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XLI.—*On* Euskelesaurus Brownii (*Huxley*).

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Euskelesaurus Brownii was discovered by Mr. Alfred Brown, of Aliwal North, at Barnard's Spruit, Ward, 15 miles south of Aliwal North. The remains were collected with some difficulty at intervals, and three separate collections of bones of the same animal were sent by Mr. Brown to Europe before the further specimens in his possession were intrusted to me in September 1889. Mr. Brown assures me that other portions of the animal are still in the rock. He at first intended his fossil for the National Museum, but forwarded it to Sir R. I. Murchison, not knowing that the Geological Society, Geological Survey, and Geological Department of the British Museum were distinct institutions. The first collection was the subject of a memoir by Professor Huxley Quart. Journ. Geol. Soc. vol. xxiii. p. 1, 1867). It gives an elaborate discussion of the characters of the femora, which in many ways resembled *Megalosaurus*. The tibia, fibula, and tarsus are described. The collection included other bones, some of which are recorded as fragments of two very large flat bones, the large metatarsal and metacarpal, and fragments which were not determined. Unfortunately no figure was given of any of these specimens, and some of the less important I have not seen. A second collection was sent to

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Sir R. I. Murchison, and acknowledged by him; but no account of it was published, and I have been unable to trace the specimens. Mr. Brown, finding that his fossil aroused less interest in this country than might have been expected from the interest taken in his discoveries in Cape Colony, consigned a third box of the remains to the Museum of the Jardin des Plantes, where the specimens are exhibited. Some were figured by M. Paul Fischer (Nouv. Archiv. du Muséum, Mém. tome vi. pls. x., xi.), and give evidence of caudal vertebræ with chevron bones and the neural arch, distal row of the tarsus, phalanges, and the nearly entire pubis, which I found to be similar to the pubis of *Massospondylus* in January 1889.

The further specimens entrusted to me by Mr. Brown comprise the maxillary and premaxillary bone, a chevron-bone, the expanded proximal part of a rib, three claw-phalanges (and a fourth imperfect), and six digital phalanges of the foot.

There are two vertebræ in the Albany Museum from Penhoek which are probably referable to the same species. One of these gives the characters of the dorsal region, the other is apparently a late caudal vertebra.

The osteology of the animal is therefore very imperfectly known, since no part of the fore limb or shoulder-girdle appears to have been preserved in the three known collections. The vertebral column is almost untouched, and is apparently still in the rock. The few specimens now available for study seem to substantially support Prof. Huxley's interpretation of 1866 * in indicating resemblances to *Megalosaurus*; the resemblances are especially interesting with *Massospondylus*, so that the type may be placed in the Saurischia in near association with the latter genus and *Zanclodon*, though with a nearer approximation to *Megalosaurus*.

The evidences for these conclusions are given in the following account of the several bones.

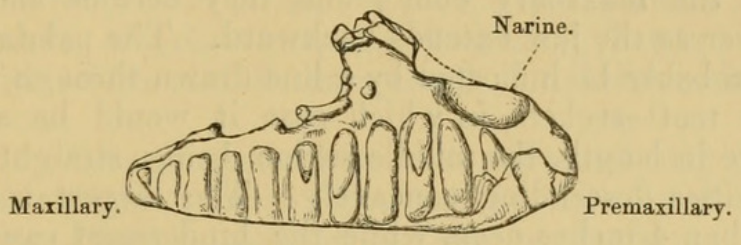
Premaxillary and Maxillary Bones of Euskelesaurus Brownii (*Huxley*). (Fig. 1.)

The left maxillary and premaxillary bones are exposed on the internal aspect of the jaw, so as to define its form fairly well except at the extremities of the premaxillary in front,

* Mr. R. Lydekker (Cat. Foss. Rept. Brit. Mus. pt. 4, 1890, p. 252) refers this genus to the Stegosauridæ; but no evidence has been given in support of this determination, and I have observed no character common to it and the Ornithischia.

the termination of the maxillary behind, and the extremity of the ascending facial process above. The specimen has been much decomposed by weathering, so that the palatal plate is lost, as is almost all the internal bone defining the alveoli;

Fig. 1.



Left maxilla of *Euskelesaurus Brownii*, showing successional teeth in three alveoli. $\frac{1}{10}$ nat. size.

so that they are mostly exposed as parallel oblong grooves, in some of which the successional teeth are preserved. As preserved the jaw is 17½ inches long and 8 inches deep below the facial process.

The inferior alveolar border is gently convex in length, especially beneath the facial process. Its margin appears to be entire in front. The premaxillary suture is shown ascending in a straight line, at right angles to the alveolar margin and oblique to the alveoli. It is within about 2½ inches of the anterior extremity, as indicated by the impression, from which the bone is broken away below the nasal vacuity. There are no indications of teeth in the premaxillary bone exposed, and if the teeth were of the same size as in the maxillary, there could not have been more than two alveoli within its limits. In the maxillary bone eleven sockets are easily traced, and there appear to have been twelve. The jaw is formed much on the type of *Megalosaurus* from the Stonesfield slate, except that there is no indication of a similarly extended posterior attenuation of the maxillary bone, and the nasal vacuity has a lower lateral position at the side of the snout, indicating relatively small depth anteriorly for the tooth-sockets. The measurement below the narial margin is 2¾ inches, so that the premaxillary teeth may have been smaller than the maxillary teeth. The nasal vacuity is longitudinally ovate, 3½ inches long and 1¾ inch deep in the anterior half; its anterior border is well rounded, and a thin plate of the premaxillary ascends to define its superior border. There is no certain indication of the nasal bone on its upper border; but this may be due to conditions of preservation, for the strength and breadth and direction of the facial maxillary

process tend to the conclusion that the head was deep in front of the orbit. The measurement from the alveolar border to the summit of the nasal vacuity in its middle length is $5\frac{1}{2}$ inches.

The sockets for the teeth are deepest and widest at the back of the nasal vacuity and below the facial process, where they are in the maxillary bone; and they become shorter and narrower as the jaw extends backward. The palatal contour may probably be indicated by a line drawn through the bases of the tooth-sockets, in which case it would be somewhat concave in length, the middle region being straight and the extremities descending concavely. The largest sockets are more than 4 inches deep, while the hindermost can be little more than 1 inch deep. Anteriorly the width of the sockets is $1\frac{3}{20}$ inch, posteriorly it is barely $\frac{8}{10}$ inch. The sockets are vertical and parallel, separated by bony interspaces, which are three or four tenths of an inch wide anteriorly, but narrower behind. The depth of the jaw below the facial process is fully 4 inches and its length behind that process is about 8 inches. The superior contour of this region is irregular and broken.

Two successional teeth are preserved within the alveoli, so as to give some conception of the form and character of the crowns, which are compressed from side to side, broad, convex on the anterior border, straight on the hinder border, with the extremity well rounded; the anterior and posterior margins are sharp and crenulate. The teeth have a very compressed aspect, all the more remarkable from their extreme width; indications of these teeth in the maxillary bone are seen in its third, fifth, and sixth alveoli in different stages of development. As compared with *Megalosaurus* they are much broader and less pointed.

The facial process extends for $3\frac{1}{2}$ inches behind the hinder margin of the nasal vacuity, which appears to indent its base in front. Its anterior margin inclines backward at an angle of about 45°, and this surface is flattened as though for contact with the nasal bone. The posterior margin, as preserved, is somewhat irregular, but nearly vertical, and it shows a vertically ovate foramen about $\frac{1}{2}$ inch in diameter near to the border. There is nothing to indicate that it is the lachrymal foramen. It is obviously situate in the position of the infra-orbital foramen, which is preorbital.

Without entering now into the general question of the nomenclature of the similar bones from Stonesfield referred to *Megalosaurus*, from the Stonesfield slate, and from the Inferior Oolite of Sherborne, which may possibly, from their

different proportions, belong to different species or genera, it is evident that in general massiveness this South-African fossil departs perceptibly from those English types, and rather approximates towards the shorter headed *Teratosaurus*, which is provisionally identified with *Zanclodon* from the Trias, and the American *Ceratosaurus*, which is said to be from Jurassic rocks. In proportion of jaw the form is intermediate between *Ceratosaurus*, *Megalosaurus*, and *Zanclodon*; but the teeth in the relative width and flatness recall *Zanclodon* rather than other types.

The only other fragment known to me which may possibly be referable to this type is a specimen in the Museum of the Jardin des Plantes, recorded in my notebook as "small fragment of a jaw, much broken and not deep, with large teeth in sockets. The teeth are compressed, of an oval form in section, with a large pulp-cavity, which is closed at the base."

Left Pubis. (Fig. 2.)

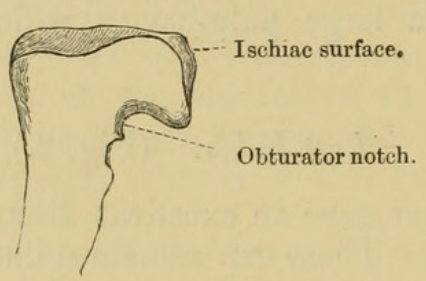
M. Paul Fischer gave an excellent discussion of the pubis of *Euskelesaurus*. There can remain no uncertainty as to its osteological determination after comparison with the pubis in *Belodon*, *Staganolepis*, *Zanclodon*, and *Massospondylus*, in which genera all the pelvic bones are known. They have the pubis more or less distinctly modified from the same plan. M. Fischer's figure (Nouv. Arch. Mus., Mém. t. vi. pl. xi. fig. 15) is reversed, and represents the external aspect of the left pubis. The bone is rather more than 24 inches long, thin and flat, with the anterior margin approximately straight, but concave in its proximal half and slightly convex in its distal half. The distal end, as preserved, is fully 8 inches wide. The posterior border is less perfectly preserved. The width of the bone steadily diminishes proximally till, at the obturator notch, the width is $3\frac{1}{2}$ inches. Above that notch the bone expands transversely in a hook-like form, to make the superior articulation with the ilium, which is transverse to the shaft, and the ischiac articulation at right angles to it. The transverse width here is 7 inches. The thickness of the bone at the acetabular and iliac surfaces is 3 inches. In the upper fourth of its length the pubis is twisted, so that the proximal surface makes an angle of about 45° with the flat plate of the distal end. From this twist the inference may be drawn that the ischium and pubis receded inward below the acetabular part of the ilium. The anterior half of the proximal surface has the aspect of having articulated with

the ilium ; but the posterior half is somewhat concavely excavated, as though it had contributed to the acetabulum.

The surface which appears to be the articulation for the ischium is remarkably strong and irregularly four-sided, $2\frac{1}{4}$ inches deep, and wider above than below. It shows a cartilaginous surface, and may possibly have been connected with the ischium by a cartilage.

The pubes appear to have been directed downward and forward, and, as M. Fischer has stated, to have met in the median line ; for at the transverse distal extremity along the inner margin an oblique articular surface extends over the bone, about an inch deep in the middle and rather narrower towards the inner and outer borders.

Fig. 2.



External aspect of proximal end of left pubic bone of *Euskelesaurus Brownii*. $\frac{1}{10}$ nat. size.

The pubis is constructed on the same plan as that of *Massospondylus*, but differs in having the obturator foramen or notch relatively smaller. The formation of the backwardly directed process above the obturator foramen is very similar in the pubes of *Zanclodon*, figured as sternum by Plieninger (Jahreshefte, Württ. 1857, t. xi. fig. 1), in which the bone appears to retain the width of the plate from the distal end upward to the obturator notch. But in the Tübingen specimen, which I have referred to as *Teratosaurus Quenstedti*, there is no such development of a subacetabular process, and the acetabular notch is much larger. In *Staganolepis* the bone is apparently similar at the proximal end so far as the subacetabular process is concerned ; but these are the only genera known in which the pubis has a similarly expanded blade and a hook-like proximal end.

I have no knowledge of the ischium or ilium.

Vertebral Column.

The only vertebræ of *Euskelesaurus* hitherto known are

the early caudals collected by Mr. Alfred Brown, which are in the museum of the Jardin des Plantes. The further materials which are known to me are a fine chevron bone in the collection of Mr. A. Brown and two vertebræ in the Albany Museum, obtained from the top of Penhoek, about 500 feet above the coal. One of these is a dorsal centrum and the other a late caudal. There is necessarily no proof that they belong to the same species; but they are preserved in a similar yellowish matrix, and, being above the coal, belong to the Stormberg or Zanclodont horizon, which I regard as Trias. In osteological character and size they are similar to the specimens collected by Mr. Brown.

Dorsal Vertebra.

The centrum has a massive compact aspect, rather suggesting that of a large Pliosaur. It is somewhat oblique. The lateral margins are broken in front, and the inferior margin is fractured behind, and from this circumstance probably the anterior articular face appears to be narrower and deep, while the posterior articular face appears to be wider. The centrum is $4\frac{1}{2}$ inches long or a little more, but the measurement augments slightly under the neural canal, indicative of an arching of the back. The length corresponds closely with that of the early caudal vertebræ at Paris, which vary from $4\frac{1}{2}$ to 5 inches. The articular faces are flattened, but slightly concave. The posterior face, which is best preserved, is $6\frac{1}{4}$ inches wide, and was originally deeper. The neural canal excavates a concave channel in the upper part of the centrum; it is 2 inches wide by 2 inches deep, and the articular face of the centrum extends above its base both in front and behind. There is no certain indication of sutural union between the neural arch and the centrum, and the bone above the summit of the neural canal is broken away. The base of the centrum is rounded from side to side and moderately concave from back to front. Above the middle of the side of the centrum the vertebra is compressed from side to side and marked on each side by a longitudinal concavity. The buttresses at the side of the neural arch (which are usually developed below the transverse process) diverge downward towards the anterior and posterior margins of the centrum, so as to leave a well-defined wedge-shaped notch excavation between them, which is continuous with the side of the centrum below.

There is no evidence that this vertebra is a portion of Mr. Alfred Brown's animal; but it is manifest from the size

of the early caudal vertebræ that the limbs were very short relatively to the allied reptiles of Europe.

Right Dorsal Rib.

Only one example of a dorsal rib has been collected by Mr. Brown; it is numbered 57, *a*, *b*, *c*. The proximal extremity is not preserved, and it is imperfect distally. The fragment is $10\frac{1}{2}$ inches long; it shows a convex curve directed outward and backward, is compressed from side to side towards the proximal end, where it deepens. The vertical measurement, as preserved, is $3\frac{1}{2}$ inches, but the articular head attached to the side of the centrum is lost, and the neck is $1\frac{1}{2}$ inch deep, convex in front, a little concave behind, narrow above, and nearly an inch from side to side below. The facet for attachment to the transverse process, about an inch from side to side, appears to have been nearly vertical, notching out the superior border of the rib. External to it the bone contracts in dimensions; but as the superior surface, which is at first narrow, is prolonged outward it becomes widened and flattened, reaching a width of more than 1 inch at the distal termination, where the bone is $1\frac{1}{4}$ inch deep and subtriangular in vertical section. The anterior aspect is flattened and the posterior surface is marked by a groove in its upper third, which originates behind the transverse process and is produced parallel to the superior contour down the length of the bone. This dorsal rib is relatively small, and from the other evidence may be regarded as not improbably one of the last of the series. The want of definition of the tubercular surface by a distinct neck may be in favour of this position in the skeleton. No affinities are deducible from the characters here shown.

Early Caudal Vertebræ.

The tail of *Euskelesaurus* is shown by the early vertebræ described by M. Fischer to have been both strong and elongated. The centrum is about $4\frac{1}{2}$ inches long in most vertebræ. The transverse process, as preserved, only extends outwards for about 3 inches.

The neural arch is compressed from side to side above the transverse processes. The zygapophyses are well developed. The anterior process is directed forward and the facet looks upward; the posterior facet looks downward. The posterior pair were separated by a narrow notch. The neural spine is broken away. The height of the neural arch, as preserved, is 4 inches; its transverse width at the base exceeds 3 inches;

it does not appear to be in close sutural union with the centrum. The longest centrum is fully 5 inches long on the base and 4½ inches along the neural canal, showing that in natural sequence the caudal vertebræ were concave on the superior contour. The posterior face of that centrum is 6 inches high.

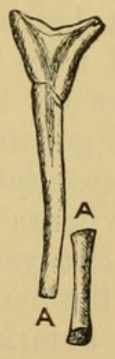
The chevron bones in the Jardin des Plantes in some cases are preserved *in situ*, and in every case the extremity of the bone is imperfect, the longest specimen being only 8 inches long. They are inclined obliquely backward, attached chiefly to the posterior face of the centrum. The bone is compressed from side to side and cleft at the proximal end for 3 inches.

The transverse width over the fork is 2¾ inches and the antero-posterior extent is 1¾ inch. In front the forked part of the process is flattened; as it extends distally it becomes rounded. At the distal fracture the bone is ⅞ inch thick and 1½ inch wide.

The Chevron-Bone. (Fig. 3.)

Mr. Brown's chevron-bone appears to be 14 inches long; but it is in two portions, 10½ and 4½ inches long, and the continuity between them (fig. 3, A A) is not quite certain, though they correspond in size and thickness. The proximal surface is 3¼ inches wide, crescentic, fully 1¼ inch deep in the middle, convex on the anterior margin, flattened or concave on the posterior margin, and concave from side to side. It would appear to have articulated with the hinder margin of the centrum, as in the specimens figured by Mons. Paul Fischer. There appears to have been a transverse connexion of the articular facets of the two sides, in the manner described by Professor Huxley in some genera of Dinosaurs; but a fracture having traversed the median line, this condition is not absolutely certain. The V-shaped excavation beneath the articular surface is small in front, not being more than 2½ inches long and less than ½ inch wide. On the posterior surface the width appears to be greater. Below the articulation the bone rapidly contracts in width, and in its compressed form, with the parallel anterior and posterior borders, has much the aspect of a costal rib. The anterior convexity in length is most marked towards its lower part. The bone is somewhat flattened in front in its middle portion, though convex from side

Fig. 3.



Chevron-bone of caudal vertebra of *Euskelesaurus Brownii*. A A, contact-surfaces. $\frac{1}{10}$ nat. size.

to side in its upper part, and compressed from side to side in what I regard as its distal extremity. The posterior border is much more compressed than the anterior border. In the middle length the antero-posterior measurement is $1\frac{5}{8}$ inch and the thickness 1 inch. In the last two inches the anterior border retreats, so that the extremity becomes smaller, though it widens a little from side to side, and terminates in an ovate surface $1\frac{1}{4}$ inch from front to back and about $\frac{7}{8}$ inch wide. This surface is rough, as though it were cartilaginous and somewhat convex. This chevron-bone is probably from an early caudal vertebra, and helps to give an idea of the great depth of the tail; for if the neural spine were developed to anything approaching a corresponding length, the vertical depth of the tail would have approached three feet if the spines and processes had been vertical; but, owing to their oblique direction, it is probable that the depth of the tail did not exceed 18 inches. There are no data for even approximately estimating the length of the tail, since the *Pœkilopleuron Bucklandi* is the only example of a carnivorous type which might be compared. It is, however, probable that the tail was long.

Late Caudal Vertebra.

This imperfect vertebra has an elongated form, and when perfect had a length of about 5 inches. It is regarded as caudal from the small size of the neural canal and apparent absence of articular processes for ribs, notwithstanding a certain general resemblance to the early cervical vertebræ of *Massospondylus* and *Zanclodon*.

The neural arch is small and is penetrated back and front by an excavation which has the aspect of a compressed canal above the neural arch, but of smaller size.

The anterior face of the centrum is lost, together with the pre- and postzygapophyses and the neural spine. The fracture shows that the neural canal contracts greatly towards the middle.

The posterior face of the centrum, imperfectly preserved, is $2\frac{3}{4}$ inches wide by less than 2 inches deep. The articular surface is concave and has the aspect of being crushed from the underside.

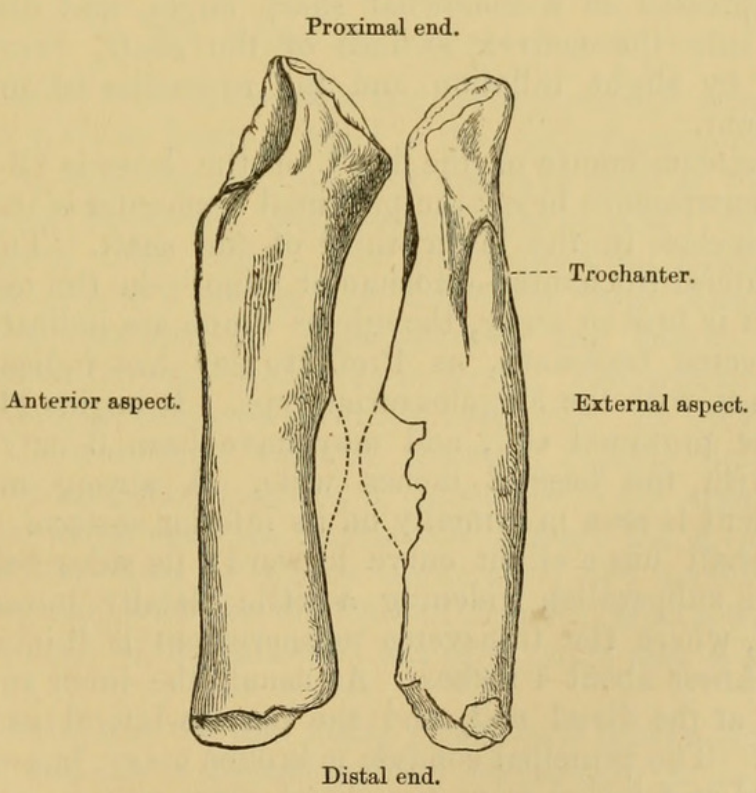
The base of the centrum contracts in the middle to a width of $1\frac{1}{2}$ inch. It is flattened and rounds convexly into the sides; those surfaces are somewhat vertical, concave in length, and are margined above by a narrow longitudinal ridge, beneath the middle of which there appears to be a foramen. This lateral ridge is on about the line of junction of the

centrum and the neural arch, and descends a little as it extends forward; seen from above its longitudinal contour is slightly concave. Above the ridge the neural arch is strongly compressed from side to side, with a forward inclination; but it is too imperfectly preserved to give any idea of the form of the neural spine, the relation of the supraneural excavation to the development of the spine, or of the development of the zygapophyses. The transverse width of the neural arch is less than $1\frac{1}{2}$ inch. The arch does not reach within an inch of the hinder margin of the centrum, and the neural canal at its extremities must have been less than 1 inch wide. The total height of the fragment, as preserved, is $3\frac{1}{2}$ inches.

Femur. (Fig. 4.)

The right femur is 26 inches long as preserved, but it has lost the proximal and distal articular surfaces, though the missing extremities would probably not have extended the

Fig. 4.



Right femur of *Euskelesaurus Brownii*. $\frac{1}{10}$ nat. size.

length more than about 3 inches. The bone is remarkably robust relatively to its length; the shaft is rounded. Seen from above the bone widens a little proximally and curves

inward, so that the inner margin is more concave than the external border is convex; seen laterally the bone has a slight sigmoid curve, the head being inclined with a somewhat Megalosauroid curve, which is also seen in the more Crocodilian types like *Palæosaurus* and *Belodon*.

The head of the bone is fully 7 inches wide as preserved, and was originally wider. Below the articular surface the neck of the bone, if it may be so named, is compressed from front to back, being flattened posteriorly, convex from side to side in front, and $3\frac{1}{2}$ inches thick in the middle, and concave from above downward; but there are no lateral concavities or constrictions to define it from the head or shaft on those borders. The neck may be considered to end at 6 inches from the proximal extremity as preserved, where the bone thickens from back to front, and the proximal trochanter is developed on the anterior external lateral angle.

The great trochanter is not divided from the shaft at its proximal extremity, but is simply a laterally compressed elevation on the outer angle of the bone. It is about 4 inches long, with the base about $1\frac{1}{2}$ inch wide; proximally its sides are compressed to a somewhat sharp angle, and distally it rounds into the convex surface of the shaft, being only marked by slight inflation and the rugosities of muscular attachment.

The circumference of the head of the bone is 18 inches. The circumference below the proximal trochanter is 16 inches, and 15 inches in the lower third of the shaft. The great infero-lateral trochanter—trochanter minor—in the middle of the shaft is broken away, though its limits are indicated. It was directed backward, as Prof. Huxley has indicated, in accordance with the Megalosaurian type. It begins 11 inches from the proximal end, and may have been 6 or 7 inches long, with the base 2 inches wide. A strong muscular attachment is seen proximally on its inferior surface.

The shaft has a slight curve forward; its sides below the neck are subparallel, widening a little distally towards the fracture, where the transverse measurement is 6 inches and the thickness about 4 inches. As usual, the inner surface is vertical at the distal end, and the postero-lateral surface is oblique. The principal condyle is broken away, but strongly indicated at 4 inches from the distal extremity, so that the bone has probably lost but little of its length.

The proximal end is stouter and wider than in *Megalosaurus*; the distal end is much less expanded than in *Zanclodon*. As a whole, the bone is not more slender than in *Massospondylus*. It is well distinguished from all other genera by

the form of the proximal end and position of the lateral trochanter. It is closely related to *Massospondylus*, but distinguished as a genus. The Zanclodonts are the nearest European allies.

Tibia and Fibula.

These bones are represented by the distal extremities of the bones of the right and left limbs and their proximal extremities on the left side * of the animal. Mr. Brown's specimens (20 *a*, 20 *b*), referred to (*l. c.*) as fragments of a large metatarsal and metacarpal, I have been able to fit together as portions of one bone, and have fitted this to the hinder fracture of the left fibula, so as to complete the distal end of that bone. Some matrix has been removed from the proximal end of the tibia, to exhibit the contour of the head of the fibula. It is possible that the anterior margin of the fibula, as a consequence of injury, may have been anchylosed to the tibia; but its hinder portion is certainly free, and the bone is displaced backward, while the surface of the tibia beneath it in front has a fractured aspect.

The Distal Ends of the Bones.

The distal end of the tibia is of subtrapezoidal form, about 7 inches wide in front, parallel to the posterior surface, which is narrow, with the external and internal sides of the bones converging backward, and the margins rounded where the two pairs of sides meet. The antero-posterior thickness of the bone is 4 to 5 inches, the difference being due to conditions of fossilization. The posterior and lateral surfaces are of about the same width (3½ inches). The lateral surfaces of the tibia approximate towards each other as they ascend, so that the transverse width of the shaft rapidly diminishes; and at the superior fracture, 5 inches above the transversely truncated distal end, the distinction between the several surfaces of the bone is almost obliterated, the section being subtriangular, with the angles well rounded, with a transverse measurement of 3½ inches in the right tibia and 4 inches in the left.

The distal end of the fibula measures 5 inches from back to front and about 2½ inches from side to side on its rounded

* Professor Huxley (Quart. Journ. Geol. Soc. vol. xxiii. p. 4) describes the distal end of the right tibia and fibula. The fibula is lost from this specimen. Mr. Lydekker suggests that Prof. Huxley mistook the left bone for the right; but the right tibia and astragalus referred to are described by Mr. Lydekker (R. 1625 *c*) as fragmentary undetermined bones (Cat. Foss. Rept. Brit. Mus. Suppl. pt. iv. p. 253).

anterior edge, and is narrower posteriorly. The distal articulation appears to descend downward and outward obliquely below the tibia, and to have a trochlear surface convex from side to side, concave from front to back. The fibula is only preserved on the left side, and its distal extension (if not due to displacement) appears to indicate that the calcaneum, which is not preserved, must have been distinct from the astragalus and have been a relatively small bone, longer than wide.

The astragalus shows no indication of an ascending process, in this respect resembling *Scelidosaurus* and *Cumnoria* rather than any other English types; this implies no affinity, although the astragalus in *Euskelesaurus* is completely separate from the tibia; the resemblance is rather with the Zanclodontidæ, which Professor Marsh has characterized as having the astragalus without an ascending process.

The anterior face of the tibia is flattened, but without any indication of an impression for the intermedium, which may have been a small separate bone, as in *Hortalotarsus*, which is not preserved in this fossil. The astragalus is transversely oblong, measuring $5\frac{1}{2}$ inches from side to side in front by $3\frac{1}{4}$ to 4 inches deep. It is preserved in both the right and left limbs. Its proximal surface is horizontally truncated and the distal surface trochlear, having a wide median channel, which is shallow and convex from front to back. In the right limb the external margin of the bone takes the form of an unarticular talon on the posterior side, but of this there is no trace in the left limb. Its presence may suggest a reduction in the number of digits in the hind limb. There is no evidence that the fibula articulated with the astragalus.

The Proximal Ends of the Tibia and Fibula.

The left tibia and fibula are only preserved for about 7 inches below the proximal articular surface. The contour of the outline of the proximal surface of the tibia is the usual subtriangular form, measuring 7 inches from front to back and $5\frac{1}{2}$ inches from side to side. The posterior margin is slightly concave from side to side, and the posterior surface of the bone is markedly concave from above downward. The internal border is oblique to the hinder border in the usual way, and this part of the shaft is convex as it extends forward to form the cnemial crest, the proximal extremity of which is broken away. The external surface is short and concave from front to back, and approximately at right angles to the posterior surface; but it is obscured, because the fibula lies in contact with it, displaced backward, with the tibial surface

imperfectly preserved, as though there had been anchylosis with the anterior margin of the fibula; six inches below the proximal end the shaft is ovate in section, 5 inches from back to front, $3\frac{1}{4}$ inches from side to side. Hence the expansion of the proximal end is small, and the cnemial crest is not much developed; so that, although the proximal surface is stout and wide, it does not differ materially from *Massospondylus*, *Agrosaurus*, &c., and makes no approach to the expanded tibia in *Zanclodon*, seen in the skeleton described by Plieninger.

The fibula has a front to back measurement of $5\frac{1}{2}$ inches at the proximal end; its external surface is convex, being $2\frac{1}{2}$ inches thick in the middle and thinning to the lateral margins. The internal surface is flattened on the posterior aspect, and the anterior margin is slightly expanded, as though a film from the tibia might be adhering to it. It rapidly diminishes in size, for at 3 inches from the proximal end the transverse measurement is $1\frac{1}{2}$ inch and the back to front measurement is 3 inches. The anterior and posterior margins are concave in length and convex from side to side.

Considered as a whole these bones are robust and characterized by the fibula being expanded at both ends, so as to be as deep as the tibial surface, with which it is in contact.

The form of the distal end of the bone separates the tibia widely from all genera with an ascending astragalus or co-ossified intermedium. It seems a somewhat more primitive type than *Ornithotarsus*.

I regard the cranial and pelvic evidence as supporting the conclusion that characters in which this region of the skeleton of *Euskelesaurus* diverges from *Zanclodon* are due to persistence rather than modification of those parts of the bones which are most liable to vary.

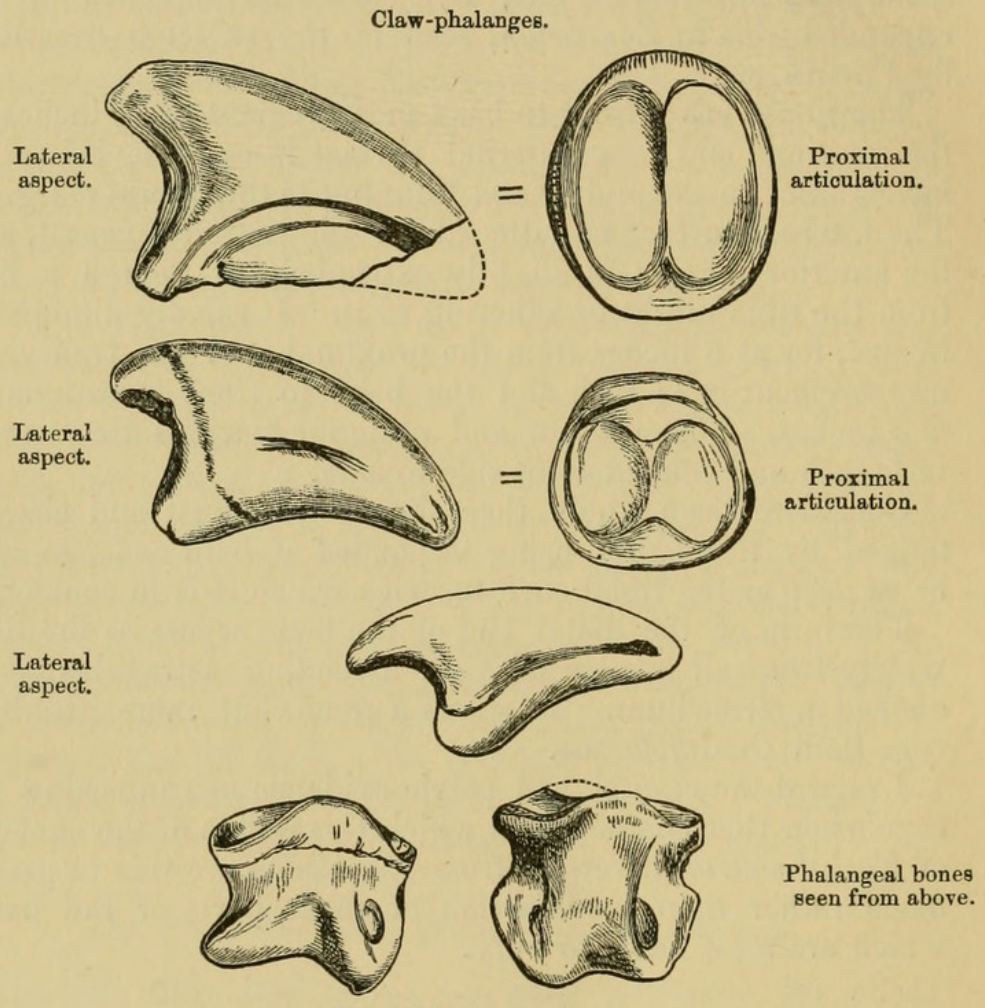
The Hind Foot.

M. Fischer figured (*l. c.* pl. x. fig. 6) a mass of bones which I regard as the distal row of the tarsus. It shows three bones in close contact, and there is a broken portion of a metatarsal in connexion with the mass. Seen from the front the transverse measurement is 6 inches and the vertical measurement of the middle bone is $2\frac{3}{8}$ inches. This is narrow in proportion to the width of the tibia, but not quite conclusive as to whether four or five digits were developed. The proximal convex surface corresponds to the concavity below the astragalus.

Of the digits, M. Fischer described two imperfect phalanges and a more imperfect terminal claw-phalange.

Mr. Brown's additional specimens, which are parts of the same foot, comprise three nearly perfect claw-phalanges and a terminal fragment of a fourth, possibly referable to the specimen at Paris. There is also a doubtful fragment, imperfect at both ends, which has some appearance of being a

Fig. 5.



Claw-phalanges and phalangeal bones of *Euskelesaurus Brownii* (Huxley). $\frac{1}{3}$ nat. size.

claw-phalange. There are also six digital phalanges and indications of two others, which are subcubical, with well ossified trochlear extremities. It would thus appear that there is evidence of four digits if all come from the same limb, and between these fourteen phalanges are distributed; but there is no evidence that the number in each digit was the same. It may be inferred that the number of bones followed the formula 5 . 4 . 3 . 2, and that the fifth was undeveloped, as in *Hortalotarsus*. The foot appears to have been short and small, with the claw-phalanges wider from

side to side than in any other carnivorous Saurischian, but about intermediate between the depressed claw of *Iguanodon* and the compressed claws of Megalosaurs.

The digital phalanges are relatively short and all substantially of the same type, only varying a little in dimensions with the size of the digit. The longest and largest are the two bones in the Paris collection, the more proximal of which exceeds $2\frac{1}{2}$ inches in length in the middle, which is the least length, and the second is about $1\frac{1}{2}$ inch in the same measurement; but the total length of the two bones as naturally connected exceeds $4\frac{1}{2}$ inches. The bones are characterized by a well-rounded, distal, pulley-shaped end, with the inferior surface widening and becoming more inflated and elevated as it extends backward. A shallow median concavity divides the distal surface into two nearly equal right and left parts, and behind and above the channel in front there is usually a considerable depression. At the sides of the pulley are deep concavities for ligamentous union. The inner side is the more nearly vertical, the outer more inclined. The superior surface is more or less flattened, with a tendency to convexity from side to side and concavity from behind forward. The proximal end increases in depth and width, being always wider than deep, forming the half of a vertical ellipse, the contour of the base being flattened and the sides and upper surface being convex. The superior and inferior outlines of the proximal end are convex from side to side, owing to the middle part of these surfaces being prolonged as a sort of talon upon the adjacent trochlear surface of the bone which is proximal to it in position. This proximal margin is roughly ligamentous all round.

Although eight digital phalanges are indicated by Mr. Brown's specimens, they are all more or less imperfect, and three are only fragments. One of the smaller specimens, numbered by him 16, is $1\frac{5}{8}$ inch deep at the proximal end, where it is rather less than 2 inches wide, this surface being evidently slightly narrower than the distal end of the bone, which fits into the proximal surface. The distal end is less than $1\frac{1}{8}$ inch deep; its transverse width does not exceed $1\frac{1}{4}$ inch. The length in the middle of the side is on the inner side $1\frac{3}{8}$ inch and on the outer side less than 1 inch. In some specimens the base is divided into two nearly equal parts by a transverse groove behind the distal pulley, but in other specimens the trochlear surface appears to be relatively smaller. What appears to be the outer side is frequently concave.

The distinctive features of these phalanges are the comparatively flattened base, the superior and inferior median

extension backward of the proximal articular surface, the large amount of vertical motion upon each other indicated by the forms of the articular ends of the bones, and the strong development of ligamentous surfaces. The smallest phalange preserved is $1\frac{1}{8}$ inch long and about $1\frac{3}{8}$ inch wide at the distal end.

Claw-Phalanges. (Fig. 5.)

The claw-phalanges are more distinctive of *Euskelesaurus* than the other bones of the digits, though perhaps they conform most nearly to the type of *Dimodosaurus*, with which the other phalanges are also best compared. There are indications of four which progressively decrease in size, but are marked by a transverse width at the proximal end which is almost equal to the vertical depth. The fragment figured by Fischer (*l. c.* pl. x. fig. 7) gives an imperfect idea of the form of the claw. In the largest bones, including the Paris fragment and the largest nearly perfect claw belonging to Mr. Brown, the bone is higher than wide at the proximal end. In the latter specimen the dimensions are $2\frac{1}{2}$ inches high by $2\frac{1}{4}$ wide near to the articular surface, but the articular surface itself is only $1\frac{3}{4}$ inch deep and nearly 2 inches wide, owing to the way in which the superior margin of the bone descends and indicates a strong ligamentous attachment towards the point from which the first measurement is taken. The superior surface of the phalange is strongly inflated, very convex from side to side, and also convex from behind forward. The sides of the bones are characterized by deep grooves, which divide the lateral surfaces by their arched contour into a smaller inferior and a larger superior portion.

The base is comparatively flat, being only gently convex from side to side and moderately concave in length. The form combines the height of the Megalosauroid claw with almost the width of the Iguanodont claw, and is therefore more massive than either. But the extremity of the claw is not so much recurved as in Megalosauroids. The largest specimen is imperfect at the extremity and measures 4 inches long in greatest extent, and was probably half an inch longer; so that it is less than twice as long as deep. A smaller specimen is fully $3\frac{3}{4}$ inches long and more than 2 inches deep. The smallest specimen is much more slender, $3\frac{1}{4}$ inches long and about $1\frac{5}{8}$ inch deep. As already indicated, the depth of the bone at the articular end slightly exceeds its width, though the depth of the articulation is always rather less than its breadth. It seems probable that the ungual phalanges decreased in size, as in *Dimodosaurus*, in passing from the

inner to the outer digit. The great width of the superior surface of the phalange best distinguishes it from the French type, which in other parts of the skeleton shows differences from *Euskelesaurus*, which probably show that the two genera were not so nearly related as the aspect of the phalanges might at first suggest. The length of the longest digit, exclusive of the metatarsus, does not appear to have exceeded 9 inches. The corresponding measurement of the four phalanges of the third digit in *Dimodosaurus* appears to be fully 10 inches.

On the Lower Jaw of Euskelesaurus; *probably referable to* E. Brownii (*Huxley*). (Fig. 6.)

On my visit to Aliwal North in September 1889 I examined, in company with Dr. W. G. Atherstone, F.G.S., and Mr. Thomas Bain, under the guidance of Mr. Alfred Brown, a locality on the Kraai River, to the south-east of Aliwal North, which we anticipated might furnish Euskelesaurian remains. The only specimens which rewarded us were found on the waggon-track, lying close to the surface, and very much broken, owing to their superficial position and exposure. They were in hard red shale and consisted of important fragments of the jaw and less useful fragments of vertebræ. I am unable to say that the vertebræ and jaw belong to the same individual, being only found within a foot or so of a spot which yielded no other vertebrate fossils.

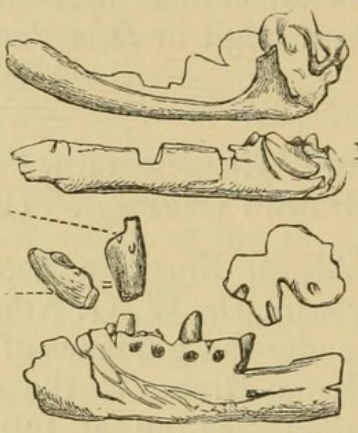
The jaw fragments comprise the posterior articular extremity of a lower jaw and the anterior dentary extremity. Both are quite unlike anything previously known. The articular extremity shows the articular bone, hitherto unknown in any Saurischian, which is massive, lying on the inner side of the angular bone. This bone appears to develop a large internal plate which extends horizontally inwards but is imperfectly preserved. There appears also to be a small subangular bone, forming the anterior margin of the articular surface, though it is possible that this appearance of suture may only be a fracture. There is no indication of any coronoid process, the superior and inferior surfaces being horizontal and parallel, and the depth of the jaw towards the articulation is extremely small.

The articulation is 4 inches wide, about $1\frac{1}{2}$ inch long in the middle, and somewhat longer at the sides, so that it is transversely reniform, with the concavity on the posterior margin. The surface is concave from front to back, divided into two portions by an oblique median ridge separating the inner

part, formed by the articular bone, from the outer and anterior margin, formed by the angular bone, which rises in front in a sharp transverse ridge to define the articulation. Posteriorly the articulation is bounded by an elevated margin of the

Fig. 6.

Articular end of the left ramus of the mandible, seen from above.



Anterior part of left ramus of the mandible, showing broken serrated teeth.

Mandible of *Euskelesaurus* from the Kraai River. $\frac{1}{10}$ nat. size.

articular bone, behind which transverse ridge, chiefly developed on the inner side, is a very slight heel. This massive articular bone is $3\frac{3}{4}$ inches long and about $3\frac{1}{2}$ inches wide; it terminates in front in a cartilaginous surface, which is rounded and was presumably invested in bone which is now broken away. It terminates behind in a somewhat vertical truncated surface. Internally it gives off an obtuse process and externally there appears to be a similar process embedded in the angular bone. On the base the internal process is defined by a longitudinal groove, and there is also a groove in front of it. The ramus of the jaw is prolonged forward from the outer margin of the articulation. It is at first $1\frac{1}{8}$ inch deep, the surface, as preserved, is flat, inclined so as to look upward and outward, slightly convex in length, rounded from side to side at first on the upper margin, which is about $\frac{5}{8}$ inch thick. This margin becomes an angular ridge, dividing the inner from the outer surfaces as it extends forward. The horizontal plate, which extends inward below the anterior end of the articular bone, appears to be directed downward, and is given off below the middle of the depth of the side. It appears to consist of two layers—an upper layer nearly $\frac{3}{8}$ inch thick, and a thin lower layer ; and these two layers have the aspect of being connected by a horizontal suture. As the superior surface is traced forward a deep groove extends above

it, so that it excavates a wide concavity in the angular bone, and the horizontal plate passes into the inferior margin of the jaw, which it presumably deepens, though this is not evident from the condition of preservation. The entire length of the fragment is 13½ inches, of which 10 inches are in advance of the anterior margin of the articulation.

In close proximity with the articular end of the jaw already described, and in the same line with it, but without the intervening bone being preserved, was the anterior dentary part of the lower jaw, almost complete at its extremity. It measures a foot in length, and presuming that the two pieces are portions of the same jaw, it would probably have been fully 30 inches long when perfect; so that it would not be inferior in size to *Megalosaurus*, *Ceratosaurus*, and types which present a similar dentition. There is no proof that it is the lower jaw of a species of *Euskelesaurus*, since the teeth are more slender than those already described in the maxillary bone. The number of teeth in the jaw is small, and they do not appear to have exceeded the number in the maxillary bone of *Euskelesaurus Brownii*. The jaw is remarkable for the evidence it gives of composite character on its inner side. A bone extends along the inner alveolar border, which is distinct from the dentary, forms the inner half apparently of the alveoli, and makes more than half the depth of the jaw, and appears to extend almost to its anterior extremity; and posteriorly there is a groove between this splenial element above and the thickened basal ridge of the dentary bone, which appears to have lodged another bone, presumably the forward tapering extremity of a large coronoid. Professor Marsh remarks that in *Ceratosaurus* the splenial bone is large, extending forward to the symphysial surface, and forming in that region a border to the upper margin of the dentary bone. There is one remarkable character, however, in which this jaw differs from almost all known Saurischia—in the jaw becoming deeper as it extends forward. At the hindermost tooth-socket preserved the depth is about 3 inches, but within 3 inches of the fractured anterior extremity the depth is 3½ inches. The jaw is remarkably straight and compressed from side to side. The width at the hindermost tooth-socket, 9 inches from the front, is 1⅛ inch; but it becomes a little inflated on the outer side anteriorly, though this character may be partly the result of distortion.

The external surface is vertical, somewhat rugose, with vascular impressions, and with a row of shallow pits corresponding to the teeth an inch below the alveolar border. There is a convex rounding of the side on to the alveolar

margin, and a more distinct and marked rounding of the side towards the base, which appears to be slightly curved in front, but forms a sharp ridge behind, which separates it from the flat inner side of the bone. There is no indication of a symphysial surface, unless it be in the slightly rugose extremity of the inner surface of the dentary bone; but that surface could only be regarded as symphysial on the hypothesis that the bone has there been distorted by pressure.

The alveolar border, as preserved, is somewhat concave from front to back. A groove which runs along the splenial bone, from a quarter to half an inch below the alveolar margin, is also concave in length, and a number of oblique impressions, as of blood-vessels, descend from this margin downward and backward over the splenial. It is thus evident that, although the teeth are here contained in sockets, any less development of the superior border of the splenial bone would give them the appearance of a Lacertilian mode of implantation. In *Megalosaurus Bucklandi* the outer alveolar margin rises much higher than the inner margin, so that all stages of intermediate development between the condition now described and the Pleurodont or Acrodont attachment of the teeth may be looked for in Saurischia. The contact between the teeth and their sockets in this specimen is extremely close, and there is some appearance of the bone of the superior alveolar surface having grown up around the tooth so as to invest it. Indications are apparently preserved of eleven teeth, without any reason for inferring that the hindermost of the series is present. The eighth tooth is preserved in natural attachment. It is directed upward, outward, and a little backward; its root or unenamelled part rises fully an inch above the alveolar border. On this base the root is transversely ovate in section, $\frac{5}{8}$ inch long, $\frac{1}{2}$ inch wide, but becoming somewhat narrower posteriorly. This upper portion of the root has somewhat the appearance of having been invested in a sheath of hard thick skin. The crown in this specimen has only its basal part preserved; it is enamelled, rounded in front, and compressed behind to a sharp ridge, which is marked with transverse serrations quite on the pattern of *Megalosaurus*, but much finer than those seen in the maxillary teeth of *Euskelesaurus Brownii*. The enamel is remarkably smooth and the extremities of the serrations appear to be rounded. Further forward a portion of a loose root was found just indicating the base of the crown, and in what I take to be the fourth socket on the inner side is a successional tooth not quite perfectly exposed, but showing the external surface of the crown for a depth of about $\frac{5}{8}$ inch. It is about $\frac{1}{2}$ inch wide,

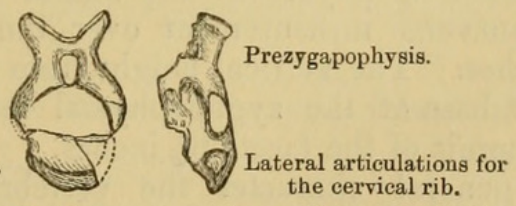
very convex on the external surface, and the convexity gives the tooth the aspect of curving a little inward. Both the anterior and posterior margins are beautifully marked with denticles, which have almost the appearance of a chain of small beads extending up each edge; and when seen from the side these denticles have their lateral borders converging to a sharp V-shaped cutting-edge, and they are apparently separated from each other to their bases. Therefore this crown shows that in all details there is a close correspondence between the teeth of *Megalosaurus* and those of this Euskelesaurian. The crown of the tooth, like its side, shows delicate transverse waving of the enamel, but there is no indication of any vertical waving or fluting.

It is remarkable as a point of difference from *Ceratosaurus* that there is no certain indication of a foramen in the lower jaw; and, presuming that the articular end belongs to the same specimen, it is noteworthy that the depth of the jaw in front of the articulation is scarcely more than half its depth in the anterior dentary region, which is the exact converse of the condition in *Ceratosaurus*. Presumably the horizontal inward plate in connexion with the articular region is not found in *Ceratosaurus* or in any other known Sauischian, since it has not been previously recorded.

Cervical Vertebra. (Fig. 7.)

Only one vertebra was collected in sufficient preservation to give an idea of the character of the neck, and this has lost the neural arch behind the prezygapophyses and a portion of

Fig. 7.



Cervical vertebra of *Euskelesaurus Brownii*. $\frac{1}{10}$ nat. size.

the base of the hinder part of the centrum. The vertebra is distinguished by its short antero-posterior measurement, which is about 2 inches. From the neural canal to the base of the centrum in front is $3\frac{3}{4}$ inches, and the transverse width above the middle of the centrum is $4\frac{1}{4}$ inches. The anterior articular face is slightly concave, but becoming convex towards the external border, and at the base there is an oblique area about $\frac{7}{8}$ inch deep, which has the aspect of having given

attachment to a subvertebral ossification. The margin of the posterior surface is broken away; but it is evident that the base was deeply concave from front to back and convex from side to side.

The anterior half of the side of the centrum is occupied by two large articular facets for the rib. Into the upper facet the base of the neural arch appears to enter; it is vertically ovate, about $1\frac{1}{4}$ inch deep and $\frac{3}{4}$ inch wide; but the articular surface is broken; it is separated from the inferior facet by an interval of $\frac{1}{4}$ inch. This facet is about an inch wide and nearly $1\frac{1}{4}$ inch deep, subtriangular in form; it is margined by an elevated rim, except in front, and is slightly concave. These articulations are closer together than in *Megalosaurus*, and less elevated from the side of the centrum.

The neural arch is strong and extends the entire width of the centrum. The neurapophyses have a broad base of nearly 4 inches, and almost meet in the median line. They are thick and enclose a neural canal about $\frac{7}{8}$ inch high and $\frac{5}{8}$ inch wide, wider above than below, and deeper apparently behind than in front, where the base of the canal excavates the centrum. The neurapophyses expand transversely and anteriorly in two zygapophyses, which are inclined a little forward. The articular facets are almost flat, ovate, inclined to each other at about an angle of 50°, as in *Megalosaurus*; separated by a median interval of about half an inch, without any notch between them, being scarcely raised above the adjacent bone. Each measures rather less than 2 inches from within outward and about 1 inch transversely. Laterally there is a convex inflation below the outer border of the zygapophysis. The least transverse measurement over the concave lateral contour of the neurapophyses at the neural canal is $2\frac{1}{4}$ inches, and the transverse measurement over the zygapophyses exceeds $3\frac{1}{4}$ inches. The vertical height from the base of the centrum to the base of the zygapophysial facet is $5\frac{1}{4}$ inches, and to the summit of the facets $6\frac{1}{2}$ inches.

In general character the vertebra most resembles the cervical of *Megalosaurus*, but is much shorter in proportion to its depth, indicating, if correctly referred, that *Euskelesaurus* was a short-necked type, different from the long-necked *Massospondylus*, which resembles *Zanclodon*. This fact is the more interesting since the forms of the pubic bones are so similar in these two South-African genera that, had this cervical vertebra been unknown, its Megalosauroid shortness could not have been suspected.