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MEMOIRS

OF THE

CARNEGIE MUSEUM.

Vol. VI.

No. 5.

CATALOG OF THE FOSSIL FISHES IN THE CARNEGIE MUSEUM.
PART II. SUPPLEMENT TO THE CATALOG OF FISHES FROM THE
UPPER EOCENE OF MONTE BOLCA.

By C. R. EASTMAN.

(Plates XLIII-XLVIIA).

When, in the spring of the year 1910, a systematic investigation of the fossil fishes in the Carnegie Museum was undertaken by the present writer on the initiative of the Director, Dr. W. J. Holland, attention was first directed to the remarkably fine series of specimens from the Upper Eocene of Monte Bolca, near Verona, in northern Italy. What was then supposed to be the entire suite of material belonging to the Museum passed through the writer's hands, for the purpose of being identified, labeled, cataloged, and in part exhibited. This done, an account of the collection of Bolca fishes, illustrated by a number of plates, was published in the Fourth Volume of the Memoirs of the Carnegie Museum.¹

Subsequently it was fortunately discovered that the paleichthyological resources of the Museum were greater than had been supposed. The discovery was made by Mr. O. A. Peterson, who in re-arranging a large quantity of paleontological material in storage, came across a case of fossils marked "Bayet Collection." This box was found to contain a number of unusually well preserved specimens of fishes from Monte Bolca, some of them having already served the purpose of illustrating the Veronese fauna in an earlier publication, and therefore ranking as hypotypes.² It can be confidently affirmed without exaggeration that in point

¹ "Catalog of Fossil Fishes in the Carnegie Museum, Part 1. Fishes from the Upper Eocene of Monte Bolca." Memoirs Carnegie Museum, Vol. IV, 1911, No. 7.

² Three such original exemplars, namely, *Amphistium paradoxum*, *Ephippus rhombeus*, and *Rhombus minimus*, were figured by A. B. Massalongo in his Memoir entitled *Specimen Photographicum Animalium quorundam Plantarumque Fossilium Agri Veronensis, etc.*, Verona, 1859.

of excellence of preservation, one of these hypotypes, that catalogued as No. 5305, is unsurpassed by any fossil fish from this locality which has thus far been brought to light. The following pages are supplementary to Part I of the Catalog of Fossil Fishes from Monte Bolca in the Carnegie Museum.

Subclass ELASMOBRANCHII.

Family TRYGONIDÆ.

1. *Trygon muricata* (Volta).

(Plate XLIII).

1796. *Raja muricata* G. S. Volta, Ittiolit. Beronese, p. 37, pl. ix, figs. 1, 2.
 1818. *Trygonobatis vulgaris* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., xxvii, p. 336.
 1835. *Trygon gazzolæ* L. Agassiz, Neues Jahrb., p. 247.
 1843. *Trygon gazzolæ* L. Agassiz, Poiss. Foss., Vol. III, p. 382.
 1862. *Alexandrinum* sp. R. Molin, Sitzungsber. Akad. Wiss. Wien, Vol. XLII, p. 579.
 1874. *Alexandrinum molinii* A. de Zigno, Mem. R. Istit. Veneto, Vol. XVIII, p. 289, Pl. XII.
 1874. *Trygon gazzolæ* A. de Zigno, l. c., p. 180.
 1894. *Trygon (Tæniura) muricata* O. Jaekel, "Die eocänen Selachier vom Monte Bolca," p. 142, pl. iv, fig. 32.
 1904. *Trygon muricatus* C. R. Eastman, Bull. Mus. Comp. Zoöl., Vol. XLVI, p. 23.
 1905. *Trygon muricatus* C. R. Eastman, Mém. Soc. Géol. France, Vol. XIII, No. 34, p. 8.
 1911. *Trygon muricata* C. R. Eastman, Mem. Carnegie Mus., Vol. IV, No. 7, p. 352.
Type.—Nearly complete skeleton; Paris Museum of Natural History.

Two well-preserved examples of this species are figured by Jaekel in his monograph on Eocene Selachians from Monte Bolca, one of which had previously been made the type of a separate genus and species, the so-called *Alexandrinum molinii* of Baron A. de Zigno. The second of Jaekel's originals was erroneously stated by that author to have been the identical specimen which is shown in Plate IX, Fig. 1, of Volta's work. In point of fact, however, Volta's type-specimens are preserved in the Paris Museum of Natural History, and were there studied by the present writer some ten years ago.

The sole character by which the genus *Alexandrinum* is said to be distinguished

from *Trygon* relates to the more distal position of the caudal spine, which arises at a distance behind the pelvic arch about equal to the maximum width of the disc. Jaekel in his memoir above referred to rightly holds that this does not constitute a valid differential character, for examination of a number of specimens shows that the relative position of the caudal sting is about the same in all.

Two examples of this Eocene ray are contained in the Bayet Collection of the Carnegie Museum, one small and preserved in counterpart, the other a beautiful specimen, larger than the type, and showing many structural details in great perfection. The small, evidently immature individual, is cataloged as No. 4521 +4521a, and the larger adult specimen bears the Catalog No. 4304. An illustration of the latter is shown in Plate XLIII. In this the various cartilages of the head, especially those about the mouth and scapular arch, and of those forming the axes of the pectoral fins, are clearly visible, and a number of small teeth, of the characteristic *Trygon*-type, are also seen to be attached to the palato-quadrate cartilage. An impression is preserved of the body-walls of the trunk on either side of the vertebral columns as far as the point of insertion of the caudal spine. The latter displays a median dorsal groove, bears a double series of strong posterior denticles, and has a total length of about 9 cm.

Subclass TELEOSTEI.

Order SOLENICHTHYES.

This ordinal term, first proposed by Dr. C. T. Regan for the Centriscoids only, and afterwards (in 1909) extended so far as to include the Aulostomids and Lophobranchs, marks the present-day conception of the evolutionary history of that group of physoclistous fishes with abdominal ventrals, of which the sticklebacks form the well-known ground-type.

The Gasterosteids and their immediate allies were first united by Cope in 1887 under the comprehensive designation of Hemibranchii, and the limits of this suborder were enlarged by A. Smith Woodward in 1901 to include also the Lophobranchs of Cuvier, pursuant to the view of Kner and Steindachner (1863) that these are only extremely specialized sticklebacks with tufted gills. For this same association of Lophobranchs and Hemibranchs the new name of Thoracostei was proposed by Swinnerton in 1902, and that of Pthinobranchii was suggested for it by O. P. Hay at about the same time. Boulenger, in 1904, having attempted to show that the Lamprididæ are related to the Hemibranchs, defined the enlarged suborder which he called "Catosteomi" as consisting of the forms just named, together

with the Lophobranchs of Cuvier, and the family Pegasidæ, whose position in the system was admitted to be still somewhat doubtful.

In 1903 appeared an important paper by C. E. Starks³ on the Osteology of the Hemibranchiate Fishes, in which he discussed the arrangement of families belonging to this division in the sense originally proposed by Cope, and calls attention to the fact that "Dr. Gill has pointed out how the tube-mouthed forms have descended in an unbroken line from *Gasterosteus* through *Spinachia* and the family Aulorhynchidæ, these constituting the superfamily Gasterostoidea" (*l. c.*, p. 622). The Danish writer H. F. E. Jungersen published in 1908 a valuable memoir, in which it was shown that the features of the Aulostomids, Centriscoids, and Lophobranchii are such as to compel us to regard these divisions as constituting a natural group. This view was supported by Regan in two papers published by him during the years 1909 and 1910, the final arrangement of families advocated by him being as follows:

Order THORACOSTEI Swinnerton.

"The order Thoracostei comprises the Gasterosteidæ and Aulorhynchidæ. Swinnerton⁴ 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 Scorpenoidea, although I readily admit that the Aulostomids are more distinct from the Thoracostei than I recently considered them to be."⁵

Order SOLENICHTHYES Regan.

Under this caption are included by Regan the Aulostomids, Centriscoids, and Lophobranchs, whose features show that they form a natural group.

A few words may be said regarding the constitution of these orders, Thoracostei and Solenichthyes. Under the first-named are now placed by Regan only the Gasterosteidæ and the Aulorhynchidæ, in which procedure he follows the example of Gill and Starks in their earlier arrangement of modern genera of sticklebacks. As early as 1871 the former of these writers had associated the families Aulorhynchidæ and Gasterosteidæ in a single division contrasting with the Aulostomids and Centriscoids, and in a subsequent review of the forms of the order in 1884 he remarks pointedly as follows:⁶ "Far from being able to see any close affinity between

³ The Shoulder-Girdle and Characteristic Osteology of the Hemibranchiate Fishes. Proc. U. S. Nat. Mus. (1903), Vol. XXV, p. 619.

⁴ Quart. Journ. Micr. Sci., XLIX, 1905, p. 363.

⁵ Ann. Mag. Nat. Hist., 1909 (8), Vol. III, p. 84.

⁶ Gill, T. N., "On the mutual relations of the Hemibranch Fishes." Proc. Acad. Nat. Sci. Phila., 1884, p. 155.

the Aulorhynchidæ and Aulostomidæ, I am unable to appreciate any very distinctive differences from the Gasterosteidæ, and the clear affinity between *Aulorhynchus* and *Spinachia* is such that I regard the family Aulorhynchidæ simply as a convenient one at the most, and as expressing the culmination in one direction of the tendency characteristic of the order. I should be scarcely disinclined to dissent from any one who should combine the Gasterosteidæ and Aulorhynchidæ in one family."

Starks' views on the same subject are thus stated:

"*Gasterosteus* and closely related genera are the most generalized of the Hemibranchs. They are the only ones in the group having the following typical characters: Anterior vertebræ unmodified; suspensorium and mouth normal; ribs typical; post-temporal approaching the normally forked condition, and parietals present (the last a superfamily character).

"Dr. Gill has pointed out how the tube-mouthed forms have descended in an unbroken line from *Gasterosteus* through *Spinachia* and the family Aulorhynchidæ, these constituting the superfamily Gasterostoidea.

"The Gasterosteidæ and Aulorhynchidæ should perhaps be regarded as a single family, but following the lead of the above authority, they are here kept separate, though the latter family is regarded 'simply as a convenient one at the most' " (*l. c.*, p. 622).

Boulenger, in the Volume on Fishes in the Cambridge Natural History (1904), subscribes to a similar opinion. He writes:

"The genera *Aulorhynchus* and *Auliscus*, each with one species from the North Pacific, much resemble *Spinachia* in outward form and in the equal size of the anterior vertebræ, but the snout is still more produced, tubiform, and the ventral fins are formed of one spine and four soft rays. The difference which justifies their separation as a distinct family resides in the disposition of the ribs, which are flattened and anchylosed to the lateral bony shields" (p. 631).

According to the writer just quoted the extinct genus *Protaulopsis*, from the Upper Eocene of Monte Bolca, does not properly belong to the group of sticklebacks, as suggested by A. Smith Woodward, but should be associated with the Scombresocidæ. Another fossil genus, *Protosyngnathus*, from the fresh-water Tertiary of Padang, Sumatra, is made by Boulenger the type of a new family, and regarded as intermediate in position between sticklebacks and the Aulostomid division of Solenichthyes. It agrees with the former group, writes this author, "in possessing slender, free ribs, and with the latter in having the first vertebræ elongate, though to a less degree than in *Aulostoma*."

As for the constitution of the order Solenichthyes, this is made by Regan in his later publications to comprise the Aulostomids, Centriscoids, and the old Cuvierian group of Lophobranchii, or specialized sticklebacks with "tufted" gills. The family Pegasidæ is admitted by Boulenger into the same association with the foregoing, but is excluded from this order by Regan and placed in a group by themselves (order Hypostomides).

We have now to consider the position of two fossil forms, concerning which there is some difference of opinion. These are the genera *Urosphen* and *Rhamphosus* of Agassiz, both from the Eocene of Monte Bolca. They were both referred to the flute-mouths (Fistulariida) by Dr. Günther, but, as recognized by Dr. Gill, and following him A. Smith Woodward, "one of them is more nearly related to the Macrorhamphosidæ and Gasterosteidæ." For the one in question the new family Rhamphosidæ was established by Gill to contain it, and *Urosphen* was also made the type of an independent family. The two new families proposed by Gill in 1884 are thus defined by him:

UROSPHENIDÆ.

Hemibranchs with the first four vertebræ much elongated, a moderately elongated body, a long tubiform mouth (ventrals abdominal?, dorsal unknown), and a very large cuneiform caudal.

RHAMPHOSIDÆ.

Hemibranchs with the anterior vertebræ normal (not elongated) and separate, about twenty-two (eight abdominal and fourteen caudal) vertebræ in all, plates on the nape and shoulders only, with a tubiform mouth, subthoracic ventrals, a dorsal spine behind the nuchal armature, and the second dorsal and anal far behind and opposite.

Regarding *Urosphen*, it may be recalled that Agassiz himself recognized its intermediate position between the Aulostomids and Fistulariids. Unlike the former, *Urosphen* is scaleless, and small teeth are present in the jaws. From *Fistularia* it is distinguished chiefly by the form of the very large cuneiform caudal fin, but in other respects approaches very closely to that genus. In grouping it provisionally with recent flute-mouths, A. Smith Woodward gives the following tabulation:

SYNOPSIS OF GENERA.

No free dorsal spines; caudal fin forked, with elongated median rays; no scales.....	<i>Fistularia</i> .
A series of free dorsal spines; caudal fin rhombic, without elongated ray; small ctenoid scales present.....	<i>Aulostoma</i> .
Imperfectly known, but all caudal fin-rays much elongated; no scales.....	<i>Urosphen</i> .

There remains to be considered the genus *Rhamphosus*, which is placed by A. Smith Woodward among the Centriscidae, and made by Gill the type of an independent family. Only two species are known, *R. rastrum* (Volta) and *R. biserratus* Bassani, both from the Eocene of Monte Bolca and both very rare. Nearly all writers who have noticed this genus have recognized its close agreement in the majority of structural characters with the modern *Centriscus* and *Amphisile*, as these terms are commonly used (not, however, in the sense employed by Jordan and Gilbert, Proc. U. S. Nat. Mus., 1883, Vol. V., p. 575). The differences which it presents were pointed out in the first instance by Agassiz, with the exception of one very important feature. He failed to emphasize the fact that in the fossil form the mouth is not borne at the end of an elongate, tubiform snout. And yet, at the very close of his diagnosis of the genus he writes: "Les mâchoires s'ouvrent peu et sont placées immédiatement au dessous de l'orbite."

This observation of Agassiz, which is undoubtedly correct, appears to have been overlooked by subsequent writers, all of whom ascribed to *Rhamphosus*, either directly or by implication, a character which it does not possess, namely, that of having a "snout produced in a long tube, with small, terminal, toothless mouth." In reality the condition is very different from that which is common throughout the order, and resembles that occurring in modern sword- and sail-fishes, or in the extinct *Aspidorhynchus*, *Hemirhynchus*, *Blochius*, &c., where the snout is produced in a sharp, spear-like rostrum. These are all forms in which a prominent beak results from a forward extension of the upper jaw only, but a parallel modification is found in the "Half-Beaks" or Hemiramphs, in which it is the lower jaw only that is produced. A still different modification is that observed in the African family of Mormyrids, where the pore-like mouth is at the extremity of a long, tapering proboscis. Regarding the latter group the following remark by Boulenger is of interest to us in the present connection:

"Some species of *Mormyrops* show how a form like *Gymnarchus* may have evolved out of a more typically-formed fish. Nothing is more striking than the variation in the shape of the snout within one and the same genus, and the names given to some of the species (*ovis*, *caballus*, *elephas*, *tamandua*, *numenius*, *ibis*) are suggestive of resemblance with the heads of various animals." (Cambridge Natural History, Fishes, p. 550.) Similar modifications of the snout are to be observed in the family Gymnotidæ.

Just as a series of stages in the formation of a tubiform snout can be traced in the sticklebacks leading from *Gasterosteus* through *Aulorhynchus* up to the flutemouths, so in the same manner a series is traceable from the non-elongate snout of

Gymnarchus, through *Mormyrus*, up to the extremely specialized organ of *Gnathonemus*. Progressive stages in the elongation of the rostrum in scombroid fishes have been pointed out by Regan. The structural changes which have attended the formation of a beak are illustrated in the following diagrams:

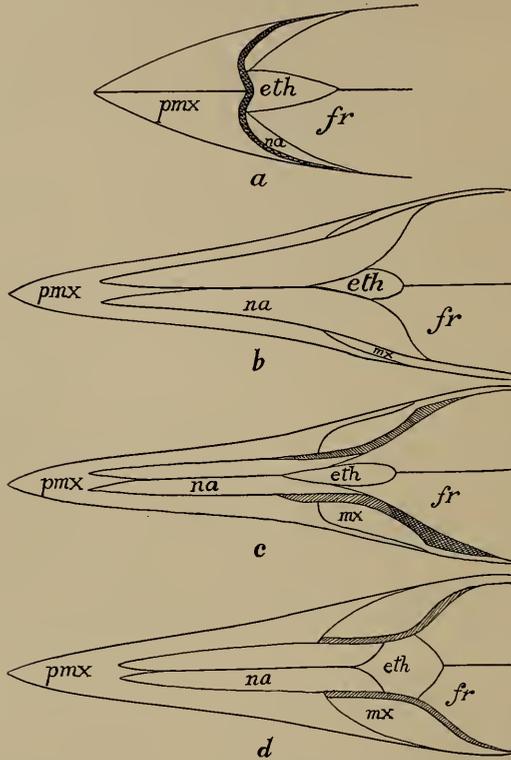


FIG. 1. Diagram showing the structure of the rostrum in *Acanthocybium* (a), *Histiophorus* (b), *Xiphias* (c), and *Xiphiorhynchus* (d). pmx, præmaxillary; mx, maxillary; na, nasal; eth, ethmoid; fr, frontal. (After C. T. Regan, Ann. & Mag. Nat. Hist. (8), Vol. III, 1909, p. 73).

No attempt has ever been made, so far as the present writer is aware, to explain by what means or processes the gradual formation of a rostral beak has been brought about. An interesting theory, however, has been advanced by Dr. Gregory to explain the progressive elongation of the pre-orbital region in the Syngnathidæ to form a tubiform snout with terminal jaws. The explanation given is as follows:

"The taste for minute prey to be sought by poking about in odd corners may have determined some of the peculiar specialization of the Sea-horse order. We may imagine these to have continually sought smaller and smaller food until the tiny particles came to be sucked up by the elongate muzzle. After probably passing through a stage somewhat like *Syngnathus*, but less eel-like, the ancestral Sea-horse did not need the quick-darting form of the body to capture its food or to escape enemies; hence the fan-like tail was suppressed (in *Hippocampus*), and the rapidly vibrating pectoral and dorsal fins enabled the fish to poise, humming-bird fashion, while sucking food through the tubular beak." (Ann. N. Y. Acad. Sci., Vol. XVII, 1907, p. 495).

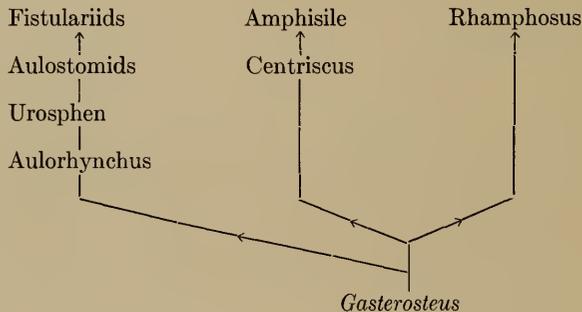
Without proceeding further into the question of origins, we wish to lay stress on the fact that among sticklebacks two distinct lines of specialization are traceable as regards the conformation of the region between the orbit and the mouth. Progressive modification in one direction leads to the pushing forward of this whole region, the jaw parts being carried along in this facial elongation and the mouth retaining its terminal position. An evolutionary series of Gasterosteiformes, showing gradual transformation with respect to these characters, was first worked out by Dr. Theodore N. Gill. And it is to be noted that at the same time that the snout was becoming elongated into a slender tube, scales over the body were becoming progressively superseded by dermal armor. The armament is first indicated in the form of bony scutes arranged in rows along the back and flanks, and finally culminates in the cuirass of *Amphisila*, which is fused with the enlarged ribs and other portions of the endoskeleton (*cf.* Gregory, *l. c.*, p. 493).

The second line of progressive modification culminates in the formation of a rostral beak recalling that found in certain Xiphiiformes (*Histiophorus*, *Blochius*, etc.), though the mouth is situated ventrally and but little in advance of the orbits. This series may also be supposed to begin with *Gasterosteus* or its immediate prototype, and leads through stages which are not recorded in paleontology up to the longirostrate type of which *Rhamphosus* is the only known example.

Now the interesting thing to note is that this second evolutionary series is not only specialized in the direction of acquiring a sword-like rostrum, but it also exhibits the unfolding of characters which are progressively displayed in the parallel evolutionary series. For convenience we may distinguish these as (1) the tube-snout, and (2), the rostrate series, both having *Gasterosteus* as a common starting-point.

The evolutionary changes that have taken place appear to have proceeded in the following manner. A generalized or "synthetic type," to use Agassiz's phrase,

contains within itself certain potentialities of continuous variation. It is charged, so to speak, with a complex of latent characteristics. One set of these is that which terminates in an elongated tubiform snout, the other in the development of a peculiar kind of dermal armor, including a long and slender dorsal fin-spine. In the tube-snout evolutionary series the gradual elaboration of these two sets of characters, which may be supposed to be resident potentially in *Gasterosteus*, goes hand in hand; and thus we find that *Centriscus* has both a tubular snout and is provided with dermal armor and a well-developed dorsal fin-spine. But in the rostrate series one of these sets of characters is suppressed, no tubular snout being developed. The second group of characters which was potentially present in *Gasterosteus* is developed in precisely the same fashion as in the Centriscoids, with the result that in *Rhamphosus* we find a body-armor paralleling that in *Centriscus*, and a remarkably similar dorsal fin-spine. The divergence in forms with reference to the splitting up of the original complex of characters might be illustrated by the following scheme:



Family RHAMPHOSIDÆ Gill (*emend.*).

Solenichthyes with *Gasterosteus*-like form of body, the anterior vertebræ discrete and not elongated, about twenty-two (eight abdominal and eighteen caudal) vertebræ in all; dermal plates on the nape and shoulder-region only; a single, elongate dorsal spine arising from the hinder end of the nuchal armature. Mouth small, and placed as in *Gasterosteus*, but the upper portion of the head produced in an elongate rostrum. Ventral fins subthoracic, the second dorsal and anal remote and opposite.

2. *Rhamphosus rastrum* (Volta).

(Pl. XLIV, Figs. 1-3).

1796. *Uranoscopus rastrum* G. S. Volta, Ittiolit. Veronese, p. 22, pl. V, fig. 4.

1796. *Centriscus* G. S. Volta, *ibid.*, pl. LXXV, fig. 1 (*errore*).

1818. *Centriscus aculeatus* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 339.
1835. *Rhamphosus aculeatus* L. Agassiz, Neues Jahrb., p. 291 (name only).
- 1839-42. *Rhamphosus aculeatus* L. Agassiz, Poiss., Foss. Vol. IV, p. 270, pl. XXXII, fig. 7.
1888. *Rhamphosus aculeatus* L. Vaillant, Expéd. Scient. Travailleux et Talisman, Poissons, p. 339.
1898. *Rhamphosus aculeatus* F. Bassani, Palæontogr. Italica, Vol. III, p. 82; pl. IX, fig. 4.
1901. *Rhamphosus aculeatus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Part IV, p. 378.
1905. *Rhamphosus rastrum* C. R. Eastman, Mém. Soc. Géol. France, No. 34, p. 20.
1911. *Rhamphosus aculeatus* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 362.

Type.—Nearly complete skeleton; Paris Museum of Natural History.

The genotype, which attains a length of about 14 cm. Maximum depth of body occurring in about the region of the pectoral arch, behind which the trunk is slender and gradually tapering. Distance between the orbit and extremity of the elongated rostrum equal to that between the orbit and origin of the second dorsal fin, and equalling also the length of the single dorsal spine. The latter is slender, acuminate, nearly rectilinear, and posteriorly denticulated. The beak also bears a series of minute denticles. Dorsal and anal fins equal and directly opposed, each with nine rays, and caudal with sixteen rays. Scales very minute, having the form of dermal granulations or papillæ.

This is an extremely rare form, only two examples being found in the Paris Museum and a small imperfect one in the British Museum. One fully grown and three immature individuals are contained in the collection of the Carnegie Museum, being cataloged as follows: 5328, 5310 + 5310a, 5312, and 4213 + 4213a. Two of these are figured in the accompanying plates.

Family UROSPHENIDÆ Gill.

Solenichthyes with the first four vertebræ much elongate, a moderately elongated and slender body, a long tubiform snout with terminal mouth, second dorsal and anal remote, similar and opposite, caudal fin relatively large, vertebræ between fifty and sixty in number; scales absent.

Genus UROSPHEN Agassiz.

No new characters can be added to the generic diagnosis of this genus, but a further study of one nearly complete skeleton in the collection warrants the establishment of a new species, the description of which immediately follows.

3. *Urosphen attenuata* sp. nov.

1911. *Urosphen dubia* Eastman, Mem. Carnegie Museum, Vol. IV, No. 7, p. 361, Pl. XCVI, fig. 2.

Type.—Nearly complete fish; Carnegie Museum (Cat. No. 4499).

A small species attaining a length of about 20 cm. having about the same proportions as the type of *U. dubia*, but more vertically compressed, and differing in the conformation of the caudal fin. This is intermediate in character between the caudal fin of *U. dubia*, which is cuneiform with all of the rays gradually increasing in elongation above and below axially, or medianwards, and that of *Fistulariids* in which two axial rays are excessively elongated. The neural and hæmal spines of the last vertebral centrum are expanded into fan-shaped laminae medially



FIG. 2. Tail of *Urosphen attenuata* Eastman. $\times \frac{1}{2}$. C. M. Cat. Foss. Fishes, No. 4499.

in contact and together forming a urostyle,⁷ which supports in all six slender, greatly elongated and closely apposed caudal fin rays, half the number being epiaxial and half hypaxial (see Fig. 2).

In addition, a series of ten short rays, increasing gradually in length from the anteriormost onwards until about the fifth, after which all are of uniform length, arise from the dorsal and ventral margins at the posterior extremity of the body, being supported by the neural and hæmal spines of the last five vertebræ. The dorsal and anal fins are remote, similar, and opposite, the former with eighteen rays, and the latter with twenty. The trunk and head are vertically much compressed, and the small, terminal mouth is provided with minute conical teeth. In the type-specimen the undigested skeletal remains of a small teleost are seen in the forward part of the intestinal tract. The holotype has already been figured in the Memoirs (1911) under the name of *U. dubia*.

⁷ Reference may be made here to the writings of R. H. Whitehouse (Proc. Roy. Soc., Vol. 72 B, 1909, p. 139), and C. T. Regan (Ann. Mag. Nat. Hist., (8) Vol. V, 1910, p. 531) on the caudal fin of Clupeoids, and the Teleostean urostyle.

The last-named author remarks (*l. c.*, p. 533):

"A comparative study leaves no room for doubt that in many cases the urostyle is merely the result of ankylosis of the uroneurals and that centra take little or no part in its formation, and I do not think that there are any fishes in which a urostyle has been formed simply by ankylosis of posterior centra; but that is a matter which requires further investigation."

Order BERYCOMORPHI.

The view is commonly entertained that the fishes belonging to this order are very generalized, as is shown by such characters as the large number of pelvic fin-rays, and the persistence of the pneumatic duct in certain genera, as well as the widespread distribution and importance of the group so long ago as the Cretaceous. The family Berycidae is represented in the Upper Eocene fauna of Monte Bolca by two genera, *Holocentrum* and *Myripristis*, remains of which are not uncommon. The typical species of these genera, which are represented in the collections of the Museum, have already been considered in the Catalog of Fossil Fishes published in Volume IV of the Memoirs of this institution.

Order HETEROSOMATA.

Physoclistic Teleosts with asymmetrical cranium and strongly compressed body, the precaudal region short; pelvic bones directly attached to the cleithra (clavicles); fins without spines.

The Heterosomata, or Flat-fishes, are to be regarded as aberrant, strongly compressed Perciformes or a derivative from that stock, instead of being asymmetrical Gadoids, as was formerly supposed. They differ from all other fishes in having an asymmetrical cranium; both eyes are on one side in the adult, this side being uppermost and pigmented, whilst the lower or eyeless side is usually devoid of pigment.

Boulenger has expressed the view that the Upper Eocene genus *Amphistium* is allied to the symmetrical ancestor of the flat-fishes, and this opinion is also shared by Regan, who, however, regards *Amphistium* as a Percoid not far removed from *Platax*, and approaching in some respects to the existing *Psettus*. As true Soles accompany *Amphistium* in the Upper Eocene, the ancestral form from which flat-fishes are derived must have been evolved at a still earlier period. Valuable descriptions and figures of the crania in flat-fishes were published by Traquair⁸ in 1865, and various classificatory schemes have been proposed for the group by recent writers.⁹

Suborder PLEURONECTOIDEA.

Dorsal fin extending forward on the head at least to above the eye; all the fin-rays articulated, each pelvic fin of six or fewer rays. No supramaxillary bone; no palatine teeth; lower edge of urohyal deeply emarginate, so that the bone appears

⁸ Trans. Linn. Soc., Vol. XXV, 1865, pp. 263-296.

⁹ Kyle, H. M., Rept. Fisheries Board Scotland, Vol. XVIII, 1900, pp. 335-368.—Boulenger, G. A., Cambridge Natural History, Fishes, 1904.—Regan, C. T., Origin and Evolution of the Teleostean Fishes of the order Heterosomata. Ann. Mag. Nat. Hist., (8), Vol. VI, 1910, pp. 484-496.

forked. On each side is a single postcleithrum or none. Vertebræ never fewer than twenty-eight (9+19).

Jordan and Evermann, in their Catalogue of North American Fishes, recognize only the two families, Pleuronectidæ and Soleidæ, but in the more recent scheme of Regan there is considerable further subdivision. Among fossil forms, *Solea* proper first appears in the Lower Miocene, and a species commonly assigned to "Rhombus" (in the Cuvierian sense) is present already in the Upper Eocene. The term *Rhombus* was, however, applied in 1800 by Lacépède to a genus of Butterfishes, or seven years before its employment by Cuvier for the turbot; hence modern usage requires it to be replaced among flat-fishes by the term *Bothus*, proposed in 1810 by Rafinesque.

Not all of the characters pertaining to the recent *Bothus* can be observed in the Eocene forms, and in particular, fewer vertebræ are present in the latter, the number being not more than nine abdominal and nineteen caudal. Hence it is desirable to designate the fossil species commonly referred to "*Rhombus*" by a new generic name. The term *Eobothus* may be conveniently employed for this purpose.

EOBOTHUS, nom. nov.

In general like the existing *Bothus*, but with not more than nine abdominal and nineteen caudal vertebræ. Mouth wide, the jaws and dentition being nearly equally developed on both sides; a narrow band of minute, conical teeth on the margin of the jaws. Abdominal vertebræ with broad transverse processes and very small, delicate ribs; epi- and hypaxial spines at base of caudal fin somewhat expanded, but not fused together into laminar plates. Both pairs of fins present; dorsal arising just over the eye; caudal fins separate, rounded behind. Scales small and thin, showing under the lens very fine parallel, more or less longitudinal or obliquely directed striæ.

4. *Eobothus minimus* (Agassiz).

(Pl. XLV, Figs. 1-2).

1796. *Pleuronectes quadratulus* G. S. Volta, Ittiolit. Veronese, p. 260, pl. LXIII, fig. 3 (*errore*).
1835. *Rhombus minimus* L. Agassiz, Neues Jahrb., p. 301 (name only).
- 1839-42. *Rhombus minimus* L. Agassiz, Poiss. Foss., Vol. IV, p. 289, pl. XXXIV, fig. 1.
1859. *Rhombus minimus* A. B. Massalongo, Specimen Photogr. Anim. Foss. Agr. Veron., p. 36, pl. XIII, fig. 1.

1901. *Rhombus minimus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., pt. IV, p. 607.

1911. *Rhombus minimus* C. R. Eastman, Mem. Car. Mus., Vol. IV, p. 383.

Type.—Nearly complete fish; Paleontological Museum, Munich.

"A very small species, attaining a length of about 10 cm. Length of head with opercular apparatus contained two and a half times in the length from the pectoral arch to the base of the caudal fin; maximum depth of trunk about four-fifths of latter measure. Vertebræ ten to twelve in the abdominal, twenty in the caudal region. Dorsal and anal fins deepest in their middle portion, the former with about sixty-five, the latter with about forty-five rays; both these fins terminating very close to the caudal, which comprises seventeen to nineteen rays. Small scales well developed, apparently cycloid" (A. S. Woodward).

Two additional examples of this early species of flat-fish, both of them beautifully preserved, have been found in the material belonging to the Carnegie Museum. These bear the catalog numbers 5313, and 5314 + 5314a. Affixed to the former of these is an original label in unknown handwriting, stating that this is the original specimen figured by Massalongo in Plate XIII, fig. 1, of the Memoir published by him in 1859.

These specimens are remarkable for the distinctness with which nearly all of the fine structural characters are displayed, and yet little can be added to the full and accurate description of the skeleton as given by Agassiz in his "Recherches." This author gives a table showing the arrangement of supports for the dorsal and anal fins with reference to the neural and hæmal spines. Some variation is to be noted in this respect, and one observes also that as a rule the extremities of these elements are not usually in contact, as represented in the figure of the holotype given by Agassiz. In both of the specimens belonging to the Carnegie Museum now under discussion the first two neurapophyses are much expanded laterally, delicate ribs are seen, the paired fins are well shown, and a number of minute teeth may be recognized. There appears to be a dense squamation, all of the scales being finely striated.

It is interesting to note that Agassiz, in commenting on the scale-characters of Pleuronectids, remarked upon their resemblance to those of Chætodonts (Poiss. Foss. IV, p. 288); and again, in the description of the genus *Macrostoma* (*ibid.*, p. 260), argued at length upon the close approximation between Pleuronectids of the *Psettus* type and laterally compressed Chætodonts like *Platax*.

Order PERCOMORPHI.

Physoclastic Teleosts with symmetrical cranium; pelvic bones directly attached to the cleithra; each pelvic fin composed of one spinous and five soft rays or still further reduced; no orbitosphenoid, and no bony stay for the pre-operculum.

Under this order are comprised in the more recent classifications of Regan the following six suborders: Percoidae, Scombroidei, Kurtodei, Gobioidae, Blennioidei, and Scorpaenoidei.

Suborder PERCOIDEI.

Family CARANGIDÆ.

Genus AMPHISTIUM Agassiz.

Trunk much deepened, and head short and deep, with rather large supra-occipital crest. Eye large; cleft of mouth of moderate size and directed upward; teeth minute or absent. Paired fins small, the pelvic pair inserted in advance of pectorals; dorsal fin not much elevated, extending along the greater part of the back, with three or four feeble anterior spines; anal fin almost or quite as much extended as the dorsal, with three or four feeble anterior spines; caudal fin rounded. Scales very small, none enlarged or thickened.

5. *Amphistium paradoxum* Agassiz.

1796. *Pleuronectes platessa* G. S. Volta, Ittiolit. Veronese, p. 179, Pl. XLIV, fig. 1 (errore).
 1818. *Pleuronectes platessa* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 357 (errore).
 1835. *Amphistium paradoxum* L. Agassiz, Neues Jahrb., p. 294 (name only).
 1834-44. *Amphistium paradoxum* L. Agassiz, Poiss. Foss., Vol. V, Pt. 1, p. 44, Pl. XIII.
 1905. *Amphistium paradoxum* C. R. Eastman, Mém. Soc. Géol. France, No. 34, p. 24.

Type.—Nearly complete fish; Museum of Natural History, Paris.

The genotype, attaining a length of about 20 cm. Length of head with opercular apparatus somewhat exceeding half the maximum depth of the trunk, which is contained twice or slightly less in the total length of the base of the caudal fin. Vertebral column composed of nine abdominal and fifteen caudal vertebræ, all abbreviate and massive. Dorsal and anal fins gently rounded and equally elevated, each with from twenty-one to twenty-three stout, articulated, and divided rays.

This rare and interesting species is considered by Boulenger "to realize in

every respect the prototype of the Pleuronectidæ before they had assumed the asymmetry which characterizes them as a group." By the author just named this supposed ancestral flat-fish is placed in close association with the Zeidæ, from which family it differs, however, in the smaller number of vertebræ, and in having the dorsal and anal spines more reduced, adnate, and continuous with the series of soft rays. A copy of Boulenger's restoration of this species is given in figure 3. It

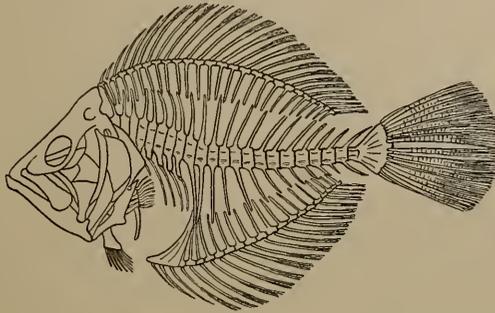


FIG. 3. *Amphistium paradoxum* Agassiz. Upper Eocene, Monte Bolca, Italy. Skeleton as restored by Boulenger, about one-half the natural size. (Cf. Mem. Carnegie Museum, Vol. IV, p. 383).

is based upon two nearly complete specimens preserved in the British Museum of Natural History and these two specimens afterwards furnished Dr. Regan the basis for the following statement:

"I much more readily subscribe to Boulenger's view that the Upper Eocene *Amphistium* is allied to the symmetrical ancestor of the flat-fishes, for in my opinion this fish is a Percoid, which should probably be placed in the family Scorpididæ near the existing *Psettus*, or may perhaps be related to *Platax*. Thanks to the courtesy of Dr. A. Smith Woodward, I have been able to examine the two examples of *Amphistium paradoxum* in the British Museum. The caudal fin has seventeen principal rays above and below (Agassiz gives the formula for this fin: 6. I. 8; 7. I. 2); the pelvic fin, preserved only in the Monte Bolca specimen, is formed of a spine, and, in my opinion, five soft rays, for I cannot see a greater number inserted on the pelvic bone which lies uppermost, the outlines of which are fairly distinct.

"Boulenger's restoration shows several features of *Psettodes* or *Zeus* which I am unable to see in the fossils; thus he shows the lower jaw nearly as long as the head and the pre-operculum vertical and scarcely curved, whereas the lower jaw appears to be only a little more than half the length of the head, and the pre-operculum to have a distinct lower limb; also the origin of the anal fin is not so far

forward in the actual fossils as it is in the restoration." (Ann. Mag. Nat. Hist., 1910 (8) Vol. VI, p. 486.)

This species is not represented in the collection of the Carnegie Museum, but there has sometimes been included under it a closely allied form which is here considered as specifically distinct, and the discussion of which immediately follows.

6. *Amphistium bozzianum* Massalongo.

(Plate XLV, Fig. 4.)

1859. *Amphistium bozzianum* A. B. Massalongo, Spec. Photogr. Anim. Foss. Agr. Veron., p. 37, pl. XIII, fig. 2.

1887. *Amphistium bozzianum* A. de Zigno, Mem. R. Istit. Veneto, Vol. XXIII, p. 14.

1901. *Amphistium bozzianum* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Vol. IV, p. 435.

Type.—Nearly complete fish; Carnegie Museum. (Cat. No. 5308).

This species appears to be known only by the original holotype, which is now the property of the Carnegie Museum. It is of relatively small size, measuring only about 5 cm. in length from the extremity of the snout to the base of the caudal fin. By Belotti it was regarded as an immature example of *A. paradoxum* Agassiz, but its claims to recognition as a distinct species were re-affirmed in 1879 by Baron de Zigno, and his views are fully confirmed by the present writer's examination of the holotype.

This latter has a less deep body than *A. paradoxum*, the vertebral column and its neural and hæmal arches are more delicately constructed, the caudal fin is relatively smaller and the dorsal and anal more elevated, and the number of dorsal fin-rays is greater (twenty-eight as compared with twenty-three) than in *A. paradoxum*. It is to be noted that the paired fins and bones of the head are much more clearly displayed in Massalongo's holotype than in the original of *A. paradoxum* figured by Agassiz.

Genus DUCTOR Agassiz.

7. *Ductor leptosomus* Agassiz.

1796. *Callionymus vestinæ* G. S. Volta, Ittiolit. Veronese, p. 140, pl. XXXII, fig. 2 (errore).

1796. *Gobius smyrensis* G. S. Volta, *ibid.*, p. 241, Pl. LVIII, fig. 2 (errore).

1818. *Callionymus vestinæ* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 359.

1818. *Gobius smyrensis* H. D. de Blainville, *ibid.*, p. 358.

1834. *Ductor leptosomus* L. Agassiz, Verhandl. Ges. vaterländ. Mus. Böhmen, p. 66 (name only).

1835. *Ductor leptosomus* L. Agassiz, Neues Jahrb., p. 293 (name only).
 1834-44. *Ductor leptosomus* L. Agassiz, Poiss. Foss., Vol. V, Pt. 1, p. 53, pl. XII.
 1876. *Ductor leptosomus* F. Bassani, Atti. Soc. Veneto-Trent. Sci. Nat., Vol. III, p. 184.
 1901. *Ductor leptosomus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. IV, p. 448.
 1911. *Ductor leptosomus* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 369.
Type.—Imperfect fish; Museum of Natural History, Paris.

Besides the examples of this species already cataloged as part of the Bayet Collection in the Carnegie Museum, an additional specimen, preserved in counterpart, is contained in the material upon which report is now being made. It is cataloged as No. 5315+5315a.

Genus ZANCLUS Cuvier and Valenciennes.

8. *Zanclus brevirostris* Agassiz.

1796. *Chatodon canescens* G. S. Volta, Ittiolit. Veronese, Pl. XXVI, fig. 2 (*errore*).
 1842. *Zanclus brevirostris* L. Agassiz, Poiss. Foss., Vol. IV, p. 236, pl. XXXVIV.
 1911. *Zanclus brevirostris* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 372.
Type.—Nearly complete fish; Museum of Natural History, Paris.

Among the additional suite of specimens that has recently come to light is an excellently preserved representative of this species, cataloged as No. 5306. It proves to be the left-hand counterpart of the example already cataloged as No. 4415. This specimen bears two original MS. labels in an unknown hand, reading as follows: "Dono di Eugenio Sardagna, Venezia, 18 Nr. 1888 (*ex Galleria Manfron*)." "*Chatodon canescens* Volta, Ittiol. Veron; Tav. 26, fig. 2."

Family CHÆTODONTIDÆ.

Genus PYGÆUS Agassiz.

9. *Pygæus coleanus* Agassiz.

- 1834-42. *Pygæus coleanus* L. Agassiz, Poiss. Foss., Vol. IV, pp. 16-256, Pl. XLIV, fig. 5.
 1838-42. *Pygæus egertoni* L. Agassiz, *ibid.*, p. 257 (imperfect fish, British Museum).
 1838-42. *Pygæus gibbus* L. Agassiz, *ibid.*, p. 257 (distorted fish, British Museum).
 1901. *Pygæus coleanus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. IV, p. 557.

Type.—Imperfect fish; British Museum.

This is an imperfectly known small Chætodont, of which nearly all of the

specimens, so far brought to light, have been more or less distorted. One such, preserved in counterpart and cataloged as No. 5317+5317*a*, is contained in the lot of material from Monte Bolca, which originally formed part of the Bayet Collection. Two others, smaller, but better preserved, are cataloged as Nos. 5322 and 5323. There are also preserved in the same collection two or three examples of an allied form from the Lower Miocene of Chiavon, Vicentin, in northern Italy.

Genus *EPHIPPIUS* Cuvier.

10. *Ephippus rhombus* (Blainville).

(Plate XLVI, Fig. 1).

1796. *Chatodon mesoleucus* G. S. Volta, Ittiolit. Veronese, p. 41, Pl. X, fig. 1 (*errore*).
1796. *Chatodon chirurgus* G. S. Volta, *ibid.*, p. 177, Pl. XLIII (*errore*).
1818. *Chatodon chirurgus* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 353.
1818. *Chatodon rhombus* H. D. de Blainville, *ibid.*, p. 353.
1823. *Chatodon rhomboides* J. F. Krüger, Gesch. Urwelt, Pt. II, p. 671.
- 1842-44. *Ephippus longipennis* L. Agassiz, Poiss. Foss., Vol. IV, pp. 15, 225, Pl. XL.
1859. *Ephippus longipennis* A. B. Massalongo, Spec. Photogr. Anim. Foss. Agr. Veron., p. 34, Pl. IX.
1876. *Ephippus longipennis* F. Bassani, Att. Soc. Veneto-Trent. Sci. Nat., Vol. III, p. 179.
1886. *Ephippus longipennis* W. Szajnocha, Pamiet. Wydz. matem-przr. Akad. Umiej. Krakow, Vol. XII, p. 108, Pls. II, III.
1901. *Ephippus rhombus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. III, p. 559.
1911. *Ephippus rhombus* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 380, Pl. XCII, fig. 2.

Type.—Imperfect fish; Paris Museum of Nat. History.

One is certainly safe in saying that no more perfectly preserved fish from the Monte Bolca locality has yet been made known than the splendid example figured by Massalongo in Plate IX of his work published in 1859. The identical specimen now forms part of the Bayet Collection in the Carnegie Museum, and is cataloged as No. 5305. It bears an original MS. label in an unknown hand reading: "E l'esemplare figurato nella tav. IX. dello Specimen Photogr. di Massalongo."

Family SPARIDÆ.

Genus SPARNODUS Agassiz.

11. *Sparnodus vulgaris* (Blainville).

The synonymy of this species is very long, and need not be given here, as no particularly noteworthy example has been added to the collection since the Catalog of Monte Bolca Fishes in the Carnegie Museum was published two years ago. However, among the material recently brought to light is one very curious specimen which is clearly of composite nature, being made up of portions of various individuals artfully pieced together, though not in accordance with the teachings of comparative anatomy. It is catalogued as No. 5330, and is worthy of preservation in its present state as a curiosity, or monstrosity.

Family LABRIDÆ (Wrasses).

Narial opening double on each side. Marginal teeth prehensile; vomer and palatines toothless; lower pharyngeal bones (rarely also upper pharyngeals) fused together. Spinous portion of dorsal fin at least as much extended as articulated portion; anal fin with two to six spines, nearly equal to, and opposite, the hinder dorsal fin. Scales usually cycloid, rarely feebly ctenoid.

Existing Wrasses are brilliantly colored marine fishes with thick lips, strong pointed teeth on the jaws, and conical or tubercular teeth on the pharyngeals. An able discussion of the group is that by Dr. D. S. Jordan, entitled "A Review of the Labroid Fishes of America and Europe," to be found in the Report of the U. S. Fish Commission for 1887 (1891), pp. 559-699.

In the paper of Dr. Jordan just referred to the procedure was adopted of uniting the genus *Crenilabrus* of Cuvier and Valenciennes with the earlier described *Symphodus* of Rafinesque.

At a later period, however, the distinguished ichthyologist in question found reason for changing his opinion, and for maintaining *Crenilabrus* and *Symphodus* as distinct genera. Thus, in a note published in *Science* for August 19, 1904, (Vol. XX, p. 245), he writes as follows:

"I should now separate *Crenilabrus* C. and V. as a valid genus from *Symphodus* Raf. (= *Coricus* C. & V.) with which I united it in 1891. *Symphodus scina* has the general characters of *Crenilabrus*, the serrated pre-opercle and other features, but it has the snout strongly produced, giving a concave profile, a matter probably worthy of generic distinction. *Crenilabrus* like *Symphodus* has thirteen or fifteen dorsal spines, and thirty-one to thirty-three vertebrae. I do not see how *C. szajnochæ* can be properly placed in it, as these numbers are fairly constant within the same genus. *C. szajnochæ* should form the type of a new genus."

EOLABROIDES gen. nov.

An extinct genus allied to the existing *Labrus*, *Crenilabrus*, *Symphodus*, etc., and known thus far only by the type species, which was originally described under the name of *Crenilabrus szajnochæ* Zigno. Adopting the suggestion of Dr. D. S. Jordan, it may be more properly considered as the type of a distinct genus, for which the new name of *Eolabroides* is proposed at the suggestion of the veteran naturalist and supreme authority in American ichthyology, Dr. Theodore N. Gill of Washington.

Diagnosis.—An extinct genus, known only by the type species, much resembling the existing *Labrus*, but with fewer vertebræ, and an extended dorsal fin with more than twice as many soft rays as in the living genus. Scales not extending over the opercular apparatus and cheeks.

12. *Eolabroides szajnochæ* (A. de Zigno).

(Pl. XLVI, Figs. 2-3).

1887. *Crenilabrus szajnochæ* A. de Zigno, Mem. R. Istit. Veneto, Vol. XXIII., p. 17, fig. 3.

1904. *Symphodus szajnochæ* C. R. Eastman, Bull. Mus. Comp. Zool. Vol. XLVI., no. 1, p. 29, Pl. I., fig. 5.

1904. *Crenilabrus szajnochæ* D. S. Jordan, Science, n.s., Vol. XX., p. 245.

A species attaining a total length of about 12 cm. to the base of the caudal fin. Snout not produced and but little pointed; trunk oblong and laterally compressed. Vertebræ about twenty-eight in number, of which sixteen are caudal. Dorsal fin much extended, with thirteen spines and eighteen soft rays; anal fin with three stout spines and eight articulated rays; caudal fin rounded, with sixteen principal rays preceded by several shorter ones above and below, which are supported by the epi- and hypaxial processes of the three hindermost vertebræ. Scales of moderate size, finely striated, but not posteriorly serrated. Operculum and preoperculum with denticulated posterior margin. Marginal teeth conical, slightly recurved; pharyngeal dentition not observed.

Type.—Imperfect fish; present location unknown.

Besides the type, which is small and imperfectly preserved, but one other example of this species has hitherto been made known. This second specimen is now the property of the Museum of Comparative Zoölogy at Cambridge, Mass., and, like the holotype, is of small size, having a total length of 10 cm. to the base of the caudal fin. In point of preservation it leaves much to be desired, and although associated with the genus *Symphodus* by the present writer, in the opinion of Dr.

D. S. Jordan it seemed preferable to regard it and also the holotype of "*Crenilabrus*" *szajnochæ* as pertaining to a distinct genus. This suggestion of Dr. Jordan is now adopted, and the two previously described specimens together with two additional examples belonging to the Carnegie Museum and figured in the present paper, are placed in a new genus, *Eolabroides*, of which the diagnosis has just been given, and the specific characters of the type-species redefined.

Both specimens belonging to the Carnegie Museum are preserved in counterpart. The larger of them is cataloged under separate numbers, one for each half (4340 and 5303). The two halves of the smaller specimen are cataloged as 4331 and 4331a respectively. One of the counterparts of each specimen is figured in the accompanying plates, and that bearing the catalog number 5303 has been submitted to Dr. Gill for examination, he having expressed a desire to study its characters, and in particular to compare the skeleton with Agassiz's figure of a unique fish from Monte Bolca, named by him *Toxotes antiquus*.

Concerning the type of the last-named form, Dr. Gill is convinced that it has nothing in common with the modern freshwater group of Toxotids or archer-fishes,¹⁰ all referable to a single genus, but on the whole is unwilling to speak confidently as to its precise systematic position, like Agassiz himself, who was perplexed to locate the example of the so-called "*Toxotes antiquus*" which came under his observation.

Under date of May 28, 1913, Dr. Gill has been kind enough to state for the writer's benefit his conclusions on these matters in the following paragraph of a personal letter: "The specimen figured by Agassiz does not belong to the genus *Toxotes*, as is evident from the general form, the development of the fins, and the abdominal cavity. The specimen you have sent me is not congeneric with Agassiz's and is, so far as the evidence goes, a Labrid. I cannot identify it with any recent form, however. If my count is correct, it has the fin-formula:

D. XIV+14; A. III+6; C. 5+13 (branched)+4.

I will count the rays again. Give my kind regards to Dr. Holland, and explain why I did not acknowledge receipt of the specimen before."

In a subsequent letter, dated August 21, 1913, the same eminent authority makes the following additional statement:

"The so-called *Toxotes antiquus* of Agassiz is entirely distinct generically from the modern genus *Toxotes*, and I doubt whether it belongs to the same family. The two differ in these respects:—

¹⁰ Gill, Theodore N., "The Archer-fish and its Feats." *Smithson. Misc. Coll.*, Vol. LII, 1909, No. 1861, pp. 271-286.

<i>Toxotes</i> (living).	<i>'Toxotes' antiquus</i> Ag.
Body rhomboid.	Body compressed, fusiform.
Back declivous from dorsal to snout.	Back convex from dorsal to snout.
Dorsal with 4 to 6 graduated stout spines followed by shorter branched rays.	Dorsal with several weak spines followed by longer branched rays.
Anal longer than dorsal, with 3 stout spines.	Anal much shorter than dorsal.

"The distinctive characters are not patent in the fossil nor in the figure of '*Toxotes*,' so that I cannot give the systematic position of either the fossil you have sent me, or of the so-called '*Toxotes' antiquus*. Like so large a proportion of other fossil fishes uncertainty must remain for the present." (Cf. Appendix, p. 345).

Family POMACENTRIDÆ.

This is a family of marine fishes, with skeleton closely similar to that of the Chromidæ and Labridæ. The narial opening is single on each side, and the scales are usually ctenoid.

Genus ODONTEUS Agassiz.

13. *Odonteus sparoides* Agassiz.

(Plate XLVII, fig. 1)

1839. *Odonteus sparoides* L. Agassiz, Poiss. Foss., Vol. IV, p. 178, Pl. XXXIX, fig. 2.

1898. *Odonteus sparoides* var. *depressus* F. Bassani, Palæont. Ital., Vol. III, p. 83, Pl. VIII, fig. 2.

1911. *Odonteus sparoides* C. R. Eastman, Mem. Carnegie Museum, Vol. IV, No. 7, p. 379, Pl. XCVII, fig. 1.

Type.—Imperfect fish; Paris Museum of Natural History.

This is an extremely rare form, only a few specimens of which are to be found in European Museums, and two in the Carnegie Museum. One of these has already been figured in volume IV of the Memoirs, and the second example is shown of the natural size in Plate XLVII, Fig. 1. It bears the catalog number 5307, and is probably an immature individual.

Family PERCIDÆ.

Teeth small and conical, usually extending over inner bones of the mouth; pre-operculum serrated. Lower pharyngeal bones nearly always separate. Spinous portion of dorsal fin usually as much extended as the articulated portion; anal fin usually with one to three, rarely five to seven spines, nearly equal, and opposite

to the hinder dorsal fin. The family comprises marine and freshwater fishes universally distributed in temperate and tropical regions.

Genus *CYCLOPOMA* Agassiz.

This genus, supposedly extinct, includes a few Tertiary species, which structurally bear a considerable resemblance to the existing *Lates*, and are actually referred to that genus by P. Bleeker (Archiv. Néerland, 1876, Vol. XI, p. 263). We prefer to follow the example of A. Smith Woodward, however, who agrees with the original author in regarding it as a distinct genus.

14. *Cyclopoma* (?) *micracanthum* (Agassiz).

(Plate XLV, fig. 3, and Plate XLVII, fig. 2).

1796. *Holocentrus maculatus* G. S. Volta, Ittiolit. Veronese, p. 234, Pl. LVI, fig. 3 (*errore*).
1796. *Amia indica* G. S. Volta, *ibid.*, p. 149, Pl. XXXV, fig. 4 (*errore*).
1818. *Amia indica* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 347.
1835. *Smerdis micracanthus* L. Agassiz, Poiss. Foss., Vol. IV, p. 33, Pl. VIII, figs. 1, 2.
1836. *Dules medius* L. Agassiz, *ibid.*, p. 93, Pl. XIII, fig. 4.
1901. *Cyclopoma* (?) *micracanthum* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. IV, p. 504.
1905. *Cyclopoma* (?) *micracanthum* C. R. Eastman, Mém. Soc. Géol. France, Vol. XIII, No. 34, p. 25.
1911. *Cyclopoma* (?) *micracanthum* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 375.

Type.—Imperfect fish; *olim* Hartman collection, Göppingen.

This is a very small species, attaining a total length of about 10 cm. Length of head with opercular apparatus about equal to the maximum depth of the trunk and slightly exceeding one-third of the total length to the base of the caudal fin. Anterior dorsal fin with one spine and eight or nine articulated rays, its anterior origin as far from the occiput as the termination from the caudal fin; the second to fourth spines about equal in size, their length not exceeding one-half the depth of the trunk at their insertion, and scarcely exceeding that of some of the divided rays. Anal fin with three spines and six articulated rays, less than the posterior dorsal in extent; the second anal spine stoutest, but not longer than the third.

Two small but excellently preserved examples of this species are contained

among the specimens belonging to the Bayet Collection, and are shown in the accompanying plates (Cat. Nos. 5320 and 5329). Most of the structural details are displayed in the larger of these to better advantage than in any other specimen which has come under the observation of the writer.

Genus DULES.

This recent genus is represented in the Upper Eocene fish-fauna of Monte Bolca by a single species, *D. temnopterus* Agassiz, of which but few examples are known. None are preserved in the British Museum; only one (the original holotype) in the Paris Museum, and but three in the Carnegie Museum. These last-mentioned examples are cataloged as Nos. 4297, 5316+6315a and 5324. They are all smaller than the holotype and are evidently immature, but well preserved. Agassiz's description of this species is to be found in volume IV, p. 91, of his *Recherches sur les Poissons Fossiles*, 1836.

Suborder SCOMBROIDEI.

Maxillaries more or less firmly attached to the non-protractile premaxillaries, which are typically produced and pointed anteriorly. Cranium with the orbito-rostral portion elongate and the postorbital portion abbreviate; parietals separated by the supra-occipital; no orbitosphenoid; basisphenoid present; pro-otics giving rise to an osseous roof for the myodome. Vertebral column of solid centra which are co-ossified with the arches. Pectoral arch attached to the cranium by a forked post-temporal; no mesocoracoid; pterygials more or less regularly hourglass-shaped, four in number, three of them attached to the scapula. Pelvic fins of a spine and five soft rays or variously reduced, thoracic or subthoracic in position, the pelvic bones attached to the clavicles.

Division XIPHIIFORMES.

Hypural nearly or quite hidden by the bases of the caudal fin-rays. A long pointed rostrum, formed by the united premaxillaries and by the nasals, the latter meeting in front of the ethmoid and then diverging and tapering forward. Mouth with lateral cleft; teeth small or absent. Epi-otics separated by the supra-occipital. Pectoral fins placed low.

Family BLOCHIDÆ.

Vertebral column consisting of twenty-four vertebræ. Pelvic fins absent. Neural and hæmal spines not expanded. Ribs apparently sessile. Body covered with slightly imbricated, diamond-shaped, bony scutes; two longitudinal series of enlarged scutes on each side.

The above re-descriptions of the larger groups of Scombroid fishes are taken from Dr. Regan's diagnoses as contained in his paper published in the *Annals and Magazine of Natural History* for January, 1909. It is of interest to note that in this paper the genus *Blochius* is removed from association with Blennoid fishes, and assigned to a position intermediate between sail-fishes (*Histiophorus* and *Tetrapterus*) and sword-fishes (Xiphiidæ).

Blochius, an extinct genus and the solitary representative of the family to which it belongs, has been regarded by paleichthyologists from Agassiz onward as of doubtful systematic position. Certain cylindrical spines, found always in the detached condition, and assigned to the provisional "genus" *Cælorhynchus*, have been compared with the slender, elongate rostrum of *Blochius*, and a theoretical association of these remains is perhaps permissible. But it is a matter of considerable interest to note the resemblances to which Regan has called attention between *Blochius* and *Xiphias*.

For instance, in the paper above referred to, Dr. Regan speaks as follows:

"The adult *Xiphias gladius* differs considerably from *Blochius*, but very young specimens clearly show its relationship to the extinct genus. An example of nearly 200 mm. in the British Museum is very similar to *Blochius longirostris*, resembling it in the long slender jaws, the elongate body with the greatest depth just behind the head, and the continuous dorsal fin. The body is covered with rough non-imbriated scales, with four longitudinal series of enlarged scales on each side, two corresponding in position to the lateral series in *Blochius* and the others running at the base of the dorsal and anal fins."

Concerning the osteology of Scombroid fishes in general, reference may be made at this point to the important papers of E. C. Starks on this subject published in the *Journal of Morphology*, Vol. XXI, pp. 77-79, and in the Leland Stanford Junior University Publications, University Series, No. 5, 1911.

Suborder GOBIOIDES.

Pelvic fins thoracic; opisthotic enlarged, extending downwards to the basioccipital.

Family GOBIDÆ.

This family comprises small fishes, which are widely distributed on the coasts of temperate and tropical seas, sometimes also occurring in fresh water. With the exception of the single genus *Eocottus*, the precise systematic position of which is doubtful, no satisfactorily preserved remains of this family have been discovered. In the opinion of Dr. A. Smith Woodward *Eocottus* should be placed in the family Cottidæ among the Scorpeniformes. More recently Dr. Regan has expressed the

opinion that "the Eocene *Eocottus* may be a Gobioid, and *Lepidocottus* also may belong to the same group."¹¹

Genus *Eocottus* A. S. Woodward.

15. *Eocottus veronensis* (Volta).

1796. *Gobius barbatus* G. S. Volta, Ittiolit. Veronese, p. 48, Pl. XI, fig. 1.
 1796. *Gobius veronensis* G. S. Volta, *ibid.*, p. 51, Pl. XI, fig. 2.
 1818. *Gobius veronensis* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 358.
 1835. *Gobius macrourus* L. Agassiz, Neues Jahrb., p. 291 (name only).
 1838-39. *Gobius macrurus* L. Agassiz, Poiss. Foss., Vol. IV, pp. 12, 203, Pl. XXXIV, figs. 3, 4.
 1876. *Gobius macrurus* F. Bassani, Atti Soc. Veneto-Trent. Sci. Nat., Vol. III, p. 180.
 1901. *Eocottus veronensis* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. IV, p. 581.
 1911. *Eocottus veronensis* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 385, Pl. XCIX, fig. 1 (figure inverted).

Type.—Imperfect fish; Paris Museum of Natural History.

The best preserved examples of this species, which have thus far been brought to light, are those contained in the British and Carnegie Museums. Three specimens are listed in the published catalog of the latter institution, and we have now to record the accession of three additional specimens, smaller than the others, but fairly well preserved. These have received the catalog numbers: 5325, 5326, 5327.

Suborder BLENNOIDEI.

Pelvic fins jugular or mental, each of one to four rays, the first of which may be spinous; parasphenoid sending up a wing on each side, which is joined by suture to the frontals.

Family BLENNIDÆ.

Elongated fishes with stout caudal pedicle; snout not produced. Most of the abdominal vertebræ with downwardly directed transverse processes bearing the small ribs. Dorsal fin occupying nearly the whole of the back, often subdivided; anal fin also much extended; caudal fin rounded or tapering. Scales small or absent, and no bony scutes.

¹¹ Regan, C. T. "The Osteology and Classification of the Telostean Fishes of the Order Scleroparei." *Ann. & Mag. Nat. Hist.*, (8), Vol. XI, 1913, p. 181.

Genus *PTERYGOCEPHALUS* Agassiz.

Head short and orbit very large; mouth small, with conical teeth. Vertebrae about ten in the abdominal, fourteen in the caudal region. Dorsal fin very high, the foremost large spine displaced forwards above the head, but the fin otherwise continuous, each scale with a longitudinal keel, and the keels forming regular lines along the trunk.

16. *Pterygocephalus paradoxus* Agassiz.

(Pl. XLV, Fig 5).

1796. *Labrus malapterus* G. S. Volta, Ittiolit. Veronese, p. 228, Pl. LV, fig. 3 (errore).
 1818. *Labrus malapterus* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., Vol. XXVII, p. 351.
 1835. *Pterygocephalus paradoxus* L. Agassiz, Neues Jahrb., p. 295 (name only).
 1839. *Pterygocephalus paradoxus* L. Agassiz, Poiss. Foss., Vol. IV, p. 191, Pl. XXXII, figs. 5, 6.
 1853. *Cristiceps paradoxus* J. Müller, Neues Jahrb., p. 123.
 1876. *Cristiceps paradoxus* F. Bassani, Atti Soc. Veneto-Trent. Sci. Nat., Vol. III, p. 178.
 1901. *Pterygocephalus paradoxus* A. S. Woodward, Cat. Foss. Fishes, Pt. IV, p. 595.
 1905. *Pterygocephalus paradoxus* C. R. Eastman, Mém. Soc. Géol. France, No. 34, p. 29.
 1911. *Pterygocephalus paradoxus* C. R. Eastman, Mem. Car. Mus., Vol. IV, No. 7, p. 388, Pl. XCVI, fig. 5.

Type.—Imperfect fish; Paris Museum of Natural History.

This, the type-species, includes small-sized fishes allied to the existing *Cristiceps*, the total length not much exceeding 5 cm. Length of head with opercular apparatus equalling maximum depth of trunk and somewhat less than one-third of the total length of the fish to the base of the caudal fin. Separate dorsal fin-spine about twice as long as the next, the length of which slightly exceeds depth of trunk at its point of insertion; continuous dorsal fin with nine spines and nine articulated rays; anal fin with three spines and seven articulated rays.

Two examples of this rare and interesting form are preserved in the Bayet Collection of the Carnegie Museum; one, cataloged as No. 4215, which has already been figured, and another which is larger and more perfect, cataloged under the numbers 5309+5309a. In this latter, which is in counterpart, all of the fins, the details of the squamation, and arrangement of cranial plates are very favorably displayed.

17. *Gobius microcephalus* Agassiz.

(Plate XLV, Fig. 6).

1839. *Gobius microcephalus* L. Agassiz, Poiss. Foss., Vol. IV, p. 204, Pl. XXXIV, fig. 2.
1901. *Gobius microcephalus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Pt. IV, p. 588.
1905. *Gobius microcephalus* C. R. Eastman, Mém. Soc. Géol. France, Vol. XIII, p. 33; pl. II, fig. 3.

Type.—Imperfect fish; British Museum of Natural History.

The type and hitherto only known example of the species which has been called by this name is a small fish doubtfully assigned to a position among the Gobies by Agassiz, and considered by Woodward as "probably a Blennoid though not satisfactorily determinable."

The original author remarks that, without undertaking to fix definitely its precise systematic position, it is yet possible to point out its leading specific characters, and among these he notes the following: "d'une part, la position très avancée de l'anale, et de l'autre, la forme très raccourcie de la tête; caractère qui lui a valu de ma part le nom de *G. microcephalus*. La colonne vertébrale est loin d'être massive; les côtes sont longues et grêles. . . . La dorsale épineuse paraît avoir été séparée de la dorsale molle par une échancrure assez profonde; ses rayons vont en décroissant depuis le premier jusqu'au septième ou dernier, qui n'a pas même la moitié de la longueur des premiers rayons mous. Ceux-ci sont au nombre de neuf, au moins, et vont aussi en se raccourcissant d'avant en arrière. . . . L'anale est composée d'au moins six rayons, qui sont assez allongés. La caudale est très ample, en égard à la taille du poisson" (*l. c.*, p. 204).

Of this species but few examples are known. The British Museum possesses only the holotype, which is a small individual, and its precise systematic position is regarded as doubtful. None are to be found in the Paris Museum of Natural History, and none in this country, with the exception of two specimens belonging to the Carnegie Museum. One of these, cataloged as No. 5504, has already been figured in Vol. IV of the Memoirs of the Museum, and the other, which is larger and more perfect, has recently come to light. It bears the Catalog No. 5319.

APPENDIX.

[Since the foregoing pages were written and after they had been put into type, the Editor received a request from the Author to incorporate in the body of the text a lengthy series of changes and additions. A careful examination of this

new manuscript has satisfied the Editor that the proposed alterations do not justify the expenditure of time and money which would be called for in practically resetting the entire article. In deference, however, to the wishes of Mr. Eastman the Editor incorporates the essence of certain of his pages which seem worthy of being printed.

After relating the result of several private interviews with Dr. Theodore N. Gill, the Author announces that the so-called "*Toxotes antiquus*" (cf. pp. 337-8) should definitely be regarded as belonging to the fossil Labroids, and suggests the erection of a new genus for its reception, for which, in honor of Dr. Gill, he proposes the generic name *Gillidia*. The Editor takes pleasure in printing the diagnosis supplied by Dr. Eastman. *W. J. Holland.*]

GILLIDIA, gen. nov.

An extinct genus allied to *Eolabroides*, known at present only by the type species, which was described by Agassiz under the name of *Toxotes antiquus*. Head relatively long and low. Body of moderate size, compressed, fusiform, the dorsal contour from the snout to the middle of the back scarcely arched. Dorsal fin with six spinous rays, of which the first is short, and none are longer or stouter than the succeeding twelve articulated rays. Anal fin much shorter than the dorsal, with three stout spines followed by twelve branched rays. Caudal fin expanded, scarcely cleft, the superior lobe with eight, and inferior with seven, articulated rays. Squamation coarse, especially in the flank-region; scales with posterior margin entire.

18. *Gillidia antiquus* (Agassiz).

1796. *Sciæna jaculatrix* G. S. Volta, Ittiolit. Veronese, p. 183, pl. XLV, fig. 1 (*errore*).
1818. *Lutjanus ephippium* H. D. de Blainville, Nouv. Dict. d'Hist. Nat., vol. XXVII, p. 347 (*errore*).
1835. *Toxotes antiquus* L. Agassiz, Neues Jahrb., p. 302 (name only).
- 1835-42. *Toxotes antiquus* L. Agassiz, Poiss. Foss., Vol. IV, pp. 16*, 264, pl. XLIII.
1901. *Toxotes antiquus* A. S. Woodward, Cat. Foss. Fishes Brit. Mus., Vol. IV, p. 561 (*sub* Chætodontidæ).
1905. *Toxotes antiquus* C. R. Eastman, Mém. Soc. Géol. France, Vol. XIII, No. 34, p. 25.

Holotype.—Imperfect fish preserved in counterpart; Paris Museum of Natural History (Cat. No. 10,812 + 10,813).

The only known example of this species is that which has already served for the original of figures and descriptions by Volta and Agassiz. It would be superfluous to here enumerate the specific characters, which have been noted in considerable detail by the latter author.

Genus MENE Lacépède.

[In Part I of the "Catalog of Fossil Fishes in the Carnegie Museum," Memoirs Carnegie Museum, Vol. IV, p. 366, Mr. Eastman alluded to the fact that numerous fine examples of *Mene rhombea* (Volta) are contained in the collection, but gave no figure of the species, except a reproduction of a text-figure, showing the cranial osteology, taken from Cramer's article entitled "Ueber *Mene rhombeus* (Volta)" (cf. Zeitschr. deutsch. geol. Gesell., Vol. LVIII, 1906, pp. 181-212). This omission the Editor supplies in Plate XLVIIA by a figure of one of the well-preserved specimens belonging to the Bayet Collection (No. 4369), showing the remarkable development of the anterior rays of the pelvic fins. The introduction of this plate is made in order to visualize the difference between *Mene rhombea* (Volta), *Mene oblonga* (Agassiz) (cf. Eastman, Memoirs Carnegie Museum, Vol. IV, Pl. XCII, fig. 3), and the species hereinafter described by Eastman as a new species under the name *Mene novæ-hispaniæ*, cf. Text-figure 4. *W. J. Holland.*]

19. *Mene novæ-hispaniæ*, sp. nov.

1755. "Fish which we call an old-wife." F. Byam, Philos. Trans., Vol. IX, p. 295, Pl. IX.

Type.—Figure of a fish found in counterpart on the island of Antigua, the location of the specimen not now being known.

Closely resembling *M. rhombea*, but the dorsal border less strongly arched, and trunk not so deep as in that species. Maximum depth of trunk equalling its length from the pectoral arch to the base of the caudal fin, and the latter apparently slightly excavated. Dorsal fin located as in *M. rhombea*; but giving no evidence as to the extent of elongation of the anterior ray of the pelvic fin.

* * * * *

From the standpoint of paleogeographical distribution, and also as a criterion for determining the age of the strata exposed at an elevation of about 900 feet above sea-level in the Island of Antigua, it is a matter of considerable scientific interest to be able to determine positively the presence of a species of *Mene*, hitherto unrecognized as such, and indeed unnamed, in the older Tertiary rocks of the western hemisphere. Historical interest also attaches to the fact that the original

specimen to which attention is now directed formed the subject of the earliest published contribution to the literature of paleichthyology emanating from the New World.

The communication referred to is in the form of a letter written by the Rev. Francis Byam under date of March 31, 1755, and read before the Royal Society of London in December of that year. It is printed in Volume XLIX (page 295) of

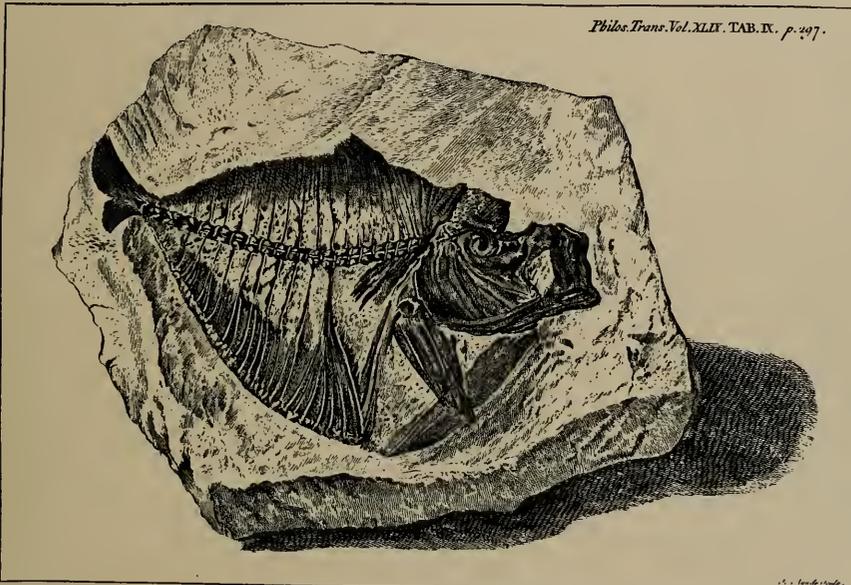


FIG. 4. *Mene novae-hispaniae* Eastman. (Type.) Being a reproduction of about one-half size of the illustration given in the Philosophical Transactions, Vol. XLIX, Plate IX, 1755. (Photographed by A. S. Coggeshall).

the Philosophical Transactions of that body, accompanied by a steel engraving which portrays the original specimen. This engraving is reproduced in fig. 4, which is a little more than one-half the size of the original. As both the illustration and the published account of the fossil fish have been overlooked by modern ichthyologists, it may be of service to quote the following passage:

'To William Fauquier, Esq., F.R.S.

. . . As you have the honour to be a member of the Royal Society, I have sent you, by Captain Barrett, in a box directed for you, what I esteem to be a great curiosity. It is a stone, that was brought from a quarry, for a building in the

town: the quarry is in the side of a mountain, and is about three hundred yards higher than high-water mark, and about two miles from the sea. When the mason struck it with his hammer, it split in two, and discovered the exact portraiture of a fish (on each stone) which we call an old wife.'

* * * * *

That which is chiefly interesting to note in regard to this specimen, which clearly belongs to a new species, is that its position in the line of evolutionary progression is intermediate between the two other known fossil forms, *M. rhombea* and *M. oblonga*. The fact that these two are both from an upper Eocene horizon furnishes additional evidence in support of the view of Dr. T. Wayland Vaughan and others that the fossiliferous strata of Antigua are of early Tertiary age. Indeed, all the data that are now available favor a correlation of these beds with the Upper Eocene.

* * * * *

Mr. Eastman also calls attention in his manuscript to the fact that two other species of fossil fishes from the West Indies have been discovered, both of which appear to have eluded the notice of some recent writers and catalogers. They are: *Aëtobatis poeyi* Castro, Anales Soc. Españ. Hist. Nat., Vol. III, 1873, p. 193, from the Tertiary of Cuba; and *Zebrosoma deani* Hussakof, Bull. Amer. Mus. Nat. Hist., Vol. XXIII, 1907, pp. 125-6.

The latter is "the first fossil species known to be referable to the genus *Zebrosoma* Swainson," cf. Hussakof. *l.c.*

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Trygon muricata (VOLTA). $\times \frac{1}{3}$ circa. C. M. CAT. FISHES, No. 4304.

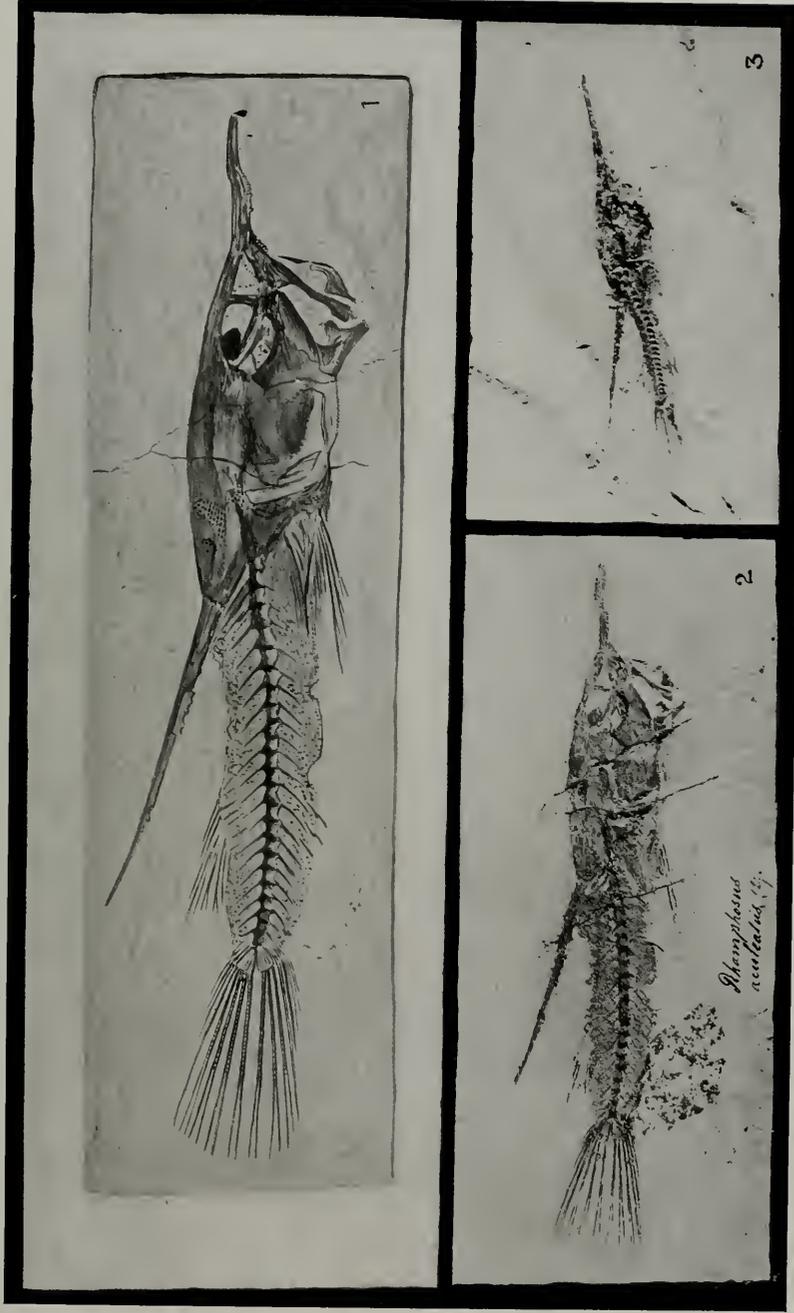


FIG. 1. *Rhamphosus rostrum* (VOLTA). $\times \frac{3}{2}$. C. M. CAT. FOSS. FISHES, No. 5328.

FIG. 2. *Rhamphosus rostrum*. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5328.

FIG. 3. *Rhamphosus rostrum* JUV. NAT. SIZE. C. M. CAT. FOSS. FISHES No. 5310.



FIGS. 1-2. *Eobothus minimus* AGASSIZ. NAT. SIZE. C. M. CAT. FOSS. FISHES, Nos. 5314a, 5314.
 FIG. 3. *Cyclopoma micracanthum* AGASSIZ. $\times \frac{3}{2}$. C. M. CAT. FOSS. FISHES, No. 5329.
 FIG. 4. *Amphistium bozzianum* MASSOLONGO. $\times \frac{1}{2}$. C. M. CAT. FOSS. FISHES, No. 5308.
 FIG. 5. *Pterygocephalus paradoxus* AGASSIZ. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5309a.
 FIG. 6. *Gobius microcephalus* AGASSIZ. $\times \frac{3}{2}$. C. M. CAT. FOSS. FISHES, No. 5319.

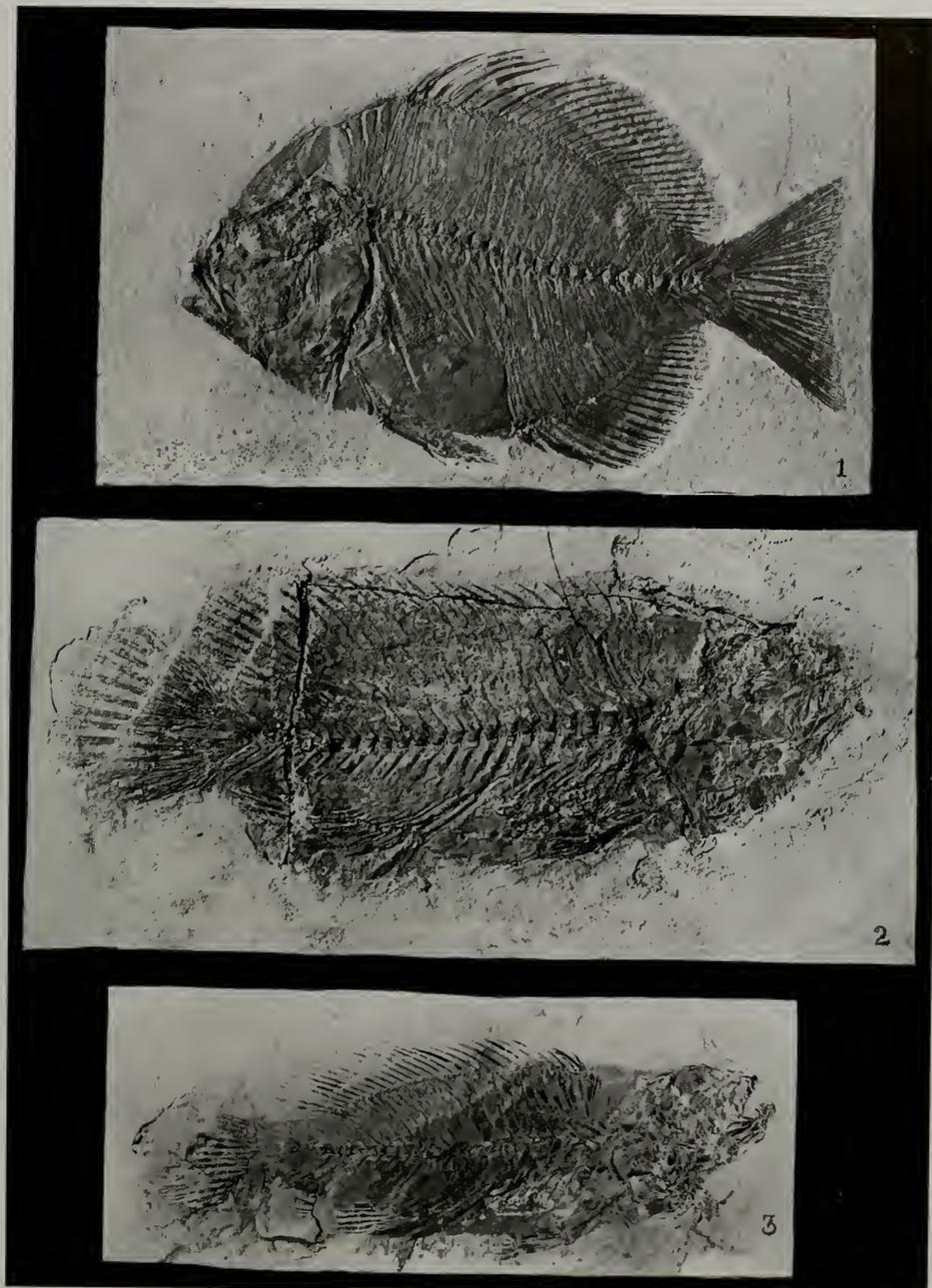


FIG. 1. *Ehippus rhombus* BLAINVILLE. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5305.
FIG. 2. *Eolabroides szajnocha* ZIGNO. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5303.
FIG. 3. *Eolabroides szajnocha* ZIGNO. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 4331a.

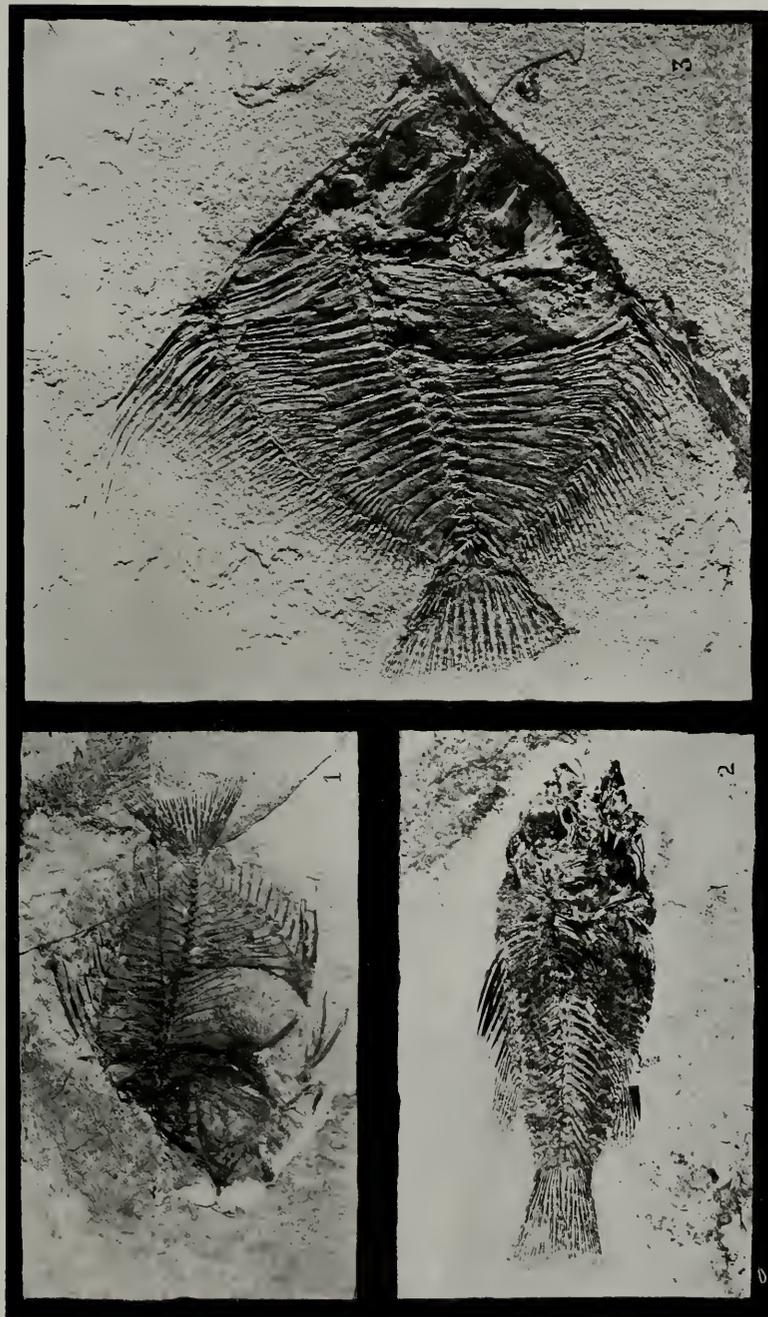


FIG. 1. *Odonteus sparoides* AGASSIZ. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5307.
FIG. 2. *Cyclopoma micracanthum* AGASSIZ. $\times \frac{3}{4}$. C. M. CAT. FOSS. FISHES, No. 5320.
FIG. 3. *Zanclus brevirostris* AGASSIZ. NAT. SIZE. C. M. CAT. FOSS. FISHES, No. 5306.



Mene rhombea (VOLTA.) C. M. CAT. FOSS. FISHES, No. 4369. (SLIGHTLY REDUCED.)

