

**A New Pterosaur from the Middle Jurassic  
of Dashanpu, Zigong, Sichuan**

by

Xinlu He  
(Chengdu College of Geology)

Daihuan Yang  
(Chungking Natural History Museum, Sichuan Province)

Chunkang Su  
(Zigong Historical Museum of the Salt Industry)

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Translated by Will Downs  
Department of Geology  
Bilby Research Center  
Northern Arizona University  
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## Introduction

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## Specimen Description

### Order Rhamphorhynchoidea Pdienger, 1901

### Family Rhamphorhynchidae Seeley, 1870

### *Angustinaripteria* (subf. nov.)

**Subfamily diagnosis:** Skull low and particularly elongated. Greatest height of the skull is approximately one-quarter of its length. Oral region relatively blunt. Antorbital fenestra large and long. Nares narrow and long, forming a crevasse-like feature. Orbits, preorbital fenestrae, and nares are mutually and completely separated, and not confluent.

### *Angustinaripterus* (gen. nov.)

**Genus etymology:** Derived from the particularly elongate nares that are clearly distinct from other genera.

**Genus diagnosis:** As for species.

### *Angustinaripterus longicephalus* (sp. nov.)

(Fig. 1, Plate I)

**Type:** A single incomplete skull. Specimen number T8001.

**Species etymology:** Reference to the exceptionally low and long skull.

**Diagnosis:** Low and long skull with a relatively blunt oral region. Cranial bones are completely fused. Quadrate is narrow with its distal end anteroventrally inclined. Orbits large and circular. Lateral temporal fenestra is large and tapers gradually ventrally. Antorbital fenestra is long, large, and nearly triangular in shape. Nares are narrow and long, forming a fissure-like structure. The depth of the nares is consistent from the anterior to the posterior end. The preorbital fenestrae and nares are completely separated from the orbits and preorbital fenestrae. A long and low vertical crest runs along the dorsal aspect of the cranium from its most anterior margin to at least above the orbits. The mandible is straight, narrow, and long, with a straight ventral margin, and displays an anterior margin that increases slightly in depth. The maxilla maintains nine teeth, among which three are long slender anterior teeth that are noticeably anteriorly inclined; the remaining six are relatively short and stocky teeth. They are arranged from the very anterior margin and run posteriorly to terminate at a point one-third the distance from the anterior margin of the antorbital fenestra. The mandible may maintain 9-10 teeth, with the anterior teeth

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being long and slender, and the central and posterior teeth short and stocky, or relatively blunt. The crowns of the dentition are all polished or unstriated.

**Stratigraphy and geographic distribution:** To date this taxon is only known from the village of Dashanpu, 11 km northeast of the outskirts of Zigong, Sichuan Province. It was derived from the middle of the lower member of the Jurassic Shaximiao Formation.

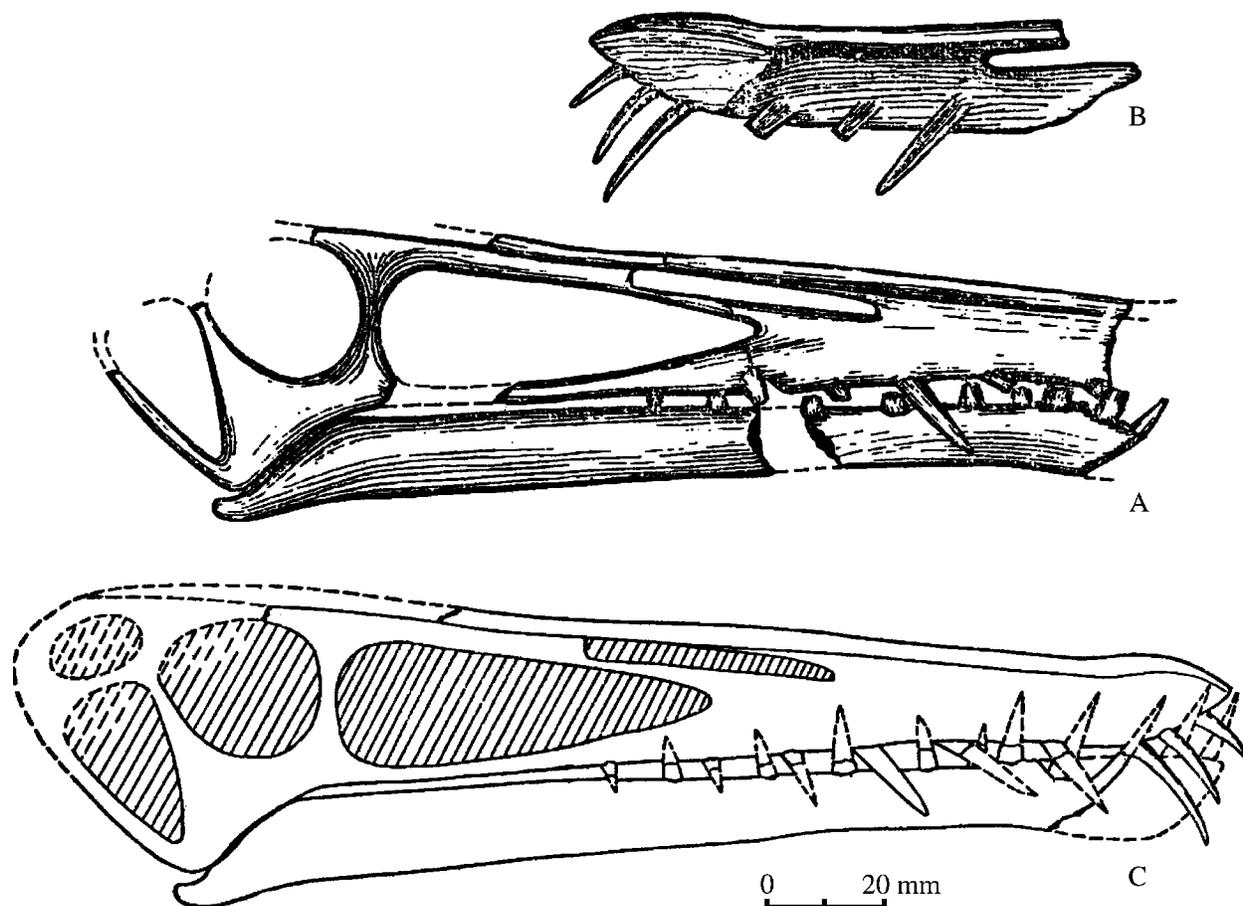
**Material:** A composite specimen with only the skull and associated mandible found. The right side of the specimen is relatively well preserved, but the left side is extremely poor. The posterodorsal section of the cranium is damaged, lacking the parietal and squamosal, the dorsal portion of the temporal is completely obscured, and the dorsal portions of the orbit and lateral temporal fenestra are damaged. Additionally, the anterior portion of the right side is damaged but this same section on the left side is still well preserved. The preservation of each side complements the other, facilitating a relatively accurate reconstruction of the morphology and size of the anterior portion of the skull. The anterior portion of the mandible is absent, but it is estimated that there were one or two teeth present. Although the central portion of the mandible is absent, its position is determinable such that the absence of this section does not influence the comprehension of its dimensions and characteristics.

### Description

The skull is low and long with a glossy surface texture and lacks any noticeable striated ornamentation. The dorsal aspect of the cranium inclines very gradually ventrally posteroanteriorly. All the osteological cranial elements have been fused, such that the suture lines are nearly completely unobservable; hence, it is only possible to resolve the presence of these elements according to their relative positions. A single long and low crest directly traverses the dorsal aspect of the skull from the most anterior end of the maxilla to the most posterior end. The height of this crest remains relatively constant, with a variation within 2-3 mm. Due to the damage of the specimen, the detailed morphology of its extension onto the dorsal aspect of the parietal and posterior section of the cranium is absent. This type of crest differs from those on other pterosaur taxa which display crests ascending noticeably from the tops of their cranium to form a crown. The Dashanpu specimen, however, is extraordinarily low and may traverse the entire length of the skull. What this morphology symbolizes regarding the living activity of this animal is not clear as a crown or crest of this fashion has definitely not been observed before.

The lateral side of the quadrate is narrow but the medial side is broad, although the length of both sides are equivalent. The ventral end is clearly inclined anteroventrally where it articulates at a low position with the mandible, or at a point just slightly above the ventral margin of the mandible. The anterior end of the jugal is damaged. The ventral aspect of the coronoid process is broad but abruptly narrows dorsally. The suture between the quadrate and jugal is unclear. The squamosal, parietal, and postorbital are absent due to the damage on the posterodorsal section of the skull. The nature of the supratemporal fenestra is also indeterminate. The cranial section above the orbit, antorbital fenestra, and nares is exceptionally narrow and long. It is postulated that the frontal, nasal, and posterior end of the premaxilla overlying this narrow space are also narrow and long. The suture lines between these elements are not clear. The anterior end of the premaxilla is noticeably broadened, relatively blunt, and partially resembles the morphology of *Scaphognathus*. The maxilla is relatively low and particularly elongated. It is estimated that its entire length is approximately equivalent to, or slightly exceeds one-half the length of the entire skull. The highest point of the maxilla lies at the anterior margin of the antorbital fenestra. The lateral temporal fenestra is large, but its dorsal end is missing. Its outline is triangular in shape with a broad dorsal margin, and narrow ventral margin. Its ventral margin lies lower than the ventral margin of the orbit. The orbital outline is nearly circular, but its length is slightly greater than its height. The antorbital fenestra is large and long, completely separated from the orbit, displays a ventral margin that lies slightly lower than the orbit, and has a perfectly round posterior margin. It gradually

tapers to a point posteroanteriorly. The greatest height of the antorbital fenestra slightly exceeds one-third its length. The nares are particularly inclined and long, forming a fissure-shaped feature that lies just anterior to the center of the skull. This clearly differs from other pterosaur nares. The greatest height of the nares slightly exceeds one-tenth their length. The nares and antorbital fenestra are quite distinctly separated.



**Figure 1.** A. Right lateral view of the skull of *Angustinaripterus longicephalus* (gen. et sp. nov.) T8001. B. Left lateral view of the anterior end of the maxilla from the same specimen. C. Reconstruction of skull. Figures are all 9/10 actual size.

The anterior end of the dentary is absent, as is a small section at the center of the mandible. The suture lines of every element of the mandible are completely indistinguishable. The surface texture of the bone is glossy. The entire mandible is relatively straight, long, and slender, with straight dorsal and ventral margins. Only at the anteroventral end is there a tendency for very slight ventral curvature. The mandible is relatively narrow at its center, but increases slightly in depth both anteriorly and posteriorly. A shallow groove is present at the posterodorsal margin of the mandible (this is not a suture line). The top of the coronoid process is not clearly visible. As the anterior end of the mandible has a tendency to increase in height, as opposed to a decrease or tendency to become thinner, it is thereby conjectured that the anterior end resembles that of the maxilla, being relatively blunt.

## Cranial and mandible measurements:

Preserved length of skull (traversing the center of the orbit) .....	192.0 mm
Estimated length of skull.....	201.0 mm
Inferred height of the posterior end of the cranium.....	50.0 mm
Height of lateral temporal fenestra.....	24+ mm
Breadth of lateral temporal fenestra.....	13+ mm
Anteroposterior length of orbit.....	28.0 mm
Dorsoventral height of orbit .....	24.5 mm
Length of antorbital fenestra.....	63.5 mm
Greatest height of antorbital fenestra .....	24.0 mm
Length of nares.....	42.5 mm
Greatest height of nares.....	4.5 mm
Length of mandible preserved.....	155.0 mm
Estimated total length of mandible.....	175.0 mm
Smallest height of mandible .....	10.5 mm
Greatest anterior height of mandible.....	14.0 mm
Greatest posterior height of mandible .....	13.0 mm
Breadth between left and right mandibles at most posterior tooth.....	22.7 mm

The dentition is relatively well preserved, although a majority of the tooth crowns have been broken off. Both the maxillary and mandibular tooth rows are relatively long. The maxillary tooth row extends from the most anterior end of the maxilla posteriorly to a point one-third of the distance beneath the antorbital fenestra. The most posterior tooth on the mandible is situated beneath the anterior margin of the antorbital fenestra, or slightly more anterior than the posterior maxillary tooth. Dental formula is present as  $\frac{9}{9-10}$ . Both the upper and lower dentition possess a glossy surface texture, lack striated ornamentation, and are all flattened conically. There are, however, very weak discrepancies between the dentition; that is to say, the three anterior maxillary teeth are long and gracile, nearly elliptical in cross section, and form sharp cones. The remaining six maxillary teeth are laterally compressed, and relatively short and stocky, or rather like blunted cones. The three most anterior teeth on the maxilla are inferred to be premaxillary dentition, with the remaining six being maxillary dentition. As stated previously, the anterior end of the mandible is lost, but the most anterior tooth preserved on it corresponds to the third maxillary tooth. It is thought that at least one tooth was present on the missing section, and possibly two (dental measurements later in the text estimate the presence of two teeth). The morphology of the first tooth preserved at the anterior end of the mandible resembles that of the third tooth on the maxilla. The teeth at the center and anterior end of the maxilla in addition to the teeth at the anterior end of the mandible are strongly inclined anteriorly. The teeth at the middle and posterior ends of the mandible are vertical or inclined slightly posteriorly.

## Dental measurements (mm):

Maxilla length 104.0

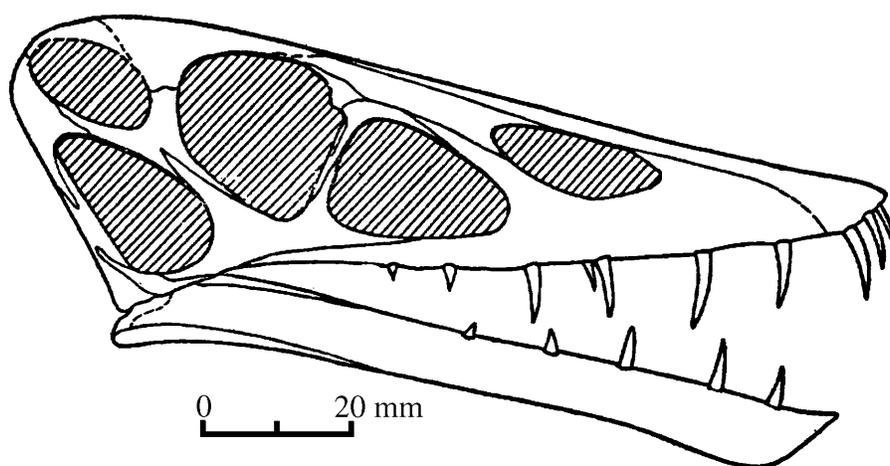
Mandible length 76+

	1	2	3	4	5	6	7	8	9	10
Greatest breadth of maxillary tooth	2.5	2.4	2.4	4.3	3.0	4.2	3.4	2.8	2.8	-
Greatest breadth of mandible tooth	-	-	-	4.0	5.3	3.25	3.25	3.6	3.6	3.9

Note: 1. Dental sequence is calculated anteroposteriorly. 2. Three anterior mandible teeth are missing.

## Phylogenetic Status

Two suborders exist within the order Pterosauria: the Rhamphorhynchoidea and the Pterodactyloidea. Because the posterior cranium of *Angustinaripterus* from Dashanpu is missing, comparisons may only be conducted on the basis of the anterior skull and dentition. Characters of this taxon that approach the suborder Pterodactyloidea include the long and low skull, and the complete fusion of all the cranial bones. However, *Angustinaripterus* shares many characters with the order Rhamphorhynchoidea, including the complete separation of the antorbital fenestra from the orbit, the distinct demarcation of the nares, the completely separated antorbital fenestra, and the anteroventral inclination of the quadrate at an angle larger than  $45^\circ$ , or a degree of ventral inclination which is lower than the pterodactyloids. Additional characters uniting the Dashanpu specimen with the rhamphorhynchoids include the dentition extended to posterior positions on the skull, or the long tooth rows on the maxilla and dentary extending over three-quarters the length of the maxilla and estimated to extend to one-half the length of the dentary or possibly further. Moreover the discrepancy of size among the teeth themselves, with the anterior teeth slightly different than the teeth at the center section, is a rhamphorhynchoid character. Pterodactyloid characters contrast clearly by the confluence of the nares with the antorbital fenestra, the antorbital fenestra occasionally partially confluent with the orbit, short dentition on the maxilla and dentary, isodont dentition, or a beak to the point of occasionally becoming edentulous, and the quadrate being strongly ventrally inclined. *Angustinaripterus* is thereby assigned to the family Rhamphorhynchidae, and due to many shared characters approaches very closely the subfamily Scaphognathinae. But careful consideration of the extensive distance separating the localities of the scaphognathids in Europe from the angustinaripterid from Zigong, Dashanpu, in addition to characters isolating it from all other families and subfamilies such as the exceptionally low skull, the complete fusion of the cranial elements, the long and narrow nares that form a fissure, and the elongated antorbital foramen, warrants the erection of the new subfamily the Angustinaripterinae. The subfamily Scaphognathinae is relatively close with the possession of a large antorbital fenestra, long, gracile, and straight mandible, and the dental morphology, tooth count, and manner of opposition, particularly on the maxilla. Distinctions of the new subfamily include the even lower and longer skull, the higher degree of osteological fusion, the specialized nares, the more elongated antorbital fenestra, and the dorsally narrowed, ventrally broadened lateral temporal fenestra. The new subfamily is particularly distinguished from the Rhamphorhynchinae by the latter's sharp and thin oral region, the small antorbital fenestra, and many other features.



**Figure 2.** The skull of *Scaphognathus crassirostris* (Golfuss) from Wellnhofer (1975) for comparison with *Angustinaripterus longicephalus*.

Pterosaur remains in China have been predominantly produced from the north and northwest sections of the country with former material described by C.C. Young from Shandong Province and Inner Mongolia. Later material, studied by Zhiming Dong and C.C. Young was derived from the Gansu Province-Xinjiang Autonomous Region, with an age assignment of Late Jurassic to Early Cretaceous. Prior publications describe Pterodactyloidea, including *Dsungaripterus weii* Young 1964, *Noriopterus complicidens* Young 1973, and *Huanhepterus qingyangensis* Dong 1982. The former two taxa were produced from the Early Cretaceous Urho region of the northwestern Jungar Basin, Xinjiang. The latter was produced from the Upper Jurassic of Qingyang County, Kansu. Reports of pterosaurs from South China, and particularly from the Middle Jurassic, have been absent. The discovery of the pterosaur from Dashanpu, Zigong, fills a vacancy among Chinese pterosaurs and is an undoubted contribution to pterosaur phylogeny, geographic distribution, and biostratigraphy. Hence, it is of some significance. It is regrettable the material is depauperate, consisting merely of a single incomplete skull. Whether more pterosaur families may be established must await the completion of excavations and arrangement of material from Dashanpu. *Angustinaripterus* from Zigong, Dashanpu, represents a different order from *Dsungaripterus* and *Noriopterus* from the Jungar Basin of Xinjiang. Their discrepancies are multifaceted, as exemplified by *Dsungaripterus* characters including confluent nares, a short and gracile oral region, short maxillary and dentary dentitions, and a crown-shaped crest on the top of its cranium. The Dashanpu specimen may be compared to *Huanhepterus*, but the latter displays a particularly elongated and gracile oral region, an even more well-developed crest on its skull, and a particularly notable dentition, which is restricted to the anterior oral region, and consists of thin, long, and closely associated teeth. Both the mandible and maxilla possess up to 25-26 individual teeth. More detailed comparisons are unnecessary due to these extreme differences from the Dashanpu specimen.

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