XI.—NOTES ON TRIASSIC FISHES BELONGING TO THE FAMILIES CATOPTERIDÆ AND SEMIONOTIDÆ.

By C. R. EASTMAN.

(PLATES XXX-XXXII).

Highly characteristic of the early Mesozoic in this and other countries is the short-lived family of "ganoid" fishes known as the Catopteridæ, a group descended in all probability from primitive Palæoniscid stock, comprising only three genera, so far as known, attaining a wide distribution in nearly all continents, and becoming extinct at the close of Triassic time.

The type-species of the genus *Catopterus*, *C. gracilis*, was described by J. H. Redfield in 1837. A decade later the second known species of *Catopterus* was described by Sir Philip Grey Egerton, and at the same time the new genus *Dictyopyge* was established by him upon the evidence of certain well-preserved fishes obtained between 1840 and 1845 from the Richmond coal-field of Virginia.

More widely distributed than Redfield's genus, which is limited to eastern North America, *Dictyopyge* differs from *Catopterus* only in the more forward position of the dorsal fin, which never arises behind the origin of the anal. *Dictyopyge macrura*, the type, first described by W. C. Redfield, under the name of *Catopterus macrurus*, is restricted to the Trias of Virginia and the Connecticut Valley. A number of other species are known, however, from the Upper Trias of England, Ireland, Germany, Switzerland, and New South Wales, and from the Upper Karoo formation (Stromberg beds) of the Orange Free State in South Africa.

The third known member of the family under consideration is the genus *Perleidus*. The type and only known species, *P. altolepis* (Deecke), occurs in the Alpine Middle Trias of Perledo, Lombardy, where it is accompanied by representatives of the families Cœlacan-thidæ and Semionotidæ, not unlike those occurring in the Trias of eastern North America. In general proportions of body, position of median fins, squamation, and arrangement of facial plates, *Perleidus* approximates *Catopterus* more nearly than *Dictyopyge*. A certain

resemblance is also to be noted between it and *Pholidophorus*. The characters of the Alpine form were first recognized as constituting a distinct genus by De-Alessandri¹ in 1910.

Turning now to the family Semionotidæ, it is apparent that its members represent a higher grade of structural organization than the primitive sturgeon-like Catopteridæ. A study of their characters shows that the Semionotidæ are fully developed Protospondyli; that is to say, they belong clearly to that large group of "ganoid" fishes which flourished chiefly during the Triassic and Jurassic periods, but declined rapidly, and is represented at the present day only by two freshwater genera, Lepidosteus and Amia. From what ancient stock the Semionotidæ and other Protospondyli are descended, we do not precisely know, but it may reasonably be inferred that the late Paleozoic forerunners (Acentrophorus, etc.) of the higher suborder were derived from a modified type of Chondrostean. Beyond this, when we inquire as to the origin of the Chondrostei themselves, we find but few facts for our enlightenment. Their origin is at least as ancient as that of the fringe-finned "ganoids," but there is as yet no evidence of a genetic connection between the Chondrostei and Crossopterygians. Enough, however, has been ascertained to show that already in the Trias and probably even earlier the divergence between Chondrosteans and Protospondyli was strongly marked.

Notwithstanding the close study which has been given to the remains of the extinct fishes included in the families *Catopteridæ* and *Semionotidæ*, our knowledge of their structural features is still in some important respects deficient. Dr. A. Smith Woodward summarizes the present state of our knowledge as to the first-named family as follows:

"The little that is known of *Catopterus* and *Dictyopyge*, the two genera of *Catopteridæ*, forms the subject of the opening pages of the present volume. Much of this information is unsatisfactory, and needs verification; but it may be asserted, with considerable probability of correctness, that these fishes possess a Palæoniscid head and shouldergirdle, while the tail is only hemi-heterocercal, and the single series of supports in the dorsal and anal fins almost equals in number the apposed dermal rays. Such being the case, here is an interesting illustration of the common law, that the links between a lower and a

¹ De-Alessandri, G., "Studii sui pesci Triasici della Lombardia," *Mem. Mus. Civico Milano*, 1910, Vol. VII, fasc. 1.

higher group are not to be sought among the specialized types of the former but among those with the most generalized secondary characters."²

There are some matters of historical interest relating to early studies of the Catopteridæ and Seminotidæ in this country, which may be introduced at this point, before proceeding to a discussion of newly observed structural details. The pioneer students of the Triassic fish-fauna of America were William C. and John H. Redfield, father and son, who contributed in all ten publications during the interval between 1837 and 1857.

In the first paper published by the junior author, to which reference has already been made, the type species of *Catopterus* is described, and provisional identifications are made of three Semionotid species. The latter were not at that time recognized as belonging to the genus *Semionotus*, nor in fact did either of the Redfields perceive that the half-dozen species of "Palæonisci" with which they were acquainted, and afterwards included in *Ischypterus* Egerton, were actually congeneric with the earlier described *Semionotus* Agassiz.

Next in chronological order after the younger Redfield's paper of 1837 appeared an article by W. C. Redfield, entitled "Short Notices of American Fossil Fishes." This was published in the American Journal of Science for October, 1841, and included brief diagnoses of the known species of "Palæoniscus" (*i. e. Semionotus*) and *Catopterus*. During the following year Sir Charles Lyell visited this country, and in company with Professor Benjamin Silliman, Jr., as he tells us, made at Durham, Connecticut, a fine collection of the remains of fishes from the Trias of the Connecticut Valley. These were examined in 1844 by Sir Philip Grey Egerton, and subsequently by Professor Louis Agassiz, whose notes in regard to them and other remains of American fishes, are quoted by Lyell in a paper published by him in 1847.³

It is in this communication by Sir Charles Lyell that the new generic terms *Dictyopyge* and *Ischypterus* were first proposed by Sir Philip Egerton, the former to include the species already described by W. C. Redfield under the designation of *Catopterus macrurus*, and the latter

² Woodward, A. S., Catalogue of the Fossil Fishes in the British Museum, Part III, Introduction, p. vii. London, 1895.

³ Lyell, C., "On the Structure and Probable Age of the Coal-field of the James River, near Richmond, Virginia," *Quar. Journ. Geol. Soc.*, 1847, Vol. III, pp. 275– 278. to include the so-called "Palæonisci" of the American Trias, or those forms which are now commonly referred to the genus *Semionotus*. The identity between *Ischypterus* Egerton and *Semionotus* Agassiz was suspected by Newberry, clearly recognized by A. Smith Woodward, and is now generally admitted.

With the exception of L. Agassiz, Sir Philip Egerton was probably the leading authority of his time on fossil fishes. His notes on the two principal genera of American Triassic fishes, incorporated in Lyell's paper of 1847, are exceedingly brief, and it is to be regretted that he did not continue his study of these forms. Some further light in regard to his views has, however, been preserved in unpublished correspondence between the two eminent scientists, Egerton and Lyell. Copies of two letters written by the former to the latter in 1844 appear to have been sent to Professor Silliman of Yale, who collected part of the material reported upon, and through him to have reached the Redfields, by whom the documents were preserved. At all events the manuscript containing Egerton's views has been stored away for many years in the cabinet containing the Redfield Collection of fossil fishes at the Peabody Museum of Yale University. For the privilege of now bringing to light these early memoranda, and of studying a number of well-preserved specimens in the collection at Yale, the writer is indebted to the kindness of his friend Professor Charles Schuchert, Director of the Peabody Museum. The text of the correspondence is as follows:

"Oulton Park, Tarporly, Dec. 18, 1844.

"Dear Lyell:

"There are two species of *Chelonichthys*, *Asmussi* and *minor*, both found in the Old Red of Riga (Russia) and of Elgin. I have the latter also from Orkney. It is the largest of the Old Red fishes I am acquainted with. The days are so dark that I cannot do much at your Black Fish. I have, however, taken out and examined the *Catopteri*. This is a very good and well marked genus of Redfield, and deserves a more ample description than he gives it. I find two species, the one *C. gracilis*, the other new, which you may call if you please *C. Redfieldi*. It is nearly as large as *C. gracilis*, but much deeper. The bones of the head are ornamented with closely packed flattened tubercles, which also extend over the nuchal scales and the scales immediately posterior to the thoracic cincture. "The scales of the flanks are distinctly serrated on their posterior margins, which serration is traceable nearly to the tail. The scales of the pedicle of the caudal fin are less elongated than in *C. gracilis*, and rarely extend so far on the upper lobe. In general aspect this fish is less elegant than *C. gracilis*, although the more prominent ornamentation of scales renders it an attractive species.

"I have not seen the publications you allude to, nor can I give any idea as to the age of the beds in which the fish occur. But I think there is every reason to warrant the creation of a new genus to receive the Palæonisci (so-called). The form of the fins is very remarkable, as observed by Agassiz in his description of *P. fultus;* but I have discovered a more important feature in the character of the teeth, which are not *en brosse* as in the Palæonisci, but more nearly resemble the teeth of *Tetragonolepis*. If on further examination these characters should prove constant, I should propose the name *Ischypterus* for this genus.

> "In great haste, yours, "PHILIP GREY EGERTON."

II.

"Oulton Park, Tarporly, Dec. 28th, 1844.

" My dear Lyell:

"I find I can do nothing with your American Palæonisci in consequence of my ignorance of what Redfield has already done. I have only got the short paper in the Yale (Silliman's) Journal, from which it is absolutely impossible to identify a single species. The specimens sent me by himself are very imperfect, with the exception of the *P. fultus* of Agassiz, and *Catopterus gracilis* Redfield. I think you have at least five or six distinct species (besides the *Catopteri*), and they all agree in the generic characters of the fins, scales, and teeth. The latter are not *en brosse* as in the true *Palæonisci*, but are strong and conical, and the oral aperture is considerably smaller.

"I know little about *P. catopterus* of Roan Hill,⁴ as my specimen is very indistinct, and Agassiz has not described the species in the *P. Fossiles*. The specific name is no doubt in consequence of the back-

⁴ "Palaeoniscus catopterus" of Roan Hill, Tyrone, Ireland, was afterwards figured by Sir Philip Egerton (1858), and still later was shown by Dr. R. H. Traquair to belong to the genus *Dictyopyge*. The so-called *Chelonichthys asmussi* is now referred to the Arthrodiran genus *Homosteus*, and the Scottish *C. minor* is identical with *Asterolepis minor*. ward position of the dorsal fin, but I do not think it could be classed with Redfield's genus *Catopterus*. The smooth character of the scales in your American specimens is the most distinctive mark I see as compared with the Palæonisci of the Kupfer Schiefer, Zechstein, and Magnesian Limestone, all the species found in these two formations having the scales more or less striated and serrated on the posterior margins. This character would, however, approximate them to the Coal Measure species, where the scales are all smooth, except in those from the Burdi House. The tails are certainly less prolonged in the upper lobe than any of the *Palæonisci* I am acquainted with.

"Believe me, Sir,

"Yours truly,

"PHILIP GREY EGERTON."

OBSERVATIONS ON THE GENUS CATOPTERUS.

Besides the type-species, C. gracilis Redfield, writers have hitherto without exception recognized at least one other valid member of the genus, namely, C. redfieldi Egerton. The original description states merely that this is a deeper-bodied fish than the type, and "with scales not so long in proportion to their depth" (Egerton, loc. cit., p. 278). It has been observed by subsequent authors, however, that in form and proportions of body the two species are very similar, and in fact intergrade to such an extent that these characters alone are an insufficient criterion for separating them. One may speak of a deeper-bodied variety, and a less deep-bodied, or slenderer variety, but the distinction is not a trenchant nor a natural one, since it depends almost altogether upon varying degrees of mechanical compression and deformation. The fact was clearly recognized by Newberry⁵ in the case of one of Redfield's cotypes of C. gracilis, which, although the body has slender proportions, was nevertheless conceived by this author to have been a vertically compressed example of the broad form, and for this the name C. redfieldi was suggested by Sir Phillip Egerton.

Two examples belonging to the Carnegie Museum and illustrated in plates XXX and XXXI, are instructive as showing that appearances may be very deceptive as to the natural contour of the body. For these specimens have been so folded over and then flattened as to display a larger number of scale-rows than belongs to a single side of the trunk, and the true dorsal contour is to be found several scale-rows

⁵ Monogr. U. S. Geol. Surv., Vol. XIV, p. 56.

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lower down than where we might suppose it to be along what appears to be the back; that is, the median dorsal line of the fish does not coincide with the uppermost margin of the fossil, as is proved by the row of dorsal ridge-scales which may be traced continuously in these specimens, but might readily be obliterated in others. These examples illustrate what may happen in *Seminotus* and other forms, where the true dorsal and ventral contours are often difficult of recognition.

Other characters which have been relied upon for distinguishing the deep-bodied and slender-bodied species, or varieties as we prefer to regard them, are the position of the median vertical fins and certain details of the squamation. It has been claimed, for instance, that in *C. gracilis* the "dorsal and anal fins are subequal in size and almost completely opposed"; whereas in *C. redfieldi* the dorsal fin is said to arise "opposite to the middle of the anal." This distinction, however, will not hold. Intergradations occur, and as a matter of fact, the alleged distinction applied in the reverse sense to one of the original cotypes of *C. gracilis*, in which dorsal and anal are not "almost completely opposed," but the former arises opposite the middle of the latter.

As for supposed differences in scale-characters, it has been asserted in the definition of the type-species that "the scales are smooth, none deeper than broad, those of the flank in the abdominal region very finely serrated." In the variety which has been called *C. redfieldi* the amended diagnosis reads: "Scales mostly smooth, but sometimes in part longitudinally striated, the striæ terminating in the coarse serrations of the posterior border which characterize the principal flank-scales; many of the flank-scales deeper than broad."

Examination also shows that in respect to such characters no rigid distinction can be made between the type-species, *C. gracilis*, and the deep-bodied variety, which has been commonly recognized as belonging to a separate species. The condition of smoothness in scale characters is a variable one, and appears to be due largely to differences in age, amount of wear, state of preservation, and in some cases to the operation of chemical agencies which have eroded the external surface or covered it with a thin glaze. Differences in age and wear will also account for degrees in coarseness or fineness of the striations along the posterior margin of the flank-scales. To sum up, therefore, a valid specific distinction between *C. gracilis* and *C. redfieldi* can scarcely be maintained, but on grounds of convenience it may be well to retain the latter name for the purpose of indicating a certain amount of variation from the typical *C. gracilis* in the direction of greater depth of body and coarser striation of flank-scales.

Concerning the extremely difficult subject of cranial osteology, very little can be added to the few facts already known. The bones forming the cranial roof are as a rule firmly coalesced and their sutures concealed by the tubercular ornamentation. Apparently the superior border of the orbits is formed by the large-sized frontals, which are bounded behind by the parietals (the latter separated in the median line by a small-sized supra-occipital) and squamosal. The inferior border of the orbit is formed by the expanded posterior portion of the maxilla, which is of relatively large size and decidedly paleoniscid-like in form. This plate bears numerous fine, acutely conical teeth, and there is also present a small dentigerous premaxilla, which is often found detached from the other mouth-parts.

Just how the facial plates are arranged in the space lying between the orbit and shoulder-region (clavicle) is difficult to determine. Newberry's interpretation of the elements covering this area in a single specimen studied by him is open to serious question. At least one postorbital is present in its normal position behind the eye, and there may possibly be another (or suborbital) below it. Behind these plates is the area commonly occupied by the operculum and suboperculum, but the pre-operculum was probably much reduced and nearly concealed by adjacent elements. The general configuration of this region is shown in one of the original co-types of this species now preserved in the Yale Museum, and also in a specimen belonging to the United States National Museum, which has been examined by the writer.

ON THE CRANIAL STRUCTURE OF SEMIONOTUS.

The cranial osteology of this genus has been studied chiefly by L. Agassiz, E. Schellwien, and Dr. C. F. Eaton. In general, the arrangement of plates is not unlike that in *Lepidotus*, except that the circumorbitals are relatively very small, and the suborbitals are not divided up into a number of polygonal plates. One of the best preserved specimens of American Triassic fishes showing the head-region is that shown in Pl. XXXII, Fig. I, which probably belongs to the species *S. micropterus* Newburg. It is from Durham, Connecticut, and bears the Carnegie Museum Catalog No. 5285. It is of interest as displaying the facial and opercular plates to better advantage than in most specimens.

ON AN AUSTRALIAN GENUS OF SEMIONOTIDÆ (PRISTISOMUS).

Much interest attaches to the Triassic fish-fauna of the Australian region, on account of the peculiar structural features exhibited by certain genera, the fact of its being to a large extent a "relict fauna," and also on account of the knowledge it affords of the distribution of well-known North American and European genera. All told not over a dozen genera are known from the locality at Gosford, and their state of preservation is not always of the best. It has seemed desirable to illustrate one nearly complete example which has been placed in the writer's hands for study by Mr. M. E. Crane of Pittsburgh, with the understanding that it will eventually become the property of the Carnegie Museum.

Genus Pristisomus A. S. Woodward.

This genus was established by Dr. A. S. Woodward in 1890 upon the evidence of a number of fairly well preserved skeletons, which exhibited characters intermediate between *Semionotus* and the geologically later and more highly specialized genus *Dapedius*. For example, as pointed out in the original description of *Pristisomus*, "the long, styliform teeth, and certain obscurely recognizable features in the head, are most suggestive of *Dapedius*; and the depth of the trunk nearly approaches that of some of the species of the last-named genus. The dorsal ridge-scales, however, and the proportions of the median fins, more nearly resemble corresponding features in *Semionotus*, though this well-known genus is distinguished by its dentition, the absence of ventral ridge-scales, the slight vertical elongation of the flank-scales, and the greater development and more forward position of the dorsal fin."

The typical species of *Pristisomus* is *gracilis* Woodward, from the Lower Hawkesbury-Wiametta series (Upper Trias) of Gosford, New South Wales. It is accompanied in the same formation by two other species, *P. latus* Woodward and *P. crassus* Woodward, these three being all that have thus far been described, and comparatively few individuals are known of each of them.

The general characters of *Pristisomus* are given by the original author as follows:

"Body comparatively deep, but fusiform, three or more series of the flank-scales vertically elongated; a dorsal and ventral series of prominent ridge-scales. Teeth large, styliform, in close series. Paired fins moderately developed; dorsal and anal fins remote, the former partly opposed to the latter; caudal fin robust, scarcely forked. Small fulcra present on all the fins."

Pristisomus latus Woodward. (Plate XXXII, fig. 2).

1890. Pristisomus latus A. S. Woodward, Mem. Geol. Surv. New South Wales Paleont. No. 4, p. 35, pl. V, figs. 2, 4.

The specimen, of which an illustration is given, is referred to this species, being distinguished from the type by its greater depth of trunk, the small size of the head, and relatively greater length of the dorsal fin. The latter is also somewhat longer than the anal, whereas in the type-species these two are described as being almost of equal size, with a short base-line, and much elevated. In the specimen before us the dorsal is seen to be composed of fifteen articular rays, and the anal of thirteen, the outermost in each being preceded by a number of short fulcra.

The head is short, triangular, and has the orbit placed far forwards. A pre-operculum, if at all present, must have been exceedingly narrow, and the operculum and suboperculum together form a long curved band, gradually widening inferiorly, and the boundaries between the two elements not directly visible. In this specimen, as in most of those described by Dr. Woodward, the actual substance of the bones and ganoid scales has been removed by chemical solution, little remaining except mineral-stained impressions.

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Plate XXX.



Calopterus gracilis Redfield. From Trias of Durham, Conn. C. M. Cat. Foss. Fishes, No. 5297. X 1.





Calopterus gracilis Redfield. From Trias of Durham, Conn. C. M. Cat. Foss. Fishes, No. 5298. X 1.



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Plate XXXII.



Fig. 1. Head of Semionotus micropterus Newberry (?). C. M. Cat. Foss. Fishes, No. 5285. $\times \frac{1}{1}$. Fig. 2. Pristisomus latus A. S. Woodward. $\times \frac{1}{1}$. (Specimen deposited in Carnegie Museum.)



Eastman, Charles Rochester. 1914. "Notes on Triassic fishes belonging to the families Catopteridae and Semionotidae." *Annals of the Carnegie Museum* 9(1-2), 139–148. <u>https://doi.org/10.5962/p.331048</u>.

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