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**Note on some Plesiosaurian Remains
obtained by J. C. Mansel, Esq., F.G.S., in
Kimmeridge Bay, Dorset**

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Notes

3. *Note on some PLESIOSAURIAN REMAINS obtained by J. C. MANSEL, Esq., F.G.S., in KIMMERIDGE BAY, DORSET. By J. W. HULKE, Esq., F.R.S., F.G.S.*

(PLATE XLI.)

THESE remains form part of the rich series of Enaliosaurian fossils obtained from Kimmeridge Bay, by J. C. Mansel, Esq., to whose courtesy I am indebted for the opportunity of bringing them under your notice. They consist of five vertebræ, four of which are nearly entire, with pieces of several ribs, a digital phalanx, and a carpal bone (?), imbedded in two slabs of clay-stone, indicating an undescribed species of *Plesiosaurus*,—and of a large number of associated bones representing another species characterized more particularly by the proportions and peculiar construction of its paddles, which sharply separate it from the typical *Plesiosaurs* of the Lias, and show an extremely close affinity with *Pliosaurus*.

PLESIOSAURUS BRACHISTOSPONDYLUS (Pl. XLI. figs. 7-9).

The middle dorsal vertebræ (the only ones in Mr. Mansel's collection) of the species for which I propose this name, are characterized by the extreme shortness of the centrum, which in three of the vertebræ lying in one slab has a length, or antero-posterior diameter, of 1 inch only, measured along the outer, non-articular surface. The length of the fourth centrum, in the other slab, is $\cdot 3$ inch more; but this centrum is a little obliquely distorted by pressure. The breadths (or horizontal transverse diameters) of the centra are respectively 4·6, 4·5, 4·3, 4·4 inches; and their heights (or vertical diameters) are 4, 4, 3·8 inches.

Centrum.	Length. inch.	Height. inches.	Breadth. inches.		
No. 1.	1	4	4·6		
No. 2.	1	..	4·5		
No. 3.	1	4	4·3		
No. 4.	1·3	3·8	4·4		
				No. 1.	No. 2.
Length of transverse process {				upper border	3·1 2·7
				lower border	3·1 2·4

Span between ends of transverse processes 6·7 inches.

Height of neural spine about 3·6 inches.

Height of entire vertebra from lower border of centrum to top of neural spine about 9·4 inches.

These centra are therefore about four and a half times as broad, and nearly four times as high as they are long—proportions which I have not found in any other *Plesiosaurus*. The articular faces are gently swollen near the circumference, and hollow at the middle, where the distance between the two faces in one centrum measures $\cdot 7$ inch. These proportions and the hollow articular faces

give the centra some resemblance to those of Ichthyosaurian vertebræ, from which, however, they may be at once distinguished by the absence of costal tubercles from the outer surface, and by the circumferential swelling of the articular face. But these vertebræ are sharply differentiated from those of *Ichthyosaurus* by their anchylosed neurapophyses bearing long transverse processes. These are laterally compressed blades directed upwards and outwards from the neural arch. Their outer end is slightly swollen, and cut obliquely, which makes the upper border of the process longer than the lower one, and gives the terminal rib-bearing surface an almost directly outward aspect.

The anterior articular processes spring from the crown of the arch, immediately above the neural canal. Their lower ends meet, and their upper ones are incurved, so that together the two prezygapophyses form about two-thirds of a circle, each half of which looks inwards and embraces the corresponding posterior articular process, the shape of which, and the aspect of its articulating surface, are the counterparts of those of the anterior one. The posterior articular processes spring from the back of the arch just below the root of the neural spine, in a rather higher level than that of the anterior. The neural spines are long and straight.

The ribs have a simple flattened head, separated by a slight constriction from the angle $3\frac{1}{2}$ inches distant, beyond which they sweep outwards and downwards in an even curve. Their upper, convex border is thick, the lower one is thin, and a shallow groove parallel to the upper one channels the surface of the rib.

The digital phalanx had the usual cylindrical figure, with constricted middle of a Plesiosaurian digit-bone. It is 1·5 long, ·9 broad at ends, ·5 broad at middle.

PLESIOSAURUS MANSELI (Pl. XII. figs. 1-6).

In November 1868 Mr. Mansel kindly sent me for examination a large series of vertebræ, evidently comprising the greater part of the spinal column of a *Plesiosaurus*, with pieces of the two humeri, and several incomplete flat bones, which some years before had been discovered in the cliffs east of Clavell's Tower, in Kimmeridge Bay.

Mr. Mansel informed me that he had himself supervised their exhumation, and that the bones were associated in such a manner as to leave no doubt in his mind that they had all belonged to one individual; and he also mentioned that, under the impression that they were Plesiosaurian remains, he had enclosed the four great paddle-bones with carpals and many phalanges in a case of Plesiosaurian fossils which he had presented to the British Museum. It was Mr. Mansel's first impression that all the four limb-bones had been enclosed in this case; but the parts actually sent were the nearly complete left femur, the proximal half of the right one, and the distal half of the left humerus. On recently taking to the Museum the proximal halves of the humeri which Mr. Mansel sent me in November 1868 (with the spinal column) one was found to fit exactly the distal fragment of the humerus already in the Museum; and the national collection now contains the nearly perfect femur and left humerus

and the proximal halves of the right femur and humerus, with the smaller paddle-bones, already mentioned, of this *Plesiosaurus*.

Mr. Mansel has recently seen these humeri and femora since their restoration; and he has identified them as the limb-bones which he exhumed together with the spinal column which he sent me. Their general facies, the peculiar texture of their surface, and the correspondence of small pieces of the clay still adhering to them, confirm Mr. Mansel's statement that these limb-bones did belong to the same individual. I may add that there is a close resemblance in these points between the paddle-bones and the large flat bones of the pelvic and breast-girdles. I have entered into these details because, on account of the remarkable construction of the paddles, it is important that their identification with one another and with the spinal column should be as complete as possible.

Spinal Column.—The spinal column is that of a long-necked *Plesiosaurus*. All the early cervical vertebræ have been subjected to lateral pressure, which has flattened the sides of the centra, and reduced their breadth, but increased their height. Throughout the spinal column the neurapophyses have been broken off from the centra, to which they were completely ankylosed; and very few of them have been recovered. The eighty-six vertebræ which have been preserved are distributed as follows. Twenty-seven bear a transverse process low on the side of the centrum, and therefore belong to the front of the neck. Their combined lengths amount to nearly 5 feet; but the original length of this part of the neck was more than this, because several vertebræ behind the axis are certainly wanting, and there is another gap between the 12th and 13th of the series. Twenty-three have the transverse process replaced by a costal pit, higher on the side of the centrum, or they have a transverse process rising from the centrum into the root of the neurapophysis. These, then, are transitional vertebræ between the front of the neck and the trunk, or between the dorsal and caudal segments. I am not acquainted with criteria by which the transitional centra of these regions can be certainly distinguished, the prethoracic and early thoracic from the lumbar ones. The larger ones I have assigned to the lumbar region, because their dimensions accord best with those of the early caudal centra. The united lengths of the transitional vertebræ amount to nearly 4 feet.

Nineteen have the transverse process borne wholly on the neurapophysis, and are reckoned dorsal or mid-trunk vertebræ. Their united lengths give 3 feet 6 inches.

Seventeen are caudals, all but the foremost bearing chevron-facets. Their combined length is 2 feet 6 inches. The united lengths of all the vertebræ make about 15 feet; and taking into account the known large gaps in the neck, and the probability that other vertebræ are also missing, the original length of the spinal column will probably be not overestimated at 17 feet.

The atlas and axis are ankylosed. A shallow vertical groove on their side indicates their original separateness. The anterior articular face of the atlas is a cup with a diameter of about 1.1 in., but

originally somewhat more, as the lip is slightly abraded. A little above its middle there is a small deeper pit. The sutures which marked the original distinctness of its component elements are no longer traceable. The sides or outer surfaces of the conjoined vertebræ are vertical; they bear a low horizontal ridge, separating an upper from a lower shallow depression; and at their junction with the under surface the atlas has a strong lateral tubercle representing a transverse process, which in the axis is a well-developed compressed ridge projecting downwards and backwards. A strong median tubercle projects downwards and forwards from the under surface of the atlas. In front a slight interval of about $\cdot 1$ inch separates this from the lower margin of the anterior articular surface; and behind it is continued into a narrow median ridge, dividing the under surface of the axis. In a longitudinal direction the under surface of the atlas is slightly convex, and that of the axis is gently concave; while transversely, between the median ridge and the lateral transverse process, this surface of the axis is more positively hollow. The posterior articular face of the axis is deeply hollow at its middle, while its lip is tumid. The neural arches of both these vertebræ are crushed and broken off.

From the first to the thirteenth of the cervical series all the vertebræ are slightly distorted by lateral pressure, by which their vertical diameter has been slightly increased and their horizontal one lessened. All the neural arches are gone. The sides of the centra are nearly plane vertically, but deeply concave horizontally. The suture marking the lowest limit of the neurapophysis is hardly visible, and in many quite undistinguishable. The transverse processes are simple downward-projecting blades attached to the whole length of the side of the centrum, ankylosed to it. A horizontal line above the root of the blade marks its junction with the centrum; and above this line the side of the centrum is deeply hollowed.

In the ninth of the cervical series the distance between the upper limit of the transverse process and the lowest limit of the neurapophysis on the side of the centrum is $1\cdot 3$ inch, the length, breadth and height of this centrum being respectively $2\cdot 1$, $2\cdot 4$, and $2\cdot 2$ inches. The under surface of the cervical vertebræ is nearly plane transversely, broken by a low median ridge, on each side of which is a hollow pierced by a vascular foramen; while axially it is concave. The articular faces are rather deeply hollowed centrally, and less so peripherally. Their true contour is subcordate, the emargination above corresponding to the neural canal. The neurapophyses arise in the form of thin laminæ from nearly the whole length of the upper surface of the centrum, coming rather closer to the anterior than to the posterior articular surface. In the later vertebræ of the anterior cervical region the laminæ become shorter antero-posteriorly, and stouter. The transverse processes are also stouter and much less compressed here; their transverse section has an oval figure; and their anterior border slants more backwards.

From the twenty-seventh of the cervical series backwards through-

out the rest of the neck, and in the vertebræ referred to the early thoracic segment of the spinal column, no anchylosed transverse process occurs; but the side of the centrum bears a costal pit at a higher level than the line of attachment of the transverse processes in the earlier cervical vertebræ. This pit, when relatively low on the side of the centrum, is a circular or roundly oval hollow, with swollen edges; but as it rises upwards towards the root of the neurapophysis (or descends from it, in the case of the lumbar vertebræ) it becomes elongated vertically, until its vertical diameter in some vertebræ is nearly double the horizontal. With the recession of the transverse process, and later of the costal pit, from near the under surface of the centrum, this surface becomes less flattened, it is more convex transversely, and the narrow median ridge is replaced by a broader swelling. The vascular foramina are in many instances more than two, and they are not regularly placed. All the dorsal vertebræ are more or less mutilated and crushed. The contour of their centrum is more circular than in the other regions, owing to the absence of transverse processes from its outer surface. The articular faces are gently hollow: their contour is a full oval figure, emarginate above at the canal. Some mutilated neural arches severed from their centra have been preserved. The neurapophyses are stout, shorter antero-posteriorly than in the neck. They rake slightly forwards. The transverse processes stand outwards and upwards from the arch. They are strong, horizontally compressed blades, having a stout and straight upper edge, and a thinner concave lower one. Their outer end expands slightly, and it is obliquely cut as in *Plesiosaurus brachistospondylus*. The caudal vertebræ are distinguished by the flatness of the under surface of the centrum, as well as by the chevron-facets. These latter are absent altogether from the largest (first?) caudal; and the second to the fifth of the series have them on the posterior margin only; while the sixth and all those succeeding it have two facets on the anterior, and two on the posterior margin. In the hinder caudals the four chevron-facets enclose a deep hollow. The transverse processes have a conical base projecting horizontally from a prominent tubercle on the side of the centrum, about midway between its under surface and the neurapophysis. Most of them are anchylosed to this tubercle, the line of union being marked by a slight cingulum. In a few of the hindmost caudals the transverse processes were not anchylosed and have become detached, discovering a deep excavation in the end of the process-bearing tubercle.

Ribs.—Of these a very large number of fragments have been preserved. Most of these represent broad, horizontally compressed, flattened and channelled ribs, with a simple, vertically extended, roughened capitulum, corresponding in shape and size to the terminal surfaces of the transverse processes of the middle dorsal region. A smaller number of fragments indicate short subcylindrical ribs with a simple, smooth, rounded capitulum; they are doubtless the flanking ribs detached from the prethoracic and lumbar vertebræ. In addition to these two kinds of vertebral ribs, a great many smaller

cylindrical pieces deeply channelled on one side indicate the presence of the ventral set common in all *Plesiosaurs*.

Breast and Shoulder-girdle.—The large flat bones, which can belong only here, differ so greatly from those of known *Plesiosaurs*, that the only ones the determination of which can be looked on as at all certain are the coracoids (Pl. XLI. fig. 5). These are joined firmly together by a very stout median border, and form a strong flattened beam lengthened transversely to the axis of the trunk, attaining in this direction a maximum diameter of 20 inches at the lower end of the glenoid cavity, and one of 18 inches at the upper end of this articular surface. Each coracoid, then, is an oblong plate having a very short sutural median border which ties it to its fellow, and a gently concave anterior border decreasing in thickness from the outer end (where it contributes to the scapular articulation?) towards the middle, from which it again increases to its inner end, where the two coracoids meet in a remarkably strong non-articular projecting boss (*a*). Only a small piece of the natural posterior edge remains. It shows that this border curved inwards from behind the glenoid cavity towards the median line. How far the bone may have extended in this direction cannot be told; but, from the inclination of its ventral and dorsal surfaces towards each other, the mesial extension backwards would seem not to have been great. The outer border of the coracoid is stout; it bears a large, hollow, oval articular surface (the glenoid cavity, fig. 6, *a*), and in front of this a smaller trihedral surface, presumably for articulation with the scapular (*d*). The dorsal (?) surface of the coracoid is slightly sinuous. The ventral surface has a deep hollow just behind and parallel to the anterior border of the bone. A stout ridge sweeping from the median boss on the anterior border outwards to the glenoid border, divides this hollow from another triangular hollow, which lies between this ridge and the median crest. Below the outer end of this transverse ridge the ventral surface is convex from before backwards, and nearly plane transversely.

Limbs.—Of the four principal limb-bones the left pair are nearly perfect; my description is taken from these. One is rather shorter than the other; and this I assume to be the humerus, because in those *Plesiosaurs* in which there is any difference in the lengths of the humerus and femur the former is the shorter bone. In our *Plesiosaur* the humerus (fig. 1) is also stouter than the femur. Its length is $20\frac{1}{2}$ inches. Its proximal half is very massive and of a subcylindrical figure, while the distal half is expanded and flattened. The preaxial border (*c*) is nearly a straight line, broken both at the middle and towards the distal end by a slight excursion. The postaxial border (*d*) in its proximal 12 inches is nearly parallel to the preaxial one; but beyond this it sweeps backwards in a long curve and makes with the distal border a great wing, much larger relatively than that of typical *Plesiosaurs*. The contour of the distal border (*b*) is formed by two slightly incurved lines which meet in a wide angle placed rather behind the axis of the bone. The postaxial division, which is much the longer, is, unfortunately, incomplete. This end of the

bone is unusually thick, reaching $2\frac{1}{2}$ inches at the angle; and the articular surface is correspondingly broad from the dorsal to the ventral margin. The proximal end bears a subhemispherical articular head (figs. 1 & 2, *a*), the axis of which makes an angle with that of the cylindrical shaft. A groove passing between the pre- and postaxial borders separates this articular caput from a prominent, non-articular, narrow, trochanteric upward production of the dorsal surface of the bone (fig. 2, *b*). The trochanter (mutilated in our specimen) descends a short distance along the postaxial border. The groove which separates this from the articular caput descends along both borders, on the postaxial one inclining to the ventral surface along the prolongation of the trochanter. A constriction below the articular head marks off on the ventral surface a smooth neck, beyond which the whole breadth of this surface and also the postaxial border of the cylindrical part of the humerus are occupied by a very rough and swollen muscular impression. The expanded distal part of this surface is smoother. From the preaxial border transversely, this surface is gently convex to the wing, where there is a shallow longitudinal hollow. The dorsal surface is smoother than the ventral. A low eminence appears at about one-third of the length of the bone, measured from the upper edge of the trochanter. I am unable to select the other bones of this fore paddle.

The femur (fig. 3) is rather longer than the humerus, and it is also less massive. This is particularly noticeable in the shaft. It has a subglobular articular head (figs. 3 & 4, *a*) placed obliquely on the shaft, separated, as in the humerus, by a groove from a very largely developed trochanter (fig. 3, *e*, & fig. 4, *b*), which projects strongly postaxially, and descends on this border of the shaft. The groove also descends on both borders of the bone. It is deeper than the corresponding groove in the humerus. The articular caput is followed by a smooth constricted neck, to which succeeds, on the ventral surface and postaxial border a large rough warty swelling. The preaxial border (fig. 3, *c*) is concave, not straight as is that of the humerus; and the postaxial border (*d*) is still more concave, its distal half curving strongly backwards, and making an extremely large wing with the distal border. This last border is very remarkable: its outline consists of three distinct segments, corresponding to as many divisions of the distal articular surface, which is one in excess of those present in typical *Plesiosaurs*. The preaxial and the next postaxial division of this surface meet in a large angle lying just behind the axis, as in the humerus. Behind this is a second postaxial division of the articular surface, answering to the wing. The greater part of this, the third division of the distal articular end, is wanting; but its form is perfectly given by that of the corresponding bone in the second segment of the paddle.

This segment of the hind limb, the equivalent of the leg, contains in a transverse row three flattened angular bones of nearly equal size (*f, g, h*), each of which articulates proximally with one of the divisions of the distal articular surface of the femur, and distally with the members of the succeeding segment of the paddle. Laterally the

two outermost of the three bones articulate with the middle one. One of these bones lies preaxially; the other two are postaxial, the hindmost corresponding to the wing of the femur.

The preaxial bone (*f*) is pentahedral. It has a long proximal border, articulating closely (all the joints here are close-fitting) with the preaxial facet of the femur, and a rather shorter distal or tarsal border. Its mesial border, articulating with the middle bone, is shorter still. Its preaxial border, nearly straight, forms the front edge of this part of the paddle; it is smooth, transversely rounded, and non-articular. At its distal end a very short convex articular surface* is intercalated between it and the long directly distal surface. The following are its dimensions in inches:—Preaxial border 3·7; proximal border 4·8; longer distal border 3·1 (its articular surface is concave from its dorsal to its ventral margins); shortest border, between the last and the preaxial one (having a smooth convex surface), 1·5. From the preaxial position of this bone, it is manifestly the tibia.

The first postaxial bone (*g*) is also a pentahedron; its long transverse diameter is 4·6 inches, and its short or axial diameter 3 inches. Proximally it joins the first postaxial division of the distal surface of the femur. Its distal border is formed by two articular surfaces (concave in both diameters), which meet, a little behind the short axis of the bone, in a salient angle. The line of union of the mesial border of this bone with the tibia nearly cuts the distal angle of the femur.

To the postaxial border of this bone the second postaxial bone (*h*) (the third and hindmost one in the row) articulates. Its proximal border articulates throughout its entire length with the femur*. Its postaxial border is convex and non-articular, forming here the posterior border of the paddle; and its short distal (tarsal) articular border makes with that of the middle bone a deep reentering angle. The transverse diameter of this bone is 5·7, and its axial diameter 3·4 inches.

The characters of the early cervical vertebræ and the long tapering neck prove beyond doubt this spinal column to be that of a *Plesiosaurus*, and differentiate it from the subgenus *Phiosaurus* as hitherto defined. From the length of the column (in its present incompleteness 15 feet) Mr. Mansel's *Plesiosaurus* must have attained a size as great as, perhaps greater than, *P. megadeirus* (Seeley), another Kimmeridge *Plesiosaurus*, represented by two series of associated bones from Haddenham and Ely, preserved in the Woodwardian Museum†. The absence of any published account of these fossils has prevented me from instituting so searching a comparison of them with Mr. Mansel's *Plesiosaurus* as I could have de-

* A line running from near the outer end of this border to the posterior border separates the proximal and posterior corner from the remainder of the bone. I am doubtful whether this is an accidental or a natural division; if the latter, the piece so separated is a fourth enclinal element.

† Catalogue of Ornithosauria, Aves, and Reptilia from the Secondary Strata, in the Woodwardian Museum, by H. G. Seeley, p. 97.

sired. From the figure of the conjoined axis and atlas of the Haddenham specimen, given by the late Mr. L. Barrett in 'Annals & Mag. of Nat. Hist.' 1858, and from some sketches of the coracoids, and of a restored paddle of the Ely one, there are evidently strong resemblances; but Mr. Davies, sen., of the Palæontological Department of the British Museum, whose opinion in a matter of this kind is justly entitled to great weight, tells me that he has seen the Haddenham spinal column, and believes it to represent a distinct species from Mr. Mansel's.

A comparison of the limbs of Mr. Mansel's, and also of *P. megalourus*, with those of the typical Liassic *Plesiosauri*, brings out so many and such important differences that these two Kimmeridge Enaliosaurians may well rank as the representatives of a very distinct subgenus.

Their coracoids are not produced forward mesially far in advance of the level of the glenoid cavity as they are in the Liassic *Plesiosauri*, but their anterior borders make a nearly straight line. They are also much extended transversely to the trunk's axis, while their greatest extension in the Liassic *Plesiosauri* is in the direction of the axis. In this the coracoids of the Kimmeridge *Plesiosauri* show a resemblance to *Ichthyosaurus*; but their front border wants the characteristic Ichthyosaurian notch.

The humerus and femur of Mr. Mansel's *Plesiosaurus* are absolutely, as they are also relatively to the length of the spinal column, longer than in any known Liassic *Plesiosaurus*. They are also more massive, and their muscular impressions are much stronger. Their subglobular articular caput appears to me to make a larger angle with the axis of the bone; and there is also the well-developed trochanter. The postaxial border has a larger backward curve; and the wing is much larger. The distal end of the femur (that of the humerus is incomplete; but by analogy it should resemble that of the femur) has a third articular facet, while that of the humerus and femur of Liassic *Plesiosauri* has two articular facets only. The second segment of the limb, the cnemion, contains three coequal bones, articulating with the three femoral facets, and answering to the tibia, fibula, and an additional element. The Liassic Plesiosaurian femur has only two distal facets, and but two principal bones in the second segment of the paddle. In some species, however (*P. rugosus*), a rudimentary third ossicle is present at the postaxial border of the fibula. The two principal bones, the tibia and fibula, in these latter Plesiosaurs are elongated in the direction of the axis of the limb, and they are very different in form from the tarsal bones; whereas in the Kimmeridge *Plesiosaurus* the three coequal bones in the cnemion are lengthened transversely to the axis of the limb, and differ little in shape from the tarsals. In this formal indifference of its cnemion and tarsus, Mr. Mansel's *Plesiosaurus* has a resemblance to *Ichthyosaurus*; but the similarity is more than balanced by the third bone in its cnemion and the perfect formal difference of the digits.

It is, however, in the subgenus *Pliosaurus* that the limbs most

closely resemble those of this Kimmeridge *Plesiosaurus*; and the points of similarity are just those wherein this departs from the Liassic types.

I find, on comparing them, a very close general and particular agreement between the humerus and femur of the Kimmeridge *Plesiosaurus* and two type specimens in the British Museum, labelled "No. 31,795. Femur, *Plesiosaurus trochanterius*, Owen," and "No. 31,787, femur of *Plesiosaurus brachydeirus*, Owen." No. 31,795 is smaller than the Kimmeridge humerus, but in all other respects closely resembles it. It has the same general form, articular caput, trochanter and separating groove, and the rough warty muscular impression on the ventral surface and postaxial border. The preaxial and first postaxial segments of the distal border are inclined at a similar angle; the preaxial segment is similarly concave. The remainder of this and the distal part of the postaxial border, including the wing, are unfortunately wanting, so that the comparison cannot be completed.

The Kimmeridge *Plesiosaurus*'s femur is extremely like No. 31,787, a femur of "*Plesiosaurus brachydeirus*, O." a longer bone (from a larger individual?), but with outlines which, so far as they are preserved, closely resemble those of the Kimmeridge *Plesiosaurus*. At first sight most striking differences are a greater axial symmetry due to the smaller size of the wing, and the subdivision of the distal end into two facets only; but it only requires a second glance to see that the distal third of the postaxial border, with the corresponding part of the wing and of the distal border, have been broken off, and the rough fractured edge smoothed with plaster of Paris. It has a similar articular caput, separated by a groove running between the preaxial and postaxial borders from a strongly formed trochanter. The preaxial and so much as remains of the postaxial division of the distal end are inclined at a like angle, and each is similarly concave.

When the comparison is extended to the second and third segments of the limb, similar resemblances are apparent. The paddles available for this purpose are two—the well-known enormous paddle of *Pliosaurus grandis*, presented to the Dorchester Museum by its discoverer and restorer, Mr. J. C. Mansel, and the small paddle of *Pliosaurus portlandicus* in the British Museum, described and figured by Professor Owen in the Palæontographical Society's Memoirs, vol. xxii.*

In both these we notice the same formal indifferentism of the bones composing the cnemion and tarsus, and the same transverse extension of the tibia and fibula. In the Dorchester paddle, an excellent cast of which is in the north gallery of the British Museum, the femur is mutilated. It manifestly wants a great part of the wing, which has been split off by a straight fracture parallel to the axis running from the postaxial to the distal border. The tibia and fibula support flat multiangular tarsals, which are succeeded by five

* Fossil Reptilia of the Kimmeridge Clay, genus *Plesiosaurus*, by Prof. Owen (Palæontogr. Soc. Mem. vol. xxii. for 1868), pl. 4. fig. 1.

digits. As often as I looked at the cast of this gigantic paddle ($6\frac{1}{2}$ feet long), I was struck with the insufficient basal support of the hindmost digit, and the suspicion forced itself upon me that something was wanting in the postaxial side of the foot. The Portland paddle proved this to be the case. Its second segment contains two coequal bones, and part of the distinct impression of a third, which has fallen out of the matrix; and corresponding to this impression in the stone there is, as may be plainly seen in the excellent figure illustrating Prof. Owen's memoir, the beginning of a second postaxial facet on the distal end of the femur. The rest of this facet, with the adjacent postaxial border, has been worn away. Prof. Owen regards the third ossicle in the cnemial row as "the homologue of the fabella which is present in some *Plesiosaurs* (*P. rugosus*, for example), where its homotype in the fore limb is represented by a detached olecranal process of the ulna," adding "that the bone in *Pliosaurus portlandicus* is relatively larger and less triangular in shape than in *Plesiosaurus rugosus*." Afterwards, describing the hindmost of the three bones present in the first row of the tarsus, which he regards as the calcaneum, Prof. Owen writes of its posterior border, "It appears to have been closely connected with the fabella (67'), which fits into the interspace between the fibula and the calcaneum; and whether to regard the ossicle marked 67' as the apophysal lever of the fibula or as the calcaneum may be a question"*.

The identity of the third cnemial bone of our Kimmeridge Plesiosaur with that which has left its impression in the matrix in which lies the Portland *Pliosaurus*-paddle cannot, I think, be questioned; and the correspondence of this to the ossicle attached to the posterior border of the fibula of *Plesiosaurus rugosus*, pointed out by Prof. Owen, appears highly probable. If this be a true correspondence, and not simply an apparent one, the determination of the serial homology of the bone is still open; for no confirmation of either of the two hypotheses is to be drawn from the Kimmeridge paddle. If the ossicle attached to the fibula in *Plesiosaurus rugosus* is the homologue of the "apophysal lever of the fibula" (the styloid process of human anatomists), we have the anomaly of its lateral, not terminal, articulation with the shaft of the fibula, and also of its articulation with both the femur and the tarsus. If, however, it is the calcaneum, we have another anomaly—the articulation of the heel-bone and femur—besides the difficulty of reconciling this determination with that of the hindmost of the three bones of the first tarsal row, which the author of the memoir quoted regards also as the calcaneum.

We have not yet, I think, sufficiently complete material for the solution of this problem, and we must be content to wait for fresh material before the homology of the bone can be settled. At present, I will merely say that its existence as a coequal bone with the fibula and tibia in the Kimmeridge *Plesiosaurus* is in harmony with the ingenious theory of the type of limb-construction recently advanced

* Paleont. Soc. vol. xxii. 'Fossil Reptilia of the Portland Stone,' p. 11.

by Gegenbaur,—and conclude with the remark that this additional cnemial element, extending, as it does, the basis of support of the tarsus and digits, suggests the presence of additional postaxial digits above five, the number in the Liassic *Plesiosauri*. Should this prove so, it will add another and a striking resemblance to those already known between this subgenus of *Plesiosaurus* and the *Pliosauri* and *Ichthyosauri*. I propose to distinguish this new Kimmeridge *Plesiosaurus* by the specific name of *Manselii* (*Plesiosaurus Manselii*).

Dimensions of Centra of Vertebrae.

	Antero-posterior diameter.	Transverse horizontal diameter.	Vertical diameter.	Distance between upper border of transverse process and level of upper surface of centrum.
Cervical.	inches.	inches.	inches.	inch.
No. 1	·8	1·2	1·2	·8
2	·8	1·3	1·0	·7
6	1·8	1·7	1·7	1·3
12	2·2	2·1	2·5	1·8
27	2·5	4·0	3·2	1·9
Transitional ...	2·4	4·4	3·4	
Dorsal	2·2	4·2	3·6	
Caudal.				
No. 1	2·2	4·3	3·4	
6	1·9	3·6	3·0	
12	1·6	2·7	2·2	
16	1·0	1·4	1·5	

EXPLANATION OF PLATE XLI.

Figs. 1 to 6 illustrate the osteology of *Plesiosaurus Manselii*.

Fig. 1. Ventral view of left humerus: *a*, proximal end; *b*, distal end; *c*, pre-axial border; *d*, postaxial border.

Fig. 2. Proximal end of this humerus: *a*, articular caput; *b*, trochanter.

Fig. 3. Ventral view of left femur: *a*, proximal end; *b*, distal end; *c*, pre-axial border; *d*, postaxial border; *e*, trochanter; *f*, preaxial bone of leg; *g*, first postaxial bone; *h*, second postaxial bone.

Fig. 4. View of proximal end of this femur: *a*, articular head; *b*, trochanter.

Fig. 5. Dorsal view of conjoined coracoids: *a*, front border; *b*, posterior border; *c*, *c*, glenoid fossae; *d*, scapular facet.

Fig. 6. View of outer end of coracoid: *a*, glenoid cavity; *b*, scapular facet.

Figs. 7, 8, 9. Vertebrae of *Plesiosaurus brachistospondylus*.

Fig. 7. Front view.

Fig. 8. Back view.

Fig. 9. Oblique view, showing the antero-posterior diameter or length of the centrum.