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**On *Mauisaurus Gardneri* (Seeley), an
Elasmosaurian from the Base of the Gault
at Folkestone**

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Notes

29. On MAUISAURUS GARDNERI (*Seeley*), an ELASMOSAURIAN from the BASE of the GAULT at FOLKESTONE. By HARRY GOVIER SEELEY, Esq., F.L.S., F.G.S., &c., Professor of Geography in King's College, London. (Read February 7, 1877.)

[PLATE XXIII.]

THE Gault hitherto has yielded but scanty remains of animals referable to the Reptilia and to the Palæosauria; so that more than ordinary interest attaches to the discovery, in a comparatively perfect condition, of remains belonging to a genus found hitherto only in New Zealand, which may be regarded as distinctive of the deposit. The remains of this Plesiosaurian were first found, rolled and abraded, at the foot of the cliffs; much of the caudal region of the animal may therefore have disappeared by attrition, and by the gradual decay of the bones as exposed in the clay, which has partly invested them with selenite. These bones were sent by Mr. Griffith, the well-known Folkestone fossil-collector, to J. S. Gardner, Esq., F.G.S., who traced them to their place in the Cliff, about 15 or 16 feet from the base of the Gault, and undertook excavations which have resulted in the discovery of a tooth, of the vertebræ of the neck and back, the principal bones of the limbs, and portions of the pectoral arch. The head, the tail, the pelvic bones, and the smaller bones of the limbs, together with most of the ribs, have not been found; and it is possible that some of these parts of the skeleton may have become severed before the specimen was covered up in the deposit, Mr. Gardner having used all possible efforts to discover the missing remains. The neural arches appear to have been united to the centrums; and several vertebræ were extracted by Mr. Gardner with the neural arches entire; but, from the brittle condition of the fossils, it was not found easy to preserve the specimens in an unbroken condition.

There is necessarily some uncertainty about the exact generic determination of this Plesiosaurian; for the bones which might have cleared away all doubt are not well preserved. It is probable that it may be referable to *Mauisaurus*, which was about as large; and I have referred it to that genus, partly because it is a Cretaceous fossil, and partly because in vertebral characters and form of limb-bones it approximates closely to that genus; while what remains of the pectoral arch does not sanction its location in *Elasmosaurus*.

Elasmosaurus platyurus is regarded by Professor Cope as having been 45 feet long, one half of which length was formed by the neck, in which 69 vertebræ are preserved, and from which 3 more are supposed to be lost. The dorsal region is supposed to have contained 24 vertebræ, of which 14 are preserved, while in the tail there are supposed to have been 51 vertebræ, of which 21 are preserved, giving a total of 147 vertebræ. Mr. Gardner's fossil gives

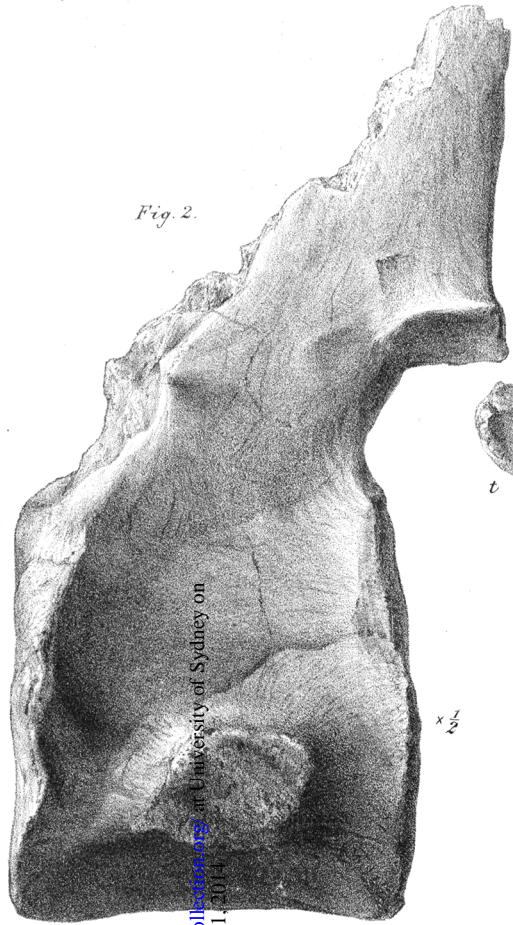


Fig. 2.

$\times \frac{1}{2}$

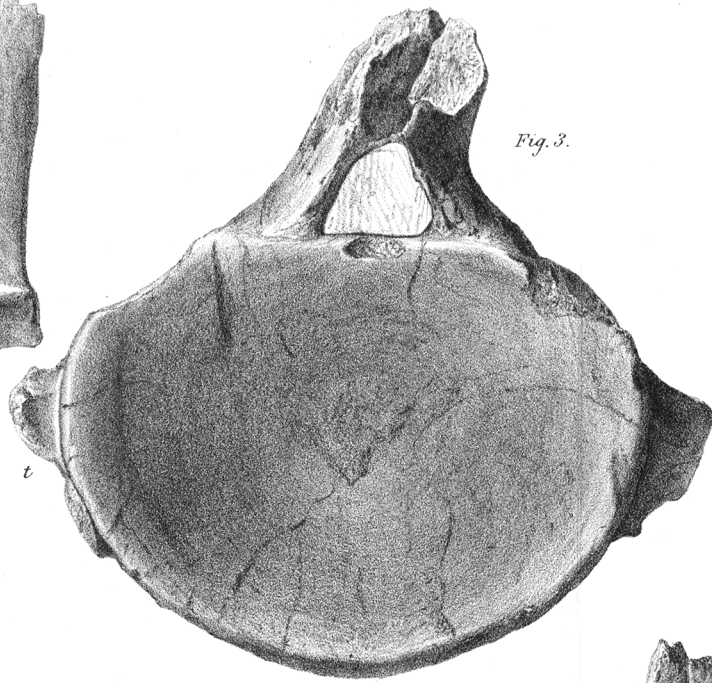


Fig. 3.

$\times \frac{1}{2}$

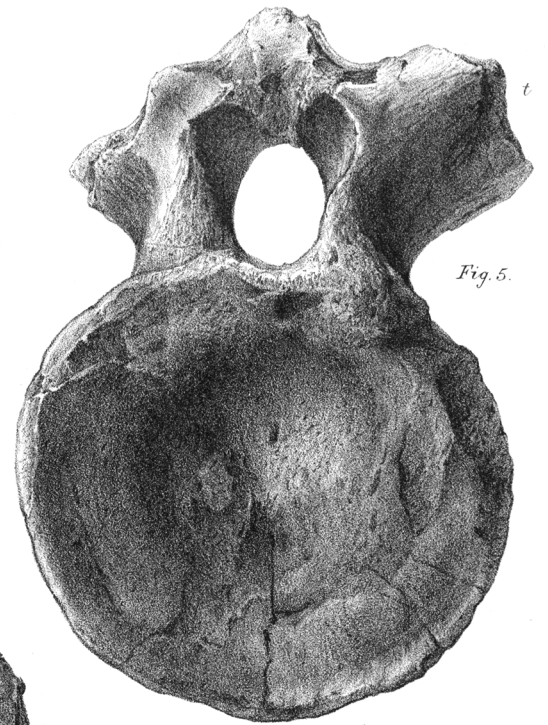


Fig. 5.

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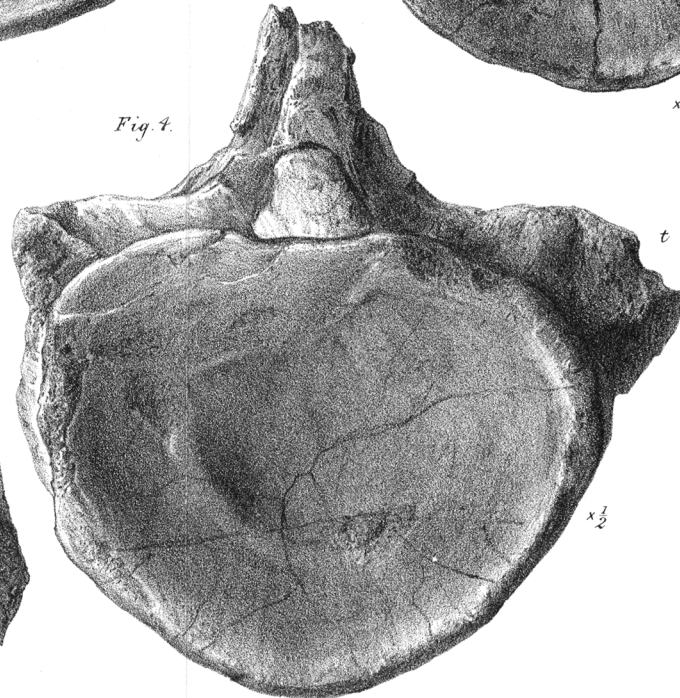


Fig. 4.

$\times \frac{1}{2}$

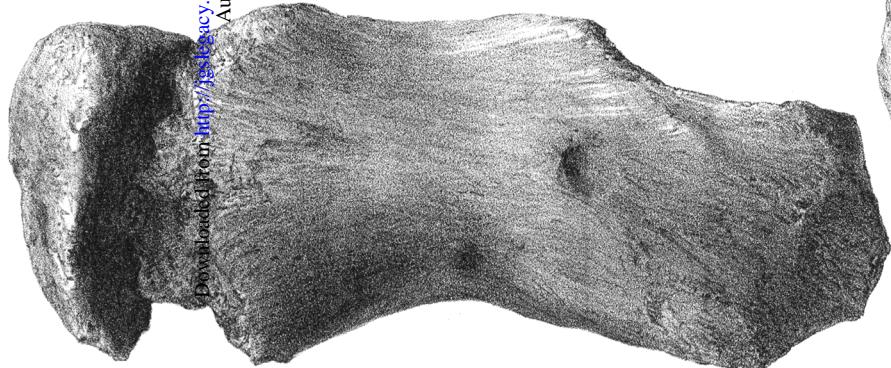


Fig. 6.

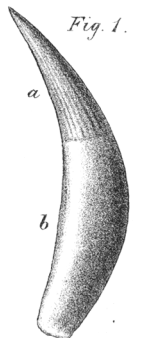


Fig. 1.

CL Griesbach lith.

M & N. Hanhart imp.

MAUISAURUS GARDNERI.

Downloaded from <http://jgs.lyellcollection.org/> at University of Sydney on August 31, 2014

no indication of this enormous number of vertebræ or length of neck; but the vertebræ are quite as large, and are larger than in any British long-necked Plesiosaurian hitherto described.

THE TOOTH. (Pl. XXIII. fig. 1.)

The tooth is perfect, and measures $1\frac{3}{4}$ inch in length. The crown is $\frac{3}{4}$ inch long; it is curved inward and backward, and is flattened somewhat on its external aspect. The crown terminates in a point, and is marked with fine close-set parallel striations rather finer than is common among Plesiosaurs. The fang continues to expand for half its length, and then contracts somewhat towards the base, so that the convex anterior outline of the tooth is an arc of a smaller circle than the concave posterior border. It is difficult to estimate the size of the head from a tooth; but it probably did not exceed a foot in length.

THE VERTEBRAL COLUMN.

The earliest vertebra preserved is an early cervical with the neural arch and cervical ribs ankylosed to the centrum. These short ribs give a subtriangular appearance to the articular surface, which is modified a little by the lateral widening of the neural arch. The antero-posterior length of the centrum is $1\frac{1}{8}$ inch; the depth of the centrum is $1\frac{1}{8}$ inch; and its breadth on the anterior face is $1\frac{3}{8}$ inch. The articular face is flattened, moderately concave, and most compressed from front to back at the base of the neural arch. The base of the centrum is marked with an elevated median ridge. The short ribs are given off from the inferior lateral corners of the centrum, and, as usual, are directed outward, backward, and downward. The neural canal is large and vertically ovate; the neural arch is constricted from side to side at the base of the neural canal; it has a subquadrate aspect as preserved, but is too imperfect for description. I am aware of no data on which to determine the number of vertebræ which were anterior to this one, or which intervened between it and the next preserved.

The second of the series has the centrum nearly 3 inches long, with the articular ends flattened and slightly concave, and the margins of those surfaces slightly rounded. The centrum has an elongated constricted appearance, and has the compressed, elongated, elevated, articular area for the cervical rib at the base of the lateral aspect; but the specimen is too badly preserved to admit of measurement.

Many vertebræ are missing between the second and the next preserved; for although the third is only $3\frac{1}{2}$ inches long, it has nearly twice the transverse diameter of the second. The articular faces, still a little concave, are transversely ovate, about $3\frac{3}{4}$ inches wide, with the centrum $2\frac{3}{4}$ inches deep in front and deeper behind. The edges of the articular margin are slightly bevelled. The base of the centrum has a strong median ridge, which becomes broader towards each articular surface. On each side of the base, between this ridge and the rib, is a large impressed crescentic area. The transverse width

of the base of the centrum external to the ribs is $2\frac{1}{4}$ inches. The bases of the ribs are strong, elevated, and directed chiefly downward. The sides of the centrum are smooth, concave from front to back, and moderately convex from above downward, and extend vertically for 1 inch above the ribs; the neural arch is confluent with the centrum, and unites with it by a large compressed squamose base, which fits into an impressed concave area.

The fourth specimen is $3\frac{3}{4}$ inches long; and the whole centrum is somewhat larger, with flatter articular faces and deeper excavations on the base of the centrum. The fifth, a trifle longer, shows the neural canal as a deep channel, concave from front to back, and at least an inch wide. The articulation for the rib is nearer towards the anterior margin of the centrum, where the process is thicker than posteriorly; as fractured it is $1\frac{1}{5}$ inch long. The seventh centrum is 4 inches deep and about $\frac{1}{4}$ inch wider; so that the articular face has become more circular. This surface is much flatter, but now has a shallow central concavity an inch in diameter. The centrum is $4\frac{1}{2}$ inches long; its basal excavations are more elongated, and the upper part of the centrum is more compressed. The eighth centrum is larger in the articular faces. The neurapophyses are remarkably extended from front to back, and greatly compressed, each being less than $\frac{1}{4}$ inch thick. On the base, separated by the rounded median ridge, are two large oval nutritive foramina about $\frac{3}{8}$ inch apart. The bases of the ribs grow stronger and are $\frac{1}{5}$ inch in depth. The tenth centrum is $4\frac{1}{4}$ inches long, with the articular face as deep and $5\frac{1}{8}$ inches wide, though the width over the articulations for the ribs is somewhat less. In the eleventh the base for the rib has become more ovate and larger, and the base of the neural canal has increased with the size of the vertebra, the neural arch being 2 inches wide externally behind.

The thirteenth vertebra has the neural arch well preserved (Pl. XXIII. fig. 2). The centrum is 4 inches in antero-posterior length. Its anterior face is $5\frac{3}{4}$ inches wide and about $4\frac{1}{2}$ inches deep. It has a central depression 2 inches broad, margined by an elevated rounded rim, between which and the circumference is a second concave area in the form of a ring, but less deep. The posterior articulation is 6 inches broad and $4\frac{1}{2}$ inches deep; it has the transversely oval central area shallow, but without the elevated rim. The base of the centrum is $4\frac{1}{4}$ inches long; it is convex from side to side, with an obtuse median ridge. The distance between the articulations for the ribs is $5\frac{1}{4}$ inches. The articular surface for the rib is subcircular, $1\frac{3}{4}$ inch deep, and nearly $1\frac{1}{2}$ inch from front to back; this area is $\frac{3}{8}$ inch from the posterior margin and more than $1\frac{1}{2}$ inch from the anterior margin of the centrum. The lateral area above the articulation for the rib is flattened, concave from side to side, and scarcely concave in depth. And the neural arch rises steadily from the side of the centrum without any break to a height of $10\frac{1}{2}$ inches, being imperfect superiorly. The neural arch is much compressed from side to side. The posterior zygapophyses hang entirely behind the posterior articular face of the centrum; they are close together, being

separated by a vertical slit. The processes are imperfect; as preserved each is $1\frac{1}{2}$ inch long and fully $\frac{1}{4}$ inch wide. These oblong facets look downward and slightly outward. The neuropophyses are greatly compressed from side to side. The neural spine is more compressed in front than behind, the base of its posterior margin is parallel to the posterior face of the centrum; it hangs backward, and measures in the upper part $\frac{3}{8}$ inch in width. The external width of the neural arch in its middle is $1\frac{3}{4}$ inch.

Fourteenth to seventeenth—as the articular tubercle for the rib begins to ascend the side of the centrum the tubercle becomes a little prolonged and is rounded. The eighteenth vertebra (Pl. XXIII. fig. 3) has the base of the neural arch preserved; its compressed anterior margin is nearly flush with the anterior face of the centrum, but as it ascends it extends forward. The face of the centrum is $6\frac{2}{8}$ inches wide. The articular facets for the ribs are nearly on the middle of the sides of the centrum; and the base accordingly becomes more rounded from side to side, and is nearly flat from front to back. The tubercle for the rib now steadily ascends the side of the centrum, leaving the base perfectly rounded. The nineteenth has the centrum 4 inches long at the base and $3\frac{1}{2}$ inches long superiorly (Pl. XXIII. fig. 4). The articular surface is more than usually flattened, 6 inches broad, and $4\frac{1}{2}$ inches deep. The transverse process was deep and narrow, placed posteriorly, and formed mainly by a downward and backward prolongation of the neural arch. This shows that the true neck is ended, the vertebra belonging to the two or three which form a transition between the cervical and dorsal series, which are conveniently named pectoral. The twentieth and twenty-first show similar characters; only the transverse process increases in size and depth, and rises higher.

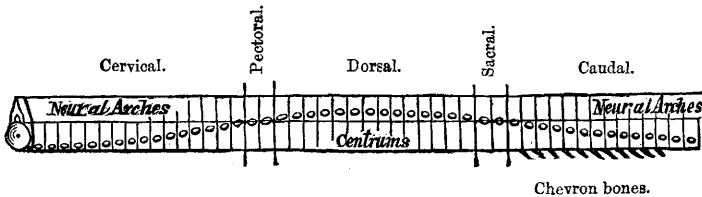
Several of the dorsal vertebræ are so similar that one may be taken as a type (Pl. XXIII. fig. 5). It is well preserved, except that the neural spine is broken away. The centrum measures $4\frac{3}{8}$ inches in length along the visceral surface from back to front; but in the line of the neural canal it only measures a little over 3 inches. Under the neural canal the articular face is $5\frac{1}{8}$ inches deep, and as preserved is $5\frac{1}{2}$ inches wide in the middle. The vascular perforations on the base of the centrum are $1\frac{3}{4}$ inch apart; the bone between them is remarkably convex. Below the neural arch the sides of the centrum converge greatly, measuring less than 3 inches transversely. The arch shows the vertically ovate neural canal; the base of the neural spine is narrow, compressed, and directed backward; and the broken transverse processes are directed outward and upward. The height from the base of the centrum to the shoulder of the transverse process is $7\frac{1}{2}$ inches. The transverse processes are compressed from front to back, about 2 inches deep at their origin, and 1 inch wide; they are twisted so that the superior margin is inclined forward and the inferior margin inclined backward. The whole neural arch is a good deal compressed from back to front. The later dorsal vertebræ are slightly shorter, and the articular face of the centrum becomes

rather smaller. The nutritive foramina become small circular pits rather further apart. In all about 40 vertebræ have been collected, of which about 14 are dorsal.

So far as can be judged from the size of the vertebræ, this species was rather larger than the *Elasmosaurus platyrurus* of Prof. Cope, and is therefore the largest long-necked member of the order Plesiosauria which has been discovered.

Since different writers have different methods of fixing the limits of the several regions of the vertebral column, which results in an undesirable confusion of characters of the species described, I venture to offer the following diagram as a convenient guide to uniformity in this particular, and as representing the characters of the divisions of the vertebral column which I have described in this and other

Diagram of the Divisions of the Vertebral Column in Plesiosaurs.



The curved line of small arches shows the position of the articulation for the rib in the several regions of the body.

Plesiosauria, in so far as they depend upon the position of the articulation for the rib upon the centrum, or upon the neural arch.

Many of the dorsal ribs of *Mauisaurus Gardneri* have a strong lateral crest at the proximal end, which makes the bone sub-triangular in section. The fragments have a considerable curve; but none are sufficiently perfect for description.

The bones of the pectoral arch are unfortunately imperfect. A fragment of a coracoid is 13 inches long, and 10 inches wide, as preserved; it does not show generic characters. The bones met in the median line anteriorly, as usual, but appear to have diverged posteriorly. Some fragments of scapula (?) appear to be not unlike the scapula of *Murænosaurus*, but are imperfectly preserved. Dr. Hector mentioned to me that he thought it possible for the scapulæ of *Mauisaurus* to have been convergent forward, and that they may not have been directed outward as in his figure (*Trans. New-Zeal. Inst.* vol. vi. 1874, pl. xxix.).

The humeri and femora have both been found. From the great size of the neck-vertebræ, and the decrease in size of the dorsal vertebræ, as they approach the sacral region, I am disposed to conclude that the humeri were larger than the femora. The humerus is 13 inches long and imperfect proximally. Midway between the proximal and distal ends the transverse width of the shaft is 7 inches. At about 4 inches from the proximal end the shaft is $3\frac{1}{2}$ inches thick; but

distally it becomes compressed and is apparently to some extent crushed from above downward, though an uncompressed fragment is 3 inches in thickness. The internal aspect is concave in length, and the external aspect convex. Both lateral margins appear to have been moderately concave; but the anterior margin is imperfect distally; if preserved it would probably have made the bone $9\frac{1}{2}$ inches wide. The distal articular margin for the bones of the forearm is nearly straight; and the surface for the radius does not make an angle with the surface for the ulna. The bone was unusually massive, and relatively to the vertebræ is much longer and broader than in Dr. Hector's *Mauisaurus Haastii*.

The femur is imperfect at both ends. The fragment preserved is 13 inches long. The proximal end of the bone is nearly cylindrical and about 4 inches in diameter. The anterior margin of the bone is very slightly concave, so as to be nearly straight; the posterior outline is deeply concave.

The phalanges appear to have been compressed from above downwards and unusually long. Only one has been found (Pl. XXIII. fig. 6) imperfectly preserved; it is about $4\frac{1}{2}$ inches long, $1\frac{1}{2}$ inch wide where most constricted in the middle, and was probably 2 inches wide at the extremities.

In the lower dorsal region of the animal about a peck of ovate and rounded pebbles occurred, varying in size from a diameter of a quarter of an inch to a length of nearly two inches. They are chiefly of opaque milky quartz. Several are of black metamorphosed slate, and a few of altered fine-grained sandstone and hornstone, some of the pebbles showing a veined character, such as might be derived from the neighbouring Palæozoic rocks of the North of France. Pebbles being of such rare occurrence in the Gault, it would seem natural to account for these associated stones on the hypothesis that they were swallowed by the animal with food, as is the case with certain living reptiles and birds. If this view should be held admissible, it would suggest that as the teeth were too small for any thing but prehension, a structure analogous to a gizzard, or the stomach of an edentate, may have used these pebbles to assist in breaking up or crushing the food on which this Saurian lived.

EXPLANATION OF PLATE XXIII.

Bones of *Mauisaurus Gardneri* from the Gault of Folkestone.

The figures of the vertebræ are half the natural size.

- Fig. 1. Prehensile tooth, of the plesiosaurian type. *a*, crown; *b*, fang. Nat. size.
2. Middle cervical vertebra, side view.
3. Late cervical vertebra, with the pedicle (*t*) for the ribs rising above the sides of the centrum.
4. Pectoral vertebra with the pedicle for the rib formed partly by the centrum and partly by the neural arch.
5. Dorsal vertebra, showing the broken transverse processes (*t*), and base of the neural spine. In the British Museum.
6. Phalange, imperfect; natural size.

DISCUSSION.

MR. GWYN JEFFREYS, with reference to the habits of the Walrus, stated, on the authority of Prof. Torell, that it feeds on the *Mya truncata*, a mollusk which lies buried in gravelly mud. In order to get this mollusk, it has to grub up the mud with its tusks, and takes up the mud and pebbles along with the *Mya* into its mouth.

MR. J. S. GARDNER said he regretted that all the vertebræ of the Saurian had not been brought for exhibition, as the smallest of the cervical vertebræ would have shown more plainly the great disproportion existing between them and the vertebræ of the trunk, and thus have given a better idea of the great length of the neck. He remarked that the bones, when *in situ*, were very fragmentary, and some had oysters adhering to them, showing that they had been long exposed before fossilization. He stated that pebbles were exceedingly rare in the Gault, and suggested that the reptile may have been stranded, and that the pebbles became entangled in its carcass.

MR. J. W. HULKE believed, with the author, that the remains indicated a new species of larger size than any previously found in this country. In the long, tapering neck, the lateral position of the articular head of the limb-bones, and the form and structure of the cervical ribs, he noticed resemblances to the large Kimmeridge *Plesiosaurus* (*P. Manselli*) which he brought under the notice of the Society several years ago, and which he thought would fall into Prof. Seeley's subgenus *Muranosaurus*. With regard to the pebbles, he suggested that the animal may not have swallowed them as an aid to the comminution of food in its stomach, but that they were introduced in the stomachs of fish which it had swallowed. The flesh and, subsequently, the bones of these would be digested and absorbed, whilst the indigestible stones, if the stomach of the *Plesiosaurus* was like that of Crocodiles, would be unable to pass through the small pyloric opening into the intestine, and must permanently remain in the stomach.

THE AUTHOR briefly replied.