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5. *Pseudorhynchopus punctatus*.

Xenodon punctatus, Peters, Mon. Berl. Ac. 1880, p. 221, pl. —, fig. 3.

Stated to be from Brazil, but its habitat will probably prove to be Madagascar. I am indebted to Dr. Paul Matschie, of the Berlin Museum, for a sketch of the dentition of the type specimen, which shows the fourth and fifth mandibular teeth enlarged.

XXXVI.—*A New Theory of Pterichthys*.

By A. SMITH WOODWARD, F.Z.S.

THE missing link between the Chordata and some of the non-Chordate phyla below has long been sought in vain among the organisms revealed by palæontology. The almost invariable destruction of soft tissues during fossilization evidently constitutes the chief obstacle to the quest; and it still seems most probable that none of the intermediate types developed hard skeletal parts such as could be preserved under ordinary conditions. There is, however, one anomalous group of early Palæozoic skeletons which has been almost invariably referred to in this inquiry, *i. e.* the tribe comprising *Pterichthys*, *Bothriolepis*, *Cephalaspis*, and their allies. At the time of their first discovery the superficial aspect of these skeletons at once led to their comparison with the contemporaneous Eurypterids, then believed to be Crustaceans; somewhat later they entered the heterogeneous order of "Ganoid" fishes; still further investigation led to a suggestion that they might possibly be a primitive armoured form of Marsipobranch fish; and a few years ago *Pterichthys* and *Bothriolepis* were compared by Cope* with the shielded types of Tunicates, *e. g.* *Chelyosoma*.

Quite recently an attempt has been made to show that this gradual growth of ideas has proceeded in a wrong direction; and a well-known investigator of the morphology of Arachnida, Mr. William Patten, now claims † to justify, on philosophical grounds, the first impressions of the earliest collectors. In the modern acceptance of the term, Trilobites and Merostomata are Arachnids; and it is in this direction, according to

* E. D. Cope, "The Position of *Pterichthys* in the System," Amer. Nat. vol. xix. (1885), pp. 289–291, with figs.

† W. Patten, "On the Origin of Vertebrates from Arachnids," Quart. Journ. Micr. Sci. vol. xxxi. (1890), pp. 359–365, fig. 13.

Mr. Patten, that naturalists must seek the ancestors of the Chordate phylum.

However plausible the theory and however convincing the arguments deduced from the morphology and embryology of existing types, we venture to think that *Pterichthys* and *Bothriolepis* cannot be cited as having any distinct bearing on the subject. More especially does it seem clear that the dermal plates in the fossils just mentioned cannot be interpreted as the homologues of certain plates of the Arachnids, in the manner the author supposes; and when it is suggested that the so-called dorsal shield of *Pterichthys* is on the hæmal aspect of the animal, an ichthyologist, at any rate, is unable to regard the statement as anything beyond unjustifiable speculation.

In the first place, Mr. Patten gives outline-sketches of the anterior hæmal shield of a Trilobite and compares it with corresponding outlines of the dorsal ("hæmal") shield of *Pterichthys* and *Bothriolepis*. Unfortunately, however, the latter are copied from old erroneous figures, the inaccuracy of which was pointed out some time ago in these pages by Dr. R. H. Traquair*. The agreement in general size and shape is first insisted upon; but that, it must be admitted, is a circumstance of very secondary importance. In the second place it is stated that, like that of the Trilobite, the "cephalothoracic" shield of *Pterichthys* and *Bothriolepis* exhibits a cervical suture, proving the concrescence of vagus segments; but the groove in question is shown by overwhelming evidence to be nothing beyond a superficial slime-canal, evidently connected with the sensory system. The same remark applies to the inner of the "great semicircular sutures extending parallel with the edge of the shield around the front and sides," which is another point of supposed similarity insisted upon; the so-called outer semicircular suture represented in *Pterichthys* (evidently after Pander) does not exist. The "ocular plates" and "facial suture" certainly are in part comparable; and there is some fanciful resemblance of the median plates to the median lobes of a Trilobite, but the comparison does not appear very satisfactory.

Having thus disposed of what is assumed to be the hæmal shield, Mr. Patten remarks that the "neural surface of *Pterichthys*, or the neural surface of a true fish," has "the median cranial plates arranged in pairs, terminating in a posterior unpaired plate," corresponding to the coxal plates

* R. H. Traquair, "On the Structure and Classification of the Astero-lepidæ," Ann. & Mag. Nat. Hist. [6] vol. ii. (1888), pp. 485-504, pls. xvii., xviii.

and the metasternum of Scorpions and Merostomata. Again we fail to find any justification for this statement in Dr. Traquair's restoration, the accuracy of which we have been able to verify in every respect. Moreover, when the conclusion is reached that "since their eyes are situated on the hæmal surface . . . *Pterichthys*, *Bothriolepis*, &c. are nearer related to the Arachnids than to the Vertebrates," it is obvious that some of the most fundamental characters in the skeleton of the first-named genus have been overlooked.

Even in the dorsal shield itself there are features inexplicable except on the supposition that it covered the neural aspect of an organism provided with a typical vertebrate brain. The plate between the eyes, for example, exhibits a deep pit on its visceral surface identical in position with that which few will deny received the pineal body in several early shielded types (e. g. *Coccosteus*), which are proved to be vertebrates by the discovery of the axial skeleton of their trunk. But the characters of the tail of *Pterichthys*, now well known, seem to the present writer absolutely conclusive of the relations of the neural and hæmal aspects. As shown by Dr. Traquair, this tail is fish-like in every respect; it has ridge-scales and a median fin on the border that continues the convexity of the eye-bearing shield, and the pointed extremity of the tail is turned upwards towards this border. Moreover, at least one specimen in the British Museum proves that there was a large terminal fin extending chiefly on the convex border of the extremity. Such structures are unparalleled in any known group except that of the fishes; and when they do occur here the produced body-lobe of the heterocercal tail is invariably directed towards the neural aspect, while the ridge-scales and median fin, when present only on one border, are without exception on the same aspect.

A tail of a closely similar character is also known in the allied family of Cephalaspididæ, and it seems to the present writer proved beyond doubt that all the organisms of this type are true Chordata, while many probably reach the phase to which the term Vertebrate is now commonly restricted. Indeed, as nearly all the special points noticed by Mr. Patten result from a consideration of insufficient or inaccurate data, it seems needless to follow him further in his wide generalization as to the arrangement of the exoskeleton and eyes in the lower vertebrates. There is much parallelism in the skeleton of totally distinct groups that yet remains to be explained; and it seems quite as philosophical to us to infer, from the known anatomy of a cockle, that the valves in the extinct *Spirifer* were lateral shields, as to interpret mere superficial resemblances in the armour of *Pterichthys* and Eurypterids as homologies.