Ichthyosaur from Guizhou, China

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Abstract A new ichthyosaur is named and described on the basis of two well-preserved skeletons from the Late Triassic Wayao Member of Falang Formation, Guizhou Province, southwestern China. The specimens represent a longipinnate ichthyosaur with a set of characters transitional from the Triassic forms to the Jurassic forms. It is similar to shastasaurids of the Triassic in the relative size and shape of the limbs but resembles *Ophthalmosaurus* and *Baptanodon* of the Jurassic in the shape of the skull. The new taxon differs from all other ichthyosaurs found in China in its unusual large orbit, distinct rostrum, and the hind limbs, that are slightly stronger than the fore ones.

Keywords: Guizhou, Late Triassic, ichthyosauria.

THE Early Mesozoic ichthyosaurs are unbelievably rare in China when compared with the enormous Triassic marine deposits in the southwestern part of the country. During the past 30 years, a few ichthyosaurs have been collected in China and most of them are represented by either incomplete or poorly preserved materials[1—4]. Recently some new fossils of ancient marine reptiles including four nice specimens of ichthyosaurs were found in the Wayao Member of Falang Formation (Carnian) of Guizhou Province, southwestern China.

As a distinctive marine group of reptiles, ichthyosaurs are known from Mesozoic strata, ranging in age from Early Triassic Smithian[5,6] to the Upper Cretaceous Cenomanian[7]. It was hypothesized that ichthyosaurs may have undergone two major evolutionary radiations that took place separately during the Triassic and Jurassic[8]. However, recent findings from the Late Triassic of the Williston Lake, western Canada have suggested that the close of Triassic was probably not marked by a major turnover in ichthyosaurian species, instead, there was probably a more gradual period of transition, that may have lasted for most of the Late Triassic[9]. Therefore, any discovery of Late Triassic ichthyosaur fossil is sig-

nificant for our understanding of the ichthyosaur evolution and interrelationships within the lineage. The purpose of this note is to provide a preliminary study of the new ichthyosaurian.

1 Systematic paleontology

Class Reptilia Linnaeus, 1758

Order Ichthyosauria Blainville, 1835

Family *incertae sedis*

Genus *Qianichthyosaurus* gen. nov.

Etymology. Derived from "Qian", the abbreviation of Guizhou Province.

Type species. *Qianichthyosaurus zhoui* sp. nov.

Diagnosis. As for the type and only known species.

Qianichthyosaurus zhoui sp. nov. (figure 1).

Etymology. In honor of the late paleontologist Zhou Mingzhen (Chow Minchen).

Holotype IVPPV11839. A nearly complete skeleton.

Paratype IVPPV11838. A nearly complete skeleton.

Type locality and horizon. Huangtutang, Xinpu, Guanling County, Guizhou Province, southwestern China; Wayao Member of Falang Formation, Carnian of Late Triassic.

Diagnosis. A small to medium-sized longipinnate ichthyosaur differing from other taxa in the combination of the following characters : rostrum moderately elongated, not much slender but distinct from the cranium, and shorter than 1/2 length of the skull. Orbit greatly enlarged, circular in outline. Postorbital region much shortened. About 42 presacral vertebrae with elongated neural spines. Trunk region of the vertebral column greatly arched dorsally, while tail only slightly bent down distally. Hind limbs slightly stronger than fore ones. Narrow paddles consisting 4 digits with a phalangeal formula of about 13—15 (hand) or 5—8 (foot) phalanges polygonal or circular in configuration. Major limb bones somewhat more elongated than in Late Triassic forms, with gap between epipodial elements.

2 Description

The holotype V11839 is exposed in right lateral aspect. The skeleton is preserved in articulation with only few vertebrae broken and anterior part of both fore and hind paddles missing. The paratype V11838 is preserved in the same way as the holotype, but its neck had obviously been twisted so that the skull can not be seen and the mandible is exposed ventrally. V11839 is 121cm long while V 11838 is longer, 160 cm. These two specimens belong to one species because the shape of their limbs is same. As suggested by the preservation of the materials before any preparation, the description is based on the skull of the holotype and the postcranial skeleton of the paratype, respectively.

Skull. On the whole, the shape of the cranium of holotype shows the typical ichthyosaurian form. It has distinct rostrum, short temporal region and strongly enlarged orbit. The teeth are cone-shaped (table 1).

Table 1 The measurement of skull (in cm)

Skull length	24
Orbit length	8.3
Orbit height	7.3
Postorbital region length	1.5
Rostrum length	13
The largest height of skull	8.5

Vertebral column and ribs. A string of 97 vertebrae in articulation are well preserved in right lateral view in V11838. Among them there are about 42 presacrals. The missing part of the specimen indicates that the total number of vertebrae must be more than 100. The cervical region is not differentiated. From the beginning of the column to the position of hind limb, there is a obvious upward arch that is more developed than any other known ichthyouaurs. On the contrary, the tail only slightly decurved. All cen-

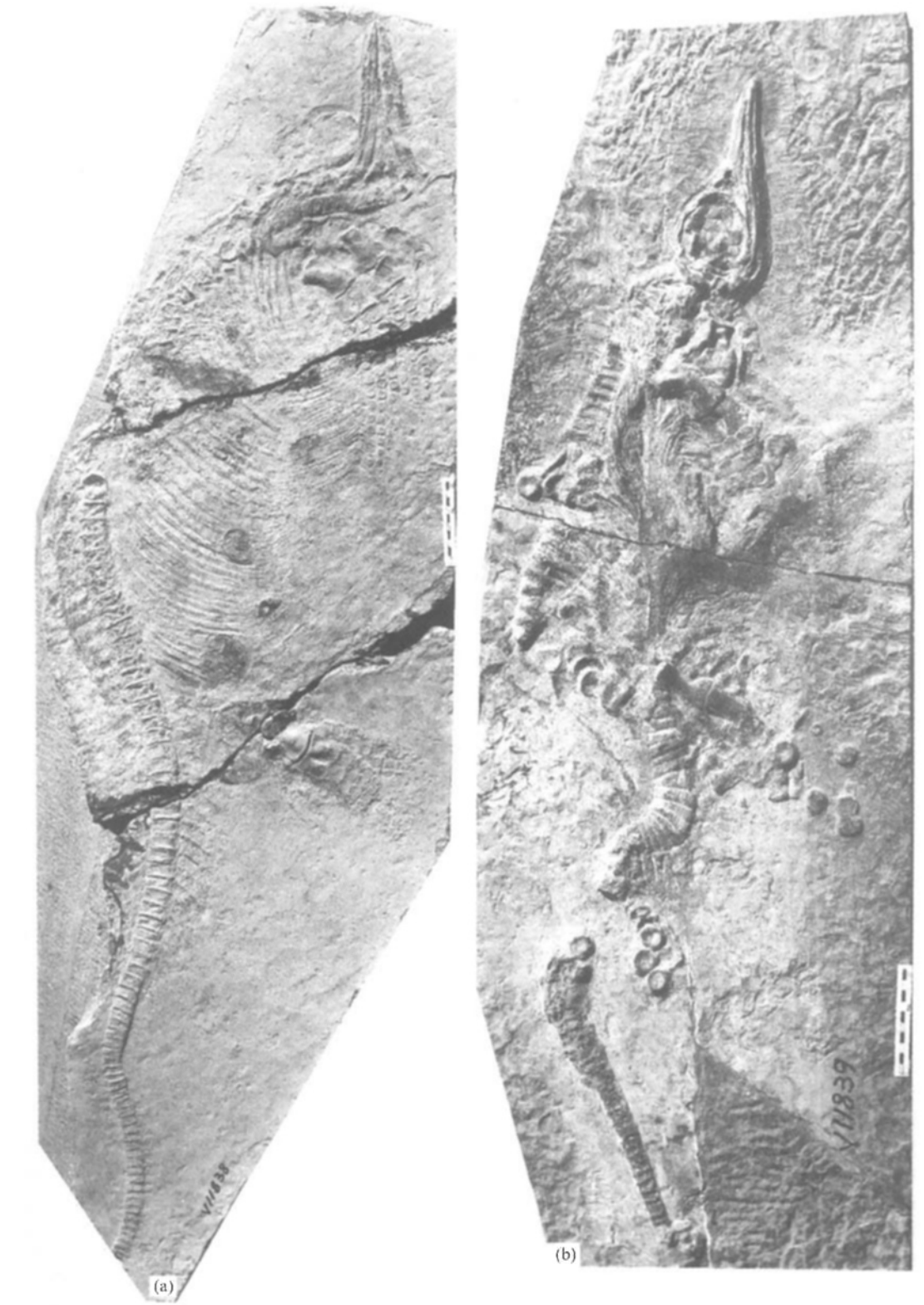

Fig. 1. *Qianichthyosaurus zhoui* Li gen. et. sp. nov (IVPPV11838, paratype (a), LVPPV11839, holotype (b)) lateral view. Scale bar: 10 cm.

trums are similar in shape, higher than long, and deeply amphicoelous. The neural spines are elongated and can be seen clearly in posterior dorsal vertebrae (and anterior dorsal vertebrae of V11839). There is a double rib articulation: a subcircular parapophysial area for capitulum articulation is anteriorly located halfway down the centrum and above this is a second facet for the tuberculum——diapophysis, which is smaller than the first one. It seems that one facet (possibly parapophysis) disappears posteriorly through the caudal.

The ribs in the trunk region are quite long and decurved postward, until to the point where hind limbs exist. The following ones decrease in length sharply and diminish passing back along the remaining part of the column, at last to terminate with small ribs in the proximal caudal region. A series of gastralia are well developed in the belly, between fore and hind limbs. As in many aquatic reptiles, the gastralia are slender and spindle-like, but seem much longer than in other ichthyosaurs.

Pectoral girdle and forelimb. Compared with most ichthyosaurs, the scapula is small, shorter and thinner than humerus. It moderately expands at its anterior end. The outer part of the coracoid is exposed, semi-circular in shape. It is a broad plate that articulates with the scapular. Two fore paddles are both preserved in lateral view and look very slender. The humerus show the tendency to become shortened and flattened but still longer than wide and not so massive as that of the Jurassic types. The ulna and radius are equal in length, about 1/2 length of the humerus, but the ulna is obviously thinner than the radius. Both two outer margins of ulna and radius are smooth while those of inner ones obviously concaved, so that a large gap between radius and ulna is present like the condition in *Merriamia*. The ratio between length and width of both bones are similar to that of humerus, which still remain some semblance of their original shape. Compared with other post-Triassic forms, these three major limb bones are somewhat more elongated. The distal end of ulna and radius has 2 and 1 articular facets for the ulnare, intermedium, and radiale respectively. The three carpals are all square in shape, with distinct radiate stripe on its surface and a small notch on anterior margin of radiale. Most metacarpus were missing, based on size of the lost two, the total number of these bones should be no more than four. There are no differentiation in shape between metacarpus and digits, all of them are circular in outline. The left forelimb is relatively complete, four digits with about 13—15 phalanges can be distinguished.

Hind limbs. The hind limb is slightly stronger than the fore limb. The most notable difference in structure to the femur being the larger extent to which the distal end is expanded and there is almost no expansion in proximal end. Fibula and tibia are very similar to the ulna and radius in most respects and articulate with one another by their inner surface, being separated in the middle by a foramen. Their surfaces for union with the femur are smooth. Distally the fibula bears a convex facet for union with the unpreserved fibulare and intermedium, which is hexagon in shape, while the tibia joins the intermedium and quadrilateral tibiale by facet of about "S" shaped. Three metatarsals are identified and the total number can not be counted until further prepared. These bones are indifferent in shape from the digits, which are most quadrilateral, and only the six phalanges distally are circular in shape. In the better preserved right paddle, the number of the phalanges in the digits from the first to the fourth is 5,7,8,7, respectively.

3 Discussion

All known ichthyosaurs in China[1—4] are from Triassic but they are quite different from *Qianichthyosaurus zhoui*. *Chensaurus chaoxianensis*, which is found in Anhui Province, differs from *Q. zhoui* in having an eel-like shape of the body with the tail not bending downward and the vertebrae longer than high. *Chaohusaurus geishanensis is* distinguished from *Q. zhoui* in its fore paddle shape, the former is more primitive and looks larger in relation to the body size. Another ichthyosaur in Guizhou Province——Mixosaurus maotaiensis is represent by few fragmentary bones, it is much smaller than *Q. zhoui* and has single-headed ribs. The large shastasaurid——*Himalayosaurus tibetensis* that is about 10 meters in length is too poor to be compared.

The general skull morphology of *Qianichthyosaurus zhoui* is quite like that of the Jurassic type such as *Ophthalmosaurus* and *Baptanodon*, which have relatively more distinct rostrum and larger orbit[10]. Furthermore, the double-headed rib indicated by the two articulate facets on the centrum is mainly the

character of Jurassic types[8]. Like some post-Triassic forms, *Qianichthyosaurus zhoui* combined primitive and advanced traits in limb structure, the humerus, radius, ulna and corresponding three bones in hind limbs show the tendency to become shortened and flattened but still retain the primitive elongated condition[11]. The shape of these three bones is mostly like that of the late-Triassic *Merriamias* (Family: Shastasauridae) that also have small notch on outer margin of the digits. Other elements of the paddle that are quadrilateral and hexagonal to circular in shape suggest this part of paddle goes further in adaptation to aquatic life than the three main bones maintained above. Obviously, the tail bent down distally more distinct than in the Triassic forms but not so sharply as that of the Jurassic Ichthyosaurids, such as *Ophthalmosaurus*. Three characters have been never seen in other ichthyosaurs, firstly the vertebral column has a great arch upward which is most developed compared with any others; secondly, the three main bones of the hind limb are slightly stronger than those of the forelimb; and lastly, in ratio to the cranium, the *Qianichthyosaurus zhoui* has proportionally the largest orbit in the Order Ichthyosauria. In summary, our new specimen seems to be a good example that represents the transitional stage from Triassic form to Jurassic form. Before the fossils can be fully prepared, it is better not to give definite referral to a family.

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