Anderson, C., 1930. Palaeontological notes no. II. *Meiolania platyceps* Owen and *Varanus (Megalania) priscus* (Owen). *Records of the Australian Museum* 17(7): 309–316, plates xlvii–li. [20 February 1930].

doi:10.3853/j.0067-1975.17.1930.768

ISSN 0067-1975

Published by the Australian Museum, Sydney

PALÆONTOLOGICAL NOTES No. II:

MEIOLANIA PLATYCEPS *Owen* and VARANUS (MEGALANIA) PRISCUS (*Owen*).

By

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(Plates xlvii–li.)

LIMB BONES OF MEIOLANIA PLATYCEPS *Owen*.

Since a description of this extinct chelonian was published in these RECORDS,[1] additional specimens have been secured at Lord Howe Island by the efforts of my colleague, Mr. E. Le G. Troughton, and Messrs. Baxter, Hines, and Nicholls, residents of the island. These afford further evidence regarding its structure and mode of life, for, fortunately, some of the bones were found associated in such a manner that one is justified in regarding them as belonging to one and the same individual. Thus, for the first time it is possible to draw conclusions as to the relative proportions of the limb bones.

The associated bones consist of right humerus, right radius and ulna, both femora, tibiæ, and fibulæ, left astragalo-calcaneum, and a number of tarsal, metatarsal, phalangeal, and dermal bones. Of these the radius and tibia have already been adequately described by Owen,[2] the others have not been described before.

Ulna (Pl. xlvii, figs. 1-3).—This is a stout bone, somewhat longer and heavier than the radius; its proximal end rises higher than that of the radius, but its distal end does not pass so low. It is flattened somewhat in a dorso-ventral plane and is slightly twisted, but not so much as the ulna of *Testudo*. The surface of articulation with the humerus (fig. 2) is roughly triangular in shape. There is an extensive rugose area near the proximal end for attachment to the radius. The olecranon is fairly well developed. Greatest length, 107 mm.

Fibula (Pl. xlvii, figs. 4-6).—A much slighter bone than the tibia, which it exceeds a little in length. It expands at both ends, particularly the distal, and the long axes of the proximal and distal articular surfaces are approximately at right angles to one another. Near the distal end on the tibial side is a prominent rugosity for attachment of the *ligamentum tibio-fibulare inferius*. Length, 94 mm.

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[1] Anderson.—Rec. Austr. Mus., XIV, 1925, pp. 223-242.
[2] Owen.—Phil. Trans., CLXXIX, 1888, B, pp. 187-189.

Astragalo-calcaneum (Pl. xlix, fig. 2).—The proximal surface of this large composite bone is divided by a slight ridge, running in a dorso-plantar direction, into two articulating surfaces; the tibial is raised in the middle and roughly quadrangular in shape, the fibular is concave and elongated. On the dorsal surface is a diamond-shaped depression for the *ligamentum tibio-tarsale anterius*. In general shape the bone resembles that of *Testudo*. Longest measurement, 70 mm.

Tarsal, metatarsal, and phalangeal bones.—A number of these bones were found in association with the left tibia and fibula, the whole being bound together along with a number of dermal bones by the calcareous matrix. Some of the bones were still articulated, but, unfortunately, it was not found possible to restore the foot skeleton. The phalanges show well developed articulating surfaces, which indicates considerable freedom of movement in the bones of the foot.

Relative lengths of limb bones.—Taking the length of the humerus as 100, we have the following proportions:

Humerus	Radius	Ulna	Femur	Tibia	Fibula
100	53	59	101	48	52

Thus the femur is very slightly longer than the humerus, and the lower arm and leg bones are about half as long as the upper bones. These proportions indicate that *Meiolania* was adapted for progression on land.

Dermal bones.—These were found attached by matrix to bones both of the fore and hind limb, and there can be little doubt that the limbs of *Meiolania,* like those of some species of *Testudo,* were armed with dermal bones as suggested by Lydekker.[3]

It is evident that the fresh evidence now obtained confirms the view that *Meiolania* was essentially a terrestrial reptile. In walking the fore and hind limbs were bent so that the long axes of the fore-arm and of the lower leg bones were approximately at right angles to those of the humerus and femur, and, apparently, the hand and foot were parallel to the humerus and femur. In gait and posture *Meiolania* must have been very similar to *Testudo.*

In my previous paper I pointed out that, as Walpole Island is of coral origin, and has apparently never been connected with any larger land mass, the occurrence there of *Meiolania mackayi,* a form very similar to *M. platyceps,* indicates that the animal was able to cross a considerable stretch of ocean. This possibility is not excluded by its adaptation for a terrestrial existence, for *Testudo* is a good swimmer, as Beebe has pointed out.[4] But, on

[3] Lydekker.—Brit. Mus. Cat. Foss. Rept., Part III, 1889, p. 164.
[4] Beebe.—"Galapagos, World's End," p. 228 (New York, 1924).

the whole, the skeleton of *Meiolania,* the proportions of its limb bone, the structure of its phalanges, and its heavily armoured condition, strongly indicate that it was built for life on land.

Varanus (Megalania) priscus (*Owen*).

Since Owen first described this extinct lizard,[5] several authors have written on the genus. References to, and comments on, the various contributions will be found in Baron Fejérváry's comprehensive paper "Contributions to a Monography of fossil Varanidæ and on Megalanidæ";[6] he seems, however, to have overlooked De Vis' "Bones and Teeth of a large extinct Lizard,"[7] and Etheridge's "Reptilian Notes."[8]

Any additional information regarding this interesting form, the largest known lizard, is worthy of record, and I propose to describe here some recently discovered teeth, which are almost certainly megalanian, and a well preserved femur, which has been in the Museum collection for some years. I also figure an ulna, for, though a similar bone has been well described by De Vis,[9] his illustration is, as Fejérváry says, somewhat vague.

Teeth.—Recently Professor Sir Edgeworth David presented to the Australian Museum a number of fossils which he had received from Mr. Bram Collins, of Rosella Plains, Mount Surprise, near Cairns, Queensland. These consist of some fragmentary bones which cannot be identified, a few small macropod molars, and five beautifully preserved reptilian teeth. From a letter addressed to Sir Edgeworth by Mr. Collins we learn that these specimens were obtained in sinking a well through the top of a hill near the homestead in a search for a supply of household water. At a depth of about five feet a flow of basalt was encountered; the bottom of the flow was reached at twenty feet from the surface, and the fossils were found at a depth of about forty feet. The probability is that these fossils occur in a "deep lead."

The teeth are all of the same type but differ somewhat in size and proportions. Two typical teeth are figured (Pl. 1), one relatively long and slender, the other shorter and stouter. All the teeth consist of crowns only, the bases, unfortunately, having been broken off. It is, therefore, difficult to estimate what their actual lengths were, but it may be conjectured that of the longer only about two-thirds has been recovered. What remains is 28 mm. long, with an antero-posterior breadth of 13 mm. and a thickness of 7·5 mm., so that the complete tooth probably had a length of about

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[5] Owen.—Phil. Trans., CXLIX, 1859 (1860), p. 43, pls. 7, 8; CLXXI, 1880 (1881), p. 1037, pls. 34, 36; CLXXVII, 1887, p. 327, pl. 13.
[6] Fejérváry.—Ann. Mus. Nat. Hung., XVI, 1918, pp. 341-467.
[7] De Vis.—Proc. Roy. Soc. Q'land, II, 1885 (1886), pp. 25-32, pls. i-iii.
[8] Etheridge.—Proc. Roy. Soc. Vict. (n.s.), XXIX, 2, 1917, pp. 127-130, pl. viii, figs. 1-5.
[9] De Vis.—Proc. Roy. Soc. Q'land, VI, 1889 (1890), pp. 94-96, pl. iv.

42 mm. The other figured tooth, of which little more than the tip of the crown is preserved, measures 19 × 14·5 × 9·7 mm.

The teeth are slightly recurved and broadly oval in section, the convexity being slightly greater on the lateral side. The anterior and posterior edges are distinctly carinated and the carinæ are beautifully and regularly serrated; the serrations extend to the fracture on the posterior edge, but on the longer teeth, the carina and serrations disappear just before this is reached. The teeth are devoid of vertical fluting, although internal striæ can be seen in the enamel layer. In colour three are light brown, the other two yellowish, and all are practically unworn.

It is apparent that these teeth are those of a gigantic lizard nearly akin to, if not actually a member of, the family Varanidæ. There is a high degree of probability that they belong to *Megalania prisca,* for there is no other known lizard large enough to have borne such teeth.

By the courtesy of Mr. H. A. Longman, Director of the Queensland Museum, I have been enabled to examine a collection of reptilian teeth preserved in that institution, as well as the maxillary fragment with three teeth *in situ,* described by De Vis under the name *Varanus dirus.*[10] Comparison with the teeth from Rosella Plains shows that the latter cannot belong to *dirus,* in which the teeth are considerably smaller, have a more decided backward curvature, slightly sigmoid, a rounded anterior border, very faintly serrated near the tip, and a compressed posterior edge, serrated but without carina. In section the teeth of *dirus* are pear-shaped, not oval.

The earliest account of the teeth of *Megalania* is contained in Owen's paper describing part of the dentary of *Notiosaurus dentatus* (= *Megalania prisca*[11]). Unfortunately, in Owen's specimen, which was discovered at Cuddie Springs, near Brewarrina, New South Wales, only the base of one tooth and portion of the base of another were preserved, so that exact comparison is not possible. About the same time De Vis described what he regarded as a tooth of *Notiosaurus dentatus* from Clifton, Darling Downs, Queensland.[12] I have not been able to recognize this specimen in the collection forwarded to me by Mr. Longman, though it contains one tooth identical in appearance with those from Rosella Plains. De Vis' figure is not good but his description is as follows: "The teeth in *Monitor* [*Varanus gouldi*], as compared with *Hydrosaurus* [*Varanus giganteus*] are broad and thick; the tooth of the latter is distinctly serrated on both edges while in the *Monitor* tooth the fore edge [sic] only is serrated and that faintly. The outline of the

[10] De Vis.—Ann. Q'land Mus., No. 5, 1900, p. 6, pl. iii.
[11] Owen.—Phil. Trans., CLXXV, 1885, pp. 249-251.
[12] De Vis.—Proc. Roy. Soc. Q'land, II, 1885 (1886), pp. 31-32, pl. iii, fig. 2.

tooth of the extinct lizard resembles that of *Hydrosaurus* but it is proportionately thicker; its fore-edge is smooth, and also like the *Monitor* tooth it has the basal fluting extended higher on the inner side towards the crown than in *Hydrosaurus*. On the other hand its shape and the almost entire want of the ridge descending upon the outer side of the tooth sufficiently differentiate it from that of a *Monitor* proper. We have, therefore, here additional evidence that the extinct lizard had greater affinity with the smaller than with the larger of these two living genera."

"The length of this tooth is 2·1 cm., its breadth 1·2 cm.; the measurements of a middle tooth of *Hydrosaurus* are 0·6 cm. and 0·3 cm.; of *Monitor,* 0·3 cm. and 0·2 cm.; and from these elements of comparison we may estimate the entire length of the animal to have been in the mean 18ft. 6in. long."

The tooth ascribed by De Vis to *Notiosaurus* approaches in dimensions those from Rosella Plains, but he does not mention carinæ on the edges and describes the front edge as smooth. It is possible that the serrations on the front edge may have been less constantly present, or may have become worn off. It may be observed, too, that the anterior and premaxillary teeth in the varanids are smaller than the more posterior teeth, and their shape is somewhat different, the front edge being more rounded. It is possible, therefore, that the tooth described by De Vis is really that of *Megalania,* as might be conjectured from its size.

In 1917 Etheridge described an almost complete maxillary bone of a large lizard, also from Clifton, Queensland, which he identified with *Megalania prisca,* of which he regards *Notiosaurus dentatus* as a synonym.[13] This important specimen is a right maxillary with the stump of one tooth *in situ,* the decayed root of another, and the impression of the bases of seven more. Etheridge doubted whether the tooth figured by De Vis as that of *Notiosaurus* is in any way related to Owen's fossil of the same name.

The Rosella Plains teeth resemble those of *Varanus komodoensis,* as described by Burden[14] and Lönnberg,[15] though in the latter there does not seem to be any carinæ on the edges and on the anterior edge the serrations do not extend so far from the tip. Moreover the teeth of *komodoensis* seem to be less oval in section, being thickest at the base of the front side, tapering to a sharp and serrated edge on the posterior side, and the backward curvature is more pronounced.

Femur and ulna.—In the Museum collection is part of the skeleton of *Megalania,* obtained in 1892 from Mr. Hermann Lau,

[13] Etheridge.—Proc. Roy. Soc. Vict. (n.s.), XXIX, 2, 1917, pp. 127-129, pl. viii, figs. 1, 2.
[14] Burden.—Amer. Mus. Nov., No. 316, May 18, 1928, p. 5, fig. 1.
[15] Lönnberg.—Arkiv f. Zool., XIX, häfte 4, No. 27, 1928, pp. 3-5.

who found it ten years before on Clifton Station, towards the head of King's Creek, Darling Downs, Queensland. He describes his find as follows:

"Here high in the bank I perceived the tip of jawbone with teeth thrusting out about eight feet below the grassy surface. Getting to work with pick and knife I brought out successively what remained from the bony skeleton. Never broke a single bone, found them just as you see them. Although I went for several days to the same spot, which I excavated to some extent, I was not fortunate enough to find more."

The bones found by Mr. Lau consisted of a right maxillary, left femur, right ulna, and a number of vertebræ and ribs, all belonging without doubt to one and the same individual. Of these specimens the maxillary has been described by Etheridge as cited above, vertebræ and ribs obtained from other sources have been dealt with by Owen, De Vis, and others. De Vis has also described and figured a left ulna,[16] which, allowing for the personal equation, is the same size (length 260 mm.) as the right ulna figured here (Pl. li, fig. 3). De Vis' specimen, too, was found on King's Creek, along with a number of associated bones, and may even be part of the skeleton now in this museum.

The femur (Pl. li, figs. 1, 2) is a massive and powerful bone 295 mm. (11¾ in.) long, its greatest breadth across the proximal end 114 mm., across the distal end 105 mm.; the greatest diameter at the middle of the shaft is 47 mm., least 38·5. In general shape it bears a close resemblance to the femur of recent varanids, except that its length in proportion to breadth is considerably less. The articular surface of the head is almost rectangular in shape, and the internal trochanter is large and strongly rugose, indicating powerful pubo-ischio-femoralis muscles. The external trochanter, as in lizards generally, is small, and the trochanteric fossa is comparatively shallow. The shaft is almost straight, the dorso-ventral diameter the greater. The internal condyle of the distal end is larger than the external and the intercondylar groove, dorsal and ventral, is shallow. Above the external condyle on the ventral and postaxial surface is a crescentic sulcus, perhaps indicating the origin of the gastrocnemius muscle. The epicondyle, or outer tuberosity, for articulation with the fibula, is well developed, and the popliteal groove distinct. On the ventral (postero-inferior) aspect of the shaft an elongated area with rugose edges and extending for almost the full length of the shaft doubtless served for the insertion of the powerful adductor muscles.

Affinities.—Megalania has been placed by Lydekker in the genus *Varanus* as *V. priscus*;[17] Fejérváry erected for it a new

[16] De Vis.—Proc. Roy. Soc. Q'land, VI, 1889 (1890), pp. 94-96, pl. iv.
[17] Lydekker.—Brit. Mus. Cat. Foss. Rept. and Amph., Pt. I, 1888, p. 284.

family Megalanidæ of the suborder Platynota (?);[18] Camp placed in a new subfamily Megalaninæ of the family Varanidæ;[19] Dunn reverts to Lydekker's view, being disinclined to regard *Megalania* as having characters which necessitate generic much less family distinction;[20] Nopcsa places it with *Saniva* and *Thinosaurus* in the subfamily Megalaninæ of the Platynotidæ.[21]

The chief ground on which *Megalania* has been separated from *Varanus* is the supposed presence of a zygosphene and zygantrum on the vertebræ of the former. But, as Longman has pointed out,[22] Fejérváry is mistaken when he says that *Megalania* had a strongly developed zygosphene and zygantrum. At the most it had a very rudimentary zygosphene, and such is also found in *Varanus komodoensis*. On the whole, and in the light of what is so far known of the skeleton of *Megalania*, there does not seem to be sufficient grounds for its separation from *Varanus*. We may therefore agree with Dunn, who, it is interesting to note, regards *Varanus komodoensis* as "definitely an Australian type derived from an animal much like *varius* and intermediate between it and the two Australian fossil forms [*V. dirus* and *V. priscus*]."

Size.—Several estimates of the length of *Megalania* have been made. Owen, by comparing the vertebræ with those of *Varanus giganteus*, concluded that its total length would be about twenty feet.[23] Lydekker, by comparison with the vertebræ of *Varanus sivalensis* (estimated to be about twelve feet long), considered that *Megalania* was at least thirty feet long.[24] De Vis compared its humerus and scapula with those of recent varanids and assigned to it a length varying from twelve to twenty-five feet.[25] Fejérváry is more moderate, estimating its length at four and a quarter to five metres (fourteen to sixteen feet).[26] Dunn, on comparison with *V. komodoensis*, which probably approached *Megalania* in proportions more closely than any other living lizard, assigns it a length of fourteen and a half or fifteen feet.[27] I have compared the femur and ulna with those of *Varanus salvator*, *V. gouldi* and *V. varius*, the results giving lengths varying from fifteen to seventeen feet.

It is evident, however, that it was much more heavily and strongly built than any of its living relatives, and that it was comparable with a large crocodile in size and weight; indeed its vertebræ and limb bones are much more massive than those of an Estuarine Crocodile (*Crocodilus porosus*), the skeleton of which

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[18] Fejérváry.—Ann. Nat. Mus. Hung., XVI, 1918, p. 449.
[19] Camp.—Bull. Amer. Mus. Nat. Hist., XLVIII, 1923, p. 321.
[20] Dunn.—Amer. Mus. Nov., No. 286, Sept. 30, 1927, p. 9.
[21] Nopcsa.—Palaeobiologica, I, 1928, p. 177.
[22] Longman.—Mem. Q'land Mus., VIII, 1924, p. 22.
[23] Owen.—Phil. Trans. CXLIX, 1859 (1860), p. 48.
[24] Lydekker.—*Loc. cit.*, p. 284.
[25] De Vis.—Proc. Roy. Soc. Q'land, II, 1885 (1886), p. 29.
[26] Fejérváry.—*Loc. cit.*, p. 449.
[27] Dunn.—*Loc. cit.*, p. 8.

is about fourteen feet in length, though its femur is shorter. With its formidable teeth and strongly muscled limbs it must have been a dangerous antagonist to any of its contemporaries in the Australian Pleistocene, even the bulky *Diprotodon*. The much smaller *Varanus komodoensis* is said to feed on deer, wild pigs, and water-buffalo,[28] and we may be sure that *Megalania* could deal effectively with much larger animals.

[28] Burden.—Amer. Mus. Nov., No. 316, May 18, 1928, p. 10.

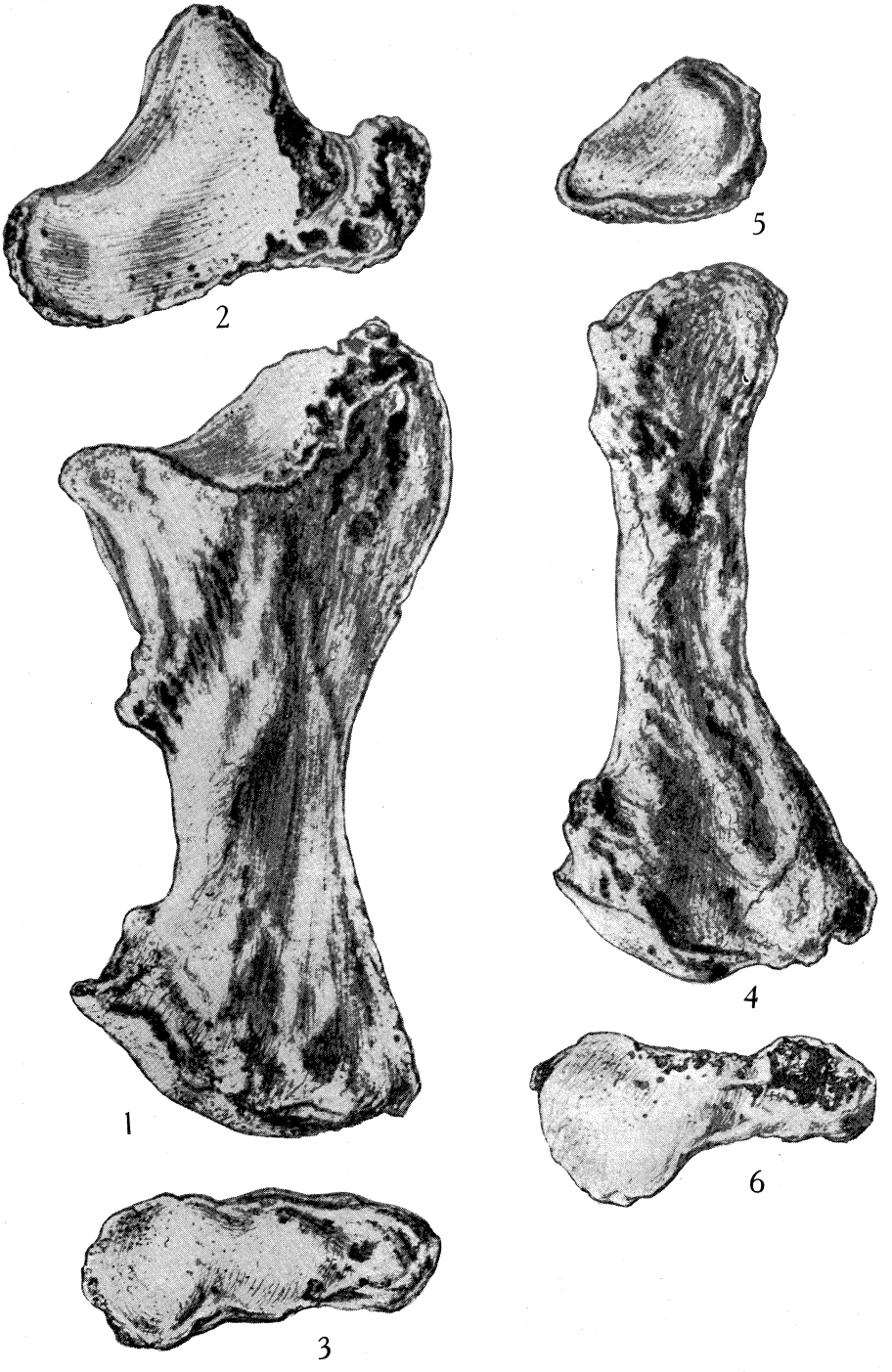
EXPLANATION OF PLATE XLVII.

Meiolania platyceps Owen. Lord Howe Island.

Figs. 1-3. Right ulna, posterior, proximal, and distal views; F. 18827.

Figs. 4-6. Left fibula, postero-dorsal, proximal, and distal views; F. 18833.

All figures natural size.



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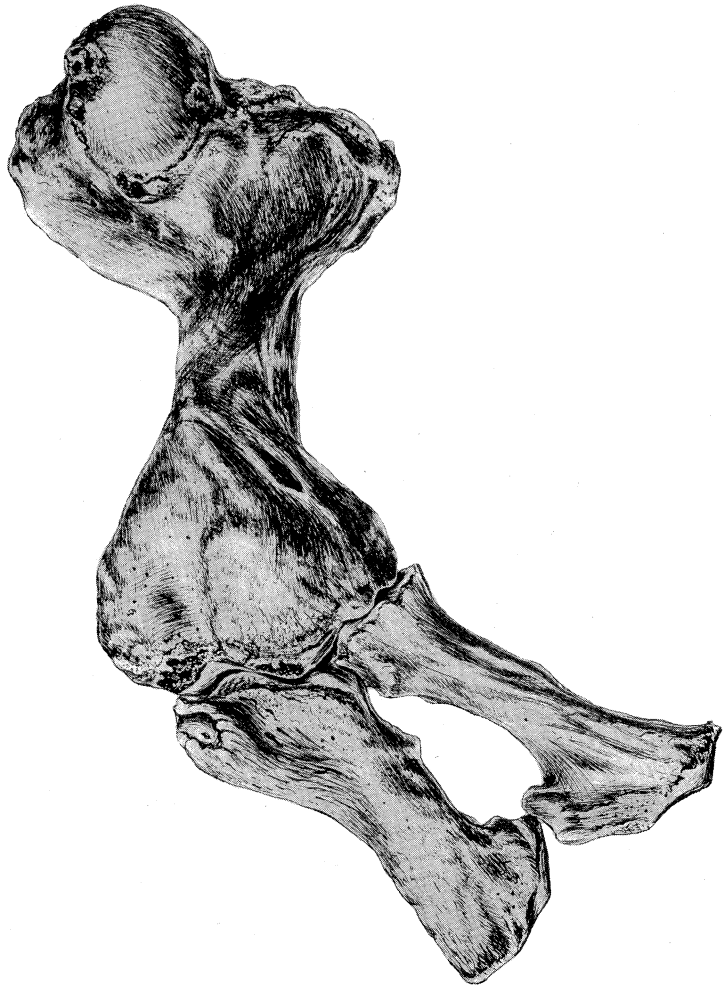
EXPLANATION OF PLATE XLVIII.

Meiolania platyceps Owen. Lord Howe Island.

Right humerus (F. 18750), radius (F. 18827), and ulna (F. 18827); antero-dorsal view.

Slightly more than half natural size.



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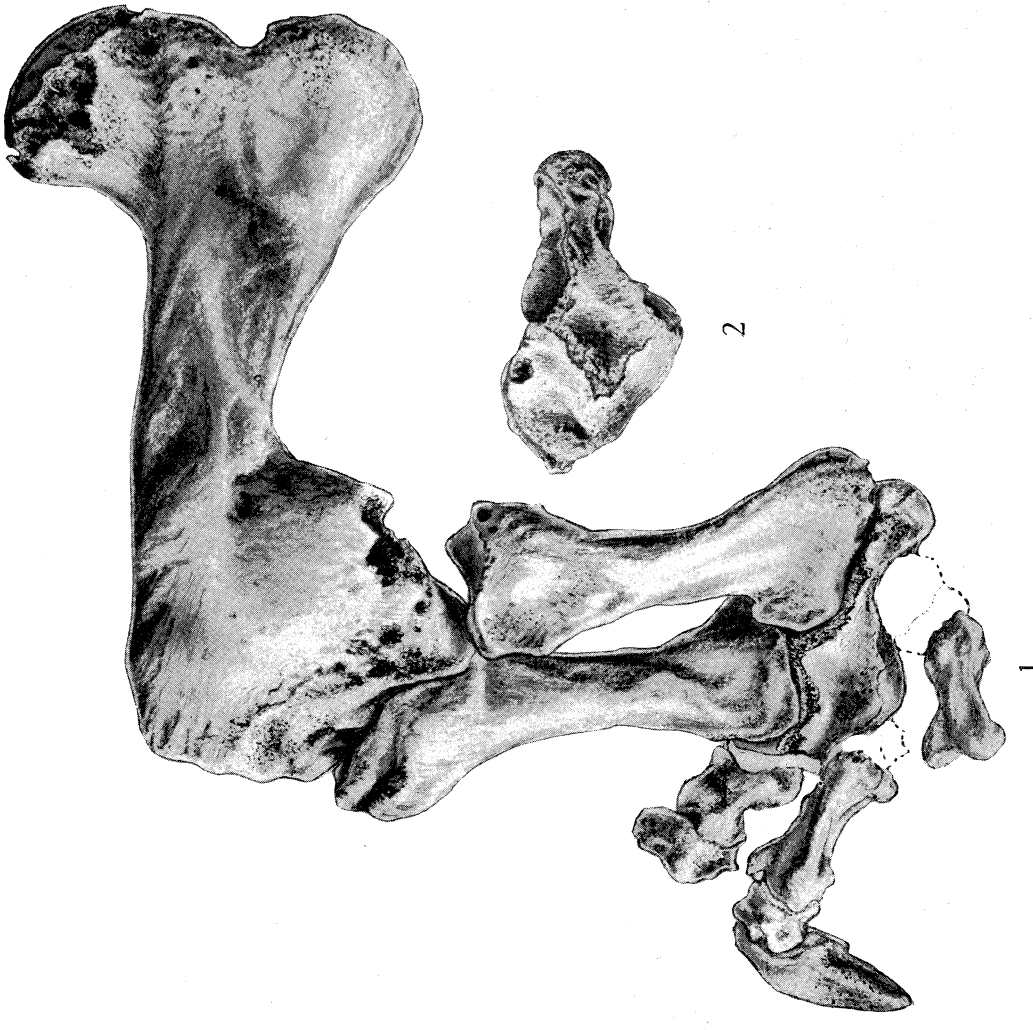
EXPLANATION OF PLATE XLIX.

Meiolania platyceps Owen. Lord Howe Island.

Fig. 1. Left femur (F. 18756), tibia (F. 18833), fibula (F. 18833), astragalo-calcaneum (F. 18834), and toe bones (F. 18833); postero-dorsal view.

Fig. 2. Left astragalo-calcaneum, dorsal view.

About three-fifths natural size.



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EXPLANATION OF PLATE L.

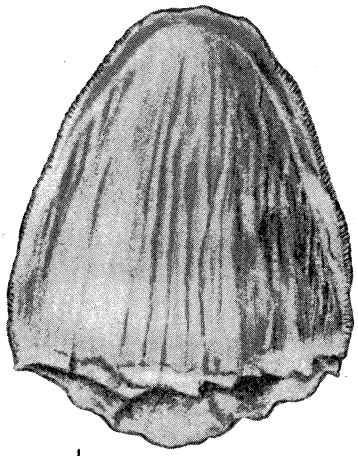
Teeth of *Varanus* (*Megalania*) *priscus* (Owen). Rosella Plains, Queensland.

Fig. 1. F. 25228.

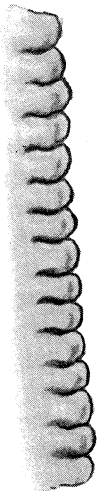
Fig. 2. F. 25227.

a, inside view; *b*, basal view; *d*, posterior view. All four times natural size.

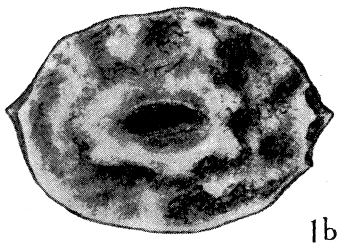
c, serrated edges. Sixteen times natural size.



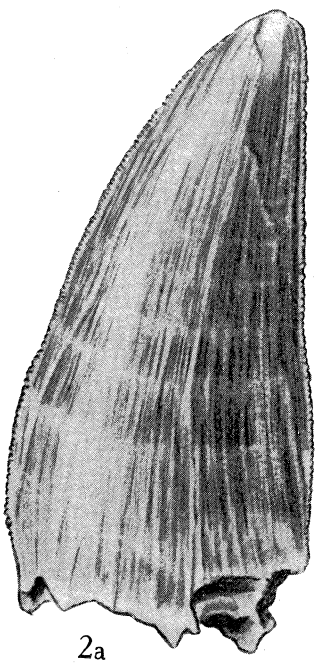
1a



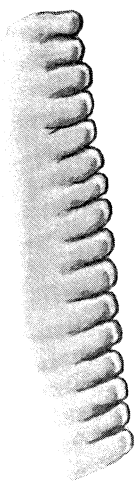
1c



1b



2a



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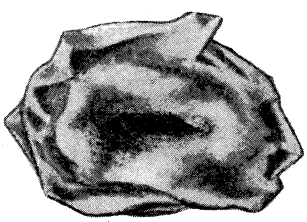

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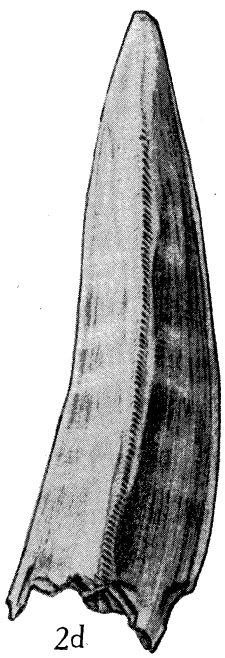

2d

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EXPLANATION OF PLATE LI.

Varanus (*Megalania*) *priscus* (Owen). Darling Downs, Queensland. About two-thirds natural size.

Fig. 1. Left femur, posterior view; F. 2206.

Fig. 2. Left femur, ventral view.

Fig. 3. Right ulna, front view; F.2207.

hd., head; *tr. in.*, internal trochanter; *tr. ext.*, external trochanter.

C. G. CLUTTON, photo.