On Eurycarpus oweni / H.G. Seeley.

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ON *EURYCARPUS OWENI.*

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Further Evidence *of the* Skeleton *of* *Eurycarpus Oweni*.

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[Plate XXI.]

In 1876[1] Sir Richard Owen figured a fossil from the Sneeuwberg which was referred to a young or small Dicynodont reptile, and described as showing impressions of the neural arches and ribs, of cervical and dorsal vertebræ, and of bones of the left fore-limb. Eight ribs are shown and described. It is stated that 'the distal end of the humerus is much expanded; the radius and ulna are distinct and in a prone position; the palm of the fore-paw has impressed the surface of the slab.' The hand is briefly described, and the author remarks upon the agreement with the mammalian formula of phalanges, seen in its five digits. This underside of the hand was figured again in 1880[2] in illustration of the foot of *Platypodosaurus*. Owen mentions no evidence of the Dicynodont characters of the specimen, though it was doubtfully referred to *Dicynodon*. It was afterwards named *Eurycarpus Oweni* and more carefully figured in 1889.[3] The original specimen was presented to the British Museum in 1872 by Mr. Thomas Bain, through Sir Henry Barkly, who was then Governor of Cape Colony.

One of my objects in visiting South Africa in 1889 was to recover, if possible, the remainder of this specimen, which was the only skeleton then known with the limbs in natural association with the vertebral column. A visit to Graaf Reinet, however, was not possible. But I ascertained that the skull was found with the complete skeleton, and that a short memorandum on its characters was made by Mr. Thomas Bain on finding the fossil. The manuscript which Mr. Bain forwarded with the specimen has been preserved in the Natural History Museum; the document is important, and is here transcribed, with a photographic reproduction (fig. 1, p. 326) of the rough sketch which it includes:—

'Skeleton of a *Dicynodon* found in the Sneeuwberg, about 24 miles from Graaf Reinet. It is lying on its back, as can be seen from the roots of the teeth. The specimen sent fits on to the right arm. It is the only perfect impression of a paddle or hand yet found of the *Dicynodon*; I speak of course of those found by my late father, Dr. Atherstone, and myself. Therefore it may be worth preserving. It is likewise rare on account of the shape of the head (big-nosed), a shape seldom found among the *Dicynodon* species. The tail is buried under the projecting slab B, which could easily be knocked off and exposed; I have marked the spot in the event of His Excellency wishing to have it taken out. The skeleton is 2 feet 4 inches long, exclusive of its tail. At the same place where it was found I discovered numerous other fossil remains, but all too large to bring away, and they required some time to be disinterred.

'10th August, 1872. Thos. Bain.'

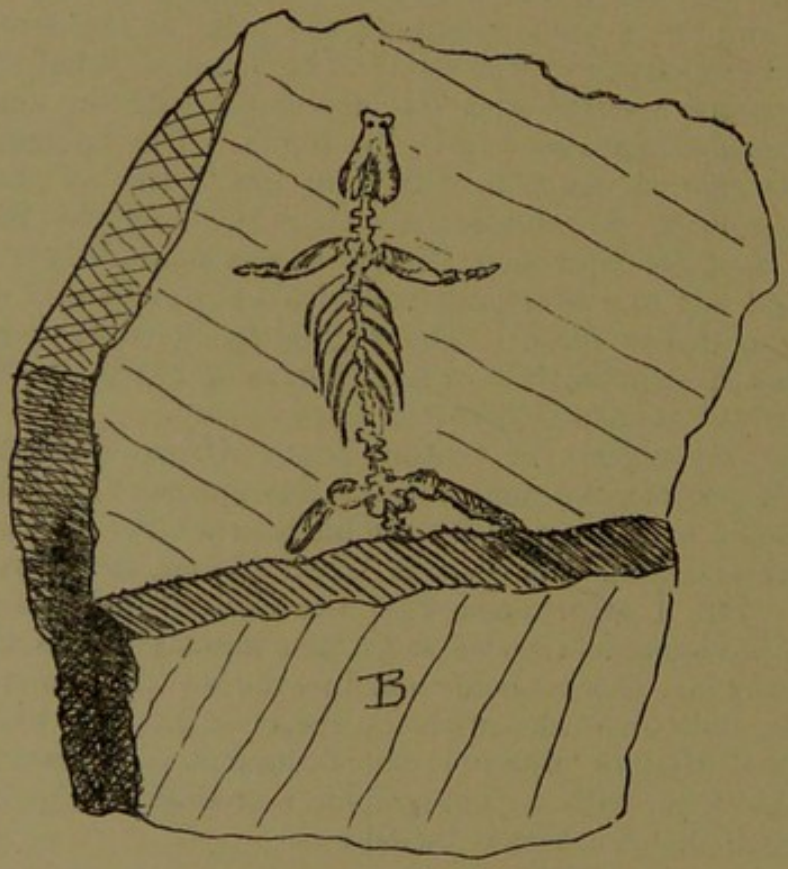
[1] Catal. Foss. Rept. S. Africa, pl. lii.

[2] Quart. Journ. Geol. Soc. vol. xxxvi, pl. xvii, fig. 5, p. 424.

[3] Phil. Trans. Roy. Soc. vol. clxxx (B) pl. xviii.

Mr. Bain wrote to me that he had no doubt that his sketch and my figure of *Eurycarpus* were both made from the same skeleton. The remainder of Mr. Bain's specimen was left in the rock and lost. The counterpart slab was in the possession of a Boer; and one half of that slab (without the head) eventually passed into the possession of the Rev. Charles Murray, of Graaf Reinet. That gentleman had the kindness to send me the specimen.[1] It shows the ventral aspect of the vertebræ, ribs, and limb-bones of which the dorsal aspect is already known.

Fig. 1.—*Photographic reproduction of Bain's sketch of the skeleton of* Eurycarpus Oweni.



An impression of the cavities left by the bones in this second slab was taken for me in the Natural History Museum. The two slabs were then fitted together, and plaster of Paris was run in between them, so as to show the upper and under surfaces and forms of the larger limb-bones and vertebræ.

The missing parts of the animal may be estimated from Mr. Bain's statement that the visible skeleton was 2 feet 4 inches long. The remains on this slab measure 1 foot 9½ inches, showing that the skull and other parts which are lost could not have measured more than 6½ inches in length.

No minute accuracy can be claimed for Mr. Bain's sketch. Its

[1] With it he sent a large fish, apparently a species of *Atherstonia*, which I presented to the Natural History Museum.

value consists in indicating the form and size of the head, which is a little less than a quarter of the length of the drawing; and thus agrees with the measurement of the Murray specimen, within a tenth of an inch.

The shape of the head as drawn was previously unknown. The discoverer differentiated it by means of the expanded form of the nose. This character was then and is still unknown in the genus *Dicynodon*. It is found to some extent in all Theriodontia, although the transverse constriction behind the canine teeth is more marked in Gomphodontia than in other Theriodonts. There is no direct evidence that the skull possessed Theriodont dentition, but the molar teeth might be hidden, and the sketch may imply that the roots of the canine teeth are seen in the lower jaw (fig. 1). The only group of Theriodonts known from the *Dicynodon*-beds is the Lycosauria; and it is probable that *Eurycarpus* may be referred to that group. A peculiar feature of the sketch is the concave anterior extremity of the nose.

The Vertebral Column. (Pl. XXI, *v*.)

The vertebræ are mostly in close order, with only very small displacements in their continuity. There may have been seven cervical vertebræ. Six appear to be indicated in Mr. Bain's original slab, by the short strong neural spines, which are not unlike those seen in *Tropidostoma Dunni*. The forms of the cervical vertebræ are not shown.

There are eleven dorsal vertebræ which support long ribs. They are succeeded by five vertebræ with short ribs. The hindermost of these terminates $1\frac{1}{2}$ inches in advance of the head of the femur. The total length of this part of the vertebral column, comprising fourteen vertebræ, is 16 inches. According to Mr. Bain's memorandum this would leave $3\frac{1}{2}$ inches for the sacrum and early caudal vertebræ which he indicated. This suggests a short sacrum, with not more than two or three vertebræ.

The depth from the summit of the neural arch to the base of the centrum is $1\frac{1}{2}$ inches, with but little variation down the length of the dorsal region; and this is in harmony with the skeletons already known of Anomodonts, such as *Cynognathus*, *Deuterosaurus*, *Procolophon*, and *Pareiasaurus*.

The front of the centrum appears to be a little wider than the back. The greatest width of an early dorsal vertebra in front is $\frac{9}{10}$ inch measured over the neural arch. The front margin of the articular surface of the centrum is a little thicker than the hinder margin. The articular faces of the centra are flattened or very slightly concave, but they are very imperfectly exposed. The length of the ventral surface of the dorsal vertebræ is $\frac{6}{10}$ inch in the front part of the back, but in its lower part they are slightly longer. The inferior margins of eight dorsal vertebræ are clearly seen, and they show no indication of intercentral ossifications such as have been described in *Cynognathus* and *Pareiasaurus*.

The external surface of each centrum is concave from front to back and rounded from above downward, with moderately elevated rounded articular margins, which are rather wider in the early dorsal than in the later dorsal vertebræ, but much narrower than the neural arches.

The Ribs. (Pl. XXI, *r*.)

As the ribs are preserved they extend in a semiovate contour, which was 12 inches long and about 8 inches wide below the middle of the back. As in many vertebrates, the ribs indicate depth in the region of the lungs, with increasing width in the lower part of the back. There is no indication of sternal or of abdominal ribs.

The anterior dorsal ribs are very imperfectly displayed at their proximal ends; but the distal ends of the first six or eight are so curved as to cross some of the later ribs transversely resting upon their undersides. The under surfaces of the ribs are rounded, with the anterior margin compressed and widened and defined by an inferior groove, like that seen in *Pareiasaurus*. There is no evidence whether the compression is also seen on the posterior margin. The ribs are compressed from above downward towards the free end. Near the proximal articulation each is also compressed from front to back. The rib terminates proximally in an expanded disc, which articulates low down on the anterior half of the side of the centrum. No tubercular attachment of the rib to the neural arch is seen. There is no evidence of articulation between the bodies of the vertebræ. In the genus *Herpetocheirus*, there is no trace of a tubercle in any of the ribs preserved. The articulation appears to be not unlike that found in *Microgomphodon*,[1] but *Eurycarpus* shows no trace of the uncinate process to the rib which Gomphodontia and Cynodontia share with some Labyrinthodonts such as *Eucheirosaurus*.

The Shoulder-girdle.

The bone in Mr. Bain's slab which I had doubtfully regarded as a scapula (or interclavicle) is proved by my new specimen to be so. Its articular surface for the humerus is seen a little in advance of the head of that bone. The scapula (Pl. XXI, *S*) lies laterally between the neural arches of the vertebræ and the humerus. It appears to extend over the length of six vertebræ and to be rather longer than the humerus. The preservation is bad, owing to the dried condition of the animal at the time of fossilization. The length of the scapula exceeds 5 inches. At the humeral end it is 2 inches wide, and towards the anterior border the bone carries a moderate ridge of the usual type, such as might have supported a clavicle. Both anterior and posterior borders of the scapula are concave, and its least width did not exceed 1 inch. Its inner surface was concave, adapted to the convexity of the ribs.

There is no indication of precoracoid or coracoid bones A small

[1] Phil. Trans. Roy. Soc. vol. clxxxvi (1895) B, pl. i.

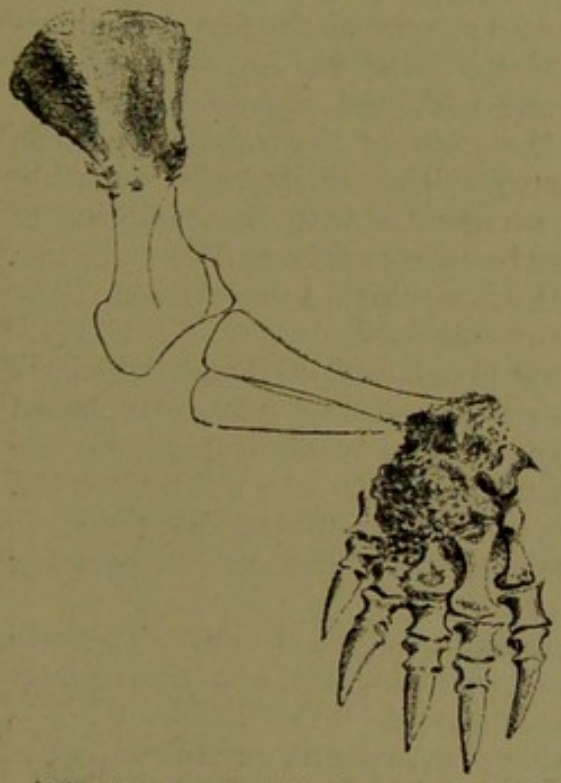
triangular impression, towards the median line of the vertebræ, is identified as displaced dermal plates.

The Fore-limb. (Figs. 2 & 3, pp. 329, 330.)

The new facts concerning the fore-limb are the characters of the humerus and the impression of the superior surface of the left fore-paw.

The humerus proves to be a little more than 4 inches long, 2 inches wide at the proximal end, and a little wider at the distal end. The inner side of the bone is concave; the outer side is straighter, and both articular ends are in the same plane. The proximal articulation is convex from side to side above and concave below, with the inner side of the bone considerably thickened and rounded at the terminal cartilaginous surface. The concavity on the underside extends halfway down the shaft, being bounded externally by the rounded ridge of the radial crest, which becomes most elevated towards the middle of the shaft, where it terminates in the manner usual in Theriodonts. The foramen at the distal end on the ulnar border is not preserved. The angle on the superior outer border of the lower third of the shaft is more pronounced than in any known Anomodont humerus; and the lateral surface which extends from this angle to the radial articulation is obliquely flattened for a length of 1 inch. The thickened flattened inner side of the bone at the proximal end is distinctive. There is no indication of the characters of the underside of the distal end of the bone. The shape of the bone conforms better to the Theriodont than to the Dicynodont type, in which the known examples are relatively wider at the distal articular end.

Fig. 2.—*Bones of the fore-limb of* Eurycarpus Oweni (*about* $\frac{1}{3}$ *nat. size*).



[The distal end of the humerus and the ulna and radius here shown in outline are drawn from the original slab in the Natural History Museum and from a plaster cast of the space between the two specimens.]

The outlines of the radius and ulna are but dimly indicated in the slab, as if a thin layer had scaled off and removed the impression of the undersides of those bones. The distal end of the

radius, which is not seen in the Bain slab, twists round the ulna, and is prominent, showing something of its truncated distal extremity, which might have been mistaken for a large carpal bone if the Murray slab only had been known. Its extremity is rather more than $\frac{1}{2}$ inch wide. The forearm is $3\frac{1}{2}$ inches long.

The hand is bent backward so as to display its upper surface, and is a beautifully sharp impression of the phalangeal bones. But a large ovate area over the carpus and metacarpus has the appearance of being covered with a patch of armoured skin, in which the granules seem to be thickly grouped as though they were in contact with each other. A similar granular condition of the bones of the forearm was suspected by Owen to be indicative of the dried skin. The granules are very distinct on the underside of the humerus, especially at the proximal end, and appear to indicate that the front of the animal was thus protected. This condition is probably most comparable with the condition of the limbs in snapping turtles and some tortoises, in which I have found bony granules beneath some of the horny tubercles.

Fig. 3.—*Hand of* Eurycarpus Oweni (*about* $\frac{1}{2}$ *nat. size*).

The specimen shows the outer distal carpal bone, which is inch long, longer than wide, concave at the sides, compressed superiorly and truncated distally, forming a slight talon on the inner side of the fifth metacarpal bone, with which it articulates. Another carpal is above the fourth metacarpal bone, but these are the only carpal bones which are not obliterated by the covering dermal armour.

Only the three outermost metacarpals are shown. They are well defined by their forms, which are elongated, and transversely expanded at the distal and proximal ends. The fifth bone is less expanded at the proximal end, where the articular surface is convex from front to back. The wide distal ends of the fourth and third metacarpal bones show in each a triangular impressed area just above the terminal articular surface. The distal extremity of the second metacarpal is only indicated, while the first appears to be a massive bone about $\frac{1}{2}$ inch long, and therefore shorter than the other metacarpals, which is shaped like a digital phalange, only larger, and is parallel to the other bones. It appears that the carpus occupies a depth of 1 inch and a breadth of $1\frac{1}{2}$ inches. The metacarpal bones diverge very slightly as they extend forward, so that the transverse measurement over their distal extremities is 2 inches, while the length of this segment of the limb is about $\frac{3}{4}$ inch in its longest part.

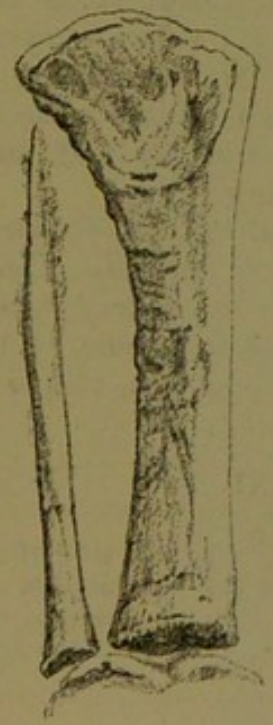
The bones of the phalanges of the digits are short, broad, strong, with the articular ends well defined. They are all in close contact, in a way that could not have been inferred from the previously-

known impression of the underside. As the digits are preserved, the interspace between the second and third digits is slightly greater than between the others. The number of bones in the fingers appears to follow the formula 2 . 3 . 3 . 3 . 3. It was already known that the terminal claw-phalanges were elongated and conical, but the middle one is 0·7 inch long, and longer than the two preceding phalangeal bones. They are all more or less rounded on the upper surface, but the first is obliquely flattened on the inner aspect, and the fourth and fifth are much more compressed from side to side than the second and third, and more arched from front to back. There is a mark in the slab prolonged beyond the fifth claw, and others for a length equal to the bone, which may indicate the original extent of the horny claw (Pl. XXI, *H*). The length of the claws and the mobility of the joints in the fore-limb, no less than the form of the bones, are suggestive of a burrowing habit in this animal.

The Hind-limb. (Fig. 4.)

The femur was very imperfectly preserved in the Bain slab, where it appears to be 4·4 inches long, and to have the proximal articular head directed inward in a way which may approximate to the form of the bone in known Theriodonts. This specimen shows that the distal end of the femur (Pl. XXI, *F*) was subquadrate, not more than 1 inch thick, flattened on the inner and hinder surfaces, with the distal surface rounded a little from front to back, but so truncating the bone as to show that the femur may have been carried in a more vertical position than is usual in living reptiles. Its form approximates to the bone which I have regarded as the femur of *Rhopalodon* more than to that of *Cynognathus*.

Fig. 4.—*Tibia and fibula of* Eurycarpus Oweni (*about* $\frac{2}{3}$ *nat. size*).



The tibia and fibula are well displayed in the Murray slab. There is the same slender mammalian proportion of fibula which has already been detected in *Microgomphodon*, and this appears to be a Theriodont character. This segment of the hind-limb is 3·7 inches long.

The tibia is slightly enlarged at the distal end, where it measures $\frac{7}{10}$ inch from side to side, and appears to terminate in a truncated articular surface, with the border slightly rounded. The proximal end is more expanded, and its width is 1·2 inches. The posterior margin of the shaft is more concave in length. The bone shows some evidence of compression, especially towards its extremities. The proximal extremity consists of two surfaces which are inclined to each other at a large angle. The smaller posterior surface is terminal and articular, and

margined by a slightly tumid round border, such as often margins cartilaginous surfaces. With this area the distal articular end of the femur is in loose contact. The other surface, which is longer than wide, looks as though it might have supported a patella. No trace of such a bone is preserved.

The slender fibula is slightly curved; it appears to extend from the posterior outer extremity of the tibia, and ends distally in a moderately expanded truncation.

Below these bones is a large tarsal bone apparently, as in *Pareiasaurus*. The fibula, which is prolonged a little farther distally than the tibia, appears to be attached to the inner margin of the same bone. The specimen, however, is not clear at this point, where a fracture has passed through the tarsal bone, removing the impression of the hind foot. The foot was probably lost when the slab was collected by the original finder, for Mr. Thomas Bain, who had seen it, only spoke of one hand as pointed out to him. I have some reason for believing that the other half of the specimen, showing the right side of the animal, may still exist in some private collection in Cape Colony, though I have been unable to hear of it.

The recovery of the missing half of the Murray slab, with evidence of the skull and pelvis which it would give, is greatly to be desired in order to complete our knowledge of this fossil animal.

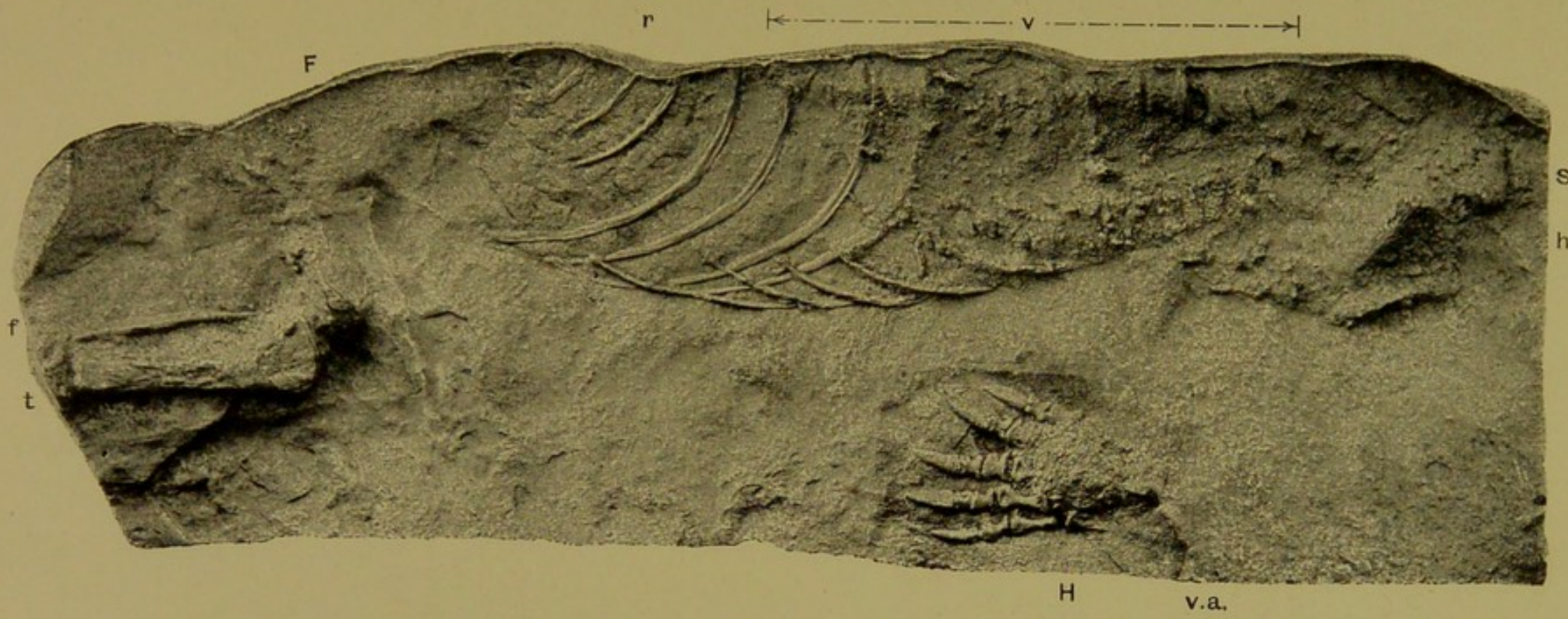
Armour. (Pl. XXI, *v.a.*)

Besides the armour which appears to have been present upon the limbs, the fore part of the body carries upon the ribs and vertebræ large granules, and thin oblong bony plates, which may measure $\frac{1}{2}$ inch in length and $\frac{3}{4}$ inch transversely, but the markings are too obscure for description. They are evidence for armour on the flanks of *Eurycarpus*, with the plates shown in one close-set longitudinal row on the under part of the front of the body, such as occur in Labyrinthodonts.

The locality, Sneeuwberg, from which this animal was obtained, had already yielded to Mr. A. G. Bain *Lycosaurus pardialis*, *Tigrisuchus simus*, *Cynosuchus suppostus*, *Scaloposaurus constrictus*, and *Dicynodon leoniceps*. It would therefore appear to be one of the chief localities for the Lycosaurian types of Theriodontia, and to be on the horizon of the *Dicynodon*-beds.

EXPLANATION OF PLATE XXI.

Photographic reproduction of the cast of a portion of the left side of the skeleton of *Eurycarpus Oweni*, about one-third of the natural size. It shows the ventral aspect of the vertebral column (*v*) and ribs (*r*), with traces of armour (*v.a.*), the shoulder-girdle (*S*), and portions of the fore-limb (*h*, *H*) and hind-limb (*F*, *f*, *t*).



CAST OF A PORTION OF THE SKELETON OF *EURYCARPUS OWENI* (about $\frac{1}{3}$ nat. size).