

Family 5. *Xiphiorhynchidæ*.

Rostrum rounded in transverse section; teeth present; nasals widely separated from the frontals by the broad ethmoid; maxillary formed of an expanded anterior and a rod-like posterior portion.

Xiphiorhynchus of the Lower and Middle Eocene.

XII.—*The Classification of Teleostean Fishes.*

By C. TATE REGAN, M.A.

BEFORE proceeding to the classification of the Teleostei two questions must be discussed, viz. the rank and the limits of the group.

I have already expressed the opinion that the true Fishes are at least as distinct from the Selachians on the one hand and the Batrachians on the other as any of the vertebrate classes are from each other, and are equally entitled to rank as a class*. The class Pisces differs from the Selachii in the presence of two external nasal openings on each side; the reduction of the interbranchial septa; the development of an air-bladder or lung; the bony exoskeleton, typically including paired nasal, frontal and parietal bones, a parasphenoid, an operculum, a series of bones, post-temporal, supra-cleithrum, cleithrum and clavicle, overlying the primary pectoral arch and connecting it with the cranium, scales and articulated fin-rays; the development of bones in or on the visceral arches, præmaxilla, maxilla, palatine, pterygoids, quadrate, dentary, &c.; the presence of supra-neural arches (well-developed in Chondrostei and Dipneusti, less evident when centra are formed). The Batrachians are separated from the Pisces especially by the presence of true internal nares and of a *fenestra ovalis*, the modification of the paired fins into pentadactyle limbs and of the hyomandibular into the stapes, and the absence of endoskeletal supports and dermal rays from the median fins.

Whilst recognizing the importance of the characters which distinguish the Pisces from the Selachii, I have hitherto been so conservative as to regard these groups as sub-classes only, using the name Teleostomi for the former. The groups which I formerly recognized as orders of the sub-class

* Regan, Proc. Zool. Soc. 1906, p. 724, and Biol. Centr.-Am., Pisces, p. viii (1908).

Teleostomi, viz. Chondrostei, Teleostei, Crossopterygii, and Dipneusti, I now regard as sub-classes of the class Pisces. These four sub-classes may be arranged in two series: in the Actinopterygian series (Chondrostei and Teleostei) the duct of the air-bladder opens dorsally or dorso-laterally into the alimentary canal, the branchiostegals retain their primitive serial arrangement, and the supports of the paired fins are either in the form of a series of parallel pterygiophores each of which is segmented into a basal and a radial portion or are modified from this plan by a simple process of concentration and reduction; in the Crossopterygian series (Crossopterygii and Dipneusti) the opening of the pneumatic duct is ventral, the branchiostegals are replaced by a pair of gular plates, and the paired fins are more or less lobate, with their supports tending to the biserial arrangement with axial basalia.

The Teleostei are well marked off from the Chondrostei by the absence of clavicles and of pelvic radials, the reduction in number of the dorsal and anal fin-rays, so that each has its own pterygiophore, and the shortening of the upturned axis of the caudal fin, which is homocercal or abbreviate heterocercal. Thus defined they include the Holostei, a group which cannot, in my opinion, be maintained.

The ordinal names are not formed on any definite plan, but usually have some reference to the peculiarities of the group; it seems to me useful always to form subordinal names with the termination *-oidei*, and when families are arranged in divisions or superfamilies to give these groups names ending in *-formes*.

*Synopsis of the Orders and Sub-orders of the
Sub-class Teleostei.*

- I. Splenial well developed.
- A. Vertebral centra incomplete, or with alternating pleuro- and hypo-centra in the caudal region . . . 1. *Protospondyli*.
1. Præmaxillaries meeting in the middle line; caudal fin supported by little expanded hæmal spines.
- No endochondral supraoccipital; parietals united by suture; opercular bones complete 1 *a.* Amioidei.
- An endochondral supraoccipital; parietals united by suture; opercular bones complete 1 *b.* Dapedioidei.
- No endochondral supraoccipital; parietals separated by a median dermal bone; sub- and inter-operculum absent 1 *c.* Pycnodontoidei.
2. Præmaxillaries separated by an ethmo-vomerine rostrum; lower lobe of caudal fin supported by a single much expanded hæmal spine 1 *d.* Pachycormoidei

- B. Vertebral centra complete, annular or biconcave; no separate pleuro-centra and hypo-centra 2. *Aspidorhynchii*.
- C. Vertebral centra complete, opisthocelous; no separate pleuro-centra and hypo-centra 3. *Ginglymodi*.
- II. No splenial; an endochondral supraoccipital; vertebral centra complete.
- A. A mesocoracoid †.
1. No Weberian ossicles; maxillary entering the gape to a greater or less extent and not acting as a lever for the protraction of the præmaxillaries; mesethmoid unpaired.
4. *Isospondyli*.
- a. Frontals united by suture.
- α. Mouth not protractile.
- * Parapophyses autogenous or parietals separated by supraoccipital.
- Parietals present 4 a. Clupeoidei.
- Parietals absent 4 b. Stomiatoidei.
- ** Parapophyses co-ossified with centra; parietals meeting, separating frontals from supraoccipital.
- Entopterygoid articulating with a lateral peg of the parasphenoid 4 c. Osteoglossoidei.
- On each side of the skull a lateral foramen or cartilaginous area superiorly and a vesicular diverticulum of the air-bladder inferiorly 4 d. Notopteroidei.
- On each side of the skull superiorly a lateral foramen lodging a vesicle which has lost its connection with the air-bladder 4 e. Mormyroidei.
- β. Mouth protractile; maxillaries not articulated to the cranium 4 f. Phractolæmoidei.
- b. Frontals united to form a single bone; gill-membranes joined to the isthmus 4 g. Gonorhynchoidei.
- c. Frontals completely separated; gill-membranes joined to the isthmus 4 h. Cromerioidei.
2. Weberian ossicles present 5. *Ostariophysii*.
- Parietals distinct; pterygoids, symplectic and opercular bones all present; anterior vertebræ more or less distinct 5 a. Cyprinoidei.
- Parietals united with supraoccipital; no metapterygoid, symplectic, or suboperculum; anterior vertebræ co-ossified 5 b. Siluroidei.
- B. No mesocoracoid.
1. Parapophyses autogenous.
- a. Parietals united by suture; mesethmoid unpaired; physoclistic 6. *Heteromi*.
- b. Parietals separated by the supraoccipital; paired dermal ethmoids; physostomous 7. *Haplomi*.
- Pectoral pterygials normal 7 a. Esocoidei.
- Pectoral pterygials represented by a cartilaginous plate 7 b. Dallioidei.

† Absent in some Argentinidæ and Siluridæ and in the Galaxiidæ and Haplochitonidæ.

2. Parapophyses co-ossified with centra.
- a. Physostomous †; pelvic fins, if present, abdominal.
- a. Præmaxillaries nearly excluding the maxillaries from the oral border; body eel-shaped; no paired fins; vertical fins confluent 8. *Symbranchii*.
- Pectoral arch attached to the skull by a forked post-temporal 8 a. *Symbranchoidei*.
- Pectoral arch free from the skull; no post-temporal 8 b. *Amphipnoidei*.
- β. Præmaxillaries absent; maxillaries articulated with the fixed ethmo-vomer; quadrate fixed; pectoral arch free from the skull; body eel-shaped.
9. *Apodes*.
- Large interbranchial slits; tongue present; opercular bones well developed 9 a. *Anguilloidei*.
- Small interbranchial slits; no tongue; opercular bones reduced 9 b. *Murænoidei*.
- γ. Præmaxillaries absent; maxillaries meeting anteriorly and suspended by the integument from a movable ethmoidal rostrum; quadrate movably articulated with the hyomandibular; pectoral arch far behind the skull; body eel-shaped 10. *Lyomeri*.
- δ. Præmaxillaries excluding maxillaries from oral border; parapophyses short or absent; epineurals present; orbito-sphenoid present and parietals united by suture or post-temporals nearly meeting above supraoccipital; an adipose fin 11. *Inioini*.
- ε. Præmaxillaries excluding maxillaries from oral border; all præcaudal vertebræ with strong transverse processes; no epineurals; no orbito-sphenoid; parietals separated by supraoccipital; post-temporals lateral; no adipose fin 12. *Microcyprini*.
- δ. Physoclistic; pelvic bones not directly attached to the cleithra §; orbito-sphenoid absent or vestigial; maxillary not protractile.
- a. Lower pharyngeals completely united; fins without spines 13. *Synentognathi*.
- β. Lower pharyngeals separate.
- * On each side a dermal plate (ectocoracoid) which in the adult is united by suture to the cleithrum and co-ossified with the coracoid. 14. *Thoracostei*.
- ** No ectocoracoids.
- † Snout tubiform; parietals absent; pterotic extending downwards to basioccipital.
15. *Solenichthyes*.
- Mouth toothed; gills pectinate; anterior vertebræ elongate, with transverse processes on each side united to form a shelf; lower 3 pectoral pterygials enlarged .. 15 a. *Aulostomoidei*.

† Some Cyprinodontidæ have recently been shown to be physoclistic.

§ Except in the Luciocephalidæ and some Anabantidæ, which seem clearly related to forms with abdominal pelvic fins.

- Mouth toothless; gills pectinate; anterior vertebræ elongate, with separate transverse processes; pectoral pterygials short 15 b. Centriscoidei.
- Mouth toothless; gills lobate; caudal vertebræ very short; pectoral arch normally attached to skull; post-temporal and supra-cleithrum similar to stellate ossifications on body 15 c. Solenostomoidei.
- Mouth toothless; gills lobate; caudal vertebræ normal; post-temporal simple, suturally united to the cranium; no supra-cleithrum; cleithrum firmly attached to the transverse processes of the two anterior vertebræ; body enclosed in bony rings 15 d. Syngnathoidei.
- †† Snout not tubiform; parietals present; pterotic not reaching basioccipital.
- § Body enclosed in bony rings; mouth inferior.
16. *Hypostomides*.
- §§ Body naked or scaly; skeleton well ossified; a homocercal caudal fin.
- φ No suprabranchial organ; anterior rays of dorsal and anal spinous; pelvic fins abdominal, without spines, each of 7 to 9 rays.
17. *Salmoperce*.
- φφ No suprabranchial organ; a spinous dorsal; pelvic fins abdominal, each of a spine and 5 branched rays 18. *Percesoces*.
- Pectoral fin and pterygials normal 18 a. Mugiloidei.
- Pectoral fin with a lower detached portion formed of free filaments; pterygials represented by a plate attached to the edge of scapula and coracoid 18 b. Polynemoidei.
- φφφ A suprabranchial organ.
19. *Labyrinthici*.
- Fins without spines, the pelvics 6-rayed; suprabranchial organ not labyrinthic; air-bladder simple 19 a. Ophiocephaloidei.
- Fins usually with spines, each pelvic of a spine and 5 soft rays or further reduced; suprabranchial organ labyrinthic; air-bladder bifurcated posteriorly 19 b. Anabantoidei.
- §§§ Body naked or scaly; skeleton in great part cartilaginous; a homocercal caudal fin; no fin-spines.
- Pelvis represented by two separate cartilages far behind the cleithra; pectoral pterygials normal 20. *Malacichthyes*.
- Pelvis unpaired, cartilaginous, articulating above with a cartilage embraced by the cleithra; pectoral pterygials represented by a cartilaginous plate 21. *Chondrobrachii*.

§§§§ Body naked or scaly; skeleton well ossified; no homocercal caudal fin; opisthotic extending downwards to the basioccipital.

22. *Anacanthini*.

c. Physoclistic; pelvic bones embraced by or articulated to the coracoids; pelvic fins without spines, often with numerous rays; maxillary free, protractile. 23. *Allotriognathi*.

α. Body deep; skeleton well ossified; an occipital crest; lower pharyngeals toothed; post-temporal forked; an orbitosphenoid.

Frontals normal, in contact below with the mesethmoid and orbitosphenoid; ribs sessile; pelvic bones articulated to the greatly expanded coracoids; each pelvic fin of 15 to 17 rays 23 a. *Lamproidei*.

Frontals forming the lateral walls of a chamber, the floor of which is formed by cartilage containing the mesethmoid and orbitosphenoid ossifications; ribs on parapophyses; pelvic bones not articulated to the coracoids; each pelvic fin of 8 or 9 rays 23 b. *Veliferoidei*.

β. Body elongate; skeleton feebly ossified; no occipital crest; lower pharyngeals toothless; post-temporal simple.

An orbitosphenoid; epiotics meeting behind the supraoccipital; palatine and pterygoids present; neural and hæmal spines present; body ribbon-shaped 23 c. *Trachyterodei*.

No orbitosphenoid; epiotics separated by the supraoccipital; no palatine; pterygoids represented by a single small element; no neural and hæmal spines; body eel-shaped 23 d. *Stylophoroidei*.

d. Physoclistic; cranium symmetrical; an orbitosphenoid or pelvic bones directly attached to the cleithra; pelvic fins usually with more than 6 rays, the first of which may be spinous; maxillary attached proximally to a process of the palatine 24. *Berycomorphi*.

An orbitosphenoid 24 a. *Berycoidei*.

No orbitosphenoid 24 b. *Zeoidei*.

e. Physoclistic; cranium asymmetrical; pelvic bones directly attached to the cleithra; fins without spines.

25. *Heterosomata*.

f. Physoclistic; cranium symmetrical; pelvic bones directly attached to the cleithra †; each pelvic fin of a spine and 5 soft rays or still further reduced; no orbitosphenoid.

α. Post-temporal more or less distinctly forked, attached to the epiotic above and to the opisthotic or exoccipital below.

* Spinous dorsal not forming an adhesive disc.

26. *Percomorphi*.

† Except in the Trichiuridæ and Tetragonuridæ, in which the indirect attachment is assumed to be due to degeneration.

- † No bony stay for the præoperculum.
- Pelvic fins subthoracic, thoracic or jugular, each of 5 or 6 rays, the first of which is spinous; ribs, if present, normal; præmaxillaries more or less protractile; opisthotic not enlarged 26 a. Percoidei.
- Pelvic fins subthoracic or thoracic; ribs normal; præmaxillaries not protractile, typically produced and pointed; opisthotic not enlarged 26 b. Scombroidei.
- Pelvic fins thoracic; ribs expanded, forming a series of juxtaposed rings enclosing the air-bladder 26 c. Kurtoidei.
- Pelvic fins thoracic; opisthotic enlarged, extending downwards to the basioccipital. 26 d. Gobioidi.
- Pelvic fins jugular or mental, each of 1 to 4 rays, the first of which may be spinous; parasphenoid sending up a wing on each side which is joined by suture to the frontals. 26 e. Blennioidei.
- †† Third suborbital produced to or towards the præoperculum § 26 f. Scorpenoidei.
- ** Spinous dorsal modified into an adhesive disc placed on the head 27. *Discocephali*.
- β. Post-temporal simple, rod-like, directed outwards, at right angles to the horizontal, backwardly directed supra-cleithrum; cranium depressed; pterygoids reduced to a single small element united to the quadrate; ribs attached at the extremities of sessile epipleurals; an adhesive ventral disc bounded posteriorly by the post-cleithra, which meet in the middle line and are attached to the pelvis. 28. *Xenopteri*.
- γ. Post-temporal, if present as a distinct element, small, simple, sutureally united with the cranium; ribs absent; gill-openings reduced.
- * Pelvic fins, if present, subthoracic or thoracic; parietals absent 29. *Plectognathi*.
- Post-temporal distinct, sutureally united with the pterotic; supra-cleithrum vertical; pectoral pterygials not enlarged 29 a. Balistoidei.
- Post-temporal co-ossified with the pterotic; supra-cleithrum oblique or horizontal; lower three pectoral pterygials enlarged 29 b. Tetrodontoidei.
- ** Pelvic fins, if present, jugular; parietals present; pectoral pterygials elongate. 30. *Pediculati*.
- Spinous dorsal normal; epiotics separated by the supraoccipital; epipleurals present; 4 or 5 pectoral pterygials 30 a. Batrachoidei.
- Spinous dorsal, if present, modified in structure and position, the anterior rays on

§ Except in the Comephoridae, which have the skeleton feebly ossified.
Ann. & Mag. N. Hist. Ser. 8. Vol. iii. 6

the head; epiotics meeting behind the
 supraoccipital; no epipleurals; 2 or 3
 pectoral pterygials 30 *b. Lophioidei.*
 § No post-temporal; pectoral arch attached to the vertebral
 column 31. *Opisthomi.*

The synopsis given above is a modification and amplification of one which formed part of a paper on teleostean classification read to the section of Systematic Zoology of the International Zoological Congress at Boston in 1907, and which will no doubt be published at some future date.

Later on I hope to give more detailed accounts of the anatomy and classification of some of the less known groups, but within the limits of the present paper only a few brief notes on some points which need elucidation are possible.

ISOSPONDYLI.

In some external characters *Rétropinna* is intermediate between *Osmerus* and *Prototroctes*. *Rétropinna*, *Salanx*, and *Microstoma* are Argentinidæ which have no mesocoracoid. The Argentinidæ, Haplochitonidæ, and Galaxiidæ are extremely similar in osteology, dentition, and in the absence of oviducts, and are undoubtedly closely related.

It is possible to maintain the order Isospondyli, with the addition of the Haplochitonidæ and Galaxiidæ, by taking into consideration the mouth-structure, the maxillary entering the gape to a greater or less extent (almost excluded in Haplochitonidæ), and the unpaired ethmoid. As thus defined, the Haplomi, Iniomi, and Microcyprini are excluded.

The cretaceous Enchodontidæ fall into the division Stomiatoidei; they agree with the Stomiatidæ in the structure of the skull and of the mouth.

The Kneriidæ, known to me from external characters only, show considerable resemblance to the Gonorhynchidæ, and may pertain to this order.

HETEROMI.

Boulenger has pointed out that the Lipogenidæ are intermediate in fin-structure between the Halosauridæ and Notacanthidæ. These three families constitute the order Heteromi, from which I would exclude the Dercetidæ, in my opinion probably belonging to the Iniomi, and the Fierasferidæ, which are without question specialized Brotulidæ.

In skeletal characters *Halosaurus* and *Notacanthus* agree in that the orbito-rostral part of the cranium is elongate, the parietals meet, opisthotics, basisphenoid, alisphenoids, and

orbitosphenoid are absent, the parasphenoid unites with the sphenotic (post-frontal) in front of the prootic, the post-temporal is simple or ligamentous, the scapula is lamellar and imperforate, the præcaudal vertebræ have autogenous parapophyses, epineurals are present, &c.

HAPLOMI.

The Haplomi as now restricted comprise only the Umbridæ, Esocidæ, and Dalliidæ, a very primitive group agreeing with the Isospondyli in mouth-structure, but unique in the character of the paired ethmoids.

APODES.

I have defined the Apodes as lacking præmaxillaries, and I am very sceptical as to their presence in *Derichthys*. If we neglect this character, *Derichthys* is very similar to the Anguillidæ, in many of which (e. g. *Conger*) there is what may be a præmaxillary dentition distinct from that of the vomer, although there is no separate præmaxillary bone. Dr. Gill does not tell us that he dissected his specimen of *Derichthys serpentinus* in order to ascertain the limits of the præmaxillaries, and it seems not improbable that he may have inferred the presence of these bones as separate elements from the presence of a well-defined præmaxillary dentition.

The Cretaceous Anguillavidæ and Urenchelidæ have a distinct caudal fin, and small abdominal pelvic fins are present in the former.

LYOMERI.

The presence of parietals, the transverse processes ankylosed with the centra, the restricted gill-openings, &c. indicate the derivation of the Lyomeri from the Apodes and not from the Stomiatoids. The Synphobranchidæ approach them in their rather broad skull, long slender maxillaries, backwardly directed suspensorium, absence of pterygo-palatine arcade, &c.

INIOMI.

The order Iniomi includes the Aulopidæ, Synodontidæ, Odontostomidæ, Paralepidæ, Alepidosauridæ, and Myctophidæ; probably also the Rondeletiidæ and the extinct Chirothricidæ and Dercetidæ. The name Iniomi may be retained for this group, although in *Aulopus* the forked post-temporal is firmly attached to the epiotic above and the opisthotic below; this generalized type has two supra-maxillaries and shows considerable resemblance in cranial

structure to the Elopidae; the orbitosphenoid, however, is rather anomalous; it is placed far forward and forms an interorbital septum extending from the parasphenoid to the frontals, whilst posteriorly paired inferior ridges of the frontals separate it from the alisphenoids. The protractile præmaxillaries exclude the maxillaries from the oral border, and this feature distinguishes *Aulopus* from all Isospondyli. In Iniomi other than the Aulopidae the post-temporals nearly meet in the middle line above the supraoccipital, but are attached by ligament to the epiotics, the maxillaries may become reduced and closely attached to the præmaxillaries, the orbitosphenoid tends to disappear, and the parietals may become separated by the supraoccipital (Myctophidae).

MICROCYPRINI.

The order Microcyprini includes the Cyprinodontidae and Amblyopsidae, usually considered to be allied to the Esocidae, which they resemble in fin-structure.

THORACOSTEI.

The order Thoracostei comprises the Gastrosteidae and Aulorhynchidae. Swinnerton* has shown that the dermal plate which appears as part of the coracoid is in reality a distinct element. I cannot accept Jungersen's view that these fishes belong to the Scorpænoidei, although I readily admit that the Aulostomoids are more distinct from the Thoracostei than I recently considered them to be.

SOLENICHTHYES.

In a valuable memoir Jungersen † has pointed out the features which show that the Aulostomoids, Centriscoids, and Lophobranchii form a natural group, to which the ordinal name Solenichthyes, recently proposed by me for the Centriscoids only, may be applied.

HYPOSTOMIDES.

The Pegasidae show certain resemblances to the Scorpænoidei Agonidae and Dactylopteridae, but they also exhibit some important differences from them, especially in the truly abdominal pelvic fins.

SALMOPERCÆ.

I am unable to find a pneumatic duct in the Percopsidae, which have hitherto been said to be physostomous. The

* Quart. Journ. Micr. Sci. xlix. 1905, p. 363.

† Vidensk. Selsk. Skr. (7) vi. 1908, p. 41.

Aphredoderidæ are precisely similar to them in their anatomy, and these two closely related families constitute the order Salmopercæ.

LABYRINTHICI.

The suborder Anabantoidei comprises the Luciocephalidæ and Anabantidæ, the latter including the Osphromenidæ, which I am unable to recognize even as a distinct family, although Boulenger has widely separated them from the Anabantoids.

MALACICHTHYES.

The order Malacichthyes is equal to the family Icosteidæ, i. e. *Icosteus* and *Acrotus**, of very uncertain relationships.

CHONDROBRACHII.

This order comprises the Ateleopidæ, a very remarkable and isolated group of fishes.

PERCOMORPHI.

In some members of this order the lower fork of the post-temporal is very short (e. g. *Acanthuridæ*), in others the upper limb may be expanded and suturally united to the skull (*Agonidæ*, *Triglidæ*); further, the interspaces between it and the lower limb may be filled in by osseous laminæ, so that the post-temporal may form an integral part of the skull (e. g. *Callionymus*).

Of the suborders of the Percomorphi the Percoidæ is by far the largest, and its classification is a matter of some difficulty. It is equivalent to Boulenger's Perciformes, after the exclusion of the Berycoids and Osphromenidæ, with the addition of the Stromateidæ, Tetragonuridæ, Carangidæ, Rhachicentridæ, Coryphænidæ, Bramidæ, Menidæ, Percophiidæ, Ammodytidæ, Trachinidæ, Champsodontidæ, Leptoscopidæ, Uranoscopidæ, Parapercidæ, Trichonotidæ, Nototheniidæ, Callionymidæ, and Agriopidæ.

Hitherto the indirect attachment of the pelvic bones to the cleithra has usually been regarded as a primitive feature, but it is difficult to see why this should always be so. It is scarcely open to question that the ligamentous connexion between the post-temporal and the epiotic in *Synodus* is derived from a direct attachment, as seen in *Aulopus*. If the pelvic fins can migrate backwards from a thoracic to a sub-abdominal position by elongation of the pelvic bones, which

* I have examined the type of *Icichthys lockingtoni*, which is a species of *Centrolophus*.

seems to have happened in the Cirrhitiformes, why should they not do so by elongation of the ligament which binds the pelvic bones to the cleithra? In the cases of the Stromateidæ and Tetragonuridæ and of the Gempylidæ and Trichiuridæ it is in the more specialized and degenerate forms that the pelvic bones are attached to the cleithra by a rather long ligament. In the Labyrinthici and Berycomorphi it is quite different; in each of these the forms with the pelvic bones remote from the cleithra (*Ophiocephalus*, *Polymixia*) are the more generalized, differing from the rest in that the pelvic fins are composed of articulated rays only.

The suborder Scombroidei includes the divisions Trichiuriformes, Scombriformes, Luvariformes, and Xiphiiformes; a more detailed account of this group is given in a separate paper.

XENOPTERI.

I am quite in agreement with Dr. Gill as to the ordinal distinctness of the Gobiesocidæ, and I am unable to appreciate their supposed close relationship to the Callionymidæ; the latter are not very different from the Parapercidæ and Nototheniidæ.

PLECTOGNATHI.

The bones named parietals in my memoir on this group may include those elements, but should preferably be termed epiotics.

Bibliography.

The following deal with the classification of Teleostean Fishes in general; the numerous memoirs dealing with the anatomy and classification of particular groups are not included:—

- (1) COPE. "Observations on the Systematic Relations of the Fishes," Proc. Amer. Assoc. xx. 1871, p. 317.
- (2) GÜNTHER. Introduction to the Study of Fishes (1880).
- (3) COPE. "Synopsis of the Families of Vertebrata," Amer. Nat. xxiii. 1889, p. 274.
- (4) SMITH WOODWARD. Catalogue of Fossil Fishes (1889-1901).
- (5) GILL. "Families and Subfamilies of Fishes," Mem. Ac. Washington, vi. 1893, p. 127.
- (6) GOODE and BEAN. Oceanic Ichthyology (1896).
- (7) JORDAN and EVERMANN. Fishes of North and Middle America (1896-1900).
- (8) BOULENGER. Cambridge Natural History, Fishes (1904).
- (9) JORDAN. Guide to the Study of Fishes (1905).
- (10) GREGORY. "The Orders of Teleostomous Fishes," Ann. Ac. N. York, xvii. 1907, p. 437.