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H. G. SEELEY.

ARISTODESMUS RÜTIMEYERI (WIEDERSHEIM).

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On an Anomodont Reptile, *Aristodesmus Rütimeyeri* (Wiedersheim) *from the* Bunter Sandstone *near* Basel. By Prof. H. G. Seeley, F.R.S., V.P.G.S., F.L.S.

I. Introduction.

Dr. Robert Wiedersheim, of Freiburg-im-Breisgau, has described a remarkably perfect skeleton of a small reptile, which is known as *Labyrinthodon Rütimeyeri*. The remains are a natural mould of the bones, in friable sandstone contained in two slabs, so divided as to display in many cases the under and upper surfaces of the cavities from which the bones have been dissolved away. The fossil was found at Riehen, near Basel, in the Bunter Sandstone; and is preserved in the Museum of the University of Basel. Prof. Wiedersheim made a restoration of the skeleton, which was published in 1878, with figures of both slabs, by the Swiss Palæontological Society.

The animal is said to show no trace of abdominal armour, such as characterizes *Archægosaurus* and most Labyrinthodonts. It does not possess the breast-girdle of median and lateral sculptured bones, found in Labyrinthodonts; and the skin is inferred to have been naked. The external surface of the skull, which would have demonstrated its form and structure, is not available, having been, as Prof. Wiedersheim states, chipped away to expose the internal mould of the head. The bones are said to have been smooth and free from sculpture; and on that account the skull is compared to *Hylonomus* of the Coal Measures.

It was regarded as an Amphibian, in opposition to Von Meyer's view that the Labyrinthodontia are true Reptilia.[1] The type is unique in Europe. The original figures were unsatisfactory, and I applied to the late Prof. Rütimeyer for casts of the slabs; but in his judgment the delicate nature of the specimen did not warrant the taking of impressions, which would show the bones in relief. The photographs which he sent me proved the animal to be an Anomodont reptile, more perfect and interesting than any specimen which was previously known, with the exception of *Pareiasaurus*. Prof. Rütimeyer made application to the Trustees of the Basel Museum to allow me the opportunity of studying the remains in this country. This arrangement was facilitated by the kindness of the late Sir William Flower, who received the fossil on my behalf in the Natural History Museum. Those most experienced in such work were unwilling to take the responsibility of making moulds from the

[1] Prof. Zittel discusses the specimen in a short note in the Neues Jahrb. 1888, vol. ii, p. 257. He doubts the existence of Labyrinthodont structures, and states reasons why the fossil might be a reptile. Further, he quotes a letter in which Prof. Wiedersheim agrees with him in regarding the fossil as a reptile, and indicates some resemblance in it to lizards and to Rhynchocephalia. In 1890 Prof. Zittel ('Handbuch d. Paläontologie' vol. iii, pt. i, p. 597) suggests that it is possibly Protorosaurian, classifying it under Rhynchocephalia.

slabs. Accordingly, in the following description I rely upon impressions of bones, taken by myself from such parts of the skeleton as would manifestly yield prints without the possibility of injury to the matrix.

These impressions suggest modifications of Prof. Wiedersheim's osteological interpretations of the bones. What was regarded as the humerus, I describe as the interclavicle. The scapula of Wiedersheim's fig. 1 is the humerus; the supra-scapula in his fig. 2 is the left coracoid; but in fig. 1 it is the right scapula. The bones interpreted in 1878 as right and left coracoids are the precoracoid and coracoid of the right side of the shoulder-girdle. The bones named clavicles are ribs. A row of teeth drawn upon the palate in the restoration, is doubtfully indicated in the specimen. In place of the four digits to the hand, I find indications of five. These modifications of interpretation reopen the question of the animal's organization. The only alternative supported by evidence of structure is, whether the remains should be referred to a Triassic mammal, or to an Anomodont reptile. Against a mammalian interpretation is, firstly, the presence of a large parietal foramen; and secondly, a composite structure of the lower jaw. There is also the presence of prefrontal, and perhaps postfrontal, bones in the skull, though as the external surface has been chiselled away the evidence on these points is not complete; and at the close of this paper evidence is adduced to show that those bones are found in *Ornithorhynchus*, together with a reptilian structure of the malar arch.

The Anomodont structure may be affirmed, firstly, on a general resemblance of the skull to the skull in *Procolophon*; secondly, there is absolute correspondence of the shoulder-girdle with that region in Anomodont types, and a close approximation to *Procolophon*; thirdly, the great transverse expansion of the proximal and distal ends of the humerus, which, like the shoulder-girdle, is only paralleled in Anomodonts and Monotremès; fourthly, a general correspondence of the vertebræ in plan, and especially in the articulation of the ribs, with *Pareiasaurus* and *Echidna*; fifthly, the Anomodont form of the pelvis, without an obturator-foramen between the ischium and pubis, or a perforation in the acetabulum; sixthly, the close parallelism in form of the femur to *Echidna*; seventhly, the general resemblance of the tibia and fibula to those of *Pareiasaurus*; and, eighthly, the structure of the tarsus, where the proximal row consists of a single bone formed from the anchylosed astragalus and os calcis.

The most distinct approximations to *Procolophon* are the un-anchylosed condition of the bones of the shoulder-girdle and pelvis; and the form of the skull, and smooth condition of the skull-bones. In so far as the fossil diverges from *Procolophon* and *Pareiasaurus*, it approximates to *Echidna*, especially in the characters of the limb-bones, such as the humerus, ulna, femur, fibula, and proximal elements of the tarsus.

As the genus is new, the fossil may be known as *Aristodesmus Rütimeyeri* (Wiedersheim).

II. Description of the Fossil.

The Skull.

Prof. Wiedersheim states that the surface of the skull was smooth and without sculpture. The cast from the interior of the skull gives practically no evidence of the extent of the cranial bones, individually. The skull-bones which roofed over the head were unusually thick, especially between the orbits of the eyes, where the frontal bone is quite crocodilian in its thickness, flattened inferior surface, and the way in which the orbits excavate its sides concavely. These lateral curvatures are the chief means of determining the positions of the eyes: they appear to have been placed in the middle length of the upper lateral margin of the head.

In general form the skull is triangular, about intermediate between *Procolophon* and *Pareiasaurus*. Apparently the head was closed behind, more on the pattern of *Rhopalodon*, than of South African genera. There is no descending pedicel for the lower jaw. Prof. Wiedersheim figured indications of ten teeth in the premaxillary and maxillary bones, which are represented as having nearly cylindrical crowns on the right side; but without any indication of separation of incisors from molars, by a functionally developed canine. In this respect, *Aristodesmus* parallels *Procolophon* and *Pareiasaurus*. The snout is flattened, and transversely rounded in front. The nares were manifestly terminal, though they are not preserved.

The internal mould of the skull in *Procolophon* makes a close parallel to this fossil in the flattened, rounded, pre-orbital nasal region, which is traversed by similar longitudinal ridges beneath the nasal bones. The sides of the skull contract in front of the orbits, in a way that is characteristic of *Procolophon* and of many Theriodonts.

On the palate there are obscure appearances, as of broken crowns of short lateral rows of palatal teeth, like those of *Procolophon*.

The Mandible and Teeth. (Figs. 1 & 2, p. 623.)

The lower jaw is very short as compared with the length of the skull, resembling in this respect both *Pareiasaurus* and *Procolophon*. The relation in length between the lower jaw and the skull in *Pareiasaurus* is as 11 : 16, in *Procolophon* as 13 : 20, and in this fossil as 12 : 16, showing very similar proportions. In the inferior slab, the under aspect of the jaw is exposed. It has a broad V-shaped form, which rather recalls *Procolophon* than *Pareiasaurus*. The median symphysis is as well-marked on the inner side and base as in either of those genera. The splenial bone appears to form the inner side of the jaw, which is concave from above downward and in length. The inferior suture, which marks its junction with the dentary bone, appears to run along the inferior edge, as in *Procolophon*. As exposed, the inner side of the jaw does not increase much in depth as it extends from front to back. At the angle of the jaw, which is not much behind its middle length, its depth is greatest. The jaw widens transversely from side to side: seen externally on the left side, it is remarkable for the distinct inferior angular process. There is a prominent longitudinal lateral ridge, towards

Fig. 1.—*Inferior aspect of the mandible of* Aristodesmus Rütimeyeri, *showing the median suture between the rami, the angle, and the composite structure.* (*Nat. size.*)

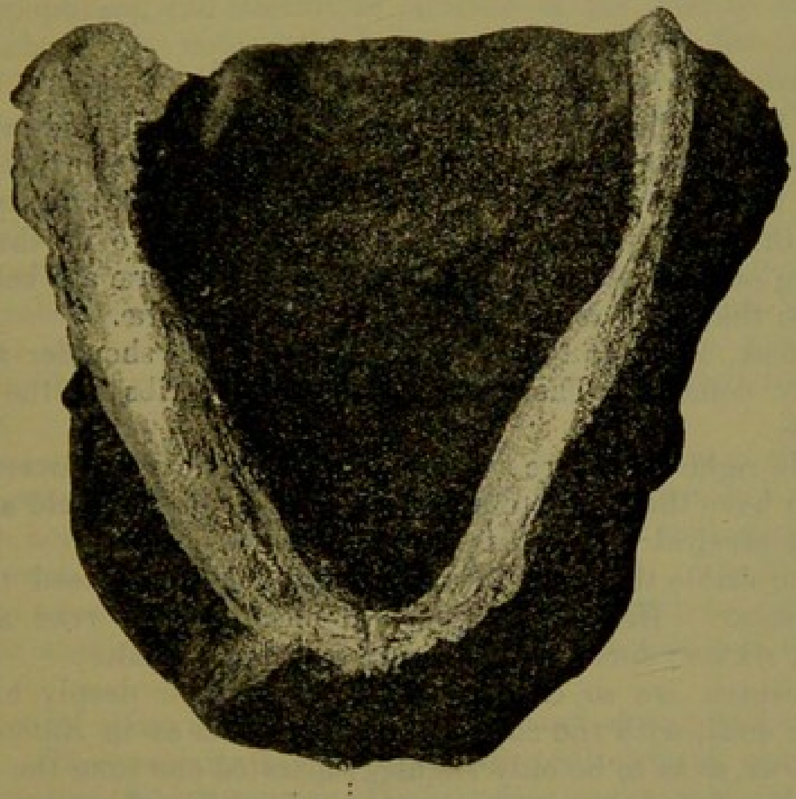
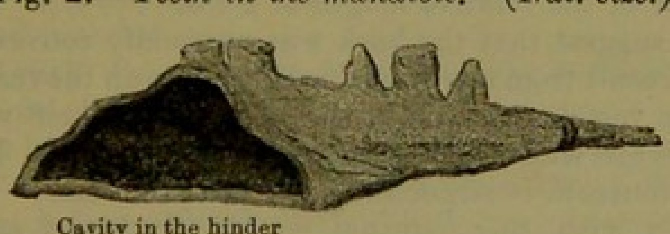


Fig. 2.—*Teeth in the mandible.* (*Nat. size.*)



the base of the jaw, behind the angle, as though for the attachment of the masseter-muscle. There was no heel extending behind the lower jaw. It may be compared with fig. 5, p. 330 in Phil. Trans. Roy. Soc. vol. clxxxiii (1892) B.

The mandible is not in articulation with the skull, but slightly displaced laterally. The external surface of the dentary bone is tumid, curving forward towards the symphysis. About six teeth are preserved. The teeth are certainly in distinct sockets: they are placed obliquely in the jaw, so that their anterior margins are inclined towards its inner side. The crowns are sharp-pointed, and moderately prominent, compressed laterally, with sharp lateral ridges, which appear to be serrated. The crowns are inclined inward. A small pulp-cavity descending into the socket is seen in the root of one tooth. In another tooth the smooth enamel appears to show the delicate transverse lines of growth.

The coronoid element appears to be somewhat elevated, rising behind the teeth on the inner side of the jaw.

The Vertebral Column.

Prof. Wiedersheim counted thirty-four to thirty-six vertebræ, grouped as twenty-one or twenty-two pre-sacral, two or three sacral, and ten to twelve caudal. There appear to me to be twenty-two or twenty-three in advance of the pubis, four or five in the ischio-pubic region, and about nine of the caudal vertebræ are behind the pelvis, so that I count a total of thirty-six vertebræ.

The neck, owing to the forward position of the shoulder-girdle, is obscurely defined. There is no evidence of ribs in the earliest vertebræ.

On the right side there are sixteen pre-pelvic ribs preserved, all of which have the characters of dorsal ribs. This would appear to limit the cervical vertebræ to seven.

It is probable that the sacral vertebræ did not exceed three in *Aristodesmus*. Hence the vertebral formula may read as seven cervical, sixteen dorsal, three sacral, and ten caudal.

The centra are so exposed as to show their deeply biconcave articular ends, with the cups penetrating much as in *Anthodon* and *Mesosaurus*, so as to be only slightly separated one from the other in the middle of the centrum by a narrow partition of bony substance. The only centrum in the dorsal region from which the form can be obtained perfect, is on the ventral border as compared with the neural border of the relative length of 2 : 5.

This may suggest that the back was unusually convex; the same effect would result from intervertebral elements on the ventral border. Hence as the vertebræ all lie in the same plane, their visceral articular borders are well separated one from the other. The anterior face of the centrum is larger than the posterior face. The form is subtriangular, with the external margin thickened and rounded. The lower half of the posterior articular face appears to make an angle with its upper part: I can only interpret the angle as due to an intercentrum.

The sides of the centra are concave from front to back, and their surfaces converge inferiorly with a somewhat pinched aspect, so as to form a narrow rounded base to the centrum.

The transverse processes to which the ribs are attached, given off from the sides of the centrum, are strong, and placed high up, though not reaching the anterior articular face. These processes are concave back and front from within outward, and compressed at the antero-inferior margin into a ridge which descends upon the centrum towards the middle of its articular border. All the characters of the transverse processes of *Pareiasaurus* are intensified in this animal, so far as comparison can be made.

The neural arches of the vertebræ have a quadrate form, and the neural spine is vertical.

The most striking feature of the neural arch is the transverse process, which gives attachment to the rib. These processes extend transversely outward, so as to be horizontal, immediately behind the pre-zygapophyses, and slightly in advance of the middle length of the vertebra. A notch which indents the side of the vertebra, between the posterior zygapophyses and this process, defines its posterior side. Its anterior border, also vertical, is defined by extending beyond the pre-zygapophyses. As exposed, these articular surfaces, which terminate the transverse processes, are nearly vertical truncated facets, slightly concave and converging a little inferiorly. There is no indication of a transverse division between the part of the articulation which is upon the neural arch and that upon the centrum; but as the articulation on the centrum is appreciably narrower, there may be an angle between the two portions of the rib-facet.

The pre-zygapophyses extend forward from the front of the transverse processes like jutting ledges. Seen from above they are subquadrate, horizontal, each a little wider than long, and approximate towards each other at the base of the neural spine. The facets are defined by a concave notch between them. The buttresses beneath the facets are margined by lateral ridges. The neural canal is of moderate size.

The neural spine is vertical, triangular, and strong without being massive. The posterior zygapophyses are well defined, compressed, rounded ridges, which continue the posterior angles of the triangular neural spine downward, outward, and backward. The concave posterior surface of the neural spine becomes a wide notch between the posterior zygapophyses. The summit of the neural spine is truncated and rounded.

Compared with *Pareiasaurus bombidens*, the stronger transverse process is more elevated.

There may be some approach in form of neural spine and transverse process to *Protorosaurus*, though the preservation of the specimens of that genus is less satisfactory.[1] Another approximation is seen in *Nothosaurus*, in which the rib has a deep vertical articular facet on the vertebra. The resemblance derives some interest from the structure of the Nothosaurian shoulder-girdle.

The Ribs.

In his restoration Prof. Wiedersheim represents twenty-one pairs of pre-sacral ribs, while there are no ribs to the first vertebra.

[1] This is not supported by the figure given by Franz Etzold, Neues Jahrb. 1898, vol. ii, p. 148.

I am not able to count more than sixteen ribs in sequence on the right side of the dorsal region, and am disposed to think that that number includes the whole of the dorsal series. The earliest are short. There appear to be indications of a few small sternal ribs, between the interclavicle and the coracoids; but the disturbed preservation makes such identification of those ribs very uncertain. Behind the region of the scapula the dorsal ribs attain their maximum length, seen in about half-a-dozen long ribs which follow the first few shorter ones. Then the ribs steadily decrease in length. They are strong without being massive; curved from above downward and outward; compressed from side to side; and somewhat flattened on the rounded dorsal surface. Their extremities terminate abruptly in truncated surfaces. There is no indication of abdominal ribs, such as characterize *Hyperodapedon*, *Mesosaurus*, *Protorosaurus*, and the Plesiosaurs.

The Sacrum.

The transverse width of the sacrum is due to the elongation of straight, horizontal, transverse processes or sacral ribs, which extend outward at right angles to the axis of the vertebral column.

Upon the upper half of the inner side of the left ilium above the acetabulum there is an impressed area which covers the width of the bone. It presumably indicates the articulation of the sacrum, and may comprise four narrow, deep, vertical impressions of greatly expanded ends of sacral ribs, as in *Pareiasaurus*, only longer.

The Caudal Vertebræ.

Behind the sacrum the vertebræ rapidly become very short. There are at least three vertebræ in close contact one with the other indicated as resting upon the left ischium, and those vertebræ are probably caudal though they are in close contact. Behind them, separated by a slight interval, are indications of nine or ten vertebræ which form the remainder of the tail. The bodies of the vertebræ become successively shorter, and the interspaces between them are well-marked. Their shortness is a distinctive character. The neural arch is well developed, and in the first four vertebræ of the series there appear to be short chevron-bones freely articulated. The posterior surface of the centrum forms oblique facets for articulation of the chevron-bones.

The Shoulder-Girdle. (Fig. 3, p. 628.)

The shoulder-girdle presumably includes nine bones, but I have not recognized the clavicles. The remaining seven elements comprise five bones on the ventral surface. First a median T-shaped interclavicle, which does not differ appreciably from the 'pickaxe'-bone in *Ichthyosaurus* and African Anomodonts. Behind each of its long lateral transverse bars is a pair of bones, thin and disc-shaped, which are divided from those of the opposite side by the longitudinal staff of the interclavicle. These bones are the precoracoid and coracoid. Laterally, the two scapulæ extended upward and backward dorsally over the ribs. These bones form a strong pectoral girdle. The head of the humerus is preserved in close contact with the articular face of the coracoid. The bones of the shoulder-girdle are situate far forward, just behind the animal's head, as in *Pareiasaurus* and *Procolophon*. The antero-posterior extent of the bones corresponds to about four vertebræ. In general character the shoulder-girdle is Anomodont. *Pareiasaurus* and *Rhopalodon* have the constituent bones anchylosed together, while this rather resembles *Procolophon* and *Keirognathus*. The former has a similar interclavicle, but exhibits closer union between the precoracoid and coracoid. The latter appears to have the precoracoid and coracoid similarly free; but its interclavicle is in form unlike the bone in other Anomodonts. The resemblance to *Eryops* deserves attention, though the shoulder-girdle bones are united in that Labyrinthodont.

(*a*) The Interclavicle.

There is a general correspondence of T-shaped form between this bone and the interclavicle in *Procolophon* and *Pareiasaurus*. The chief difference in these types is in the parallelism of the sides of the longitudinal staff of the bone in *Procolophon*, and the posterior divergence of the sides in *Pareiasaurus*, in which however the extremity of the staff of the bone is imperfectly preserved. In this Bunter fossil the interclavicle is intermediate in character between those genera, for there is a very slight posterior widening of the staff, and it is so short as not to extend back beyond the middle of the coracoids.

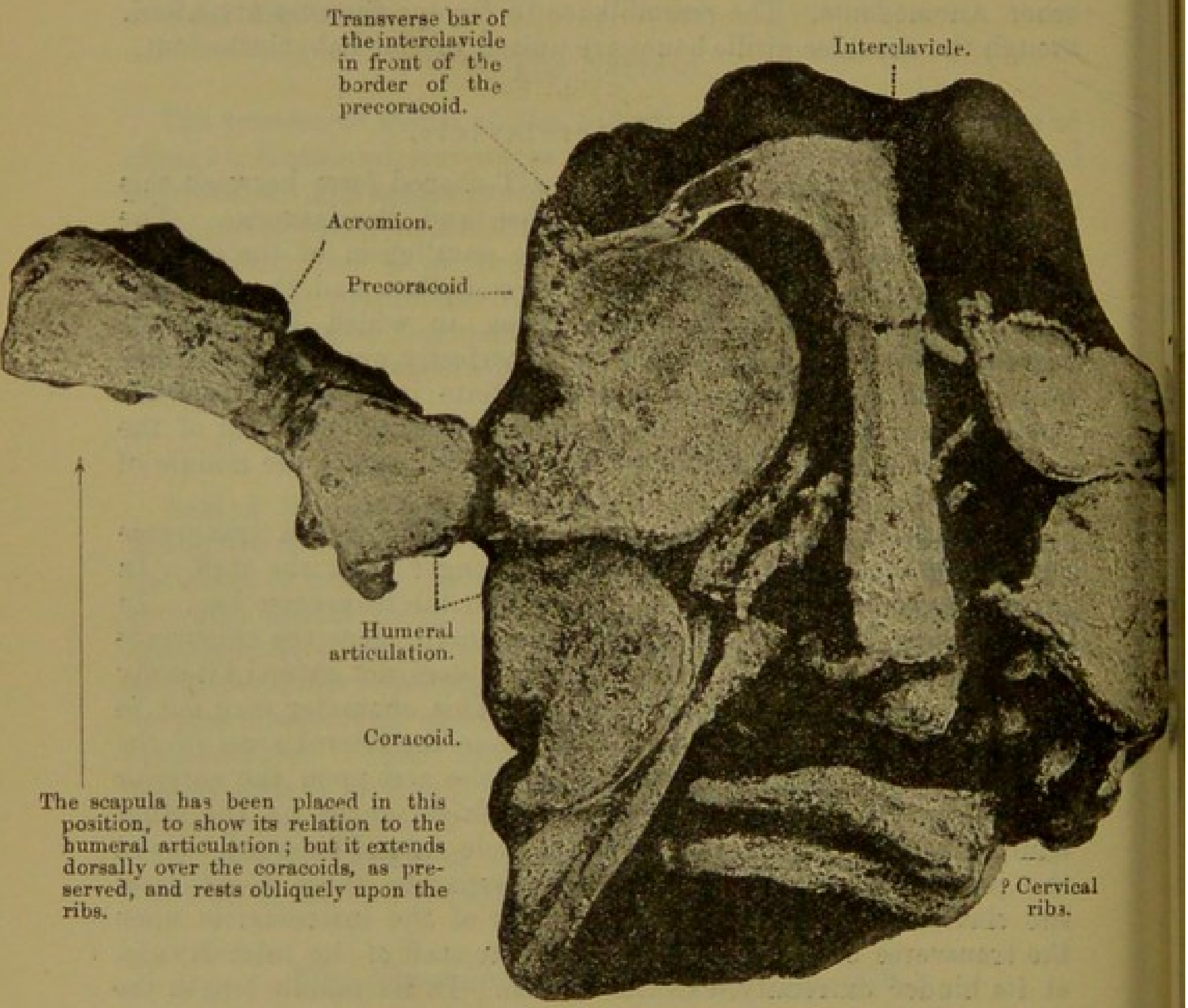
The indications preserved on the right side give a transverse width to the bar, so that it is actually longer than the staff. In *Procolophon* the staff is much longer than the transverse bar. In *Aristodesmus* the bone is relatively rather small, since the transverse bar, which is inclined a little backward, does not extend laterally outward so far as does the precoracoid. This character may not be of much importance, since in *Keirognathus* the lateral arms of the interclavicle are very short, and the clavicles rest upon the anterior margins of the precoracoid bones. In *Pareiasaurus*, on the other hand, the lateral arms of the interclavicle extend outward beyond the precoracoids, so as to completely separate those bones from the clavicles, which are carried in front of the interclavicle upon the transverse bars. The widening of the staff of the interclavicle, at its hinder extremity, exceeds ·4 inch. In its middle length the width is ·3 inch; and it widens again anteriorly towards the transverse extension of the anterior bar. These lateral arms measure from front to back at their origin about ·3 inch, and ·1 inch each at the outer extremity.

The external surface of the interclavicle is elevated. This makes a flat median longitudinal surface, on each side of which the staff is slightly grooved. The grooving is not distinct at the posterior extremity of the bone. There is an ossification behind and below the posterior extremity of the staff, which is of small size, imperfectly exposed. It may be the extremity of a small sternum: a sternum is found in Anomodonts.

Its resemblance to the interclavicle of *Saurosternon*, which is an Anomodont, had not escaped the notice of Prof. Wiedersheim. It differs from the interclavicle of *Echidna* in the longer staff, and less expanded extremities of the bone. The staff is not developed in *Eryops*.[1]

The clavicles have not been recognized.

Fig. 3.—*Portion of the shoulder-girdle of* Aristodesmus Rütimeyeri. *(Nat. size.)*



(*b*) The Precoracoid and Coracoid Bones.

The Anomodontia are the only group of reptiles in which the precoracoid is developed in a disc-like shape, similar to the coracoid bone in form. In this fossil they are slightly separated one from

[1] The reputed sternum of *Platypodosaurus* may be an interclavicle without a staff.

the other. They may have diverged a little posteriorly, like the bones in *Echidna*.

The external surface of the right precoracoid is a little longer than wide. Its inner border is convex from before backward, so as not to correspond with the contour of the interclavicle. The external border has a lateral notch in the middle: this appears to divide the thickened posterior part, which adjoined the scapula, from the anterior part. A similar notch is seen in the precoracoid of *Procolophon*, and apparently in *Keirognathus*; but the conditions are dissimilar in *Pareiasaurus*, *Rhopalodon*, etc., in which a foramen is developed at the junction of the precoracoid and coracoid, and not between the precoracoid and scapula as in the other known Anomodont genera. The external surface of the precoracoid is flat, with the internal and posterior margins slightly raised. The internal articular edge of the precoracoid is vertically truncated, in the manner seen in the expanded coracoid bones of the shoulder-girdle in Plesiosaurs and Ichthyosaurs, forming a narrow edge which is rough and cartilaginous.

The coracoid is nearly as long as the precoracoid. Its transverse width as preserved is less. It is a somewhat lunate plate, convex on its interior margin, with the posterior margins retreating outward in a convex curve. The bone appears to be flattened on its visceral surface. The external border is divided into two parts: the anterior half forms the articulation for the humerus. But behind this thickened border the bone appears to be concavely notched on the side.

It is not certain that these bones came into median contact. They may have united with a cartilaginous sternum, but there is no evidence of such a structure.

(*c*) The Scapula.

The right scapula extended dorsally over the ribs, above the coracoid and precoracoid. The bone is moderately long, curved in length, so as to be adapted to the ribs, inclined a little backward, compressed from above downward. Its thickness augments from the middle length to the humeral articulation. The free extremity is transversely truncated, and the middle length of the blade narrower.

At the proximal end the width is divided into two articular parts: an anterior, sutural, precoracoid portion, and a posterior, glenoid, humeral portion. The posterior margin is the more concave, thicker, and more regularly rounded. The anterior lateral margin is nearly straight, and compressed to a sharp edge. The external surface of the bone is flattened, as in *Pareiasaurus* and *Rhopalodon*, and gives no indication of a twist such as elevates the anterior margin of the bone in African Theriodonts, and apparently in some Dicynodonts. There is an imperfectly preserved anterior mesoscapular thickening or slight acromion-process on the middle of the anterior border of the bone. The bone is not unlike the scapula of *Pareiasaurus* in proportion; the acromion appears to have been similarly placed.

Affinities of the Shoulder-Girdle.

The shoulder-girdle has its first affinities with the Anomodontia, in the second place with the Monotremata, and in the third place with *Eryops*. The first affinity with the Anomodontia, and the second with the Monotremata, are of the same order. In wanting the anchylosis of the precoracoid to the coracoid and scapula, *Aristodesmus* differs from the Russian Deuterosauria, the Pareiasauria, and apparently the Theriodontia.

The loose relation of the precoracoid to the coracoid is not perhaps more marked in *Echidna* than in *Keirognathus*. In *Procolophon*, although the union appears to be sutural, it is a straight suture.

Affinity with *Procolophon* is most evident in the forward extension of the precoracoid, so that it has a lateral surface in advance of the scapula. This character is a distinction from all other Anomodonts, and supports the classification of *Procolophon* as a primary division of the group, well distinguished from Pareiasauria.

The Fore-Limb. (Fig. 4, p. 631.)

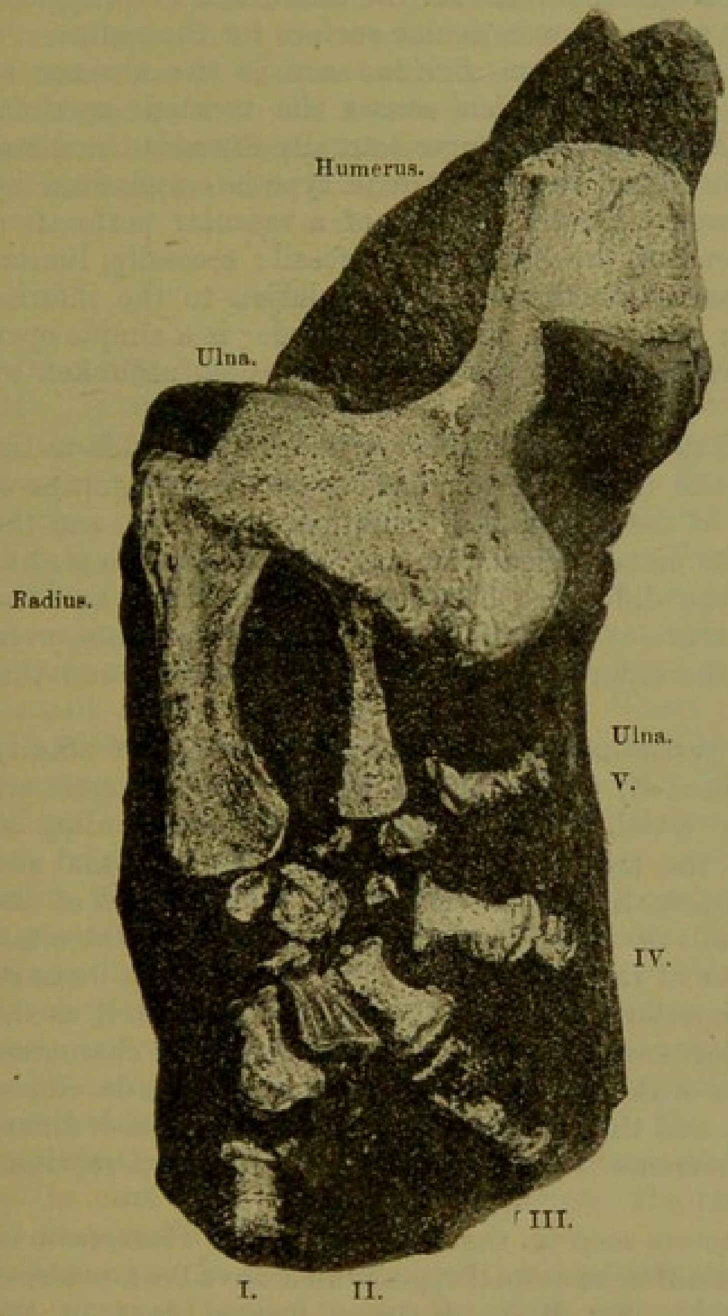
The bones of the fore-limb are only evidenced on the right side of the body, though fortunately there are superior and inferior impressions of the humerus, ulna and radius, carpus, metacarpus, and digits. In form, proportion, and many details of structure, the limb somewhat resembles *Echidna*. These Monotreme characters extend to the form of the humerus, the proportions of ulna and radius, and the general aspect of the digits; though the phalanges are relatively longer, and the claw-phalanges relatively rather smaller. Prof. Wiedersheim has drawn four digits in his restoration of the fore-limb, and four only are preserved on each slab. There appears to be evidence of five digits, by superimposing the upper and lower surfaces. Five is also the number in the hind-limb. One remarkable feature of the fore-limb is the way in which the fifth digit is directed outward at right angles to the ulna; and the outermost digit is directed forward below the radius, so that the five digits radiate towards the outer side of the foot.

(*a*) The Humerus.

The ventral surface of the humerus shows the transverse expansion, and concavity from side to side, of the proximal fan-shaped half of the bone, which is in articular relation with the coracoid and is relatively wider than in *Echidna*. This transverse extension and the absence of an hemispherical head are shared with Anomodonts. The proximal articular surface is narrow and long, with downward reflexion of the radial part of the bone. Its articular surface is markedly convex along its length: the convexity consisting of two portions, which, though not sharply defined, are inclined one to the other at rather more than a right angle.

The articular part of the proximal end of the humerus is narrower than the radial crest. The bone is flattened superiorly, with a tendency to be concave from above downward; and it makes an angle of about 45° with the radial crest, which is of similar size and form. The longitudinal lateral margin on the ulnar side of the bone is much more concavely excavated proximally than the radial side, behind the talon-like process.

Fig. 4.—*Right fore-limb of* Aristodesmus Rütimeyeri. *(Nat. size.)*



The entire humerus is compressed, so that its lateral margins are thin. The compression and the twist in the bone are like those known in *Protorosaurus*, *Dicynodon*, and *Rhopalodon*, though it is more like the humerus of *Echidna* in the expansion of its proximal and distal ends. The twist of the bone makes the curved lateral contour on the radial side appear to be deeply concave; the concavity on the ulnar side of the bone is deeply excavated.

The transverse width of the middle of the shaft below the middle length of the bone is less than a fourth of the width of its extremities. The distal expansion transversely is much more rapid than the transverse expansion of the proximal end. The inferior distal margin is nearly straight transversely, but notched external to the radial articulation; it is thin. The vertical lateral borders of this expansion are nearly parallel.

The distal end of the bone has a sort of hammer-headed appearance. The superior surface is smooth, inflated proximally on the ulnar side by a broad convex ridge, which prolongs the convexity of the shaft obliquely across the expansion of the distal end of the bone towards the ulnar side, exactly as in *Dicynodon*. The ridge makes the middle part of the distal end a shallow concavity, with the middle of the distal margin notched; but the concavity is less marked than in Monotremes. There is a small flattened triangular articular surface for the ulna; and there appears to be a second long and narrow articular surface for the radius.

The essential differences from *Echidna* are in the absence of the strong lateral curvature, which causes the twisted proximal end of the bone in Monotremes to curve laterally towards the distal end. This divergence from the Monotreme type is emphasized by three other differences. Firstly, absence of a vascular perforation through the distal end of the bone in the fossil; secondly, limitation of the two facets for the distal articulation to the inferior surface of the bone; and thirdly, the lateral border is a simple open curve from the proximal end to the distal expansion, unbroken by processes.

Comparisons with the humerus in burrowing animals, such as the mole, suggest that the transverse expansions of the extremities of the bone, the curve of the proximal articulation downward, and the lateral position of the distal articulation, may all be adaptive modifications; and that the difference between the Insectivore and the Monotreme in structure of the humerus is not greater than, even if so important as, the difference between the Monotreme and this fossil.

The value of the resemblances to mammalia as marks of affinity can only be determined by the extent to which the characters are shared by animals which there is no ground for regarding as mammalian. Thus the transverse expansion of the proximal and distal ends of the bones, the constriction of the middle waist of the humerus in the fossil, the downward direction of the radial crest, the unbroken contour of the ulnar border, the absence of a foramen opening on to the superior surface on the ulnar side, as well as the long narrow articular surface at the proximal end, are characters found in the humerus of *Protorosaurus*, though they are not developed in the same degree; and therefore in all those points in which difference from the Monotreme is most pronounced, there is a reptilian approximation.

Most of the characters seen in the Permian reptile *Protorosaurus* are also found in the different animal types which have been referred to the Anomodontia. Sir Richard Owen figured four in the humerus of *Dicynodon*—the transverse expansion of the proximal and distal ends, the constriction of the waist of the bone, the smooth contour of the ulnar border, and the downward reflexion of the radial crest at the proximal end. In details there are striking differences, for all these points are intensified in *Aristodesmus*. On the other hand, in *Dicynodon* the articulation of the bone makes a rounded distal surface to the humerus as in *Rhopalodon* and allied types, while in this fossil the resemblance in the mode of articulation of the radius is closer with Monotremes. Several types of humerus are included under the Anomodontia. In *Pareiasaurus* the distal expansion of the bone may be so far lost, that it extends only a short distance on each side of the trochlear articular surface. The expansion of the proximal end, the constriction of the shaft, and the reflexion of the radial crest are closely paralleled in *Procolophon*. The variability of the humerus in Theriodonts such as *Herpetocheirus* and *Theromus* leads to the conclusion that many of the resemblances of *Aristodesmus* to *Echidna* are adaptive modifications; that the affinity of *Aristodesmus* to the Anomodonts is much closer than to *Echidna*; and that *Aristodesmus* approaches more closely to *Echidna* than any Anomodont hitherto known.

(*b*) The Ulna and Radius.

The ulna and radius are unequal strong bones exposed side by side. Their proximal ends are partly hidden beneath the distal end of the humerus, and they are not easily determined, because there is some appearance in one impression of the slender bone extending beyond the transverse process of the distal end of the humerus, so that the ulna is anterior to the radius, as in *Ornithorhynchus*.

The radius is a flat strong bone, its transverse width greatly exceeding that of the ulna. The proximal end is wide, and transversely truncated. The distal end is a little narrower, and exceptionally convex from within outward. There is some appearance of a contact-surface upon the radial border of the distal end, but no corresponding surface is seen upon the ulna. The inner side of the radius is markedly concave. The external borders of these bones are relatively almost straight. A shallow vertical channel begins in its lower third, and increases in depth proximally. This makes a prominent ridge at the proximal external border, which shows ligamentous roughnesses; and on the inner side a ridge is strongly developed, thickening the bone, which widens the radius so as to come into contact with the ulna at its proximal end.

The stoutness of the radius is a divergence from some African Anomodonts, in which the condition of the bone is at present imperfectly known. There is some evidence that the proximal end of the ulna extended appreciably beyond the radius in the manner of *Herpetocheirus*.

The ulna is more expanded and massive at the distal than at the proximal end; it has the shaft somewhat flattened behind, and narrowed in front by side-to-side compression. The distal articulation is a truncated transversely-ovate flat surface wider than deep, which has a sharp margin, and is inclined somewhat obliquely. There is no single carpal bone exposed which would fit the distal extremity of the ulna. The sides of the ulna are concave from above downward, especially the inner border, its external side being straighter. On the anterior surface, the proximal is slightly wider than the distal end. A portion of the shaft is wanting.

The radius gave attachment to the larger part of the carpus.

The large size of the radius as compared with the ulna, and the expansion of the ulna at the distal end, are the distinctive features of this segment of the limb, and derive their importance from the resemblances which other parts of the skeleton show of the same type. Both Monotremes have these two bones unlike the fossil in details. The olecranon-process is developed in the following Anomodont-types:—*Pareiasaurus*, *Procolophon*, *Keirognathus*, *Theriodesmus*, and apparently in *Herpetocheirus*; while there is no indication of an olecranon-process in *Eurycarpus Oweni*. In the latter genus there is evidence of pronation in the crossing of the ulna over the radius, and in that genus also the proximal ends of ulna and radius are articulated, side by side, to the distal end of the humerus.

(*c*) The Carpus.

The carpal bones number 6 or 7. They are separated one from the other, and are mostly of small size; it is difficult, therefore, without the aid of cartilages, to suppose that the proximal ends of the metacarpal bones could have articulated with the carpal elements preserved. In the superior aspect there are not more than four bones that can be counted as proximal, two below the radius and two below the ulna. Two are manifestly distal, and between these and the proximal bones is a large ossification.

(*d*) The Metacarpus.

The inferior aspect of the slab shows four metacarpal bones, and the upper surface shows five. The hand is bent backward, and the digits radiate outward. The first is directed forward and the fifth is directed outward.

The metacarpal bones are longer on the superior aspect than on the under side, and the bones are individually broader. The proximal ends are flat with a prominent margin. The sides are concave, the concavity being emphasized by the expansion of the extremities. The distal end is thickened and rounded.

(*e*) The Digits of the Hand.

The phalanges are much shorter than the metacarpal bones. They show the short broad form with expanded ends, and a distal trochlear extremity. In the first digit there appear to be two phalanges, without indication of the claw-phalange. In the second digit are three phalanges and the claw. The third includes three bones. The fourth comprises three phalanges; but whether the third is the claw-phalange is uncertain. The fifth only shows two phalanges preserved, without any indication of the claw. The claw-phalanges are exposed on their inferior surfaces: they have an inferior callosity below the articulation; are long, pointed, curved, and compressed, so that they carried sharp claws.

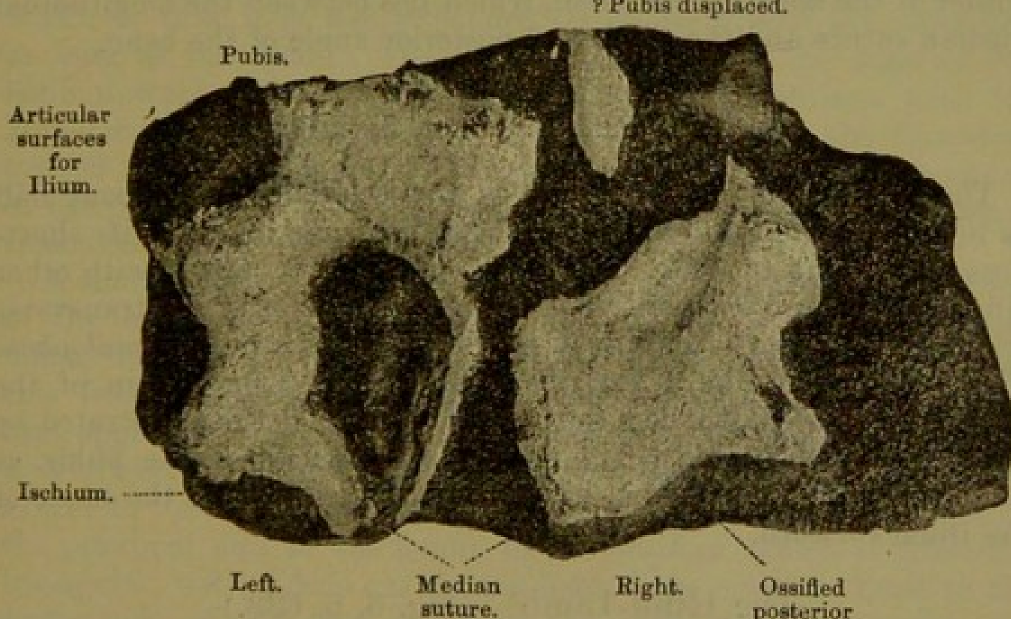
The Pelvis.

The pelvic basin is formed by the pubis and ischium, of which only the inner or visceral surface is seen. The bones of the left side are in sutural union throughout their length, but the form of the anterior margin of the pubis is not evident, nor is the whole shown of the pubic part of the acetabular border. The absence of an obturator-foramen between the pubis and ischium is a character shared with *Pareiasaurus* and *Procolophon*; a median sutural union occurs in the Cetiosauria, but the forms of the bones are dissimilar.

(*a*) The Ilium. (Fig. 6, p. 638.)

The right ilium was almost vertical, being very slightly inclined forward. The bone is moderately deep, from the superior slightly convex margin of the iliac crest to the middle of the inferior angle of the acetabulum, which was imperforate, in the way that has been described in various South African Anomodonts. The bone is convex from above downward. Its anterior and posterior margins are reflected outward, so that the blade of the bone, which is ·9 inch wide, is concave from side to side, and convex from above downward. The blade is very slightly expanded from front to back.

Fig. 5.—*Visceral surface of pubis and ischium in* Aristodesmus Rütimeyeri. *(Nat. size.)*



(*b*) The Ischium. (Fig. 5.)

The right and left ischia were inclined together, and united by a median sutural surface, so as to form with the pubic bones a broad basin of moderate depth. The ischium has a subquadrate aspect, owing to the straight transverse suture, which separates it from the pubis, and the straight longitudinal suture, equally long, which divides it from the bone of the opposite side. Both the posterior and external borders of the ischium are concave; and the antero-posterior measurements internally and externally are similar, so that the approximation in form is rather towards *Pareiasaurus* than *Procolophon*. An external lateral area, concave from above downward, is defined by a thickened ridge which strengthens the bone and extends backward. It is shorter from front to back than in *Dicynodon leoniceps*, in which all the pelvic bones are anchylosed together. The ischium moreover approximates in type to *Procolophon*, but in that genus also the anterior margin of the bone terminates superiorly in a point. The pelvic acetabulum excavates the bone concavely in front, being defined by posterior and anterior ridges, more on the type of *Phocosaurus* than of *Dicynodon*, though without the superior wedge on the ilium to support the head of the femur, which *Phocosaurus* possesses in common with some Theriodonts. The acetabular surface of the ilium has the bone greatly thickened on its internal border, and the thickening recedes from the pubic articulation, so as to define a thin concave area in front of the mass of the bone. If this thin portion were absorbed, a large transverse obturator-foramen would appear, which would bring the pelvis into easy comparison with the pelvic bones of Plesiosauria. This transverse union between the ischium and pubis is the character which seems of greatest value in illustrating the affinity of the pelvis with that in *Procolophon*. The most distinctive feature, however, is in the prominence of the thin concave posterior border of the bone in this fossil, which lies between the longitudinal median suture and the thickened posterior angle of the bone.

(*c*) The Pubis. (Fig. 5, p. 635.)

The pubis is not quite so wide as the ischium, and is about half as long from front to back. The bone is remarkable for its shortness from front to back, in which character it agrees with other Anomodonts, and especially with *Procolophon*, though the transverse width of the bone is relatively much greater than in *Procolophon*. There appears to be a thickening of the anterior margin of the bone, but whether that is a normal character is not demonstrated by the evidence available. The relative narrowness of the pubis, as compared with the ischium, has the effect of throwing the blade of the ilium forward.

The Hind-Limb. (Fig. 6, p. 638.)

There is little difference in length between the humerus and the femur, which is equal to the length of four or four and a half vertebræ. The fore-leg is relatively and actually a little shorter than the fore-arm.

The Monotreme characters of the bones are rather more conspicuously developed in the leg than in the arm; for though the resemblance to *Echidna* is most striking in the femur and humerus, it may be considered that the prolongation of the fibula proximally so as to extend beyond the tibia is an approximation, as far as it goes, to Monotreme character. The bones of the fore-leg are capable of rotation, such as usually occurs in the fore-arm, the fibula crossing the tibia obliquely. This probably indicates use of the hind-limbs in burrowing.

(*a*) The Femur.

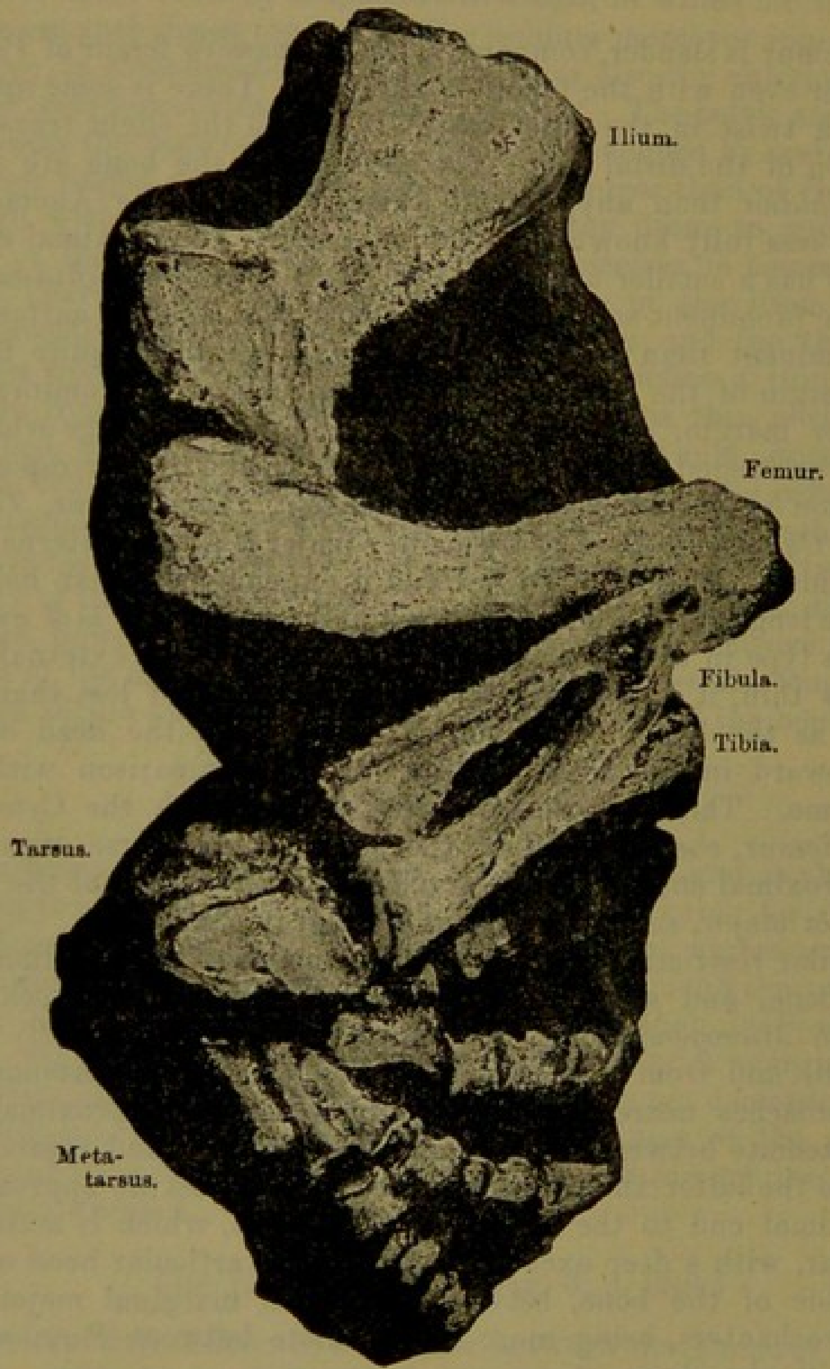
The femur is slender, compared with the massive femur of *Pareiasaurus*, or even with the femur of *Echidna*. There is some appearance of a twist in the bone, which is due to the slight transverse expansion of the distal end. The affinities of the bone are closer with *Echidna* than any known Anomodont, but the Anomodont femur is less fully known than the humerus. The proximal end of the bone has a smaller articular head than is seen in *Echidna*, and although prominent so as to extend above the adjacent surfaces, is less prominent than in *Echidna*, and may not reach quite to the inner margin of the bone. The trochanter minor is prominent on the inner margin, near the proximal end, and the ridge which it forms is prolonged down the shaft. It is unlike the corresponding ossification in *Ornithorhynchus*, *Rhopalodon*, *Pareiasaurus*, *Tribolodon*, or *Cynognathus*. The trochanter major is a thin external film which widens the shaft. In *Echidna* it extends more than halfway down the length of the femur; but while the trochanter is of exactly the same type in this fossil, terminating in a straight external edge which is thin, it is less expanded transversely, and less than half as long as the bone. The vertical direction of the head of the bone upward in the fossil, rather favours comparison with the Monotreme. There is no close correspondence with the Cynodont type of femur, characterized by the singular transverse expansion of the proximal end of the bone, and forward reflexion of the short trochanter major, seen in *Cynognathus* and in *Tribolodon*.

A similar restriction of the trochanter major to the proximal end of the bone, and a longitudinal development of the trochanter minor in *Microgomphodon*, distinguish that genus equally from this fossil and from *Echidna*. *Pareiasaurus* is the Anomodont that approaches nearest to this femur, which in its proximal end is intermediate between *Echidna* and *Pareiasaurus*, and appreciably nearer to the latter than to the former. It makes no approach in the proximal end to the femur in *Procolophon*, which is massively triangular, with a deep excavation behind the articular head on the under side of the bone, between the small marginal major and minor trochanters, being more intermediate between *Pareiasaurus* and *Ornithorhynchus*.

The middle of the shaft, on its superior aspect, is well rounded from side to side.

The femur appears to widen transversely at the distal end, while its depth is augmented by the articulation with the fibula and tibia. The exposed condylar surfaces of the distal end are rounded from above downward. The lower half of the shaft is longitudinally channelled in front by a deep groove, which stops short abruptly above the distal extremity, and appears to penetrate into the bone

Fig. 6.—*Right hind-limb of* Aristodesmus Rütimeyeri. *(Nat. size.)*



between the condyles in a foramen, in the way seen in the femur of *Propappus* and *Pareiasaurus*. There is some approach to this channelling of the distal articulation of the femur in *Iguanodon* and some Ornithischian reptiles; but I have not observed it in any of the Saurischia, or indeed in any other Anomodonts. The distal articulation appears to truncate the distal end of the bone somewhat obliquely, in the manner seen in *Pareiasaurus*. It makes no approach to the trochlear condition of the femur in *Tribolodon* and other Theriodonts. The internal condyle of the femur is more developed than the outer condyle.

(*b*) The Tibia and Fibula.

The fibula is produced proximally into a process like the olecranon-process of an ulna: a character which may be present, but is not clear in the ulna itself. The tibia is a stout bone, while the fibula is comparatively slender. In both these Monotreme characters, as well as in form and curvature, there is some approximation to the tibia and fibula in *Cryptobranchus*, the giant salamander of Japan.

The proximal end of the tibia, which is sub-reniform, is divided into two surfaces, corresponding to the two condyles of the femur by a deep vertical groove. The fibula does not lie in the groove of the tibia, but articulates by a definite surface with the hinder margin of the proximal end of the bone. The sides of the tibia are concave, and upon this middle portion of the shaft a sharp ridge crosses obliquely from its external or fibular side to its internal border. The distal end expands transversely, is somewhat compressed, but moderately convex, with the fibular margin gently concave, and the internal border gently convex. The fibula slightly overlaps the tibia in front, and articulates with it by a small surface.

The fibula contracts in the middle, and expands at the proximal end somewhat abruptly. Its proximal articular surface is oblique and concavely excavated, forming a concavity for the femoral condyle, though the fibula does not appear to be prolonged proximally appreciably beyond its articular surface. The internal border of the bone is concave; the external border is straight. The bone maintains a nearly uniform thickness from end to end, becoming somewhat flattened externally; it is margined laterally by a slight ridge in its lower half, which helps to make the distal end of the bone very slightly concave.

In *Pareiasaurus* the proximal end of the fibula appears to have been greatly expanded, and terminated backward in a vertically compressed plate. It is only known from the left fibula of *Pareiasaurus Baini*, found resting horizontally on the spines of the vertebræ in advance of the sacrum.[1] That form of proximal end is essentially a modification of the Monotreme type in its expansion, but it shows a certain resemblance to *Aristodesmus*, in which the bone is produced a little forward as in *Pareiasaurus* and in *Echidna*. Both tibia and fibula are intermediate between those of *Pareiasaurus* and those of *Echidna*.

[1] See Phil. Trans. Roy. Soc. vol. clxxxiii (1892) B. p. 314, fig. 2, reproduced from my sketch made at Bad before the specimen was removed from the rock.

(*c*) The Tarsus.

The tarsus is characterized by a great compressed triangular tarsal bone, which consists of two elements blended together. It is compressed from back to front; and I regard the larger part, which articulates with the tibia, as the astragalus. It is possible that both tibia and fibula articulate with the same proximal surface, so that the os calcis may project outward as a thick compressed ossification standing beyond the tibia and fibula. There is a proximal surface transversely truncated, the inner half of which, formed by the astragalus, may alone have given attachment to the fibula.

There is no trace of any bone of the distal row of the tarsus; and presumably the distal elements of the tarsus were cartilaginous.

The great transverse width of the proximal bone is sufficient to have given attachment to about four digits, but the fifth may have been directed internally, though there is no evidence of this position.

(*d*) The Metatarsus and Digits.

The metatarsals increase in length from the first to the fourth and fifth, but they become successively narrower; the first and second are both broader, stouter bones than the fourth and fifth, and the third is intermediate. They are flattened above, have concave sides, and are somewhat concave on the under side. Their proximal articular surfaces are truncated, with elevated borders; and the distal ends show a moderate rounding, as of a pulley-shaped articulation.

The first digit is strong and short, and consists of a single phalange with the sides deeply notched, followed by a claw-phalange in which a strong triangular callosity is developed below the articulation.

The second digit is much longer, and contains three phalanges; the difference in length being due mainly to the intercalation of an additional phalange. The third digit also includes three phalanges; the bones are not quite so wide as in the second digit. Their aggregate length is the same.

In the fourth digit, which is only seen in the superior aspect, there are four phalanges, which are individually rather smaller than in the third digit, and have similarly short proportions, terminating in a sharp claw-phalange, which is convex on the upper surface.

Of the fifth digit no phalange is preserved. The form of the long metatarsal is consistent with the phalanges having been as well developed as in the other digits. In general form this hind-foot closely resembles the fore-foot of the South African *Eurycarpus*. In the character of the phalanges there is some resemblance to *Echidna*, but the metatarsal bones are different in being stouter than in the Monotreme.

The Armour.

The dorsal surface of the animal appears to have carried two or three longitudinal rows of irregular small scutes, which were isolated one from the other. The rows were widely separated. On the cast, between the impressions of the ribs, are a series of holes, one between each pair of ribs as a rule. Their forms are irregular, identified with uncertainty; they may indicate prominent dermal scutes.

III. Conclusion.

The skeleton now described appears to leave no doubt as to its systematic position. The skull and shoulder-girdle demonstrate a preponderance of Anomodont characters. The Anomodontia in the present state of knowledge are better defined by the structures of those regions than in other parts of the skeleton. But while the shoulder-girdle is distinctly Anomodont, the free condition of its constituent bones makes a partial resemblance to the Monotremata. The pelvis also is Anomodont, so far as can be judged from its state of preservation.

On the other hand, the limbs in *Aristodesmus* make a more decided approximation to those of Monotreme mammals than has hitherto been seen in any fossil, although they also show affinity with the Anomodontia. Judged by the limbs alone, the evidence already available from this genus and African Anomodonts almost obliterates the interval between Monotreme and reptile; just as the evidence drawn from comparisons of the skull alone, tends to keep the two groups distinct.

There is no proof at present that the skull may make a complete transition between the two groups. Chelonian reptiles have shown that the reptilian prefrontal bone may in most genera be combined with the nasal bone, and yet remain distinct in a few types like the fossil *Rhinochelys* and the existing *Podocnemys*. There is no evidence that the union between the frontal and postfrontal bones, or between the dentary bone and other elements of the mandible, is obliterated in reptiles. So long as the lower jaw is composite, and prefrontal and postfrontal bones exist, the animal may be technically a reptile; although the blending of the prefrontal and nasal bones in Chelonians shows the first step in a change by which the reptilian skull might lose its most distinctive characters. The Chelonian modification rather tends towards the possibility of reduction of the reptilian to the mammalian type of skull, but lends no support to a supposition that a mammal might preserve pre- and post-frontal bones, a parietal foramen, or a composite lower jaw. The obliteration of distinct ossifications varies in time of disappearance.

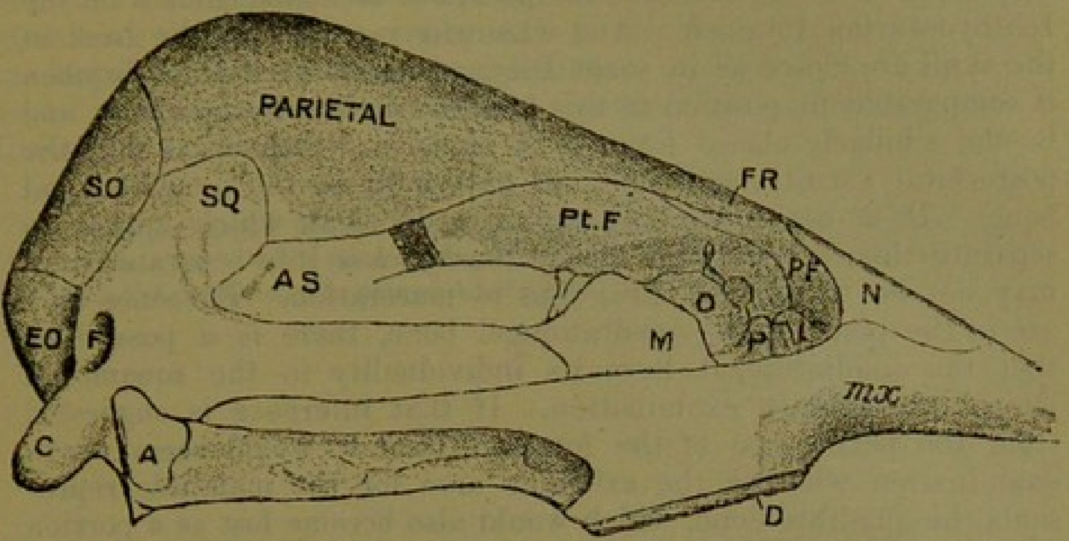
Until the embryology of *Echidna* is known, it would be premature to affirm that the Anomodontia and Monotreme mammalia are not members of a natural alliance, which might be termed Theropsida. From the point of view of the osteologist, it may be a reasonable inference that the interval between the Monotreme mammal and Anomodont reptile is no more than an ordinal separation. The gap between these two orders is certainly smaller than the gap between *Iguanodon* and other Ornithischian reptiles, and birds. It is not, however, an approximation of the Anomodont type to the mammalian type as commonly conceived which *Aristodesmus* exhibits, but an approximation to the points which are distinctly Monotrematous, and by which the Monotremata differ from all other mammalia, such as the structure of the shoulder-girdle, the general form of the humerus, the stoutness of the ulna, the proximal development of the fibula, and the character of the proximal row of the tarsus. These structures separate Monotremes from other mammals, and link them with Anomodonts. Therefore, having regard only to the oviparous reproduction of the Monotreme, and other reptilian conditions in the structure of its soft parts, there is a sense in which all these characters must be regarded either as reptilian, in view of their occurrence in the Anomodontia, or as Theropsidan in forming a basis for alliance between the Anomodontia and the Monotremata. There does not appear to be any closer approximation to the higher mammals in the Monotremes than is shown in *Aristodesmus* and other described Anomodontia, except in the obliteration of sutures in the skull, the distinctive form of the atlas, and the presence of marsupial bones, which have not yet been recognized in Anomodontia.

The affirmed absence of prefrontal and postfrontal bones in *Ornithorhynchus* deserves better demonstration than has been given. The frontal bones converge forward; their anterior termination is flanked laterally by the nasal bones; but between the nasal and the frontal there is a bone in the front of the orbit, which is above the lachrymal foramen. It corresponds to the prefrontal bone. There is a large separate postfrontal ossification at the back of the orbit, external to the junction of the frontal and parietal. These two bones, which are partly separated from the frontal by a process of the parietal bone, quite exclude the frontal bone from the orbital margin. The presence of prefrontal and postfrontal bones in the orbit in Monotremata goes towards showing that their resemblances to the higher mammalia are associated with reptilian divergences, which establish a closer relation between *Ornithorhynchus* and Anomodontia, and other reptiles, than was obvious. (See fig. 7, p. 643.)

In the skull of *Ornithorhynchus* there is a foramen above the articular surface for the lower jaw, which extends longitudinally from front to back, and is narrower in some skulls than in others. This may be termed the supra-articular foramen. It is stated by Owen to be present in the skulls of some recent reptiles. A foramen is seen in the same position in *Ichthyosaurus*, which lies between the quadrate bone on the inner side and the quadrato-jugal and supratemporal, which extend to the squamosal so as to define its external side. This condition is approximated to in Ornithosauria. There is a foramen above the articulation which is external to the quadrate bone in many Anomodonts,[1] though it is

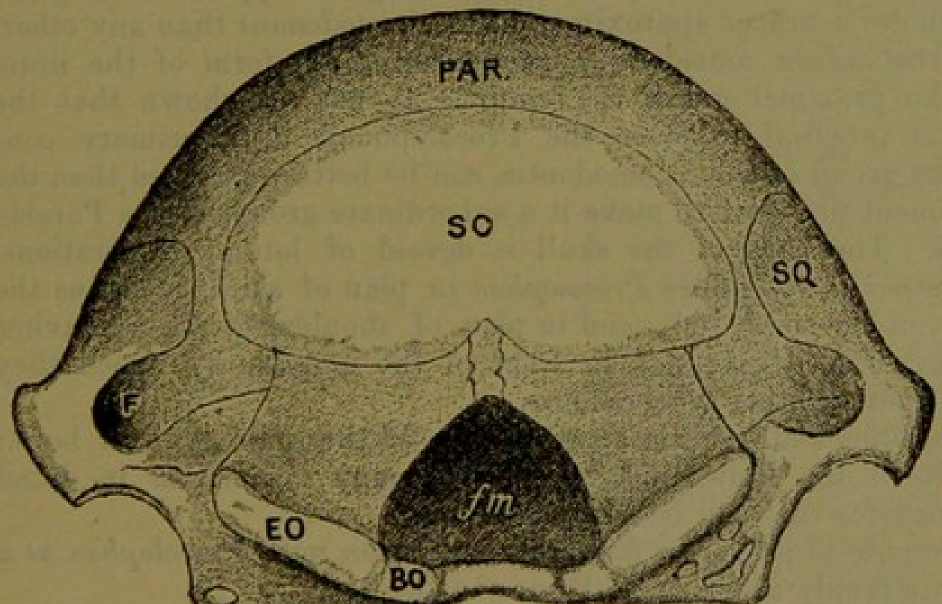
[1] Phil. Trans. Roy. Soc. vol. clxxx (1889) B, pl. x, fig. 4.

Fig. 7.—*Right side of the skull of* Ornithorhynchus, *showing separate postfrontal and prefrontal bones and the malar bone.* (×2.)



SO = Supra-occipital.
EO = Ex-occipital.
C = Occipital condyle.
SQ = Squamosal.
F = Supra-articular foramen.
A = Articulation for the lower jaw.
AS = Alisphenoid.
Pt.F = Postfrontal.
O = Orbitosphenoid.
P = Palatine.
L = Lachrymal.
PF = Prefrontal.
FR = Frontal.
N = Nasal.
mx = Maxillary.
D = Dental horny plate.
M = Malar bone.

Fig. 8.—*Occipital aspect of the skull of* Ornithorhynchus. (×2.)



fm = Foramen magnum.
BO = Basi-occipital.
EO = Ex-occipital condyle.
F = Supra-articular foramen.
SQ = Squamosal bone.
SO = Supra-occipital.
PAR = Parietal.

[The transverse imperfect divisions in the supra-articular foramina are of uncertain significance.]

very small in *Pareiasaurus*. It appears to be homologous with the Ichthyosaurian foramen. And when the vacuities in the back of the skull are closed as in some Dicynodonts, the quadrate foramen is comparable in position to this foramen in *Ornithorhynchus*; and to the similarly-placed foramen in *Hatteria*, which opens into the postorbital vacuity, and is defined externally by the quadratojugal bone. It is not proved whether the divisions which appear to separate this external film in *Ornithorhynchus* into separate bones may not be tension-fractures due to maceration. But since they are in the place of the quadratojugal bone, there is a possibility that the quadratojugal loses its individuality in the squamosal, which may require examination. If that inference is suggested from the persistence of the foramen, then it would seem worth examination whether the articular area for the mandible represents the quadrate bone, which would also become lost as a portion of the squamosal bone. Owen considered that the presence of a distinct tympanic bone (with which he identified the quadrate bone in the usual position in *Ornithorhynchus*) 'nullifies the supposition that the upper root of the zygoma can be the analogue of the os quadratum in the Ovipara.'[1] (See fig. 8, p. 643.)

The teeth of *Aristodesmus* are not only distinct from those of *Ornithorhynchus*, but appear to be different from those in Anomodonts, resembling a type like *Rhopalodon* in the individual form of the molars, and a type like *Procolophon* in the absence of distinction between teeth in different parts of the series. This resemblance has led to a detailed examination of the evidences of structure in *Procolophon*, which justify me in regarding that type as making (on the whole) a nearer approximation to *Aristodesmus* than any other, notwithstanding considerable differences in the form of the ilium and the proximal end of the femur. It has also shown that the original proposal to place the Procolophonia as a primary constituent group of the Anomodontia, can be better sustained than the subsequent proposal to make it a subordinate group of the Pareiasauria. The back of the skull is devoid of lateral perforations. *Aristodesmus* resembles *Procolophon* in plan of skull, so far as the parts can be compared; and in plan of shoulder-girdle in having the precoracoid extended in front of the scapula, by which they differ from all other Anomodonts.

The pubis and ischium appear to be of the same type in both; though in the limb-bones there are many differences in detail in structures that can be compared.

I propose to place the fossil in association with *Procolophon* as a separate family in the tribe Procolophonia.

The presence of *Aristodesmus* in the Bunter Sandstone is an additional organic link between the Trias and the Permian strata in which other remains of Anomodont reptiles have been found in Scotland, Russia, and France.

I am indebted to Prof. Charles Stewart, F.R.S., for enabling me to

[1] Since this was written Dr. J. F. van Bemmelen has described these structures in the Monotremata; see Koninklijke Akademie van Wetenschappen te Amsterdam, 1899, Zoology, p. 81.

establish the reptilian characters of the skull of *Ornithorhynchus* by examining the skull of a young male in the Physiological Series of the Royal College of Surgeons, No. 323 c [1] in November 1895. I desire also to reiterate my thanks to the Trustees of the Basel University Museum.

[1] Sir Richard Owen figured a still younger skull in fig. 172, p. 371, article Monotremata, in 'Todd's Cyclopædia of Anatomy & Physiology' vol. iii. In that skull the postfrontal is named alisphenoid.