

Article VII.—SOME POINTS IN THE STRUCTURE OF THE DIADECTID SKULL.

By R. BROOM.

The skull of *Diadectes* has been described by Cope, Case, v. Huene, and Williston, and as there are many fairly good specimens in the American Museum and other collections, most of the structure is pretty well known. There are, however, a number of points on which there is considerable doubt.

Very full accounts of the skull have been given by Case and v. Huene, and in the present paper I shall only deal with a few disputed points.

Four years ago I gave a side view of the beautiful skull in the American Museum collection, No. 4839, and indicated the sutures between the cranial elements. V. Huene in his recent paper casts doubts on the accuracy of my determinations, saying that "the skull . . . shows on the outside no clearly discernible sutures, so that Broom's figures remain hypothetical." During my short visit to the American Museum four years ago, I devoted most of my time to the study of the Pelycosaur, and only examined this one skull of *Diadectes*. In fact I was not aware that there were any other good skulls of the genus in the American Museum collection. I have recently carefully gone over again this skull and compared it with quite a number of other specimens in the collection, and find that every suture indicated in my 1909 paper is absolutely accurate with the exception of those in the post-temporal region. The skull has been prepared by having the surface smoothed off down to the bone, and as in *Diadectes* the cranial elements other than those of the occiput are not ankylosed, every suture can be traced by simply following with a lens the lines of matrix, and the only chances of error are by mistaking cracks for sutures.

One of the best skulls in the American Museum collection is that numbered 4352. Cope referred it to *Diadectes phaseolinus* in 1883 and Case in 1911 regarded it very doubtfully as belonging to *Diadectes molaris*. He gives a figure of the upper side in which the reduction is given as $\frac{3}{8}$. This is an error probably due to reduction of the original figure to suit the plate. It is more nearly $\frac{3}{4}$ natural size. V. Huene gives upper, lower, and side views of the specimen and calls it *Diadectes molaris*. If specimen No. 4350 which is the neotype of *Diadectes molaris* be correctly identified, as seems very probable, specimen No. 4352 cannot be the same species as it differs from it very greatly. Nor can it be *D. phaseolinus*. In fact it differs so markedly from all other species that I have no hesitation in making it the

type of a new species which I have much pleasure in calling *Diadectes huenei*. The skull measures 258 mm. in length, and the dental series from the root of the 1st incisor to the root of the last molar is about 137 mm. The incisors are very large, the root of the 3rd measuring 14.5×9 mm. The 4th is

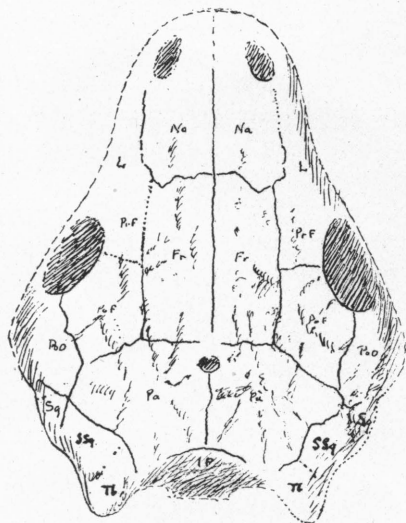


Fig. 1.

Fig. 1. Skull of *Chilonyx rapidens*. Am. Mus. No. 4357.

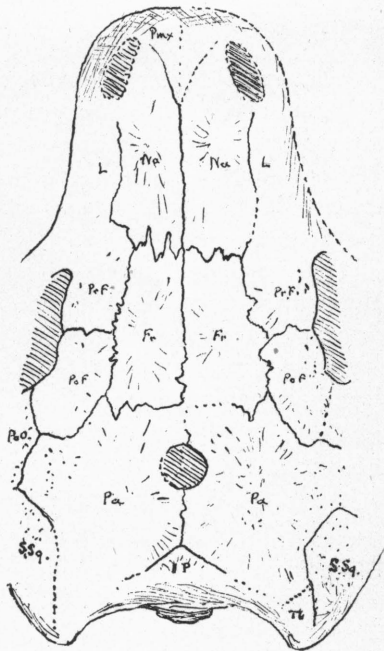


Fig. 2.

Fig. 2. Skull of *Diadectes huenei*. Am. Mus. No. 4378.

relatively considerably smaller. The 1st maxillary tooth is absent but the socket shows that it and the 2nd maxillary teeth were both larger than the 3rd and 4th teeth. There are altogether 12 maxillary teeth and the series measure 94 mm. The following are comparative measurements of the teeth in the 6 species represented by good specimens.

	maxillary series	5 largest teeth
<i>Diadectes molaris</i> Cope	68	38
<i>Diadectes phascolinus</i> Cope	72	35
<i>Diadectes fissus</i> Cope	—	52
<i>Diadectes latibaccatus</i> Cope	80	33
<i>Diadectes lentus</i> Marsh	56 ¹	29 ¹
<i>Diadectes huenei</i> Broom	94	44

¹ These measurements are taken from the figure given by Case and Williston.

I have given views of the upper surface of the skulls of *Diadectes huenei* and of *Chilonyx rapidens*, another Diadectid, showing the position and rela-

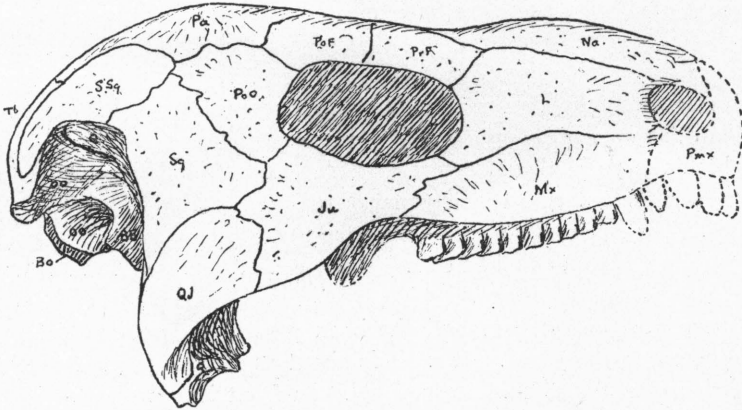


Fig. 3. *Diadectes molaris*. Am. Mus. No. 4350.

tions of the upper cranial elements. On the whole my drawings agree fairly closely with those of v. Huene.

The nasals, frontals, prefrontals (lacrymals), and postfrontals are, in my opinion, exactly as figured by v. Huene. I differ, however, as regards the parietals. In all Diadectids the parietals are very large, and pass outward and backward for a very considerable distance from the parietal foramen. The bone marked *So* (supraoccipital) is in my opinion the interparietal, and there is, I believe, no other bone between this and the parietal. This is also the opinion of Case.

The bones of the post-parietal and occipital regions are best seen in the American Museum specimen No. 4378, also figured by v. Huene and referred by him doubtfully to *Notodon lentus*. In the absence of the front of the skull, there is of course doubt about the determination of this specimen, but it agrees sufficiently closely with speci-

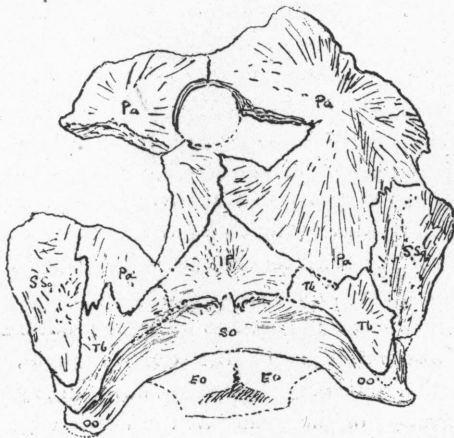


Fig. 4. *Diadectes huenei*. Am. Mus. No. 4378.

men No. 4352 as to lead me to believe that it is also *Diadectes huenei*. In this specimen it is perfectly manifest that fitting in between the posterior borders of the parietal is a triangular bone which may be referred to as the interparietal. It is a single median element, but from the direction of the fibres of the bone it seems probable that it has originated from two centres of ossification. Assuming this to be the case, it would manifestly be homologous with the postparietals (dermo-supraoccipitals) of the Stegocephalians, as is also the opinion of v. Huene.

Behind the parietal and external to the interparietal, is a small bone which forms the outer posterior corner of the skull. This is manifestly the tabulare. The sutures between the interparietal, parietal and suprasquamosal and the tabulare can all be clearly made out in specimen No. 4378, and are as indicated in my figure.

External to the tabulare and the back part of the parietal is a well developed suprasquamosal. It extends about as far back as the tabulare, and forwards as far as the interparietal. In front it articulates with the squamosal. This region of the skull has hitherto been misunderstood by Case, von Huene, and myself. In the drawing of the skull which I published four years ago I took the suture between the squamosal and the suprasquamosal for a fracture and made the squamosal extend too far up and include the greater part of the suprasquamosal. In specimen No. 4378 the sutures between the suprasquamosal and the tabulare and the parietal are beautifully shown and are as I have indicated in the figure.

The structure of the occiput cannot be made out with absolute certainty owing to some of the bones being ankylosed in all the specimens, but by tracing the direction of the fibres of the bones it is possible to be moderately sure of the structure.

Below the interparietal is a large supraoccipital, separated from it by a suture. It is about equal in size to the interparietal. Laterally it is indistinguishably fused with the opisthotic but it is only very loosely articulated with the exoccipitals below — so loosely that in most specimens the basioccipital and exoccipitals are detached.

The exoccipitals are relatively very small. They form the whole of the lateral walls apparently of the foramen magnum and the outer and upper fifth of the occipital condyle.

External to the exoccipital and supraoccipital is a large opisthotic. It is fused into a single mass with the prootic and supraoccipital.

The relations of the quadratojugal, jugal, squamosal, postorbital, maxilla, and lacrymal are as shown in my previous drawing except for the correction of the suture at the upper edge of the squamosal which I have corrected in my new figure.

Case and Williston in a recent paper have called attention to "certain

errors" in my restoration. They say, "Broom shows an enlarged anterior maxillary tooth resembling a canine, a diastema, and a decrease in the size of the incisors from within outward. The character of the incisors is evidently hypothetical as they are shaded, but the arrangement is wrong as can be made out from this specimen and from several others in the American Museum. There is no diastema and in no specimen of *Diadectes* is there any indication of an enlarged maxillary. It was upon such an error that Cope founded the genus *Empedias*."

My drawing of the premaxillary was mainly hypothetical, as I had not seen any specimen, and founded the restoration on a drawing of Cope's. As there is no specimen of *Diadectes phaseolinus* known so far as I am aware, except the type and this one skull, I do not think either Case or Williston is in a position to criticize the restoration, nor is it a matter of much importance. I have since compared the restoration with all the specimens of various species of *Diadectes* in the American Museum, and there is not anything in the restoration which I would be inclined to alter except in that the fourth incisor should probably be placed closer to the canine, and the crowns of the incisors made longer and directed more forward.

With regard to the criticism of my drawing for placing an enlarged anterior maxillary tooth, I do not see any occasion for any alteration. It is a matter of very little importance whether, when the first maxillary tooth is rounded and enlarged and not molariform, we are justified in calling it a canine; but it seems to me there can be no objection in doing so, as has been done by Cope. But when Case and Williston go the length of saying that "in no specimen of *Diadectes* is there any indication of an enlarged maxillary [tooth]," they are entirely in error in a matter of fact. One has only to turn to Case's Plate 3 to see a photograph of the palate of *Diadectes phaseolinus* showing the enlarged, rounded anterior maxillary tooth, and in his text figures (Fig. 20, B and E) the tooth is even better shown. There may be a little doubt as to whether this specimen belongs to *Diadectes phaseolinus*, as at present we know nothing of the sexual variations of any of the species, and though this specimen has a larger canine than is found in the type, it may be that the one is a male and the other a female. Certainly the two specimens agree so closely in the dental measurements of the maxillary teeth as to lead one to infer that they belong to the same species. The first maxillary tooth has a greater antero-posterior diameter than any of even the largest molariform teeth. In *Diadectes huenei* the first incisor is missing but probably as large as the second, the second is very large, the third rather smaller and the fourth considerably smaller; and the first maxillary tooth, though smaller than the first three incisors, is larger than the fourth, and has a greater antero-posterior diameter than any of the molariform teeth succeeding. In the specimen which forms the neotype of *Diadectes molaris*,

the incisor teeth are small, the largest one being only about one-third the size of the largest molar, and the first of the maxillary teeth is quite small. The incisors steadily decrease in size from the first to the fourth. In a specimen, No. 4370, Am. Mus., which not improbably is *Diadectes fissus* Cope, the front incisors are large but the outer incisors steadily decrease in size to the fourth, which is quite small, and the first maxillary tooth is also quite small. In a specimen which is in my opinion *Diadectes latibaccatus* Cope, the incisors are all fairly large, the fourth only being slightly smaller than the first, and the anterior maxillary teeth are also small, though the first one is larger than the three succeeding teeth, and rounded. It would thus appear that in most specimens of *Diadectes* the first maxillary tooth, though smaller than the largest of the incisors, is larger than the two or three maxillary teeth succeeding it, and generally larger than the fourth incisor in front of it. Occasionally, as in the specimen of *Diadectes phaseolinus* which Case and I have figured, the first maxillary tooth is very distinctly larger than the immediately succeeding maxillary teeth.

Reference may be made to one or two points in the structure of the palate. There is no doubt from an examination of the palate in *Diadectes huenei* as pointed out by Huene that the median pair of toothed ridges are not entirely formed by the prevomers as I had inferred but that the posterior part is formed by the pterygoids. It is also probable that the pterygoids pass much further back than as indicated in my restoration.

In the restoration I gave of *Diadectes phaseolinus* I indicated the presence of a transpalatine (ectopterygoid), and Case has stated that in specimen No. 1078 University of Chicago "an imperfect ectopterygoid can be traced," though he failed to detect one in the Am. Mus. specimen No. 4839. V. Huene states, "Broom assumes the presence of a transverse, and I think I can verify this on skull 4352 (right) but towards the jugal I can find no suture." Case and Williston in their recent paper say, "There is no evidence of an ectopterygoid. This bone has been in question, but it seems to us there can no longer be doubt of its absence."

In the type of *Diadectes huenei* the transpalatine can in my opinion be clearly seen, the suture between it and the palatine and maxilla being quite distinct as shown by Huene, and quite as distinctly the suture between the transpalatine and the pterygoid. The suture between the transpalatine and the jugal is less distinct in this specimen but is quite distinct in specimen No. 4839 Am. Mus. though my drawing of 1909 indicates it a little too far out.

If the drawings given by Case and Williston of *Diadectes lentus* and *Ani-masaurus carinatus* be compared the position and relations of the transpalatine will be readily seen. In the specimen shown in fig. 1 it has been completely detached; in the specimen represented by fig. 3 it is present.