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## Annals and Magazine of Natural History: Series 6

Publication details, including instructions  
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Published online: 12 Oct 2009.

To cite this article: R.H. Traquair M.D. F.R.S. (1890) XVI.—On the structure of *Coccosteus decipiens*, Agassiz, *Annals and Magazine of Natural History: Series 6*, 5:26, 125-136, DOI: [10.1080/00222939009460795](https://doi.org/10.1080/00222939009460795)

To link to this article: <http://dx.doi.org/10.1080/00222939009460795>

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# THE ANNALS

## MAGAZINE OF NATURAL HISTORY.

AND

[SIXTH SERIES.]

No. 26. FEBRUARY 1890.

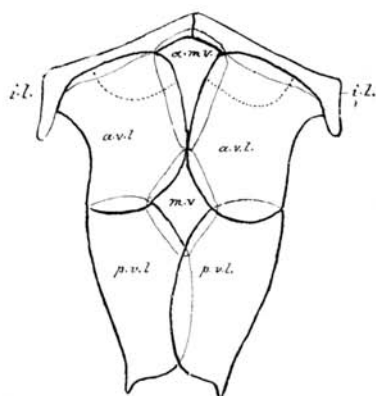
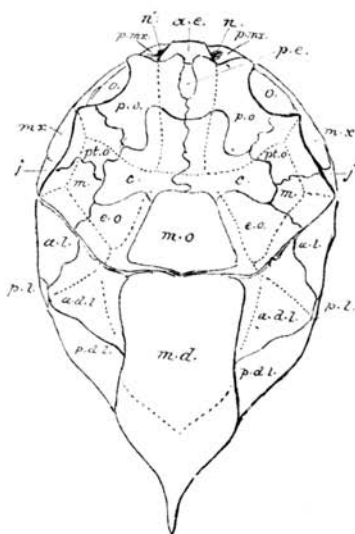
XVI.—*On the Structure of Coccosteus decipiens, Agassiz.*  
By R. H. TRAQUAIR, M.D., F.R.S.\*

[Plate X.]

In a paper on *Homosteus* (13) published in the 'Geological Magazine' for January 1889 I entered into the structure of *Coccosteus* so far as was necessary for the purpose of instituting a comparison between the two genera. In the present communication I propose to consider the structure of *Coccosteus* in greater detail.

The figure which I gave in that paper of the cranial shield is reproduced in Pl. X. fig. 2, with the addition of the dorsal cuirass. It is, I believe, accurate, and represents the result of a close study of a very great number of heads. Comparatively few specimens are, however, available for the purpose, those especially from Lethen and most of those from Orkney being ill-adapted for following the sutures separating the plates, while Cromarty and Edderton furnish those in which the surface is most perfectly preserved, thus affording the best opportunity for accurately distinguishing the true sutures from those superficial grooves which in past times have been so often confounded with them. Quite recently, however, the

\* Read before the Royal Physical Society of Edinburgh, 18th December, 1889.



Edinburgh Museum has acquired a small collection of *Cocco-steus*-remains from Stromness, in Orkney, in which the details of the surface of the cranial plates are most beautifully shown, and are entirely corroborative of the sketch which I published a year ago.

As I have previously stated (12, p. 511), I retain only two species of *Coccosteus* from the Scottish Lower Old Red Sandstone, namely *C. decipiens*, Ag., and *C. minor*, H. Miller, the differences which have led to the separation of "*oblongus*," Ag., "*cuspidatus*," Ag., *microspondylus*, *trigonaspis*, and *pusillus*, M'Coy, and *Milleri*, Egert., being dependent either upon the mode of preservation or upon trivial variations in the shape of certain plates, which are extremely common up to certain limits. That which I find especially difficult to understand is how Prof. von Koenen (10) should propose to remove *C. Milleri*, Egert., and *C. pusillus*, M'Coy, from *Coccosteus* altogether, placing them in *Brachydeirus*, the fact being that they are simply synonyms of *decipiens*, Ag. *C. minor*, H. Miller, once mixed up with *C. pusillus*, M'Coy, may possibly have to be put into a new genus on account of the structure of the vertebral column, which presents an appearance as if possessed of ossified centra\*; but I can see no reason for associating this species with v. Koenen's *Brachydeirus*.

The following description of the structure of the bony skeleton of *Coccosteus* is therefore based upon an examination of the common and well-known species *C. decipiens*, Agassiz.

*Head*.—In Pl. X. fig. 2 the bones forming the cranial shield are sketched, as well as the ramifications of the lateral-line grooves. These bones are:—one median occipital (*m. o.*), two external occipitals (*e. o.*), two central plates (*c.*), two *marginals* (*m.*), two *postorbitals* (*pt. o.*), two *preorbitals* (*p. o.*), one *posterior ethmoidal* (*p. e.*), and one *anterior ethmoidal* (*a. e.*), between which last and the premaxillæ (*p. mx.*) the nasal openings (*n.*) are observable. I have already (13, p. 5) explained that I have applied those names without the intention of considering any of the bones exact equivalents of bones similarly named in ordinary fishes.

The orbit, the upper margin of which is formed by the excavated outer edges of the post- and preorbital buckler-plates, is completed below by the *superior maxillary* bone (*m. x.* fig. 1), which strongly resembles in shape that of typical Palæoniscidæ in being broadly expanded behind, where it covers the cheek, and suddenly excavated to form a tapering process

\* This is apparently the species "with a true bony vertebra" referred to by Murchison in 'Siluria,' 3rd ed. p. 504.

directed forwards under the eye to the premaxilla. To the posterior margin of the maxilla is fixed the *jugal* or post-maxilla, a triangular plate with posteriorly directed apex, which fills up the space between the maxilla and the lateral part of the body-cuirass.

So far as I can see, the maxilla of *Coccosteus decipiens* does not seem to have borne any teeth. But in a specimen from Gamrie in the Edinburgh Museum there is distinct evidence of the presence of both vomerine and palatal teeth. The specimen lies on its back, giving a beautiful view of the ventral cuirass, in front of which are the two rami of the mandible converging to meet each other anteriorly, while external to and in front of them the upper margin of the oral cleft is seen formed by the maxillæ and premaxillæ. No teeth are, as usual, seen on the maxillæ, but internal to them and between them and the contiguous mandibular ramus is seen a row of conical teeth, evidently placed on the edge of a palatal or palato-pterygoid bone, which I have not yet seen in its entirety. Also in front of the meeting of the mandibular rami and behind the premaxillary and ethmoidal region is a clump of five conical teeth, clearly vomerine in position at all events. It is also clear that the whole of the dentition of the front of the mouth is not here exposed, as the clump referred to is on the left side of the middle line, and the corresponding space on the right side is covered by the anterior extremity of the corresponding mandible.

The bone representing the mandible is well known from the description of Hugh Miller. It is an elongated, vertically-flattened plate (fig. 1, *mn.*), broader behind than in front, with rounded posterior extremity, slightly sigmoid contour when seen from the side, and near the anterior extremity sharply bent inwards towards its fellow. It is remarkable for having two sets of conical teeth, one consisting of a row of about half a dozen being situated about the middle of the upper margin of the bone, while another row of about the same number occupies the vertical anterior margin, which would otherwise be *symphysial*. This is certainly a very curious circumstance, and one is simply at a loss to imagine of what use teeth could be in such a situation, or how they worked. It was indeed the position of these peculiar symphysial teeth that led Hugh Miller originally to compare the working of the jaws of *Coccosteus* with those of an Arthropod (2, 1st ed. p. 57; see also footnote in 4th and subsequent editions).

There are no traces of ossified internal cranial bones, of hyoid or of branchial arches; consequently these parts must have been entirely cartilaginous. I may mention that the

bones figured by Huxley as "the chief parts of the hyoidean arch" are in reality the ventral rami of the dermal plates which I have termed "interlateral."

*Body-Cuirass.*—The front part of the body behind the head is encircled by a girdle of osseous dermal plates, somewhat comparable to a shoulder-girdle, expanded backwards dorsally and ventrally, while at the lower part of the sides the cuirass is so deeply cut in that the dorsal and ventral expansions were long considered to have no connexion with each other. Most of the osseous plates which form this cuirass are well known from the writings of Pander, H. Miller, and Sir P. Egerton, but nevertheless some correction is still necessary.

The great *median dorsal* plate (fig. 2, *m. d.*) is of an elongated pentagonal figure, its short base articulating with the median and lateral occipitals, its acute apex and elongated sides articulating with the two dorso-lateral plates, which it extensively overlaps. Its under surface shows the well-known median longitudinal ridge, ending behind in the "nail-head" prominence, as in the corresponding plate in *Homosteus*. The *anterior dorso-lateral* plate, the *os articulare dorsi* of Pander, (*a. d. l.*), is of a somewhat rectangular form when detached, though *in situ* it appears irregularly trapezoidal owing to its upper and lower margins being obliquely overlapped by the median dorsal and by the antero-lateral respectively; its anterior margin shows a small articular process by which it is joined to the external occipital. Immediately behind it is placed the *posterior dorso-lateral* (*p. d. l.*), or the *os triangulare* of Pander, a triangular plate which also articulates with the median dorsal above and the postero-lateral below, while its oblique hinder border is free.

The antero-lateral plate (*a. l.*), being the *os marginale* of Pander, occupies a position below and in front at the narrowest part of the lateral portion of the cuirass. It is peculiarly trapezoidal in shape, or it might be described as triangular, with the downward and forwardly directed apex obliquely truncated. Its anterior border, gently convex in the middle, forms part of the anterior margin of the cuirass, though it is for the most part shut out from that by the anterior dorso-lateral above and the interlateral below; its postero-superior margin, somewhat wavy or zigzagged, overlaps the anterior dorso-lateral besides articulating with the small postero-lateral. The postero-inferior margin is free and slopes obliquely downwards and forwards; the short anterior margin is fitted on to the interlateral. This antero-lateral plate is the one lettered "*c*" by Huxley (8, p. 30) and "3" by Hugh Miller (7, p. 133, fig. 6), though he has represented

the very same plate on the preceding page (p. 132, fig. 5, *z z*) as forming a part of the ventral cuirass.

The postero-lateral plate (*p. l.*) is a small one situated at the posterior angulated margin of the lateral part of the cuirass and articulates with the antero-lateral, the anterior dorso-lateral, and the posterior dorso-lateral, its posterior margin being free. This plate is not noticed by Pander or Huxley, but it is lettered 2 by Hugh Miller (7, p. 133, fig. 6).

The *interlateral plate* (*i. l.*) is one of great interest, as its form and relations have not yet been properly recognized. It consists of two parts, lateral and ventral, united at a considerable angle to each other when uncompressed, which, however, is very rarely the case. The lateral portion, seen in fig. 1, forms a sort of fork, on which the short inferior margin of the antero-lateral plate articulates, and thus is formed that connexion between the dorso-lateral and ventral portions of the cuirass which was unknown to Pander and Huxley, and which, so far as I am aware, has not previously been demonstrated. The lower limb of the fork forms a conspicuous rounded lower margin, tuberculated like the other plates, and bears a most suspicious resemblance to the part represented by Prof. v. Koenen as a pectoral spine in *C. Bickensis* (10, pl. ii. fig. 2). In *C. decipiens* it is, however, very much shorter than the part alluded to in *C. Bickensis*; however, in *C. minor* it attains a very considerable proportional length (13, pl. i. fig. 3, *i. l.*). The ventral portion (see fig. 3), devoid of tubercular ornament, is elongated in shape, and, passing inwards and slightly forwards to meet its fellow of the opposite side, forms the anterior margin of the ventral portion of the body-cuirass; to it posteriorly are articulated the anterior ventro-lateral and the anterior median plates. This part of the bone was known to Pander, and is represented in two of his figures (6, pl. ii. fig. 2, and pl. v. fig. 1, *a*), though in the text he compared it with the jugular plate in *Polypterus* or *Osteolepis*. Huxley, on the other hand (8, p. 35, fig. 21, *a*), considered the bone to be hyoidean in its nature, as we have already noticed.

Neither Pander nor Huxley seems to have recognized the lateral portion of this bone, which serves to articulate the dorso-lateral portion of the cuirass with the ventral; indeed, Huxley remarks (8, p. 32) that "the ventral shield appears to me to have had no connexion with the dorsal." But of the connexion of the two in the manner I have described there cannot be the slightest doubt. See also my figure of the parts in *C. minor* (13, pl. i. fig. 3).

The plates forming the expanse of the ventral shield are



already so well known from the figures of Pander and Hugh Miller that I need hardly enter into detail regarding them, especially as I have in Pl. X. fig. 3 accurately given their respective shape and mode of overlap. They are six in number:—*anterior median ventral* (*a. m. v.*), *posterior median ventral* (*p. m. v.*), two *anterior ventro-laterals* (*a. v. l.*), and two *posterior ventro-laterals* (*p. v. l.*). I may, however, mention that, judging from the course of the lateral-line groove on the anterior ventro-lateral plate, Pander has reversed its position, putting the front end behind and *vice versâ*; for we shall presently see that on this plate the sensory canal occurs on the anterior and not on the posterior part of its surface.

*Distribution of the Lateral-line Grooves.*—The course of the lateral sensory canal is indicated on certain of the dermal bones by conspicuous grooves, which, as in the case of *Pterichthys* and *Bothriolepis*, have often been mistaken for sutures. There is, however, no difficulty in distinguishing them from sutures, when one by experience really comes to know the characteristic appearance of the latter.

On the anterior half of each anterior ventro-lateral plate is seen a curved groove, starting from near the middle of the anterior margin and then curving sharply round to proceed to the inner border close behind the antero-internal angle. On the median dorsal plate a groove is seen of a V-shaped contour, the apex being in the middle line somewhat in front of the posterior extremity of the bone, the limbs diverging forwards towards the superior margin of the posterior dorso-lateral plate. On the anterior dorso-lateral plate a continuation of this groove runs forwards to the postero-internal angle of the external occipital, near which it is met by a branch coming diagonally upwards and forwards from the postero-inferior angle of the plate. The side-canal thus formed passes now on to the cranial shield at the point indicated, and there at once gives off a branch running forwards and slightly inwards, parallel with and close to the outer margin of the median occipital, becoming lost on the posterior margin of the central. The main groove then runs forwards and outwards parallel with the outer margin of the shield, giving off first a branch passing to the external projecting angle of the marginal plate, then turning forwards and inwards still parallel to the shield-margin it passes on to the postorbital plate, where it gives off another branch to the postorbital angle. Here it bends sharply backwards and inwards at an acute angle, runs on to the central plate, approaching its fellow of the opposite side, and near the middle of this plate it again

turns sharply forwards, passes on to the anterior part of the preorbital and ends near the small nasal opening in front. In some specimens a cross commissural branch is seen on the central plates, connecting the two main trunks at the conspicuous angles which they make in that place.

A groove is also observable on the maxilla, apparently continued from the second external branch of the main groove on the postorbital, and passing along as a suborbital branch close to the hollowed-out orbital margin of the bone. It gives off behind the eye another branch, which passes in a curved manner downwards and backwards towards the margin of the bone posteriorly.

*Sclerotic Ring*.—A specimen from Gamrie in the Edinburgh Museum shows evidence of a sclerotic ring such as has been figured by v. Koenen (10, pl. ii. fig. 2, pl. iv. fig. 2).

*Internal Skeleton*.—In the typical *Coccosteus decipiens*, Ag., there is no trace of vertebral centra, the space occupied by the persistent notochord being always empty in the fossils. Agassiz in his restored figure (1, pl. vi. fig. 3) has represented on both dorsal and ventral aspects of the notochordal space a continuous row of distally-pointed neurapophyses and hæmapophyses, also a dorsal and anal fin situated opposite each other, each supported in Teleostean fashion by a series of proximally-pointed interspinous bones, dipping down between the neurapophyses, the supposed fin-rays being, according to the same idea, pointed at their extremities. Pander (6, pl. iv. fig. 1) still retains the two median fins, with the long hæmapophyses in front of the anal, though he was more correct in making the interspinous bones articulate end to end with the neurapophyses by expanded extremities. But though M'Coy had previously (5, p. 602) strongly doubted the existence of an anal fin in *Coccosteus*, Pander's figure has been copied into almost every text-book; Prof. von Koenen has transferred the body-skeleton and fins as there represented to his restoration of the allied genus *Brachydeirus*, while the anal fin is also mentioned as present by Zittel in his handbook (14, p. 160). M'Coy was, however, correct—there is no anal fin in *Coccosteus*; but besides this Pander's figure is incorrect in other points, which I shall now indicate.

It is not possible to trace the vertebral column to its commencement, owing to its obscuration by the dorso-lateral cuirass; where it first becomes visible is about the middle of the length of the great median dorsal plate. There we find short broad neural pieces continued obliquely backwards and upwards into neural spines, which gradually lengthen until we come to the dorsal fin, which commences a little beyond

the apex of the plate just mentioned. Here we have two sets of interspinous bones articulated end to end with each other and with the neural spines, which latter are truncated and not pointed. In a very good specimen in the British Museum I count about fifteen ossicles in the proximal set and twelve in the distal, though probably the numbers were equal in the perfect state, and in both sets they have the same form, namely they are slender, elongated, and expanded at both extremities. It is evident from the last-mentioned circumstance that the ossicles of the second row are not dermal fin-rays, but belong to the same category as those of the first; two rows of interspinous bones being, in fact, of constant occurrence in the primitive Ganoids.

Beyond the dorsal fin the neural spines become very short as well as less oblique in their direction.

On the hæmal aspect of the vertebral axis no such elongated apophyses occur anteriorly, as depicted in the restorations of Agassiz and Pander. Immediately behind the lateral plates of the cuirass we find small, nearly circular, hæmal pieces *without spines*, then spines are added which, gradually lengthening, become longest in the region opposite the dorsal fin, whence they again diminish towards the extremity of the tail. It is this peculiar lengthening of the hæmapophyses under the dorsal, a fact also noticed by M'Coy, which has evidently given rise to the old idea of the presence of an anal fin.

In all specimens of *Coccosteus* where the internal skeleton is well preserved there is found a pair of peculiar slender bones (*x*), each of which is pointed at both ends and bent below the middle at an obtuse angle in somewhat L-shaped fashion, the long limb pointing upwards towards the vertebral axis, the short one forwards. These bones were noticed by Pander (6, p. 73), who, though extremely doubtful as to their nature, supposed that they "vielleicht den Extremitäten als Stützen der weichen Flossen angehörten." Their position is certainly suggestive of their having had something to do with pelvic limbs—more I cannot say.

Mr. A. Smith Woodward has pointed out to me that in several specimens in the British Museum a small oval or somewhat rhombic bony plate (*y*) is seen lying in a position posterior to the last-mentioned bones. I have not observed it in any other specimens than those; but its presence in a similar position in more than one example would seem to indicate that it was a scute placed in the ventral mesial line.

*Were pectoral members present?*—I have now examined with the utmost care a very great number of specimens of

*Coccosteus decipiens* in all conditions of preservation and from all the beds and localities of the Scottish Old Red Sandstone which have yielded such remains, including the collections in the British Museum, in the Museum of Practical Geology, in the Edinburgh Museum of Science and Art, the Gordon-Cumming collection at Forres, and many others, but without meeting with any other parts either of endo- or exoskeleton than those I have described. And, in particular, I have not seen the smallest evidence of the presence of any pectoral limb, nor any trace of an articular surface on any of the bones to which such a limb could have been articulated. It can scarcely be believed that had such a limb been present it would either have escaped preservation or observation in so large a number of specimens. Nevertheless more than one author has been disposed to believe in the presence of such a limb in *Coccosteus*.

In the restored figure of *Coccosteus* given by Hugh Miller in the first edition of the 'Old Red Sandstone' (2, pl. iii.) no limb is represented, and its absence is positively affirmed in the text. But in subsequent editions, and also in Duff's 'Geology of Moray' (3, pl. viii. fig. 1), a peculiar "paddle-shaped" body is represented appended to the head. However, Hugh Miller, in a footnote, explains that he has ascertained that the supposed arms "were simply plates of a peculiar form." Of course there is not the smallest doubt that the idea of this limb owed its origin to a displaced maxillary bone.

But more recently, in connexion with what appear undoubtedly to be fragments of a large and peculiar form of *Coccosteus*, Trautschold (9 and 11) has described and figured from the Old Red Sandstone of Russia certain peculiar bodies, which he considers, though not without doubt, to appertain to supposed large arms or "Ruderorgane" belonging to that species, which he accordingly names *Coccosteus megalopteryx*. What the fragments are to which he applies the term "Oberarm" I have not the slightest idea, as I have not seen them, and certainly nothing like them has ever been found along with *Coccosteus decipiens*. But with regard to the peculiar flat triangular bodies represented in his first memoir on the subject (9, tab. vi. and tab. vii. fig. 2), I have had the privilege of examining two specimens contained in the British Museum.

In the first place there is no evidence whatever that these bodies belong to *Coccosteus* at all, any more than the supposed "Oberarm," as nothing in any way resembling them has ever been seen in connexion with the most perfect specimens of *C. decipiens*, the type of the genus, which the Scottish Old Red

Sandstone has afforded. Prof. v. Koenen has also expressed grave doubts (10, supplementary note) as to their having belonged to *Coccosteus*, though he thinks it not impossible that the piece referred to as "Oberarm" may be identical with the "stabförmiges Ruderorgan," the existence of which he himself maintains.

In the second place it seems to me highly probable that they are Selachian appendages; indeed, their form and appearance is strongly suggestive of an affinity with *Oracanthus*, which is certainly Selachian, although some years ago Mr. J. W. Davis was inclined to refer it to the Placodermi, though *not* as a pectoral limb. These so-called "Flossen" are flat bodies, of a horn-shaped outline, pointed, with one margin convex, the other concave, truncate base, and rounded lateral edges. A great part of the surface is sculptured with closely-set tubercles, which are occasionally irregularly elongated, and all with stellate bases; these tubercles being an integral part of the substance of the appendage, the term "Schuppenhaut" applied to them by Prof. Trautschold seems hardly appropriate. The basal margin of the body is not tuberculated but striated, and this striated portion extends further up on one side than on the other.

Now, Prof. Trautschold admits (11, p. 36, note) that the body figured by Pander as an "*ichthyodorulithe*" (6, pl. vii. fig. 22) is identical with the end of one of the supposed "fins" of *Coccosteus megalopteryx*; and if so, then its microscopic structure is not that of a Coccostean bone, but of a Selachian appendage. For here are the words in which Pander refers to the body in question:—"Fig. 22. Ein *Ichthyodorulithe*, mit ausgezeichnet schönen Sternen auf beiden Flächen und Kanten. Die Sternchen sind äusserlich von denen von *Asterolepis*, *Coccosteus* und *Homosteus* unmöglich zu unterscheiden, aber die microscopische Structur ist ganz verschieden. Knochenhöhlen fehlen gänzlich. Die Tuberkel bestehen aus wahrer Dentine und die ganz innere Masse aus einem Gewebe von Markcanälen, umgeben von concentrischen Kreisen, in der Grundsubstanz, welche von den nach allen Seiten ausstrahlenden feinen Zahnröhrchen unter rechten Winkeln durchschnitten werden" (6, pp. 102, 103). From this description, along with Pander's figure of the microscopic structure (*ib.* fig. 34), the true nature of these bodies is, I think, pretty evident.

I am therefore quite unable to accept Prof. Trautschold's views as to the "fins" of *Coccosteus*.

But, as already mentioned, Prof. von Koenen has affirmed the presence in *Coccosteus* of a "Ruderorgan," and in his re-

stored figure of his "subgenus" *Brachydeirus* (10, pl. iv. fig. 1) he has represented the same as a long, pointed spine diverging backwards from the antero-inferior angle of the antero-lateral plate of the cuirass. In tab. ii. fig. 2 of the same work he has also represented the spine *in situ* in a specimen of *Coccosteus Bickensis*, v. Koen.; but the supposed spine is here much shorter than in the restoration, and lies horizontally just below the antero-lateral plate, in the very spot where the outer margin of the interlateral plate occurs in Scotch specimens of the genus. I have already stated that the appearance here is strongly suggestive to my mind that this "Ruderorgan" or pectoral spine is nothing but the outer *Kante*, as the Germans would call it, of the interlateral plate. But though the corresponding part in *C. decipiens* is very much shorter than that here represented, it attains a very considerable proportional length as well as a *very spine-like appearance* in *C. minor*, H. Miller, as is shown in my outline figure of that species (13, pl. i. fig. 3). That it should also attain similar proportions in other species is highly probable.

Of course I have not seen Prof. v. Koenen's specimens, and it is not always safe to judge from figures and descriptions alone. This much I am, however, entitled to say—that if such a pectoral swimming-organ really does occur in Prof. v. Koenen's species *Bickensis*, that species cannot be referred to *Coccosteus*, in which no such organ is present. And, again, if it is present in *Brachydeirus bidorsatus*, v. Koen., then *Brachydeirus* is not merely a "subgenus" of *Coccosteus*, but a genus with a very great distinction indeed.

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136 *On the Structure of Coccosteus decipiens, Agassiz.*

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EXPLANATION OF PLATE X.

(In all the figures the same letters refer to the same things.)

|                                    |   |
|------------------------------------|---|
| <i>m. o.</i> Median occipital.     | <i>m. d.</i> Median dorsal.               |
| <i>e. o.</i> External occipital.   | <i>a. d. l.</i> Anterior dorso-lateral.   |
| <i>m.</i> Marginal.                | <i>p. d. l.</i> Posterior dorso-lateral.  |
| <i>c.</i> Central.                 | <i>a. l.</i> Antero-lateral.              |
| <i>pt.o.</i> Postorbital.          | <i>p. l.</i> Postero-lateral.             |
| <i>p.o.</i> Preorbital.            | <i>i. l.</i> Interlateral.                |
| <i>pt. e.</i> Posterior ethmoidal. | <i>a. m. v.</i> Anterior median ventral.  |
| <i>a. e.</i> Anterior ethmoidal.   | <i>m. v.</i> Median ventral.              |
| <i>p.mx.</i> Premaxillary.         | <i>a. v. l.</i> Anterior ventro-lateral.  |
| <i>n.</i> Nasal opening.           | <i>p. v. l.</i> Posterior ventro-lateral. |
| <i>mx.</i> Maxillary.              | <i>x.</i> Peculiar internal bones.        |
| <i>j.</i> Jugal.                   | <i>y.</i> Posterior ventral plate.        |
| <i>o.</i> Orbit.                   | <i>mn.</i> Mandible.                      |

- Fig. 1.* Restored outline of the skeleton of *Coccosteus decipiens*, Agassiz. The dotted lines indicate the ramifications of the lateral-line system; the thin lines on the body-cuirass here and in *fig. 3* denote the overlapped edges of the plates.
- Fig. 2.* View of the head and dorso-lateral portion of the body-cuirass from above.
- Fig. 3.* View of the ventral portion of the body-cuirass from below. The thin lines denote the overlapped edges of the plates.