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XII.—On the type of the genus Massospondylus, and on some Vertebrœ and limb-bones of M.(?) Browni

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XII.—*On the Type of the Genus* Massospondylus, *and on some Vertebræ and Limb-bones of* M. (?) Browni. By H. G. Seeley, F.R.S.*

In 1854 the museum of the Royal College of Surgeons received from the Harrismith district, on the border of Natal in the Drakensberg range, a series of bones presented by Dr. R. J. N. Orpen and Mr. Joseph Millard Orpen. No further remains of this animal have since been recovered. Mr. J. M. Orpen, Member of the Legislative Assembly, Cape of Good Hope, on August 5, 1889, wrote for me the following further memorandum on the locality from which they came:—"The spot where I obtained some large bones of a saurian about 1853, which my father sent home, was on a hill capped by sandstone on the east boundary of the farm Beaucherf, in the district of Harrismith, on the watershed of the Drakensberg. Below the sandstone is a chocolate-coloured shale. I think more of the bones would be found on the spot by excavating. The fossils were on the east face of the beacon-hill which is north-west of Beaucherf House." I was unable to visit this locality, and the genus rests still upon the materials collected by Mr. Orpen, which have never been figured.

Fifty-five fragments or bones, numbered 331–386, were selected by Sir R. Owen and briefly described in the 'Descriptive Catalogue of the Fossil Organic Remains of Reptilia and Pisces contained in the Museum of the Royal College of Surgeons of England' (4to, London, 1854), pp. 97–100. They were then regarded as indicating three or more genera or species of large extinct carnivorous reptiles, combining in their vertebræ and bones of their extremities both Crocodilian and Lacertilian characters, with an indication of a structure of the sacrum like that seen in Dinosauria. The species were named *Massospondylus carinatus*, *Pachyspondylus Orpeni*, and *Leptospondylus capensis*. They were grouped under the Lacertilia in 1854. In Owen's 'Palæontology,' 2nd ed. 1861, p. 300, *Massospondylus* is mentioned under the Crocodilia and placed in the suborder Amphicœlia or Teleosauria. A later reference to the type is made in Quart. Journ. Geol. Soc. vol. xxxvi. 1880, p. 415, where all the genera are compared with the Anomodont reptile *Platypodosaurus*, but only to indicate differences.

An examination of the remains shows that they are not all

* Read before the Geological Society of London as Part 6 of "Contributions to Knowledge of Saurischia," June 22, 1892.

referable to one individual. The presence of portions of three pubic bones of different sizes indicates at least three individuals; but those bones show no divergence of character. There are three vertebræ, which are of different type from the majority of the remains, and probably belong to other species. Most of the bones, however, are referable to the species *Massospondylus carinatus.* The early dorsal vertebræ, of which the centrums are preserved, have, when taken by themselves, enough resemblance to the Teleosaurian type to explain Sir R. Owen's recognition of a Teleosaurian affinity. But the pubis of *Zanclodon*, which I examined in 1878 at Stuttgart and Tübingen, proved to be identical in type with *Massospondylus*, and therefore fixed the systematic position of the genus among the Megalosaurian Saurischia. Some other parts of the skeleton approximate to *Zanclodon*, but the differences are considerable. The ilium conforms to the Triassic type, as represented by *Zanclodon*, *Aëtosaurus*, &c., in having the vertical plate of the bone high and more developed posteriorly than anteriorly; but it does not develop descending pedicles to give attachment to the pubis and ischium, approaching in this respect to the type of *Cetiosaurus*.

My conclusions also diverge from the College of Surgeons Catalogue in the following osteological determinations. The vertebræ of *Massospondylus carinatus*, which were regarded as probably from the tail, I believe to be cervical, from their resemblance to the cervical vertebræ of *Zanclodon*. The dorsal vertebræ show a similar affinity. It seems to me not improbable that the caudal vertebræ named *Pachyspondylus Orpeni* are the tail of this species of *Massospondylus*, though it is impossible, in the absence of history of the specimens, to make the identification with certainty. There is one sacral vertebra, which Professor Owen recognized as having some Dinosaurian characters. It is the only evidence of the sacrum preserved. There is a close resemblance in form between the ischium and scapula in animals of this type. The bone 349, regarded as a left scapula, seems to me to be the ischium; no. 350, termed upper part of the same scapula, I regard as distal end of the same ischium. A similar bone, 359, is named ischium; another example, 357, was referred with doubt to the proximal end of the humerus. The bone 351, named lower end of left scapula, I regard as the proximal end of the pubis; and the bone 352, which is compared to the scapular end of a right coracoid, is also the proximal end of a pubis.

Pachyspondylus and *Leptospondylus*, in the absence of further evidence of their characters, may be held for the present in abeyance, though the specimens exist on which definitions might be based.

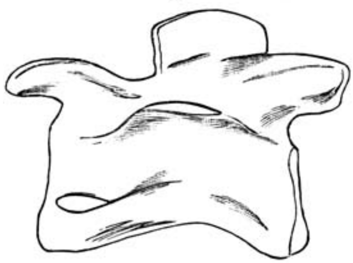
Vertebral Column.

Few vertebræ were collected; they represent the cervical, dorsal, sacral, and caudal regions. Since the bones belong to two or three individuals of different sizes, caution is necessary in using them as evidence for the reconstruction of the form and proportions of the animal. The cervical vertebræ are most elongated; but the dorsal vertebræ are more compressed from side to side than the cervical at the articular ends, and they have the centrum shorter. The single sacral centrum is shorter than the dorsal and has the body of the vertebra more depressed. The caudal vertebræ, on the other hand, are longer than the sacral, have larger articular faces than the dorsal, and carry chevron-bones.

Cervical Vertebræ. (Fig. 1.)

The specimen numbered 331 (fig. 1) was regarded as a vertebra probably from the tail; I interpret it as cervical. Compared with the figure of the cervical vertebra of *Zanclodon** it is seen to be almost identical in plan, the obvious difference being that the neural spine is a little more posterior in position in *Massospondylus* and that the transverse plate, extending outward like a film, which makes the upper tubercular articulation for the rib, has a more posterior position.

Fig. 1.



Left side of a cervical vertebra. About $\frac{1}{3}$ nat. size. No. 331.

The aspect of the vertebra is somewhat elongated, with a strong low neural spine, strong zygapophyses (low in position and deeply cleft), with the centrum compressed from side to

* 'Popu ar Science Review,' n. s. vol. iv. pl. ii. fig. 3.

side, and moderately elevated long parapophysial facets for the rib, below the middle of the sides of the anterior face for the centrum. The body of the vertebra is $4\frac{3}{10}$ inches long at the base and hardly more than 4 inches long at the neural canal, showing that the cervical vertebræ were carried in a curve which was convex on the anterior or ventral surface, from which it follows that the neck was elevated. The anterior face of the centrum is slightly distorted, but appears to have been circular, $1\frac{7}{10}$ inch in diameter. The surface appears to have been concave and bordered by a sharp margin, but it is imperfectly excavated. At the base of the articular surface is an appearance as though there may have been a narrow, thin, intercentral ossification, not unlike that seen in *Pareiasaurus*. A somewhat similar bevelling, which I should attribute to a like cause, is seen below the posterior articular margin, and may account for the original identification of the vertebra as caudal. The posterior end of the centrum is rather larger. A sharp, straight, median ventral ridge extends concavely from front to back along the base. The sides of the centrum are greatly constricted and consist of inferior portions, which converge downward from the lower articulation for the rib, and superior portions, which are nearly vertical and parallel. The centrum is thus constricted in the middle to less than half its width at the ends. This constriction or excavation is greatest below the transverse process, which is given off just above the neuro-central suture. That process has a long base, is directed outward and a little downward; it is compressed from above downward, is slightly convex above and rather concave below. There is no evidence of a pneumatic foramen on its underside.

The neural arch, in harmony with the slender centrum, is chiefly remarkable for the low truncated neural spine and strong cleft divergent zygapophyses. Seen from above the anterior and posterior ridges of the zygapophyses approximate almost in the form of a capital X, owing to the lateral transverse constriction above the transverse processes being similar to that of the centrum. The neural spine is $1\frac{4}{10}$ inch above the zygapophysial ridge; its vertical anterior border is in a line with the middle of the transverse process. Superiorly it is gently convex from front to back. Its short posterior border is rather in advance of the slight notch for the intervertebral nerve. From the base of the neural spine the zygapophyses diverge as compressed wedge-shaped processes, separated throughout their length, with the articular facets inclined, so that the anterior pair look inward and upward. These facets are slightly convex. The process is concave on its under surface from front to back and convex from side to side.

Nos. 332, 333, 334, 335 are probably cervical vertebræ; but their condition of preservation contributes nothing to knowledge of the type, and I believe they pertain to another species.

Dorsal Vertebræ.

The dorsal vertebræ have the centrum only preserved, though in the specimen numbered 336 the base of the neural arch is seen. These vertebræ, owing to the lateral compression of the centrum and the attachment of the neural arch along the whole length of the centrum, have a Teleosauroid aspect; they measure $2\frac{7}{10}$ inches in length. The measurement on the neural canal exceeded that on the ventral border, showing that the back of the animal was arched upward in the antero-posterior direction. The articular ends are laterally compressed, being higher than wide, vertically ovate, 2·2 inches high by 1·7 broad, flattened but slightly concave. The transverse measurement in the middle of the centrum is about $\frac{8}{10}$ inch. The base is markedly concave from front to back and notably convex from side to side. There is only a slight indication of the transverse widening of the neural arch. This vertebra apparently is figured in Cat. Foss. Rept. Brit. Mus. pt. iv. p. 249, 1890 *.

Sacral Vertebræ. (Fig. 2.)

The specimen 346 (fig. 2) I regard as referable to *Massospondylus carinatus*. It was referred to *Pachyspondylus Orpeni*

Fig. 2.

Ventral aspect of sacral vertebra. No. 346.

in Sir R. Owen's Catalogue of the Royal College of Surgeons. It is depressed, broadly convex on the base, with an oblique

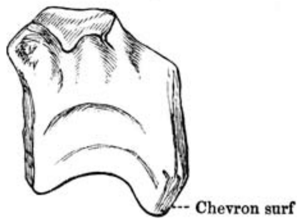
* The genus there rests partly upon teeth from India named *Massospondylus Hislopi*, from Maleri Gondwana beds, and the *Massospondylus* (?) *Rawesi*, from the Lameta beds. I am not aware that any teeth from South Africa of the type of *Massospondylus* have been found. The teeth of *Rhopalodon* are not unlike those attributed to *Massospondylus Hislopi*. The Indian bones of Anomodonts hitherto known, however, are from the Panchet rocks.

vertical truncation of the anterior parts of the sides, so as to leave only a narrow vertical median strip of the centrum to meet the sacral vertebræ, which was placed in front. This is due to the encroachment of the sacral ribs, which were situate at the junction of the two vertebræ, as in most of the Old-World Saurischia and as in *Deuterosaurus*. The encroachment of the sacral ribs, no less than the short length of the centrum, indicates that the sacrum was consolidated early in life. The centrum is less than 2 inches long, $1\frac{3}{10}$ inch deep, $1\frac{7}{10}$ inch wide.

Caudal Vertebræ. (Fig. 3.)

The vertebræ which have been regarded as caudal all retain the transverse processes above the level of the base of the neural canal. The centrum (fig. 3) has a conspicuous lateral compression in the middle, rounded base, and large facets for the chevron-bones. The articular surface is conically concave

Fig. 3.



Right side of centrum, early caudal vertebra. $\frac{1}{3}$ nat. size.
No. 338 reversed.

in front and more flattened behind, with a rather small neural canal and depressed neural arch, with the neural spine inclined backward. The spine diminishes in height as the vertebræ diminish in size. The caudal vertebræ are referable to more than one individual.

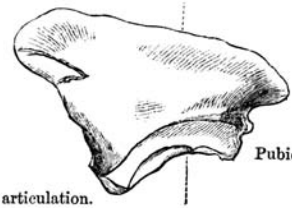
Pelvis.

Sir R. Owen identified the ilium 358 and the ischium 359. He remarks that the left ilium terminates anteriorly in a short obtuse process in advance of the acetabulum; but it is supposed that its anterior part has been broken away, and the bone in form and proportions was said (1854) to most resemble the iliac bone of *Iguanodon*. Notwithstanding some uncertainty in determination of the ilium in allied animals in Sir R. Owen's later writings, these remarks appear to indicate that the pelvic affinities of the animal were rightly appreciated.

Ilium. (Fig. 4.)

The form of the ilium (fig. 4) is, so far as I am aware at present, without close parallel in any carnivorous member of the same group.

Fig. 4.



Left ilium, inner lateral aspect. $\frac{1}{6}$ nat. size. No. 358.

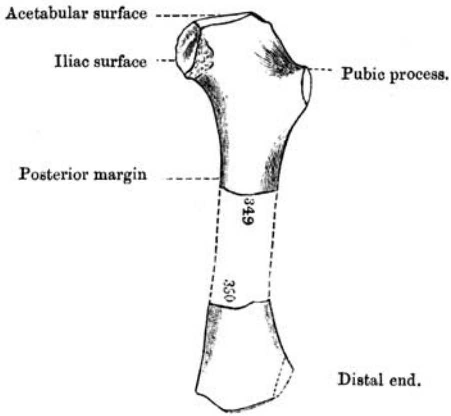
The bone is subtriangular, with a long, superior, slightly convex iliac crest, which terminates in a small preacetabular process and a larger postacetabular process. The length of the crest is 9 inches; it is gently curved from front to back, so that there is a slight reflexion outward of the extremities of the bone. Assuming that the sacral vertebra and ilium belong to the same animal or animals of similar size, this length would indicate that there were not fewer than three or more than four vertebræ in the sacrum. The vertical height from the articular surface of the acetabulum in front is $3\frac{1}{2}$ inches, and the corresponding height from behind is 6 inches, so that in general configuration the form of the ilium approaches most nearly to *Aëtosaurus ferratus* (Fraas); but the preacetabular process is less developed, as are the descending processes of the ilium for the pubis and ischium. The acetabular arch between the limits of the ischium and pubis is $3\frac{1}{2}$ inches long; it is 2 inches wide in front and $1\frac{1}{2}$ inch wide behind. The surface is divided into two portions, an external and an inner: the external portion is convex from the outer margin inward and increases in width as it extends posteriorly; the inner portion is somewhat shorter and concave in width as well as in length.

I suppose the superior crest to have been more or less parallel to the vertebral axis, so that the thickened rounded posterior angle of the ilium was thrown downward and did the major work of supporting the femur. The ischiac suture is slightly worn; it is about $1\frac{3}{10}$ inch wide and 1 inch long and has a subquadrate form. The articulation for the pubis is semicircular, $2\frac{1}{2}$ inches wide and 1 inch long, the convexity being in front.

The Ischium. (Fig. 5.)

There are several examples of ischium—nos. 349, 350, 357, and 359; the last was identified by Sir R. Owen as the body of the left ischium. There is no certain evidence of the length of the bone, though its form and general characters are obvious. I regard the specimen 349–50 (fig. 5) as having been a foot long, and believe that it was articulated obliquely to the ilium. Its proximal end is concave on the posterior border and becomes straight distally; its anterior border is divided into two parts by a tuberosity near the proximal end, which was directed inward. This tuberosity has the form of the anterior

Fig. 5.



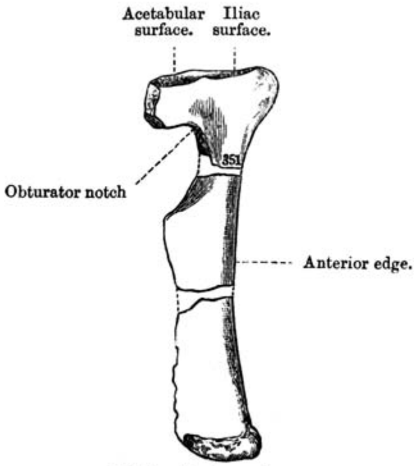
Restoration of the ischium based upon two fragments. $\frac{1}{6}$ nat. size.

acromial crest of a scapula, and makes the anterior outline of the length of the bone concave. The proximal anterior margin above the tuberosity is thin and fractured. Thus the ischium is nearly 3 inches wide at the proximal extremity; $1\frac{1}{2}$ inch of the surface is for articulation with the ilium, and the anterior smooth concave part is a portion of the acetabular border. The width at the tuberosity is a little greater and at the posterior fracture the bone is 2 inches wide. The distal extremity of no. 350 must have been more than 3 inches wide, and terminated in a flat oblique cartilaginous surface. If that be taken as indicating the horizontal base of the bone, then the ischium must have been directed backward, so that its posterior border was inclined at an angle of about 45°. The subacetabular process, which I have described, at $2\frac{1}{2}$ inches below the articular surface was directed inward, so as to enclose a pelvic basin, as in other Saurischia.

Pubis. (Fig. 6.)

The hind bone of the pelvis (fig. 6) is represented in the College of Surgeons Museum by several specimens, some of which have hitherto escaped attention, and remain as originally received, without numbers. Nos. 351 and 352 are the proximal extremities of the pubic bone, showing the articular surfaces. The notch beneath the acetabular margin is morphologically the remains of the foramen in the pubic bone of *Belodon*, which appears to have become modified in a way that can only be compared with the condition in *Zanclodon*

Fig. 6.



Pubis, inner side. $\frac{1}{6}$ nat. size. Restored from three fragments.

and *Staganolepis*. In the drawers are preserved the middle portion of the pubis as well as its distal end, so that the bone is now known from all its parts, though these cannot be actually fitted together into a single specimen. This is less important, since the left pubis of *Euskelesaurus* figured by Mons. Paul Fischer as a pelvic bone of a Dinosaurian exactly parallels the conditions of the several fragments of the bone in *Massospondylus*.

The transverse width of the head of the bone is less than 4 inches in the largest specimen and more than 3 inches in the smallest, and the transverse width at the notch below the articular head is about $1\frac{3}{4}$ inch. The bone is about $1\frac{1}{2}$ inch thick proximally and the surface is divided into two portions, one for articulation with the ilium, and the other is part of the acetabulum. This acetabular portion is truncated posteriorly and compressed on the underside, as though it had extended in an antero-posterior direction to meet the acetabular part of the ischium.

The middle portion of the shaft is twisted at an angle of about 45° to the articular head, directing the expanded distal plate of the bone inward. The inner margin is fractured. I infer that the pubes approximated towards each other posteriorly, converging by the thin inner border, which thus became posterior, and that the bones each had a nearly straight though slightly concave border, which was anterior and external. The middle portion of the shaft preserved is nearly 4 inches long and fully 2 inches wide to the fracture. The distal portion of the pubis is about $5\frac{1}{2}$ inches long, less than 2 inches wide proximally, and $2\frac{1}{4}$ inches wide distally, with the distal extremity truncated and thickened. It has a cartilaginous border $\frac{1}{2}$ inch deep on the inner side, and has the anterior extremity of the fragment directed a little outward. Hence I conclude that the pelvic girdle was constructed upon the same plan as in other Saurischia, in which the ischium and pubis are flattened elongated bones. The form of the pubis seems to be conclusive in indicating affinity with the Triassic Saurischia of Europe.

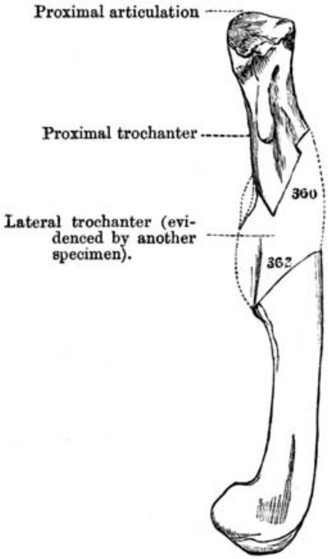
The Hind Limb.

The hind limb is known from the femur, tibia, metatarsus, and phalanges; its characters are in harmony with the indications of the pelvis. The femur, however, is more slender than might have been expected, and rather conforms to the type of *Palæosaurus* than that of *Zanclodon*. The tibia is similar in its characters.

The Femur. (Fig. 7.)

The femur (fig. 7) was relatively short and strong. It is known from the proximal end 360, the distal ends 361 and 362, and the middle of a shaft which preserves much of the internal lateral trochanter. The distal end shows the base of the lateral trochanter to be $8\frac{1}{2}$ inches from the distal extremity. The middle of the shaft shows the trochanter to have had a length of not less than 3 inches. The proximal fragment, 4 inches long, shows no trace of the lateral trochanter. These measurements prove that the femur was more than 16 inches long; I assume it to have been probably not less than 18 inches long.

Fig. 7



Restoration of the external aspect of the right femur. $\frac{1}{6}$ nat. size.

The proximal head of the bone was directed inward, and measured about 4 inches transversely from the rounded head, which was at right angles to the shaft. Its superior surface is flattened, moderately convex from within outward, and slightly concave from front to back. There is no indication of a twist in the shaft, and I infer the proximal and distal ends to have been approximately parallel to each other.

The head of the bone is compressed from above downward, flattened on the underside, and convex on the superior surface. Below the head the bone becomes stouter, so that while the thickness of the head is $2\frac{2}{10}$ inches, and of the neck about $1\frac{6}{10}$ inch, the thickness at the fractured lower extremity exceeds 2 inches, where the width from within outward is $2\frac{3}{10}$ inches.

The fragment of the shaft showing the lateral trochanter appears to belong to a smaller individual. It shows that the trochanter was longitudinal, compressed, and directed downward to a depth in that specimen of about $\frac{8}{10}$ inch, recalling the condition in *Palæosaurus* and *Zanclodon*.

The distal fragment at its proximal extremity is 2 inches wide, and rather thicker, owing to the breakage occurring at the base of the lateral trochanter. The bone widens distally to 4 inches. The external border is rather more concave than the internal border. The thickness is about $1\frac{6}{10}$ inch where the elevation below the trochanter has subsided; but at the distal extremity the development of the condyles gives the bone a thickness of $2\frac{8}{10}$ inches. The distal condyles are, as usual, a large internal, vertically ovate, prominent process and a smaller external condyle, external to which is the usual oblique external infero-lateral area, though much less compressed than usual, so that it produces a convex inflation of the external distal side of the bone. There is a deep groove between the two condyles, and this divides the distal articular end in a broad U-shape into two nearly equal but unsymmetrical parts. In this respect also the bone is intermediate between *Palæosaurus* and *Zanclodon*.

The Tibia. (Figs. 8 and 9.)

The bone no. 363 is the proximal end of a right tibia (fig. 8) more perfect than 365, which is the corresponding proximal end

Fig. 8.

Fig. 9.

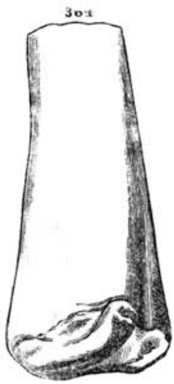


Fig. 8.—Proximal end of right tibia, seen from above.
Fig. 9.—Anterior aspect of the distal end of the left tibia. $\frac{1}{3}$ nat. size.

of the left tibia; 364 is the distal end of a left tibia (fig. 9), probably from the same individual as 365. On the hypothesis that these bones are portions of one animal, the tibia would not be less than 15 inches long. Both proximal and distal ends of the bone are typically Saurischian, and may be compared with *Palæosaurus* and *Agrosaurus*, but are well distinguished by the shaft being less constricted and the distal end more compressed from front to back. The length of the proximal fragment is about $6\frac{1}{2}$ inches, while the distal fragment measures $5\frac{1}{2}$ inches. The proximal articular surface has the usual subtriangular form and is inclined a little backward; its extreme length is $4\frac{3}{10}$ inches and extreme width over 3 inches. The internal border is convex, though the convexity is broken by two angles. The posterior surface has the usual intercondylar notch, and the outer side is longitudinally channelled by the fibular groove, which helps to define the cnemial crest, which is moderately compressed from side to side. The anterior margin is at first slightly convex and the posterior margin concave, as it extends downward. The transverse width at the fracture is about $1\frac{8}{10}$ inch. The distal end at its superior extremity is about $1\frac{1}{2}$ inch wide, but the distal articular surface has widened regularly, so that the bone is about $1\frac{8}{10}$ inch from back to front, and $2\frac{1}{2}$ inches from side to side, supposing the slight notch in connexion with the astragalus to be towards the fibular border.

The distal articulation is irregularly four-sided, the anterior border being shorter than the posterior border, which is obliquely truncated by the short inner border. The distal surface is divided into two portions, anterior and posterior, by a wide groove, there being a descending area for a talon towards the antero-external side. These limb-bones have large internal cavities. The forms of the ends only indicate a generic difference from *Palæosaurus* and *Agrosaurus*, in neither of which is the bone relatively so wide transversely.

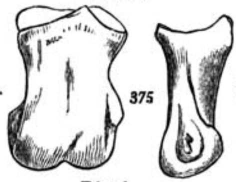
Bones of the Foot.

All the bones of the foot which are preserved appear to belong to the same limb. They make known the metatarsus and phalanges, but do not afford any evidence of either the number of digits or number of phalanges in a digit.

The first metatarsal no. 374 is short and broad, about $2\frac{1}{4}$ inches long by $1\frac{3}{4}$ inch wide. Other metatarsals appear to indicate that the longest did not exceed 6 inches in length; but they are all represented by fragments. They have the proximal ends deep, the form of the bone slender, with the distal end but little expanded. No. 367 has a depth of $2\frac{1}{2}$ inches at the proximal end, but only $\frac{9}{10}$ of an inch at the distal fracture; and no. 371, which has nearly this width at its proximal fracture, is $1\frac{3}{10}$ inch wide at the distal end. The distal extremities are rounded from above downward, sometimes with a slight concavity in the middle, and with lateral pits for ligaments.

The phalanges are as wide as the metatarsals. No. 375

Fig. 10.



A metatarsal phalange. $\frac{1}{3}$ nat. size.

(fig. 10) is $1\frac{7}{10}$ inch wide at the proximal end and $1\frac{1}{2}$ inch at the distal end, $2\frac{3}{10}$ inches long, and 1 inch thick at its extremities, with all its surfaces slightly concave except the pulley-shaped distal end, at the sides of which are the usual concave pits. No. 378 is smaller, being only $1\frac{7}{10}$ inch long, but the reduction in thickness is not in proportion to the less length and breadth. No. 379 is rather more slender and has the sides more concave. These phalanges indicate a strong broad foot. The terminal claw-phalanges 382, 383, 384, 385 present two types; 383 (fig. 11) and 385 have the posterior articular surface, which

Fig. 11.

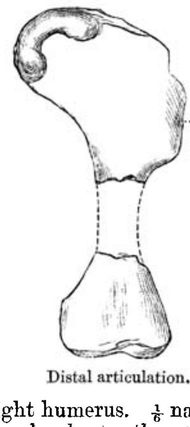
A claw-phalange. $\frac{1}{3}$ nat. size.

is deeply concave, raised above the ground by a deep inferior callosity, while in the other two there is no callosity. The depth of the posterior end of no. 383 slightly exceeds $1\frac{1}{2}$ inch; an oblique ridge descends the articular surface. The claw is compressed from side to side, convex above, concave below, tapering downward in front, but imperfectly preserved for a length of $2\frac{1}{2}$ inches; it may have lost half an inch. A small lateral groove runs along the middle of the side. The thickness of the bone posteriorly is only about $\frac{1}{2}$ inch. No. 382, which wants the inferior callosity, is less compressed from side to side. These remarkably compressed claws are a character of some importance in defining the genus *Massospondylus*. They distinguish it readily from *Euskelesaurus*, just as the absence of the proximal externo-anterior trochanter distinguishes the femur, and the comparatively small size of the head of the bone distinguishes the tibia from that genus, which is also separated by the form of its distal end.

The Humerus. (Fig. 12.)

The humerus is a broad flat bone with transversely expanded ends and a slender shaft, which, in its general form, approximates towards that figured by Sir R. Owen as *Dicynodon tigriceps*. There are, however, many approximations in the skeletons of Saurischia and Anomodontia. I infer that the length of the bone did not exceed 11 inches, so that it would be much shorter than the femur. No. 354 (fig. 12) is the proximal end of the right humerus, no. 356 is the distal

Fig. 12.



Restoration of the right humerus. $\frac{1}{6}$ nat. size. The middle of the shaft, which is lost, may be shorter than the dotted space between the two ends. No. 354.

end of the right humerus, apparently the same bone. The proximal end of the bone is transversely expanded, the articular end being directed inward and thickened, as in *Palæosaurus*, while the radial crest is similarly directed downward; but the shaft of the bone appears to have been relatively wider and the distal end to have been modified by greater transverse expansion. The width of the proximal end, as preserved, is about $5\frac{1}{2}$ inches, the articular head of the bone is about 5 inches wide. The extremity is convex from within outward, and forms two eminences on the superior surface, one at the innermost angle and the other an inch further outward, each being an inch wide, with an inch interspace between them. The radial crest is not suddenly bent down, as in *Belodon*, but curves outward and downward, so that the superior surface is convex transversely and the inferior surface concave towards the radial crest. The remarkable lateral position of the radial crest, well defined from the head above, is a distinctive character; it extends vertically down the shaft for $2\frac{1}{2}$ inches, and is half an inch thick at its lower extremity; it gives to the bone a width of less than 3 inches, and an inch lower down, at the fracture, the width is about $1\frac{1}{2}$ inch. This condition is closely approximated to by an undescribed humerus in the Royal Museum at Stuttgart referred to *Zanclodon levis*; but there the radial crest is relatively thinner, being $\frac{1}{2}$ inch thick in a proximal fragment which is $18\frac{1}{2}$ inches long, and the concave external outline below the radial crest is less marked. The thickness of the humerus of *Massospondylus* towards the middle of the shaft is $1\frac{4}{10}$ inch. This end of the bone may also be compared with the bone figured by Mr. J. W. Hulke as humerus of *Hylæosaurns* *.

The distal end of the bone is compressed from front to back; but there is no evidence to show whether the proximal and distal ends were in the same plane, as would seem probable. The distal fragment is a little over 3 inches long at the fracture and nearly 2 inches wide; it is $3\frac{6}{10}$ inches wide towards the distal articulation, which is transversely extended, rounded, with the articulation extending about $\frac{1}{2}$ inch on to the ventral aspect, and truncated on the internal border. The shaft is compressed towards the external and internal margins, and is broadly concave in the middle of its length, so that two slight rounded ridges extend downward, diverging towards the inner and outer angles of the articular surface. On the superior side there is a moderate compression on the external border. The compression of the distal end is in harmony with that of the Stuttgart humerus already referred to.

There is no evidence of the scapular arch, of the ulna and radius, or other bones of the anterior extremity. The relatively large size of the humerus suggests ordinary quadrupedal movement.

* Quart. Journ. Geol. Soc. 1874, vol. xxx. pl. xxxi.

The specimen 386, which is compared in the College of Surgeons Catalogue to a segment of the lower jaw of a Teleosaur, does not show any characters which I recognize as justifying its reference to the jaw; and the bone seems to me more likely to be a segment from a large chevron-bone of an undescribed Saurischian.

From these evidences of the structure of the vertebral column, pelvis, hind limb, and humerus, it seems to be probable that the unknown parts of the skeleton will also show a general resemblance to the types found in the Trias of Europe, such as *Palæosaurus* and *Zanclodon*.

I express my thanks to the President and Council of the Royal College of Surgeons for permission to draw these bones.

On some Vertebræ and Limb-bones from the Telle River, Cape Colony, provisionally described as Massospondylus (?) Browni (*Seeley*).

Mr. Alfred Brown, of Aliwal North, obtained a small series of bones from the Telle River, north of the Witte Bergen, in the Mattisi country, which are of some interest. They comprise the right and left femora, one and a half cervical vertebræ in contact with each other, a dorsal vertebra, three small caudals, together with five fragments of metatarsal bones, six claw-phalanges, and fourteen digital phalanges of the foot, which appear to indicate five digits decreasing in size from the innermost outward.

In general character the bones approximate most closely to *Massospondylus*, but they are much smaller than the bones of *M. carinatus*. The extremities of the limb-bones are less expanded, and there is a twist and curvature in the femur of which the remains of *Massospondylus carinatus* give no evidence. The neck-vertebræ are similarly elongated, the dorsal vertebra is similarly compressed. The phalanges are somewhat depressed, but not to the same extent as in the species already described. The claw-phalanges are of similar character. It is possible that the remains may hereafter show generic differences; but at present it is not inconvenient to refer this fossil provisionally to *Massospondylus*, as a new species, which may be named *M. Browni*.

The geological horizon is apparently above the coal of Cape Colony, in the Stormberg beds, to which the bones are referred by Mr. Brown.

Cervical Vertebræ.

Two cervical vertebræ were found in natural articulation with each other, but only the anterior half of the second is preserved. They appear to be the axis and the third cervical; the axis is $2\frac{1}{2}$ inches long, remarkably slender, probably narrowed a little by side to side compression; otherwise it presents a resemblance to the Würtemberg fossil, which I regard as the axis of *Zanclodon Quenstedti*. No odontoid ossification is shown in the South-African specimen, and the posterior zygapophyses are in a less elevated position and more extended transversely. The neural spine appears to be but slightly developed. The sides of the neural arch converge upward and forward from the flat inclined posterior zygapophyses, which diverge outward and backward, as in *Zanclodon*. They extend as far back as the posterior articular face of the centrum, forming, as in *Zanclodon*, a W-like notch when seen from above, owing to a slender process being developed between them in the median line. The posterior zygapophyses measure in transverse extension $1\frac{1}{4}$ inch; they are triangular in section, being flattened on the underside, on the inner side, and below. The inferior flattening extends laterally for fully $1\frac{1}{4}$ inch, because the zygapophyses extend transversely outward beyond the middle of the centrum for half the length of the vertebra. The centrum is compressed from side to side, is most constricted at the anterior third, has the lateral portions nearly vertical, and the base formed of two inclined surfaces which meet in a sharp median ridge; but posteriorly the surfaces are rounded. Anteriorly the angles between the lower part of the side and the base are prominently developed, and may have given attachment to slight ribs, though no facets are seen. The face of the centrum in front is subpentagonal and appears to be flattened. The neural canal is much wider than high. There are no indications of anterior zygapophyses. The greatest width of the centrum in front exceeds $\frac{3}{4}$ inch, the least width where most constricted is $\frac{3}{8}$ inch, and the width behind, as preserved, is $\frac{3}{4}$ inch. The height of the vertebra in the middle, as preserved, is $1\frac{3}{8}$ inch. Except in the transverse extension of the zygapophysial processes beyond the inferior part of the neural arch and centrum, there is no character of importance to distinguish this vertebra from the axis of *Zanclodon*.

The anterior part of the third vertebra is chiefly remarkable for two features—first, the greatly increased width of the centrum, which is $1\frac{1}{16}$ inch. This is partly the result of lateral thickening of the anterior terminal ridges at the sides, apparently to form facets for the attachment of ribs, though these facets are not well defined. Secondly, the prolongation forward of prezygapophyses, which extend $\frac{3}{4}$ inch in advance of the face of the centrum, diverging as they extend outward to a width of $1\frac{3}{8}$ inch. The upper articular surfaces of these processes are flat, as though to allow of some lateral movement, and the lower surfaces are convex. The extremities of the facets curve downward, as though there were also some degree of upward and downward movement of the slender neck. There is the same median ridge on the base of the centrum and similarly inclined parts form its base. It is possible that the cervical vertebræ were of unequal length.

Dorsal Vertebra.

Only one dorsal vertebra is preserved. It is relatively shorter than in *Zanclodon*, for while the atlas is four fifths as long as that of *Z. Quenstedti*, this dorsal vertebra is less than half as long. The centrum measures $1\frac{1}{2}$ inch from front to back, is compressed from side to side, with the sides flattened and rounded at the base. The compression may be slightly increased by distortion and fossilization. The anterior and posterior faces are much deeper than wide, measuring $1\frac{1}{4}$ inch deep by $\frac{7}{8}$ inch wide, the width being a little greater in front. The neural arch is compressed and defined from the centrum by a longitudinal suture at the base of the neural canal, as in *Massospondylus carinatus*. At the anterior border of the base of the neural arch is the vertically ovate facet for the head of the rib, which is flat and just raised a wafer thickness above the level of the bone. It is fully $\frac{1}{2}$ inch deep. The transverse processes are directed outward and upward, more so than in the anterior vertebræ of *Iguanodon*; so that in place of the usual horizontal platform a concave channel appears to lie on each side between them and the narrow neural spine, which is $1\frac{1}{8}$ inch from front to back and $\frac{1}{8}$ inch thick. The usual buttresses appear on the sides of the neural arch, the anterior being a slight ridge ascending from the middle of the summit of the rib articulation; and the posterior, which is longer and more concave, ascends from the hinder margin of the centrum. These ridges are still separated by more than $\frac{1}{4}$ inch on the underside of the short transverse process, which extends out $\frac{3}{4}$ inch beyond the neural spine and rises $2\frac{1}{2}$ inches above the base of the centrum. The neural spine extends as far back as the flattened posterior face of the centrum and as far forward as the margin of the facet for the head of the rib.

Both anterior and posterior zygapophyses are broken away, as is the upper part of the neural spine. This is the first example in which the neural arch of a dorsal vertebra has been found preserved in a South-African Saurischian.

The upward direction of its transverse processes recalls the condition in *Belodon* and *Staganolepis*, but is more marked than in either. It makes no approximation apparently to the American *Ceratosaurus*, in which Professor Marsh's figure does not indicate any transverse process at all in the dorsal region. It differs from *Megalosaurus* not only in the ascending transverse process, but in the relatively lower situation of the articulation for the head of the rib.

Caudal Vertebræ *.

The only caudal vertebræ collected are three small specimens from towards the extremity of the tail, which are somewhat elongated and slightly decrease in length. The earliest of the three is about an inch long, somewhat distorted by pressure, with the articular face in front less than half an inch in diameter. The underside of the centrum is marked with two parallel ridges, separated by a groove, and the anterior face is flattened, with a slight oblique area at the basal margin, which may indicate a chevron attachment. The sides are concave in length, convex from above downward. The neural spine is not preserved, and the neural arch is narrow and appears to extend along the centrum. The zygapophyses are not preserved.

The other two vertebræ are rather shorter; they show indications of slight transverse tubercles. The articular faces are concave; the sides are convex vertically, as is the base transversely. The association of these specimens rests upon their being collected together. When the articular faces of the three vertebræ are put together they form a curve which is concave on the underside, as though the tail hung downward.

Bones of the Foot.

The proximal ends of five small metatarsal bones are the only part of those bones collected. When placed together in contact they have a transverse width of less than 3 inches. The innermost has a vertically ovate articular surface, an inch deep and half an inch wide. It was probably oblique in

* There are no characters which would indicate the association of these vertebræ with the cervical and dorsal, as parts of the same animal; and I only notice them as collected at the same time.

position, like the metatarsal in the foot of a crocodile, resting upon the second. That bone is triangular at the extremity, being inclined and flattened internally, flattened at the base, short on the outer side, which is more vertical and grooved. The third appears to have been the stoutest; it has the proximal end subquadrate, somewhat convex, and each of the lateral margins is concave, except the external margin. The fourth bone is much more compressed from side to side; its articular surface is somewhat oblique and rounded. The fifth bone is very small. All the bones after the first show ligament-grooves on the underside. There is on the whole a steady decrease in size from the first to the fifth, if the bones are rightly identified; but the remains are very imperfect and chiefly interesting from their reputed association.

The Phalanges.

These appear to belong to two limbs, since there are not fewer than six terminal claw-phalanges, and probably fragments of eight are preserved. The digital phalanges preserved may probably be referred to five digits, in which case there would be no claw-phalange preserved for the fifth digit; and three claw-phalanges may possibly be referred to the other limb. As arranged, the bones in the first digit are stoutest, three in number, in the second digit four in number, in the third five, fourth four, and in the fifth two at least are preserved. The phalangeal bones are stout, of moderate length, not depressed, but with rather a tendency towards lateral compression.

In the first digit the first phalange is $1\frac{1}{4}$ inch long, with the pulley-shaped distal end $\frac{1}{2}$ inch wide, and the bone almost as deep. A ligament-pit is developed on each side of the distal pulley. The bone is flattened.

The claw-phalange is imperfect; it was about $\frac{3}{4}$ inch deep at the proximal end, where it is less than $\frac{1}{2}$ inch wide. The length, as preserved, is less than $1\frac{1}{4}$ inch, and was probably not less than $1\frac{1}{2}$ inch. The phalange is compressed from side to side. The lateral surface is divided into two nearly equal parts by a longitudinal groove on each side, above which the surface is convexly rounded, and about half as wide as the inferior portion, which is somewhat flattened on the underside. In harmony with this form the proximal articular surface is somewhat triangular; the bone is convex both below and above it.

In the second phalange the bones are somewhat smaller, rather more depressed, especially the last phalange. The total length of the four bones placed together in contact is rather less than 4 inches. The claw-phalange is somewhat broader on the upper surface, and, besides being generally smaller, is relatively less deep. The groove on the side of the phalange is chiefly developed on the inner margin; on the outer side it is short and shallow. There is no inferior thickening, but a slight thickening above the articular surface, which is wider below than above.

The third digit I regard as including five phalanges and as having a length of $4\frac{1}{4}$ inches. These bones are more elevated than in the other digits and somewhat narrower from side to side. They preserve the same general character, but the fourth phalange, if rightly referred to this limb, is small and short, being less than $\frac{5}{8}$ inch long and $\frac{1}{2}$ inch wide. The claw-phalange is very similar to that in the first digit.

What I suppose to be the fourth digit is very slender, and the first two phalanges are much compressed from side to side, though the compression may be partially due to squeezing. The first is $\frac{9}{10}$ inch long, fully $\frac{3}{8}$ inch wide at the distal end, and about as high. The second is $\frac{5}{8}$ inch long and somewhat narrower at the distal end. The third phalange is $\frac{1}{8}$ inch shorter and more depressed; but this depression seems to me to characterize the penultimate phalange in each digit. The claw-phalange, as preserved, has lost the extremity and is much compressed from side to side. It is about $\frac{1}{4}$ inch wide and more than $\frac{1}{2}$ inch deep. It may have been $\frac{7}{8}$ inch long when complete.

The fifth digit can only be restored conjecturally. A small bone, which has the aspect of being a proximal phalange, is $\frac{5}{8}$ inch long, as deep as wide, expanded at both ends, the distal end being almost hemispherical, without any trace of the vertical median channel which characterizes all the other digital phalanges. The fourteenth phalange is different in shape to any other, and may have been a depressed penultimate phalange or have belonged to another limb. The distal end shows no trace of the usual vertical superior groove, and it is only slightly indicated on the underside. There are slight ligamentous pits at the sides of the articulation, which appear to indicate that the digit terminated either in a claw or another phalange, which is not preserved.

So far as they admit of comparison, these bones are very similar to those which have been attributed to *Massospondylus carinatus*, especially the claws, and the phalanges only differ in being rather better ossified. A similar type of digital phalange is observed in the fossil described from Eagle's

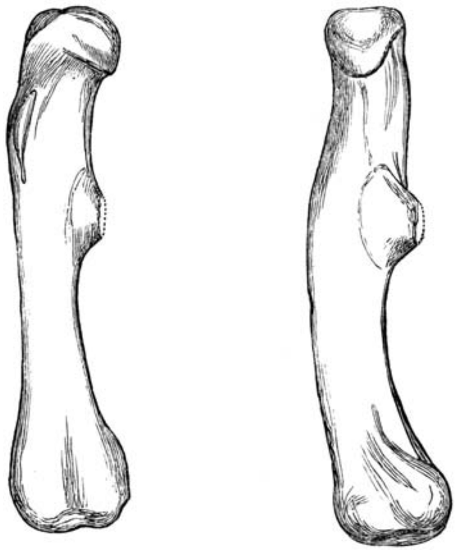
Crag as *Hortalotarsus*, in which the proportions of such of the foot-bones as can be compared are almost identical. This is the more interesting, since that fossil is manifestly very unlike *Massospondylus* in the form of the distal end of its tibia, and on that basis is referred to a different genus.

Femur. (Figs. 13 and 14.)

Mr. Brown collected both the right and left femora, which are fully $9\frac{1}{2}$ inches long. Both bones are slightly distorted, and the right femur is obviously compressed at the proximal end, while the left is somewhat compressed at the distal end. The bone is Megalosauroid in type, in having the articular head bent inward at an angle to the distal end, so as to look inward and forward; it is rounded from within outward, and at about $\frac{5}{8}$ of an inch below the proximal extremity on the inner side there is an impressed area continuous with the shaft which defines the head of the bone. The external trochanter is but slightly developed; it forms a ridge on the externo-anterior border, fully $1\frac{1}{2}$ inch below the proximal articulation. It is but slightly elevated, widens as it descends, and is traced for fully an inch in length. Seen from the side the bone has a sigmoid curve, owing to the proximal head being bent forward, the body of the bone curving forward and upward and the distal end being directed backward and downward. The greatest measurement of the proximal end from within outward and its greatest transverse measurement is $1\frac{3}{8}$ inch. The internal lateral trochanter is compressed from side to side as usual, and directed vertically inward and downward; it is $1\frac{1}{2}$ to $1\frac{3}{4}$ inch long, and approaches within less than 3 inches to the proximal end and 5 inches from the distal end. The bone is rather compressed in the shaft from side to side, so that it is deeper than wide, nearly vertical on the external side, flattened in front at the distal end. The distal extremity is well rounded from front to back, with two well-developed condyles, divided from each other by a moderately deep notch. The depth of the bone is here $1\frac{3}{4}$ inch in the left femur. The internal condyle appears to be the larger; there is a compression on the hinder border of the external condyle. The breadth of the distal end of the bone, as preserved, is nearly $1\frac{3}{4}$ inch.

The distinctive features of this femur are, first, the ovate form of the articular head seen from above, which has some resemblance to *Massospondylus*; but the proximal end is not so broad as in *Massospondylns carinatus*, nor is the distal end so much expanded; the condyles are less developed backward, and the inner lateral trochanter appears to be more proximal in position. The external proximal trochanter is rather better marked than in *Massospondylus carinatus*, but rather less marked than in *Euskelesaurus*. The inner lateral trochanter is not quite so near to the proximal end as in *Belodon* or *Palæosaurus*, the bone in the latter genus being

Fig. 13. Fig. 14.



Massospondylus (?) *Browni.*
Fig. 13.—Right femur, anterior aspect.
Fig. 14.—Right femur, internal aspect.

more slender, more compressed above the external trochanter, and otherwise of different character. On the whole, the bone approximates nearest to *Massospondylus*, indicating an animal about three fifths of the dimensions of the type, with the femur not more than half the diameter of the larger bone at its extremities.

It is not certain that these remains may not be referable to *Hortalotarsus*. That could only be determined by discovery of the tibia or other distinctive element. While there is this possibility that the remains may belong to the Eagle's Crag genus, I prefer, in the absence of evidence, not to affirm the identity. The differences from *Massospondylus* are sufficiently obvious to prevent inconvenience from recording the species as (?) *Massospondylus Browni*.

I am indebted to Mr. Brown for the opportunity of making this description.