

to the south and west. The principal shock took place at 1min. 20sec. past 8 a.m., or thereabouts, at a depth of 5 miles approximately. The velocity of propagation was 4,378ft. per second; the intensity of the shock, measured by the velocity of the earth-particle, about 2ft. per second, or rather more than viii. on the Rossi-Forel scale.

*Theory suggested.*—The principal shock was preceded by others at a much greater depth, and we may, if we please, imagine a succession of rock-falls (or slidings or crushings) to have taken place in the interior of that portion of the earth's crust underneath the epicentric area K, F, E<sub>3</sub>, E<sub>2</sub>.

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ART. XXXVIII.—*On a New Plesiosaur from the Waipara River.*

By Captain F. W. HUTTON, F.R.S., Curator of the Canterbury Museum.

[Read before the Philosophical Institute of Canterbury, 1st November, 1893.]

Plate XLII.

THERE is in the Canterbury Museum a remarkably fine specimen of a sauropterygian, which was collected by Mr. A. McKay in June, 1872,\* from the Cretaceous rocks of Bobby's Creek, Waipara. It is mentioned by Sir James Hector in his descriptions of the fossil reptiles of New Zealand in the Wellington Museum, but no description or figure of the present specimen has as yet been published.

The skeleton is imbedded in a hard, grey, argillo-calcareous concretion, like all the others from the same locality. This portion of the concretion is nearly 6ft. long, and has been split longitudinally, showing the ventral aspect of the animal. Originally it was in several pieces, but they have been placed together and set in plaster. As at present seen, the head and neck are absent. The pectoral arch is represented by the coracoids—that of the right side being nearly perfect—and a fragment of the right scapula. The proximal half of the right humerus is also seen. Between the coracoids, and stretching out behind them, is a series of eleven dorso-lumbar vertebræ with only their hæmal surfaces exposed. On either side, lying almost in their original positions, are some abdominal ribs—eight on the right and ten on the left side—four of which on

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\* Geol. Canterbury and Westland, p. 169.



the left side have been turned round so as to expose their inner surfaces. Portions of four pectoral ribs are seen near the right coracoid. Behind these vertebræ are the pubes and ischia, which have been but little displaced. Those on the left side are nearly perfect, but those on the right side have lost their outer margins. Behind the pelvic arch is the tail, the fourteen vertebræ of which have been split longitudinally in section, so that no surface is seen. Anteriorly these vertebræ present an indistinct mass, but the last seven on the slab show distinct outlines. Here the specimen ends abruptly, but it is evident that the tail must have been continued much further, as it tapers but little. The transverse breadth of the last vertebral centrum is 55mm., while the largest lumbar centrum has a transverse breadth of only 65mm. These caudal vertebræ, being in section, show that the articular surfaces of the centra are more deeply concave than in most of the plesiosaurs; and the same can be ascertained for the trunk vertebræ by removing a portion of two of the centra.

In the abdominal region, just in front of the pubes, there are a number of rounded pebbles of quartz—about seventy-five can be seen—varying in size up to 20mm. in diameter. As similar pebbles are not found elsewhere in the rock containing the saurian remains, it is evident that these have been swallowed by the animal, probably to adjust the specific gravity of its body with that of the water.

The total length of the specimen is 5ft. 2½in., of which the tail occupies 1ft. 8in. The distance from the post-axial margin of the coracoid to the pre-axial margin of the pubis is 1ft. 8in., and the greatest antero-posterior length of the pelvic arch, from the pre-axial margin of the pubis to the post-axial margin of the ischium, is 1ft. 1in. The animal was about the size of *Plesiosaurus australis*, to which it was referred by Sir Julius von Haast; but Sir James Hector pointed out that it does not agree with that species either in the shape of the ribs or in the form of the vertebral centra, and he considers that "it must have been a very different animal."\* The pelvic bones also differ much from those figured by Sir James Hector. In the distinctly but moderately cupped articular surfaces of the vertebral centra this specimen resembles *P. crassicostatus* and *P. hoodii* alone of the described New Zealand sauropterygians; but in both those species there is a tubercle in the centre of the cup, which does not appear here, and they both have the centra proportionately shorter than in the present specimen. The proportions of length to breadth of the vertebral centra resemble those of *P. mackayi* and

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\* "On the Fossil Reptilia of New Zealand," Trans. N.Z. Inst., vol. vi., p. 341.



*Mauisaurus haastii*; but both of these have the articular surfaces flat, while in *P. mackayi* they are said by Sir James Hector to be "quadrate, not circular,"\* which is quite different from the present specimen. Lastly, *M. haastii* has a very different coracoid and humerus, while *M. latibrachialis* is only known by its humerus, which appears to differ much from our animal. It is therefore necessary to make a distinct species of the present specimen, and I have given it the name of *caudalis*, in allusion to its long and powerful tail. Mr. R. Lydekker has referred all the New Zealand Cretaceous sauropterygians with which he is acquainted to Leidy's genus *Cimoliosaurus*,† because the vertebræ seem to resemble closely those of *C. constrictus* and *C. planus*. *Cimoliosaurus* is also a genus which ranges from Middle Jurassic to Upper Cretaceous, while *Plesiosaurus*, as now restricted, is found in Europe only in the Rhætic and Lower Jurassic. The principal generic character of *Cimoliosaurus* is the shape of the scapula, and, although this is not yet known in any of the New Zealand species, I think it most prudent, for the present, to follow Mr. Lydekker, and I therefore call this saurian *Cimoliosaurus caudalis*.

#### DESCRIPTION.

*Vertebræ*.—The neck is entirely missing. A row of eleven dorso-lumbar vertebræ exhibit their ventral sides only; the transverse processes, zygapophyses, and neural arches being buried in the matrix. However, a fragment can be removed which enables the centrum of the eighth of the series to be accurately measured. These measurements are as follows: Antero-posterior length, 48mm. (1.9in.); length at middle of cups, 39mm. (1.5in.); transverse breadth of articulating surface, 65mm. (2.6in.); height of articulating surface to bottom of neural canal, 55mm. (2.2in.). The transverse breadth at the middle of the centrum is 56mm. (2.2in.). There are two pairs of venous foramina on the ventral surface of each vertebra. The outer pair, which are the larger, are about 33mm. or 34mm. apart, and the inner about 20mm. apart. They are not situated in any cavity, nor are they bounded by any mark, but the ventral surface of the vertebræ is smooth and rounded. The tail probably exceeded the body in length. As at present displayed there appear to be fourteen vertebræ, but it is only the last seven which can be accurately measured. Of these the antero-posterior length is 34mm. in the most anterior, and 28mm. in the most posterior; while the length at the centre of the cups is 25mm. and 22mm. respectively. The transverse diameter of the articular surface is 61mm. in the most anterior

\* *Loc. cit.*, p. 345.

† Catalogue of the Fossil Reptilia in the British Museum, vol. ii.



and 55mm. in the most posterior. The cups are simply concave, without any flattening or tubercle in the middle. The chevron bones were not anchylosed to the centra. One of these (Pl. XLII., fig. A, *c.v.*), lying on the surface alongside the vertebra which is the last but two in the series, is 40mm. in length, and the two limbs are 28mm. apart at their ends. Two others are seen lying on their sides, each being 43mm. in length and 14mm. in breadth. As the ventral surfaces of all the caudal vertebræ are missing, it is impossible to say whether these chevron bones were or were not attached to the centra by longitudinal ridges.

*Ribs.*—The shafts of four displaced pectoral ribs (*p.r.*) are partially exposed on the right side of the animal at and just below the coracoid. They are thick and strong, and slightly compressed, their diameters being about 20mm. and 16mm. Several abdominal ribs (*a.r.*) show on each side, and these are but little displaced. They are more slender than the pectoral ribs, their diameter being only 13mm. The external surface is rounded and longitudinally striated, while the internal surface is flattened, and has a deep and broad longitudinal groove.

*Pectoral Arch.*—The coracoids (*co.*) are but slightly displaced, and the two still touch each other anteriorly. They are longer than broad, deeply notched in front, concave on the outer margin, and convex on the posterior margin. The inner margin is also apparently concave. I am aware that in the plesiosaurs the coracoids are often thin and broken in the middle, but that is not the case with this specimen. In it the inner margins are smooth and rounded, and that of each coracoid is symmetrical with that of the other, which could not be the case if they were broken. Consequently the coracoids must have been separated by a large fontanelle in the middle, and have touched anteriorly and posteriorly only, as represented in the diagram (Pl. XLII., fig. B). At the anterior symphysis the bone curves ventrally so as to make a longitudinal keel with its fellow. The inner anterior corner is broken, and we cannot say how far it projected forward, or whether it articulated with a pro-coracoid. The antero-posterior length of the coracoid is 10·5in. Its anterior breadth, from the posterior end of the glenoid cavity, is 6·5in., its posterior breadth is 5in., and the breadth in the middle is 2·5in. Only the post-axial extremity of the scapula remains, and it is too fragmentary to afford any reliable characters. The proximal end of the humerus is 2·5in. in diameter, and at a length of 3·5in. from the end it has expanded to a breadth of 4·5in. This end of the humerus is not well preserved, and it cannot be ascertained whether it bore any trochanterial ridges.

*Pelvic Arch.*—This is but slightly displaced, and better



preserved than the pectoral arch. The *pubes* have been crushed notwithstanding that they are strong—about 8mm. in thickness, and with a thickened symphyseal margin. The shape is somewhat quadrate, broader than long, slightly concave on its post-axial and slightly convex on its pre-axial margins; the shape of the external margin is doubtful. The antero-posterior length of the symphysis pubis is 5·5in., and the greatest transverse width of each bone is 7·5in. The *ischium* is strong, and thick in the centre. It is elongated transversely, with concave anterior and posterior margins. The posterior margin projects post-axially at its inner corner. Its antero-posterior length at the inner margin is 6·5in., and in the middle 2·5in. The greatest transverse width is 7·5in. I have attempted a restoration of these bones in Pl. XLII., fig. C.

No ilium is seen, nor any of the bones of the hind limb.

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#### EXPLANATION OF PLATE XLII.

Fig. A. *Cimoliosaurus caudalis*, ventral aspect, reduced to  $\frac{1}{10}$ : *hu.*, humerus; *sc.*, scapula; *co.*, coracoid; *p.r.*, pectoral ribs; *a.r.*, abdominal ribs; *q.p.*, quartz pebbles; *pu.*, pubis; *is.*, ischium; *c.v.*, chevron bones. About one-tenth of natural size.

Fig. B. Restoration of coracoids.

Fig. C. Restoration of pubes and ischia.

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#### ART. XXXIX.—On *Conchothyra parasitica*.

By Captain F. W. HUTTON, F.R.S.

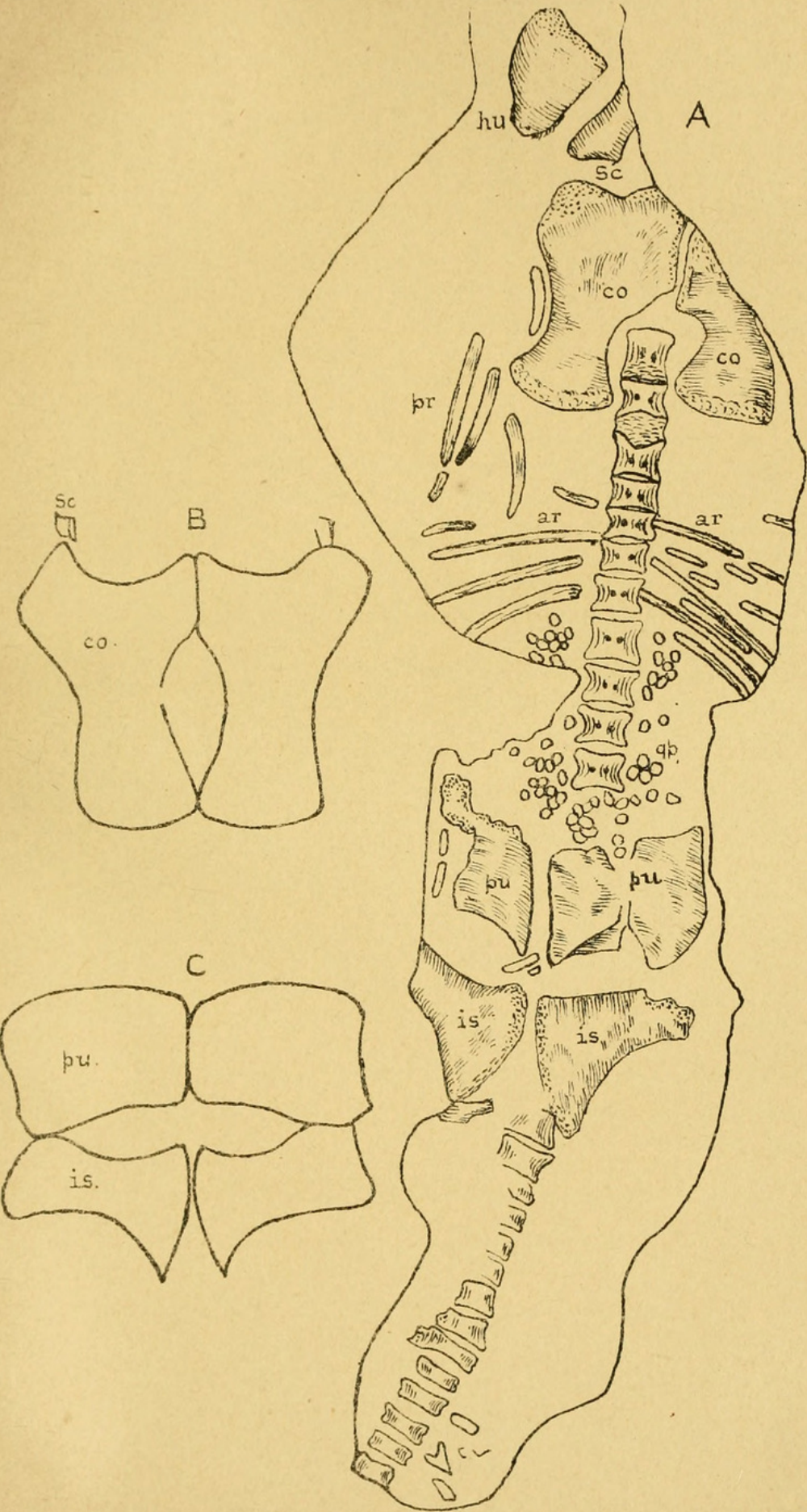
[Read before the Philosophical Institute of Canterbury, 2nd August, 1893.]

#### Plate XLIII.

CONCHOTHYRA PARASITICA is a fossil gasteropod mollusc highly characteristic of the reptilian beds at the Waipara River, but it has also been found at the Clarence River, at the Malvern Hills, at Broken River, and on the Canterbury Plains near the gorge of the Waimakariri River. It is from this last place that the figured specimens come.

The name appears first in the Catalogue of the Colonial Museum, Wellington, 1870 (p. 193), and again in Dr. Von Haast's report on the geology of the Waipara district, in





*Cimoliosaurus caudalis.*



Hutton, Frederick Wollaston. 1894. "Art. XXXVII.—On a new Plesiosaur from the Waipara River." *Transactions and proceedings of the New Zealand Institute* 26, 354–358.

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