PISTOSAURUS, A MIDDLE TRIASSIC PLESIOSAUR.

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ABSTRACT. *Pistosaurus* from upper part of Middle Triassic in southern Germany is the earliest Plesiosaur of which a complete restoration can be given, it still has long legs, not yet ordinary paddles.

ARTICULATED skeletons of Plesiosaurs are known from the lower Lias, but not from the Trias. The responsibility may now be taken for a restoration of *Pistosaurus* from the Middle Triassic upper Muschelkalk of southern Germany. Two skulls are described and named by H. v. Meyer (1. Pl. 21, 1-3 and 22, 1) from Bayreuth. He also gives a short description and a sketch (1. p. 48, Pl. 34, 4) of parts of a postcranial skeleton which he thinks might possibly belong to *Pistosaurus*. It comes from the same locality as the skulls; the Bindlacher Berg. Another later find from the same place is a much better, articulated post-cranial skeleton described by Geissler (2) and after that newly developed by

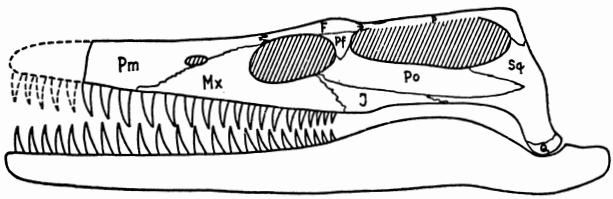

Fig. 1. *Pistosaurus longaevus*, restored lateral view of skull. ¼ nat. size. F, frontal; J, jugal; Mx, maxilla; Pm, premaxillary; Po, postorbital; Q, quadrate; Sq, squamosal.

Strunz. The genus is founded on the skulls, *P. grandaevus* which is lost (it is said to have been in a collection of a medical or anatomical institute at Berlin and *P. longaevus*). The latter is preserved in the Kreissammlung at Bayreuth. There are good casts of both skulls at Tübingen. One has recently been described by Dr. T. Edinger (3) and the author (4) gave illustrations of the accurate osteology of this skull; they need not be repeated here. To both of these authors it became clear, that *Pistosaurus* is a Plesiosaur and has nothing to do with the Nothosaurs.

The bones of the skeletal fragment described by H. v. Meyer, mentioned above, are distinctly different from *Nothosaurus* and

fit very well into primitive Plesiosaurs. The skeleton described by Geissler was thought by him to be a Nothosaur. He put with it a big Nothosaur skull (*N. baruthicus*), which was found in a somewhat lower level. But this is notably wrong. This skeleton is part of the Strunz collection now in the Senckenberg Museum at Frankfurt a/M. In Tübingen there is a good cast of it. Strunz himself suggested to the writer, that this skeleton is a *Pistosaurus*, and I think he is right. Already in 1902 (Geol. u. Pal. Abhandl. 6, 1) I had

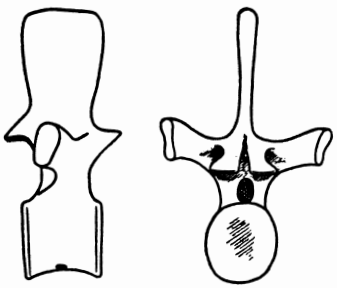

Fig. 2. Dorsal vertebra, a lateral and b posterior view. ¼ nat. size.

described dorsal and cervical centra from the Muschelkalk (as *Plesiosaurus priscus*) with a pair of foramina for vessels. Both of the mentioned skeletons have such vertebrae. The same is true for the Cymathosaurids in the lower Muschelkalk. I take them as the beginning of the Plesiosaur line. Also in the Jurassic plesiosaurs these foramina are present. The transverse processes in the dorsal vertebrae of these two skeletons are situated high and are relatively long; in Nothosaurs they are shorter and there are no foramina in the centrum.

In the "Geissler skeleton" the vertebral column is articulated from the axis to the 23rd dorsal vertebra. There are 21 cervicals without the atlas, making 22 cervicals. Behind the 23rd dorsal is a gap until the beginning of the tail. Three or four dorsals may be missing. The complete number of dorsals was probably 27. As this is a primitive Pleisosaur I am suggesting three sacrals. There are 16 articulated caudal vertebrae, beginning probably with the first, having a big transverse process. All presacral neural spines have at their upper end the axial length of the centrum; in the anterior cervicals these spines are very low; backward they slowly increase in height, in the dorsals they are rather high,

especially in the middle region. The zygapophyses are strong and are situated relatively high above the centrum. In contrast to the Nothosaurs these vertebrae have no zygosphen. In the cervicals both of the separated rib-articulations are on the middle part of the centrum and some even behind the middle, and not in the anterior part. The most anterior cervical ribs have the length of a vertebra, backward they very slowly increase in length. All cervical ribs, except the last one,

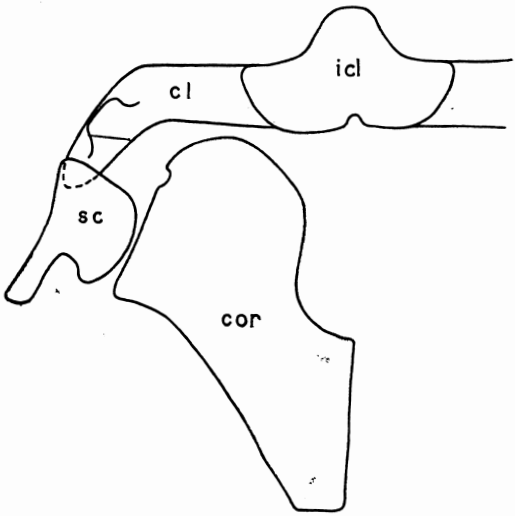

Fig. 3. Pectoral girdle. ¼ nat. size. Cl, clavicle; Cor. coracoid; Icl, interclavicle; Sc, scapula.

have a pointed anterior extremity in front of the forked articulation. The articular processes of the capitulum and tuberculum are relatively long and form nearly a right angle with the straight cervical rib. The dorsal ribs are single-headed; their length is increasing and from the eighth to the tenth, here they are longest and farther backward they diminish again; the last presacral ribs are short. The dorsal ribs are strongly curved; their transverse section is round to oblong. Only the anterior caudal vertebrae have transverse processes; their neural processes are narrow and not high. Haemapophyses (chevrons) are present. From the degree of diminishing of the 16 caudals it may be concluded that the complete tail had about the length of the dorsal region.

Of the shoulder girdle in the "Strunz skeleton" there is only a small scapula and both rather broad coracoids. The

scapula is not very different from that of *Nothosaurus* and the same is true of the coracoids. On the articular border the coracoid has an incisure, not a foramen; the symphyseal border is oblique. Clavicle and interclavicle are missing. But in the "Geissler skeleton" they are present. The clavicle is strong and thick and forms an angle. On the lateral half there is a high and narrow winglike process for the trapezoid muscle. The interclavicle has two thick, lateral wings and a broad and

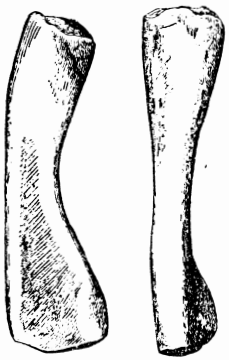

Fig. 4. Left humerus in a) anterior and b) radial view. ¼ nat. size.

blunt anterior process, so that the clavicles cannot form a symphysis. This interclavicle I can only compare with that of *Plesiosaurus mudgei* Cragin from the lower Cretaceous of Kansas (Williston S.W. 1903, Field Columbian Mus. 73, Geol. Ser., II, No. 1, Pl. 27, fig. 1). The "Geissler skeleton" may possibly represent another species of the same genus, because of little differences in the shape of scapula and coracoid.

Also the pelvis is quite different from that of the Nothosaurs. The ilium is a long strap bent backward, without anterior tip but with a thick acetabular part. Such isolated ilia are also in the Tübingen and the Strunz collections. The Nothosaur ilium is quite different, very short. The ischium in the "Strunz skeleton" is a more or less triangular plate. Of the pubis there is only an articular fragment. I am not sure whether a single bone of curious shape from the Bindlacher Berg near Bayreuth figured by H. v. Meyer (1. Pl. 42, 3) could be taken as a pubis of *Pistosauris*, otherwise it would be indeterminable.

Interesting are the long legs in the "Strunz skeleton." They are somewhat altered terrestrial limbs. Humerus and femur

are long, slender bones of more or less similar shape and of the same length. Lower arm and leg have about 2/3 of their length preserved. Radius and specially ulna are astonishingly broad, much broader than the distal extremity of the humerus. The carpals were displaced. Few very slender metacarpals are preserved, also a few dumbbell-shaped phalanges. A straight tibia and a curved fibula are only represented by their proximal halves, I suppose, they had the same relative length as the

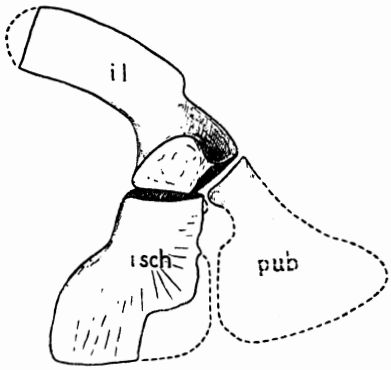

Fig. 5. Right pelvis in lateral view. ¼ nat. size. Isch, ischium; Il, ilium, Pub. pubis.

lower arm. In the reconstruction I have adopted a slight hyperphalangy. Few gastral elements are preserved too, a nearly straight middle element with small median anterior point, and several thin lateral pieces.

Fig. 6. Medial element of gastrals. ¼ nat. size.

So it was possible to make a reconstruction of this skeleton with the skull of *Pistosaurus*. It has the length of about 3 meters. There is no doubt, that it represents a primitive Plesiosaur, the same result is also given by the details of the skull. With exception of interclavicle and clavicle the whole skeleton is drawn from a single individual, the "Strunz skeleton"; the skull is drawn from *Pistosaurus longaevus*. It is possible that the "Strunz skeleton" is specifically different from the "Geissler skeleton" of which interclavicle and clavicle are taken, but both are Plesiosaurs, and so are both of the

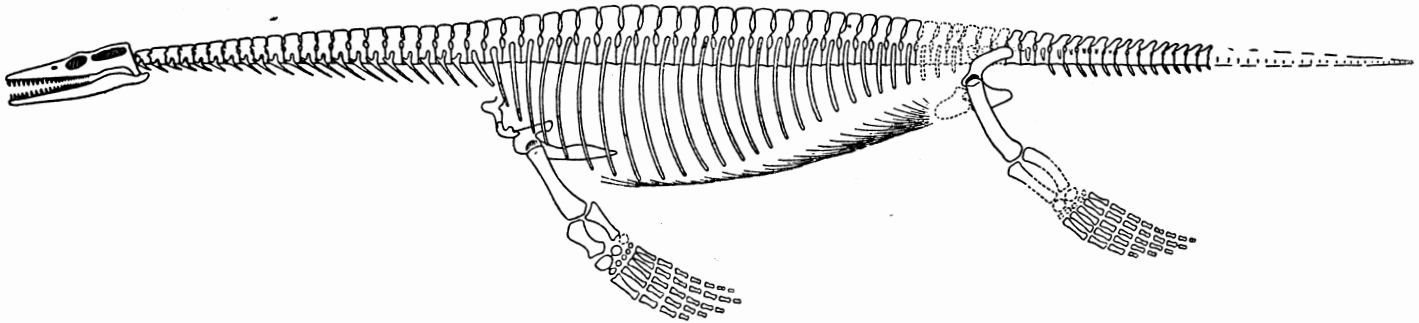

Fig. 7. Restoration of *Pistosaurus*. 1/16 nat. size.

described skulls. An eventual difference will be small. Therefore the reconstruction is a trustworthy *Pistosaurus*. Personally I rather think all of the skeleton is one and the same species. In the collections of Frankfurt, Tübingen and Bayreuth there are a number of single vertebrae and other skeletal bones of *Pistosaurs* from the same and other localities.

With the Cymathosaurids in the uppermost Bunter and in the lower Muschelkalk is the beginning of the Plesiosaurs contemporary with the different Nothosaurids. *Simosaurus* and *Corosaurus* are other Plesiosaurs also contemporary with *Pistosaurus*. Descendents of these Triassic lines of Plesiosaurs are the two great branches of Jurassic and Cretaceous Plesiosaurs. Two shorter early parallel sauropterygian stems to the Plesiosaurs are the Triassic Nothosaurids and Pachypleurosaurids; all of these together are forming the order Sauropterygia.

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