Bridge.

it is claimed, "occur in certain families of elasmobranchs, and in five families of teleosts, viz., the Blenniidæ, the Cyprinodontidæ, the Scorpænidæ, the Comephoridæ and the Embiotocidæ" (p. 418). To this list should be especially added the remarkable Zoarcidæ and Brotulidæ combined in a single family under the name Zoarcidæ in the systematic part of the work (pp. 712, 713). Some fresh-water 'Scombresocidæ' of the genus *Zenarchopterus* are also viviparous (p. 638). Certain Cyprinidæ (p. 584), Siluridæ and Cottidæ have also been declared to be viviparous, but the claims have not been quite fully proved.

VI.

The Cyclostomata are ranked as a class, and the two principal divisions, called 'Myxinoides' and 'Petromyzontes,' are designated as 'orders.' Why the old names Marsipobranchii, Hyperotreti, and Hyperoartia should be abandoned is not obvious. The groups, however, are valued in accordance with general current usage, but the last two are of at least subclass rather than ordinal value. The immense gap between the 'Myxinoides' and 'Petromyzontes' is apparently scarcely appreciated by most naturalists, but it was recognized by Ray Lankester a generation ago (1877) in his distinction of the two groups as *classes*. The differences are fundamental and affect all parts and organs. If, for example, Professor Bridge had presented a figure of the auditory organs of *Petromyzon* to compare with those of *Myxine* and other types (p. 388), the contrast could not fail to strike the observer with the requisite knowledge of comparative anatomy to judge of the facts.

The 'Myxinoides' are divided into two families—'Myxinidæ' and 'Bdellostomatidæ.'

The 'Petromyzontes' are aggregated in a single family, as usual called 'Petromyzontidæ.' (It should be Petromyzonidæ.) Professor Bridge evidently had an imperfect knowledge of the species. He mentions (p. 426) *Petromyzon* with 'three species widely distributed in Europe,' and just afterwards states that '*Ichthyomyzon, Bathymyzon, Entersphenus* [= *Entosphenus*] and *Lampetra* are also northern forms.' *Lampetra* was originally distinguished for two of the 'three species widely distributed in Europe.' The genera mentioned fall into two primary groups: *Petromyzon, Bathymyzon* and *Ichthyomyzon* in one, *Lampetra* and *Entosphenus* in the other.

The statement is made that 'a new genus and species from Chili has been recently described under the name of *Macrophthalmia chilensis.*' The supposed new type was later (1902) shown by its author (L. Plate) to be simply a stage ('Jugendstadium') in the development of the *Geotria chilensis*. The Petromyzonids of the southern hemisphere differ remarkably from those of the northern in their development as well as otherwise.

VII.

The Elasmobranchii are treated in the old-fashioned style. After the extinct orders Pleuropterygii (p. 436), Ichthyotomi (p. 438) and Acanthodei (p. 440), the now extant types are considered under the orders Plagiostomi (p. 442) and Holocephali (p. 466), and the Plagiostomi are, as of old, divided directly into Selachii and Batoidei (p. 457). Such a division is certainly not expressive of the facts of morphology. There can be no question that the structural differences between the so-called Notidanidæ and Chlamydoselachidæ, on the one hand, and all the other Selachians, are of much more morphological significance than those between the sawfishes of the families Pristiophoridæ and Pristidæ. The Heterodontidæ also appear to be widely differentiated from the others, though not as much so as might be inferred from the old-time allusions to them. In fine, the segregation into (1) Diplospondyli or Opistharthri (Notidanidæ), (2) Prosarthri (Heterodontidæ), (3) Tectospondyli (sharks without anal and rays) and (4) Asterospondyli (other living sharks) appears to comport best with structural and developmental facts as well as with the paleontological record.

The name Notidanidæ has been used just because it is the term employed by Professor Bridge, but it should be discarded. Professor Bridge, apparently, is content to take a name as he finds it without caring whether it is

justified by history or not. A number of the names adopted by him would be discarded by those who were willing to obey the codes of nomenclature formed by naturalists whose large experience had convinced them of the necessity of adherence to rules. The persistent violator of such rules places an obstacle in the path of the zoological student and helps to prolong unhappy discord and difficulty. Too often, however, he assumes the attitude of the wolf to the lamb! Examples of family names wrongly used are Notidanidæ (for Hexanchidæ), Scylliidæ (for Scylliorhinidæ), Spinacidæ (for Squalidæ) and Trygonidæ (for Dasybatidæ). The Linnæan name *Squalus* is not used at all and the name *Læmargus,* though at the same time much younger than *Somniosus,* and long preoccupied, is still retained. Of course it may be said nomenclature is of trivial importance and too much has been made of it, but if so why should those who regard it from such a standpoint be obstinate in ignoring rules when adherence need not affect them while it does others?

There is, too, sometimes inconsistency between Professor Bridge's definition of a group and its contents. The family Lamnidæ is said to be composed of "large stout-bodied sharks with two dorsal fins, the first just behind the pectoral fins, the second, which is small, opposite the small anal fin; * * *. Tail with a prominent lateral keel on each side. * * * Branchial clefts very wide." It would thus appear as if Professor Bridge had adopted the family with the same limits that had been given to it by Müller and Henle and American ichthyologists. On looking at its contents, however, it appears that the genera for which the families Odontaspididæ (or Carchariidæ) and Alopiidæ have been framed are referred to it. Yet *Odontaspis* certainly has not the first dorsal 'just behind the pectoral fins,' nor the second or anal 'small' (but unusually large), nor 'the tail with a prominent lateral keel.' Nor does *Alopecias* (properly *Alopias*) agree better. That genus has not the first dorsal 'just behind the pectoral fins,' nor 'the tail with a prominent lateral keel,' nor the 'branchial clefts very wide.' As Professor Bridge had recognized the importance of the differentiating characters in the diagnosis of the Lamnidæ, he should have recognized the families Odontaspididæ (or Carchariidæ) and Alopiidæ by name.

A word may be in place as to *Alopias* and *Alopecias.* It is true that *Alopecias* was the ancient Greek name of the thresher, but Rafinesque thought it was too long and preferred to give a new name to the genus (as he had a perfect right to do); he selected *Alopias,* which can be perfectly and legitimately formed from ἀλωπος and the suffix *-ias.* Müller and Henle first substituted *Alopecias,* but in their great work reverted to *Alopias: Alopias* it should be.

Another notable case of inconsistency is manifest in the treatment of the family 'Scylliidæ' (Scylliorhinidæ). That family is defined as being 'oviparous,' having 'egg-cases large, quadrate,' etc. (p. 446). To it are referred '*Chiloscyllium,*' 'a widely distributed genus,' and *Crossorhinus* (*Orectolobus*). Yet both of those genera were shown in 1901, by Edgar R. Waite, to be ovoviviparous, like most selachians, and referred to distinct families, the Hemiscylliidæ and Orectolobidæ.

VIII.

The non-teleost 'Teleostomi' are disposed of in a somewhat peculiar manner. In the group are included the 'order I. Crossopterygii' (p. 476), 'order II. Chondrostei (Acipenseroidei)' (p. 485), and 'order III. Holostei (Lepidosteoidei)' (p. 495) and from it are excluded the 'subclass III. Dipneusti (Dipnoi)' (p. 505). It appears to be more than problematical whether such an arrangement is the best expression of the present state of our knowledge of the fishes involved. The relationship of the primitive Crossopterygii and Dipneusti was so close that they were confounded in one and the same group (suborder Ganoidei crossopterygidæ) by Huxley, and the gap between the two appears to be much less than that between the Crossopterygii and the nearest related of the existing fishes. Further dissent need not be expressed here. It may be recalled, however, because the discovery is so recent, that George

Wagner (1904)* has recorded the presence of a scaly zone behind the gill cavity, as well as the existence of a pair of minute barbels in *Polyodon,* thus falsifying the characters body 'apparently scaleless' and 'barbels absent' attributed to the family Polyodontidæ by Bridge.

The Teleostei, including almost all the living fishes, have been classified by Boulenger, and the work is worthy of that master of taxonomy and verbal expression of relationships. The group, formerly and generally designated as a subclass, is degraded to ordinal rank, and all the chief divisions, mostly called orders by American and some other ichthyologists, are designated suborders. Of the suborders there are eleven.

A large number of the groups familiar to American ichthyologists are accepted with practically the same limits as are current in the United States, but always with the inferior rank indicated, the orders being designated by Boulenger as 'suborders.' Such are the (1) Malacopterygii, (3) Symbranchii, (4) Apodes, (9) Anacanthini, (10) Acanthopterygii, (11) Opisthomi, (12) Pediculati and (13) Plectognathi. Other suborders have received families which had been ejected from other groups, the suborders thus enlarged being the (5) Haplomi, (6) Heteromi and (8) Percesoces. Another suborder (2. Ostariophysi) has been made to include the Nematognathi and Plectospondyli, the main difference from American practise being in the fusion of the groups, for the relations of the constituents of the so-called 'suborder' have long been recognized, as has the group itself as a 'superorder.'

How divergent this arrangement is from that long adopted in Europe is told by Boulenger (p. 543). "In the classification of Günther, which has been generally in use in [England] for the last thirty years, the Teleosts were divided into six principal groups, of ordinal rank: I. Acanthopterygii; II. Acanthopterygii Pharyngognathi; III. Anacanthini; IV. Physostomi; V. Lophobranchii; VI. Plectognathi. Group [order] I. corresponds to sub-order 6 (part), 7 (part), 8 (part), 10 (part), 11 and 12 of the present work; Group II. to sub-order 10 (part); Group III. to sub-order 9 and 10 (part); Group IV. to sub-order 1, 2, 3, 4, 5, 6 (part), and 8 (part); Group V. to sub-order 7 (part); and Group VI. to sub-order 13.

Some of the modifications introduced into the system are rather startling. The Muræniдæ, we are told, differ from the other Apodes in that their dentigerous bones are the palato-pterygoid, the maxillaries being absent, while in the Anguillidæ and others the dentigerous bones are the maxillaries. It is difficult to believe that the dentigerous bones, specialized as they are, should be so different homologically. Exception must also be taken to the reference of the genus *Derichthys* to the family Anguillidæ. That genus has both intermaxillaries and maxillaries, and if it must, perforce, be referred to some former order, it is with the Symbranchii and by no means the Apodes that it should be associated. Anyway, it is the representative of a very distinct family—Derichthyidæ. Another group whose new allocation we can not assent to is the Saccopharyngidæ. The fishes of that family differ markedly from the true Apodes by the absolute want of all opercular and branchiostegal as well as various other bones, and, indeed, have no similarity, except in elongation of body, to the eels. They are more likely to be divergents from some stomiiform stock. From all other fishes, however, they are widely differentiated, and well entitled to rank as the equivalent at least of the suborders of Boulenger—the Lyomeri.

The Comephoridæ are extended to embrace, besides *Comephorus,* the recently described *Cottocomephorus* as well as *Anoplopoma* and *Triglopsis.* Dr. Boulenger expresses the opinion (p. 697) that 'no doubt can be entertained as to the propriety of referring [*Comephorus*] to the neighborhood of *Anoplopoma,*' but after a careful comparison of specimens the reviewer is unable to appreciate a resemblance sufficient to entail approximation in the same family. We may well avail ourselves of the technical character admitted by Boulenger himself; in *Comephorus,* 'the second suborbital is *not produced* over the cheek, a unique exception to the main

* SCIENCE, XIX., pp. 554, 555, April 1, 1904.

characteristic of this division,' and this alone will permit us to keep *Anoplopoma* apart as the type of a distinct family, Anoplopomidæ (or Anoplopomatidæ, if you will), since in this genus the suborbital bone is 'prolonged over the cheek towards the præoperculum' (p. 693).

Triglopsis is unquestionably a typical Cottid and scarcely distinguishable generically from the common *Cottus* or *Oncocottus quadricornis*.

If as to these (and a number of other groups) we must agree to differ, it is gratifying to find that such a self-reliant investigator as Dr. Boulenger, who would rather differ than not, has independently reached the same conclusions as American naturalists in many cases, and has correspondingly abandoned the views so long current in Europe. For example, he has recognized the distinctions and mutual relations of the families of Hemibranchii, Scleroparei, Pediculati and Plectognathi, or at least most of them, which were so long denied by the Güntherian school. There is, too, a notable agreement or approximation to agreement in very many other respects.

The recognition of the high rank of the Discocephali is also a triumph of reason over prejudice and leadership. Its type, *Echeneis*, was declared by Dr. Günther in 'The Introduction' (p. 460) to be closely allied to 'the genus *Elacate*, from which it differs *only* by the transformation of the spinous dorsal fin into a sucking organ'! Gill, after a study of the skeleton (1883) declared that *Echeneis* 'differs *in toto* from *Elacate*' and revived a name given long before by Bleeker. Nevertheless, a man who gave some consideration to osteological characters (F. A. Smitt), in his 'Scandinavian Fishes' (p. 89), thought the 'genus may still lay claim to a place among the Scombridæ, though the family-diagnosis can scarcely notice all such variations'! Boulenger is willing to be influenced by the characters and, therefore, remarks (p. 691) that, 'in spite of a superficial external resemblance to the genus *Elacate*, the sucking-fish bear certainly no affinity to that genus nor to other Scombriformes, as first observed by Gill.'

There is the usual statement (p. 593) in ichthyological works, that the 'only European representative of the family' Siluridæ is the *Silurus glanis*. Over twenty-two centuries ago, however, Aristotle described the habits of a Grecian species differing much from those of the *Silurus glanis*, and Agassiz and Garman have recognized the old *Glanis* as a distinct species closely related to one of Asia (*S. asotus*); it is the *Silurus* (or *Parasilurus*) *Aristotelis*.

The old 'Introduction' purported (very mistakenly) to give the names of all genera supposed to be valid and diagnoses of very many of them. The new work merely gives the names of most of the genera of each family or only the 'principal genera.' None of the genera are diagnosed as many were in the introduction.

Typographical or authorial slips are not numerous. A few of them, however, might perplex the reader and consequently may be noticed here. The name *Anostomus*, properly used for a genus of Characinids (p. 576), also appears as a generic name under Mugilidæ (p. 640); *Agonostomus* is the actual name of the Mugiloid genus. Trichodontidæ is a family name of certain Perciformes (pp. 654, 633); the name appearing for fishes of the suborder Jugulares (p. 704) is merely a slip for Trichonotidæ (p. 706). In the statement that the family Lipogenyidæ 'has lessened the gap between the Lyomeri (Halosauridæ) and Heteromi (Notacanthidæ) of Gill,' Lyomeri (p. 622) is evidently a lapsus for Lyopomi. Lyomeri (p. 622) is properly the name of the group represented by Saccopharyngidæ. *Gnathacanthus* (p. 695) is a slip for *Gnathanacanthus*, the latter meaning exactly the opposite of the former. The Connecticut investigator of the origin of the lateral fins (James K. Thacher) is misnamed 'Thacker' (p. 245).

IX.

The differences between the new ichthyological school of Britain and that of America result chiefly from the different modes of approach to the subject. Dr. Boulenger had

long concentrated his attention chiefly on reptiles and amphibians, and the orders of those classes admitted by him are trenchantly separated by well-marked osteological characters. When he entered the ichthyological field he found that orders generally recognized in that class had not the same morphological value as the reptilian ones, and naturally groped around till he conceived he found a corresponding one in the group generally ranked as a subclass—Teleostei. The American naturalists took the orders as they found them left by their predecessors in the field, but a little examination and comparison showed that differences manifest within each of the large orders were of even greater morphological value than those used to differentiate the old orders. Some of those orders were consequently much contracted, as the Malacopterygii, Apodes, Anacanthini, Acanthopterygii and Plectognathi, and types ejected therefrom were set apart as of equal value, such as the Nematognathi, Plectospondyli, Symbranchii, Heteromi, Opisthomi, Pediculati and others. While these may not compare with the reptilian orders, they do with the mammalian and avian. One who has derived his knowledge of the orders of mammals and birds from a comparative examination of their skeletal features, and not from definitions in books alone, must admit that the average orders of mammals are not of greater morphological importance than the orders or 'suborders' of fishes, and that most of the orders of birds are of much less value. Likewise are the most contracted families of fishes of greater morphological value than most of those of birds—especially the Oscine birds—and of as great importance as the majority of those of mammals. A desire to establish for the fishes groups comparable with those adopted by the numerous students of birds and mammals has led American students to the narrow limitations of groups manifest in their works. The contrary method isolates ichthyology and gives a false or distorted idea of the significance of the terms order, family and genus. An expression of hope may be pardoned, therefore, that inasmuch as a long established standard for comparison has been adopted by many ichthyologists, others may in time recognize the propriety of accepting such a standard themselves.

The consideration of other differences must be left to other times and other places. Meanwhile we may congratulate European naturalists that the incubus which has long depressed ichthyology in the old world has been, to some extent at least, lifted, and that investigation may now be so directed that it will be profitable to systematic development. It was a bad and unscientific method that has paralyzed science in Europe for these many years, and let us hope that the new work may force it far into the background, if not wholly eradicate it. Let it be distinctly understood that the only sound foundation for scientific ichthyology is a profound *comparative* anatomy, and especially osteology of all the genera. This truth has long been recognized in the United States by some investigators, but it has not yet been appreciated by our museum authorities and in that respect the investigators of the old world and especially of London will for the present have a great advantage over Americans. We may envy our European colaborers, but shall be glad, nevertheless, to admire and avail ourselves of their superior advantages. We shall be grateful, also, for the new light which the coauthors of the 'Cambridge Natural History,' and especially Dr. Boulenger, have thrown and will continue to throw on mooted questions of morphology and classification. We thank them now. THEO. GILL.

SCIENTIFIC JOURNALS AND ARTICLES.

THE March number of the *Botanical Gazette* contains the following papers: John M. Coulter and W. J. G. Land give an account of the gametophytes and embryo of *Torreya taxifolia*, a species localized in eastern Florida, and closely related to *Taxus*. The type seems to be specialized rather than primitive, with a solitary archegonium, remarkably early fertilization, and no 'open cells' in the proembryo. The peculiar 'rumination' of endosperm proves to be due to the irregular encroachment of endosperm upon perisperm. Pehr Olsson-Seffer discusses the principles of phy-