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记新疆准噶尔盆地中侏罗世一新甲龙

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关键词 甲龙科 (Ankylosauridae) 中侏罗世 新疆准噶尔盆地

摘 要

一小的甲龙,作为甲龙科 (Ankylosauridae) 中一新属新种,明星天池龙 (*Tianchisaurus nedegoapeferima* gen. et sp. nov.) 被记述。化石是1974年,新疆大学地质地理系的师生在新疆阜康县三工河地区作野外实习时采得,其产地的地层层位经新疆石油管理局东疆石油指挥部彭希龄核对为中侏罗世头顿河组。化石包括破的头骨碎片,五个颈椎,六个背椎,一个完整荐部(由七个椎体组成),三个尾椎,和许多膜质的甲胄,甲板,以及一些四肢骨。标本编号:V.10614. 新属新种的特征是:一个小的,原始的,体长约三米的甲龙;头骨较高,有小的膜质的甲片复盖;下颚高,外侧无甲片复盖,有纵的饰纹,环椎与枢椎不愈合;颈椎椎体短,双凹型;背椎椎体较长,双平型,横突与背肋不愈合;荐部由七个愈合脊椎组成:前两个是背椎,形成一个荐前棒 (presacral rod),最后的一个是尾椎,四个荐椎的椎体是整个椎柱中最大的,荐椎的神经棘愈合,形成一个纵的板状脊,远端的尾椎愈合形成小的,扁的尾锤。股骨直,骨干上有饰纹,第四转子呈嵴状。蹠骨和趾骨为甲龙型,与晚期甲龙的蹠骨和趾骨比较显得瘦小。在肩部有一个由四对大的膜质的甲板愈合形成肩甲带,甲板厚有发育的中嵴。在身体覆盖着许多大小不同,形状各异的甲片。*Tianchisaurus nedegoapeferima* 的种名是应著名科幻电影导演 Steven Spielberg 之约请赠送给大型科幻电影片-侏罗纪公园之明星们:Sam Naill, Laura Dern, Jeff Goldblum, Richard Attenborough, Bob Peck 和 Martin Ferraro. 我们称之明星天池龙(*Tianchisaurus nedegoapeferima* gen. et sp. nov.)。*Tianchisaurus nedegoapeferima* 是目前甲龙亚目在亚洲的最早纪录。它的发现将甲龙的化石记录推到中侏罗世。

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AN ANKYLOSAUR (ORNITHISCHIAN DINOSAUR) FROM THE MIDDLE JURASSIC OF THE JUNGGAR BASIN, CHINA

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Abstract

A small and primitive ankylosaur, described as a new genus and species *Tianchiasaurus nedegoapeferima*, was collected from the Middle Jurassic Toutunhe Formation of the Sangonghe Valley of Fukang County, Xinjiang. The locality is near the famous Tianchi (Heavenly Lake) of the Tianshan Mountains. This is the first ankylosaur discovered in the Middle Jurassic of Central Asia.

Introduction

Ankylosaurs are a group of heavily armoured ornithischian dinosaurs that are best known in Asia, North America and Europe. Most paleontologists(Coombs 1978,

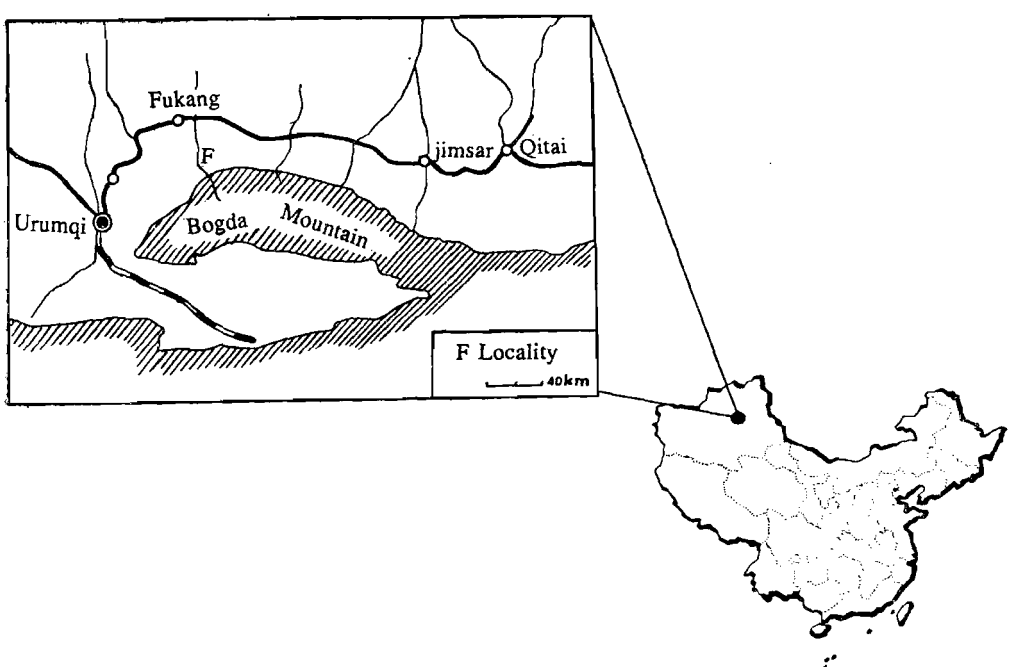

Fig. 1. Map of Xinjiang, northwestern China showing the locality of *Tianchiasaurus nedegoapeferima* gen. et sp. nov in the Sangonghe Valley.

图 1 明星天池龙 (*Tianchisaurus nedegoapeferima* gen. et sp. nov.) 的产地位置图。

Maryanska 1977, Ostrom 1970, Steel 1969) believed that the fossil record of ankylosaurs was restricted to the Cretaceous, but Galton (1983) described several specimens of armoured dinosaurs from the Middle (Callovian) and Upper Jurassic (Oxfordian, Kimmeridgian, Portlandian) of Europe. The new material from Xinjiang represents the first ankylosaur from the Middle Jurassic of Asia.

The specimen was collected in 1974 by students doing fieldwork training with the Geological Department of Xinjiang University. It was sent to the Institute of Vertebrate Paleontology and Palaeoanthropology (IVPP) for identification in 1976.

Fragments of the skull, five cervical, six dorsal, seven associated sacral (including two dorsosacrals and one caudosacral) and three caudal vertebrae, fragmentary limbs and many scutes were collected with some unidentified ankylosaur elements. Two teeth, several limb bones and two claws of a theropod (Plate 4) were recovered from same quarry.

This new form, although consisting of only a portion of the trunk with incomplete limbs and scutes, is the most complete Middle Jurassic ankylosaur known. In addition to its taxonomic significance, this specimen is the first to show the presence of ankylosaurs in the Middle Jurassic of central Asia. The early presence of ankylosaurian remains on the Euro-Asian continent suggests they evolved in this region, possibly from a small armoured ornithopod of the Early Jurassic(Colbert 1981).

Systematic palaeontology

Ornithischia Seeley

Ankylosauria Osborn, 1923

Ankylosauridae Brown, 1908

Tianchiasaurus gen. nov.

Type species *Tianchiasaurus nedegoapeferima* sp. nov.

Etymology The generic name is derived from "Tianchi", which is pinyin Chinese meaning the Heavenly Pool (Tian = heaven, Chi = pool or lake), and is a famous lake in the Tian Shan Mountains. The specimen was discovered near the lake. The specific name (*nedegoapeferima*) is for the stars of the 1993 film "Jurassic Park", Sam Neill, Laura Dern, Jeff Goldblum, Richard Attenborough, Bob Peck, Martin Ferraro, Ariana Richards and Joey Mazello. It was constructed from the first one or two letters of the family names.

Holotype IVPP V 10614, fragments of a skull; five cervical, six dorsal, seven sacral, and three caudal vertebrae; some limb bone fragments; many scutes; fragmentary unidentified elements. All bones belong to one individual.

Associated specimens Two teeth and several limb bones recovered from the same site have been referred to as a megalosaurid.

Locality and Age The holotype was recovered from the Sangonghe Valley (Fukang County, Xinjiang, China) on the north slope of Bogda Feng (the summit of which is 5,445 m above sea level) of the Tian Shan (mountains), near the fam-

ous lake known as Tianchi (Fig. 1). The site is 35 km northwest of Urumqi, the capital of Xinjiang. All the remains described in this paper were discovered in sandstone in a single quarry in the upper part of the Toutunhe Formation. This formation is exposed mainly on the north slopes of the Tian Shan Mountains and in the southern part of the Junggar Basin. It is about 245 to 620 m thick, and consists of gray-yellow and purplish red, fine to medium sandstones with gray-green siltstones and mud. There are 36 to 60 m of calcareous sandstones and conglomerates at the base of the formation (Wang et al.1985). The fluviolacustrine facies of the Toutunhe Formation have generally been considered as Middle Jurassic because of the ostracods (*Trimiraisevia catenularia*, *Darwinula impudica*, and *D. sarytimenensis*), molluscs (*Margaritifera isfarensia*, *Psilumio manasensis*, *P. globitriangularis*) and plants (*Coniopteris hymenophylloides*, *Equisetites ferganensis*, and *Cladophlebis* sp.). The Toutunhe Formation is estimated to be the same age as the Wucaiwan Formation, which is exposed in the northeastern part of the Junggar Basin, and yields the small sauropod *Bellusaurus* (Dong 1992) and the theropod *Monolophosaurus* (Zhao and Currie, 1993 in press).

Diagnosis A primitive, small (up to 3 meters long) ankylosaur with well developed armour in the shoulder region and many small scutes in the thorax. Skull relatively heavy, and a little wider than that of *Scelidosaurus*. Mandible thinner than in other known ankylosaurs, but similar to those of stegosaurs. Intercentrum and arch of atlas not co-ossified with ribs. Dorsal vertebrae amphiplatyan, and primitive for an ankylosaur. Dorsal centra and ribs not co-ossified. Sacrum consists of seven vertebrae, including two clear dorsosacrals and one caudosacral. Small, flat tail club. Fourth trochanter of femur long and prominent. Metatarsals (I-IV) rather primitive for an ankylosaur.

Description Only two cranial fragments were recovered, the largest of which is thick and heavy with many small co-ossified dermal scutes (plate 1A). It is probably represents the prefrontal and frontal region. The other fragment is a hemispherical occipital condyle with a short neck, and is formed by parts of the basioccipital and exoccipitals (Plate 1B).

The fragmentary right mandible includes parts of the coronoid, angular and articular (Plate 1C). The lateral surface is prominently sculptured by irregular, shallow depressions. The coronoid process was broken and lost. Overall, the mandible is relatively thinner and weaker than those of Cretaceous ankylosaurs, and is proportionally closer to those of stegosaurs, even though it lacks the mandibular foramen.

The complete vertebral count is not known. Of the seven or eight segments of an ankylosaur neck (Coombs and Maryanska 1990), four cervical centra are preserved. The neural arches were lost to erosion, but the characters of the centra and parapophyses suggest they are the axis, third, fifth and seventh cervicals.

It is evident that the atlantal intercentrum and arch were free from the axis as in some primitive ankylosaurs (Ostrom 1970). The moderately-sized, round odontoid of the atlas is fused to the axis. The upper surface has a wide and deep longitudinal concavity, but the ventral surface is convex. In anterior aspect the odontoid is

hemispherical. The axial centrum has a keel on its ventral surface. The third cervical was relatively small with a short, wide centrum. Its length and width are subequal, and there is a small ventral keel. The neural canal is large. The parapophyses are short and distinctly dorso-anteriorly directed. The fifth and seventh cervicals differ very little from the third in general structure. Their centra are strongly biconcave, are invaded by the large deep neural canal, and have well developed ventral keels.

Six dorsal vertebrae are preserved, but some have lost their neural spines and/or arches. Three of the vertebrae were found in articulation. The ribs are not fused to the centra. The positions of the parapophyses suggest the first, third, sixth, and ninth to eleventh dorsals are represented. All dorsal centra are long and amphiplatyan, and lack notocordal knobs and pleurocoels. They are laterally and ventrally constricted, with expanded subcircular articular facets. Slight lateral depressions are found in the middle of the centra. The eleventh dorsal has its neural arch, with its complete prezygapophyses forming a single U-shaped articulation as in most ankylosaurs. The neural arch and canal are low.

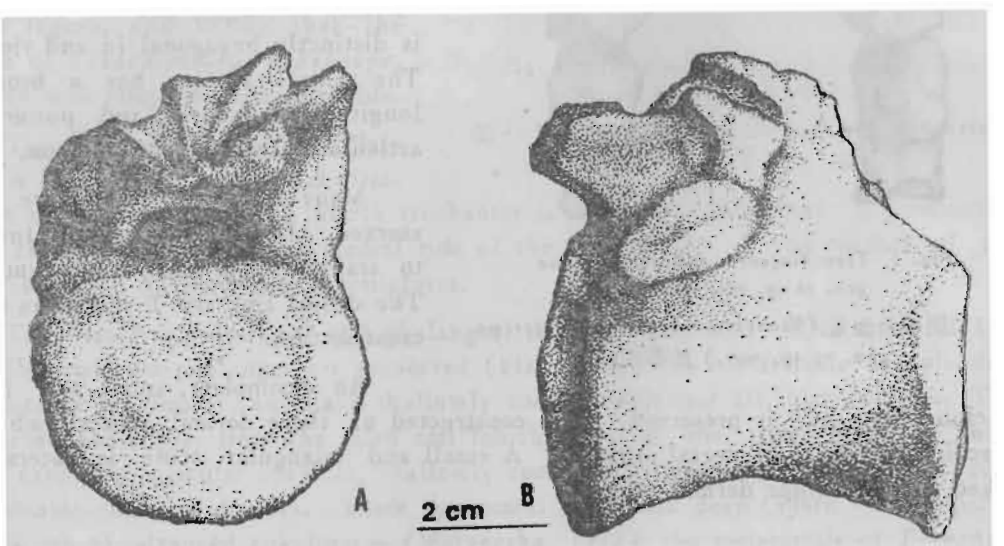

Fig. 2. *Tianchiasaurus nedegoapeferima* gen. et sp. nov. Dorsal.

图 2　明星天池龙（*Tianchisaurus nedegoapeferima* gen. et sp. nov.）的背椎。

The sacrum is composed of seven coossified vertebrae (Fig. 3). The first two vertebrae are dorsosacrals, and form a presacral rod (Ostrom 1970, Coombs 1978). The last one is a caudosacral. The sacral count corresponds with *Sauropelta edwardsi* (Ostrom 1970), although in this genus there seems to be one more dorsosacral instead of the caudosacral.

The four true sacrals of *Tianchiasaurus* have low and broad centra, each of which is expanded at both ends and relatively narrow in the middle. The ventral surfaces of these four centra have a shallow and broad groove. The low neural spines are fused together. The transverse processes are horizontal and directed poste-

rolaterally, presumably to contact the postacetabular region of the ilium. The back surface of the sacrum is covered by a pavement of small dermal ossicles, which apparently also covered the pelvis.

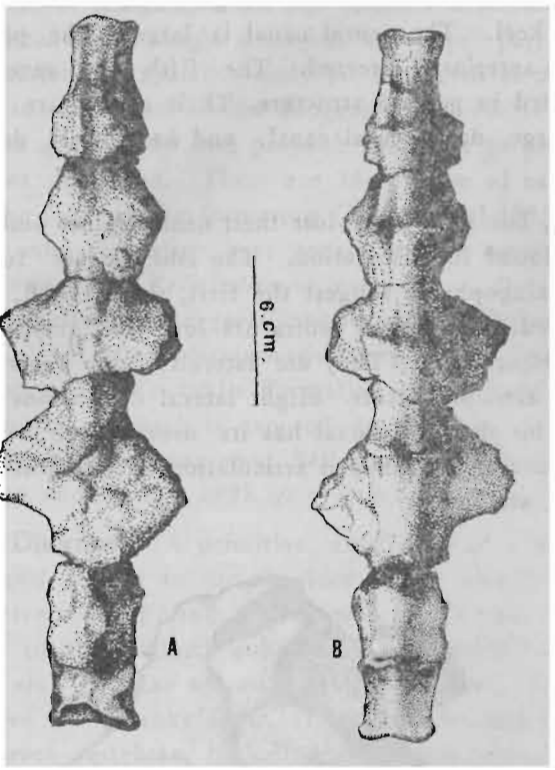

Fig. 3 *Tianchiasaurus nedegoapeferima* gen. et sp. nov. Sacrum.

图 3 明星天池龙 (*Tianchisaurus nedegoapeferima* gen. et sp. nov.) 的荐椎。

Three caudal vertebrae are preserved,probably representing the first (Fig. 4) and second centra, and a mid-caudal. The first two caudals have massive transverse processes that project anterolaterally from the entire height of the centrum. The caudal centra are short, equal in height and breadth. Each is slightly biconcave. and lacks ventral facets for chevrons. The mid-caudal vertebra is longer, and its centrum is distinctly hexagonal in end view. The ventral surface has a broad, longitudinal groove, and posterior articular facets for the chevron.

Many fragments of ribs are preserved. Dorsal ribs are not fused to transverse processes or centra. The dorsal ribs are T-shaped in the cross-section.

An incomplete, small and flat tail club (Plate 4C) is preserved. It is constructed of three dermal scutes, which are sculptured on their dorsal surfaces. A small and triangular scute is laterally flanked by two larger dermal scutes.

Table 1 Measurements (in mm) of the sacral vertebrae of the *Tianchisaurus*.

表 1 明星天池龙 (*Tianchisaurus nedegoapeferima* gen et sp nov.) 的荐椎测量(毫米)。

Number of Sac,	Length	Height	Width
SD1	61	35*	45
SD2	65	45	52
S1	64	47	61
S2	55	48	53
S3	55	50	49
S4	56	49	48
SC1	45	37*	50

* Incomplete

The elements of the pectoral girdle and fore limb are poorly known. The preserved fragments are probably from the scapula and humerus. The proximal end of the humerus is strongly expanded, and the articular surface is prominently pitted.

The pelvic girdle and hind limbs of *Tianchiasaurus nedegoapeferima* are represented by a fragment of ilium, two incomplete femora, and several metatarsals and phalanges.

A thick massive bony plate, with many small dermal scutes on the dorsal surface, is a fragment of the ilium. The relatively flat bone is probably a piece of the preacetabular region, and shows that the trunk of *Tianchiasaurus nedegoapeferima* was relatively flat and wide.

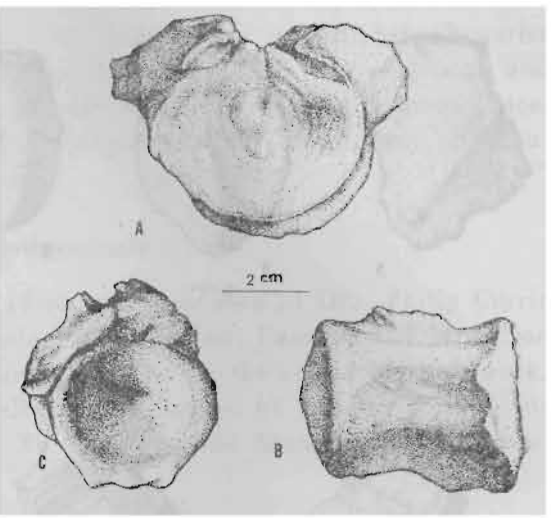

Fig. 4 *Tianchiasaurus nedegoapeferima* gen. et sp. nov. The first caudal

图 4　明星天池龙（*Tianchisaurus nedegoapeferima* gen. et sp. nov.）的第 1 尾椎。

The shaft of the femur (Plate III) is relatively straight, and distally is oval in section. The fourth trochanter is well developed with a prominent, long ridge midlength on the medial side of the femoral shaft. The surface of the shaft is pitted by many small sculptures.

The complete metatarsal and phalangeal count is unknown. Metatarsals II, III and IV, and two phalanges are preserved (Plate IV). The metatarsals are slender, compressed proximally, and have shallowly concave proximal articular surfaces. The preserved phalanges, from the third and fourth digits of the right pes, are short with expanded articular surfaces, shallowly concave proximal articulations, and convex double condyles distally. Their ligamental fossae are deep (Plate 4). Compared to the pes of advanced ankylosaurs (Maryanska, 1977), the metatarsals of *Tianchiasaurus nedegoapeferima* are slender, probably because of the relatively small size of the animal.

The dermal armour of *Tianchiasaurus nedegoapererima* was not found in position. Several types of plates overlapped and apparently covered most of the body of the animal. An incomplete band of armour is preserved, consisting of three pairs of large, thick, keeled bony plates fused to each other. The band as preserved is 45 cm long and 11 cm wide, and seems to have covered the pectoral region. The distal region of the armour band is thin, unkeeled, and irregularly sculptured on the dorsal surface. The ventral surface of the fused section is smoother, with irregular cavities and convexities.

Many dermal scutes and fragments are represented by several distinct types. Small oval, subcircular dermal scutes (Figs. 5A, 5B) are like those of *Dracopelta*

zbyszewskii (Galton 1983). The upper surfaces are convex, with central keels. The ventral surfaces are gently concave. One example is 50 mm long, and 41 mm wide.

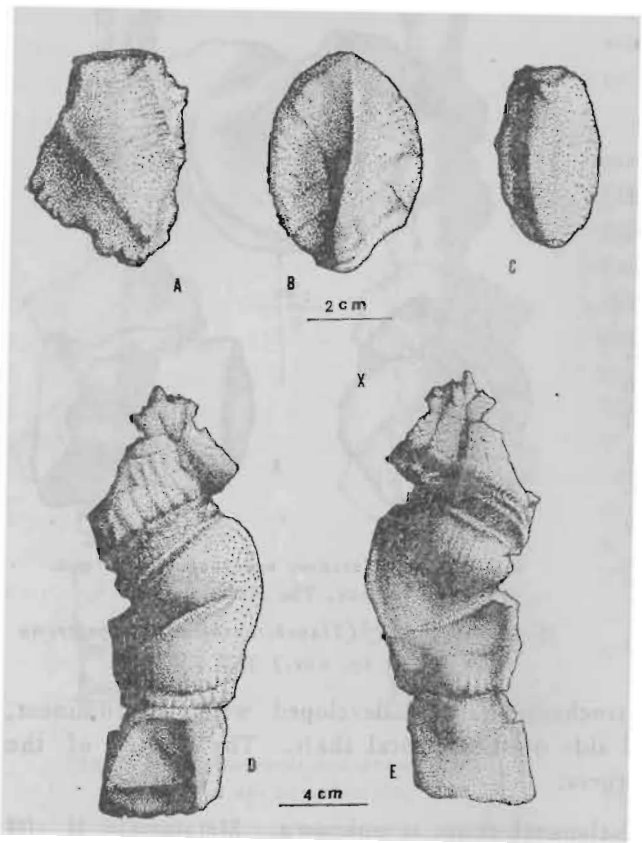

Fig. 5. *Tianchiasaurus nedegoapeferima* gen. et sp. nov. Armour plates and scutes.

图 5 明星天池龙 (*Tianchisaurus nedegoapeferima* gen. et sp. nov.) 的甲板和甲片。

On the dorsal surface of the ilium, there are many small dermal scutes and ossicles. These irregularly arranged dermal scutes are circular and subcircular in shape.

Several large bony fragments are preserved with oval or subcircular bases, which are slightly hollowed out ventrally. They narrow dorsally to dull points, suggesting that they may have been the spikelike dermal scutes often found along the lateral margins of ankylosaur bodies.

Discussion

The dermal scutes of IVPP V 10614 clearly identify it as a thyreophoran, a group that includes stegosaurs and ankylosaurs as well as their more primitive relatives, *Scelidosaurus* and *scutellosaurus* (Weishampel 1990). To determine the systematic position, the specimen was compared with Scelidosaurus, the Middle Jurassic stegosaurs *Hauyangosaurus* and *Lexovisaurus*, and ankylosaurs. The ankylosaur affinities are apparent from the construction of sacrum, which includes seven sacral vertebrae. The lateral surface of the mandible has a prominent sculpturing consisting of irregular, shallow depressions. This is also a feature of ankylosaurs. The prezygapophyses of at least one vertebra form a single U-shaped articulation like those of most ankylosaurs. There is a large belt of armour plates in the shoulder region. The flat dermal plates and small dermal scutes are also a primary feature of ankylosaurs.

The Ankylosauria contains two families: Ankylosauridae and Nodosauridae (Coombs and Maryanska 1990). *Tianchiasaurus nedegoapeferima* has a small, flat bony tail club, which suggests it is an ankylosaurid. The mandible is thin, and in this feature better compares with those of stegosaurs, thereby distinguishing it from all of known ankylosaurids. The dorsal vertebrae are more primitive than those of more advanced ankylosaurids from the Cretaceous. The belt of armour plates con-

sists of three pairs of large, keel-shaped ossicles that are fused with one another,and covered the shoulder region.

Olshevsky (1979) pointed out that both ankylosaur families are related to each other, yet are different enough to suggest long independent evolutionary histories before the Cretaceous. *Tianchiasaurus nedegoapeferima* confirms that stegosaurs and ankylosaurs were separate lineages by the Middle Jurassic, and their common ancestor, which is probably a small armoured ornithopod (Colbert 1981), must be sought in Lower Jurassic strata.

Acknowledgements

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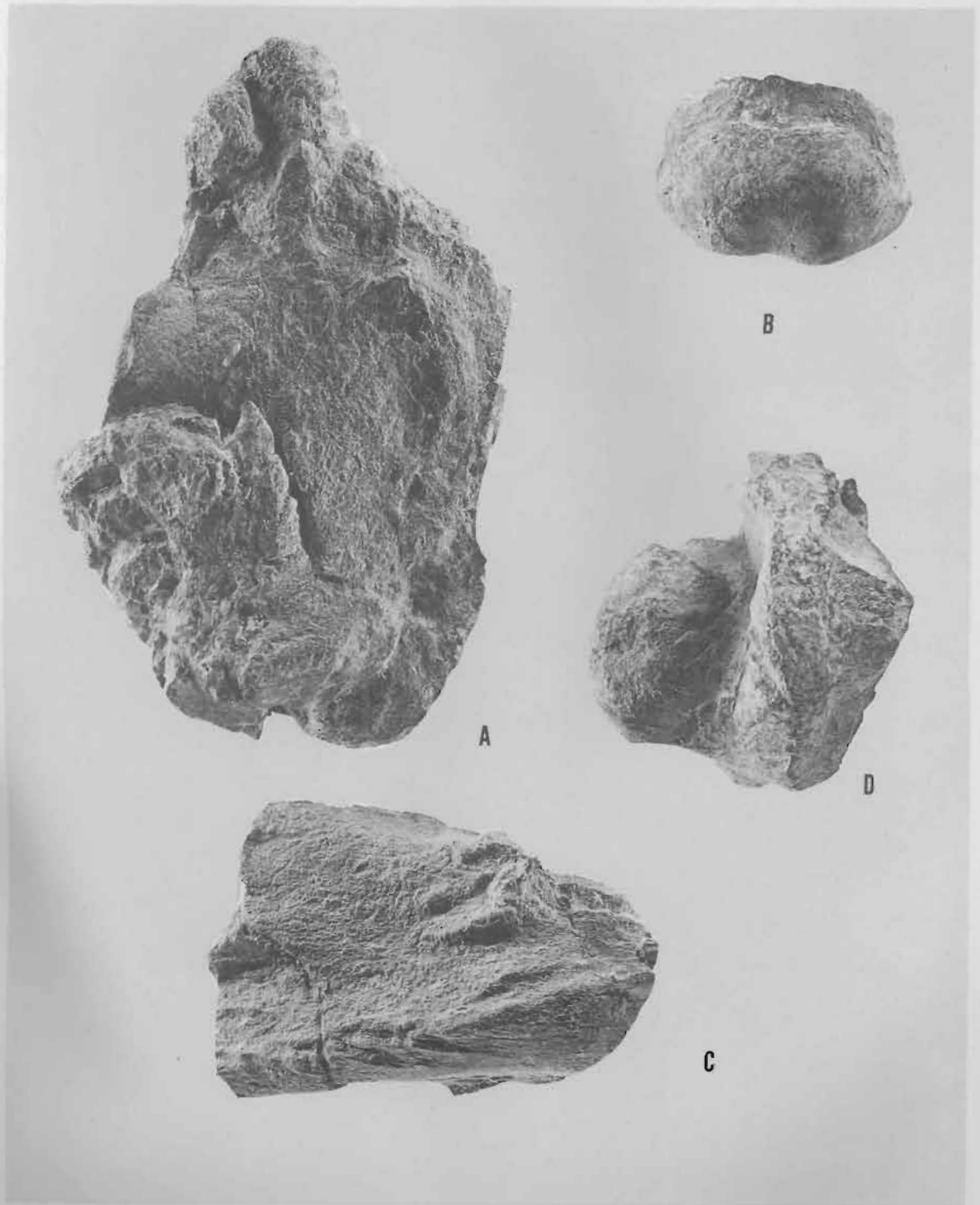
Explanation of plates

Plate I. *Tianchiasaurus nedegoapeferima* gen. et sp. nov. A. Fragment of skull, B. occipital condyle, C. incomplete mandible, D. odontoid is fused to the axis.

Plate II. *Tianchiasaurus nedegoapeferima* gen. et sp. nov. A—H Various Scutes, 1. Dermal Armour on the shoulder region

Plate III. *Tianchiasaurus nedegoapeferima* gen. et sp. A. Dorsal 11, B. Dorsal 3, C. Caudal 1,2, D and E. cervical F and G. Right Femur

Plate IV. *Tianchiasaurus nedegoapeferima* gen. et sp. nov. A. Caudal 1—2 B. Right pes, C. Tail club, D. Tooth of Megalosauridae indet. E. Phalage of Megalosauridae indet, F. Claw of Megalosauridae indet.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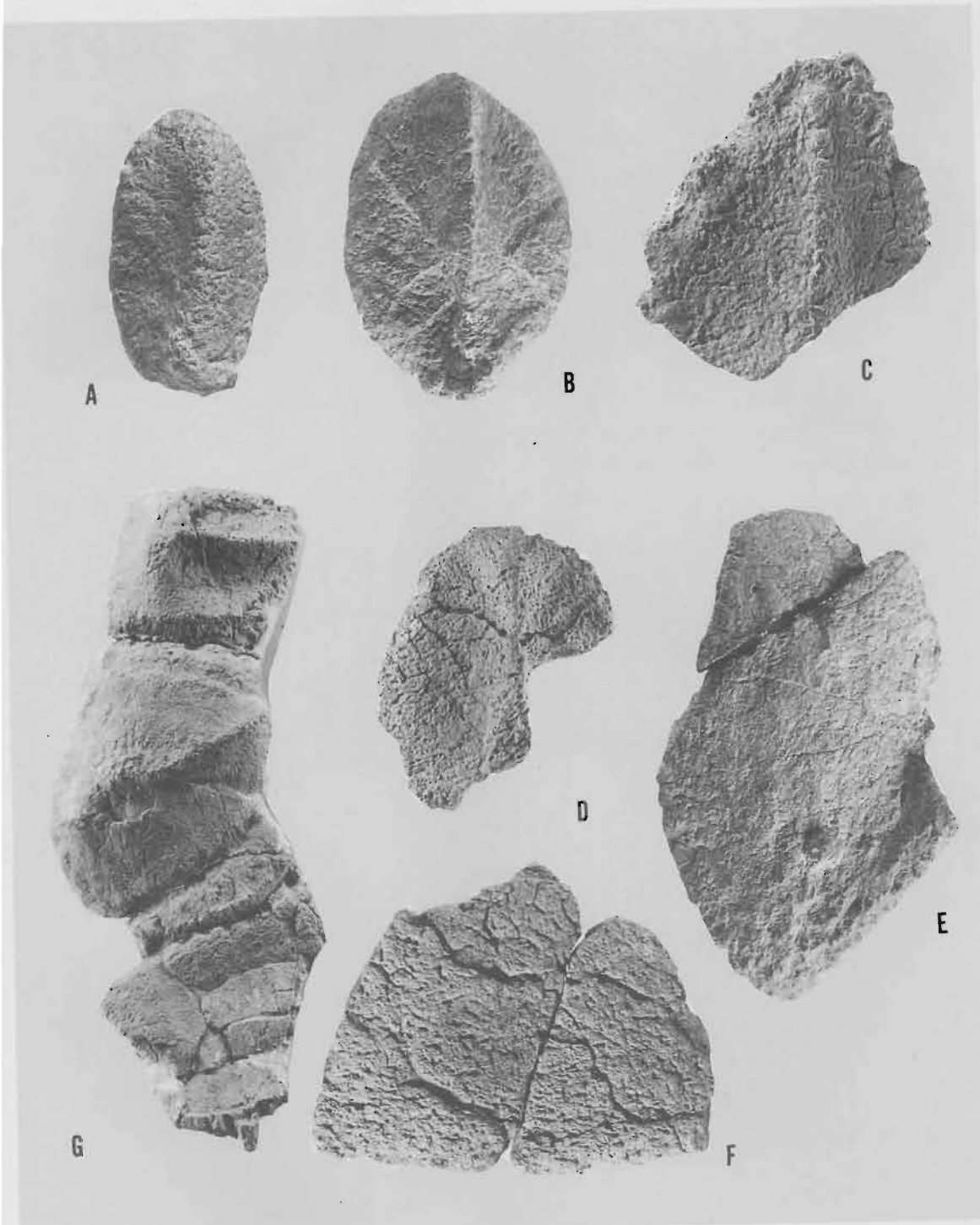
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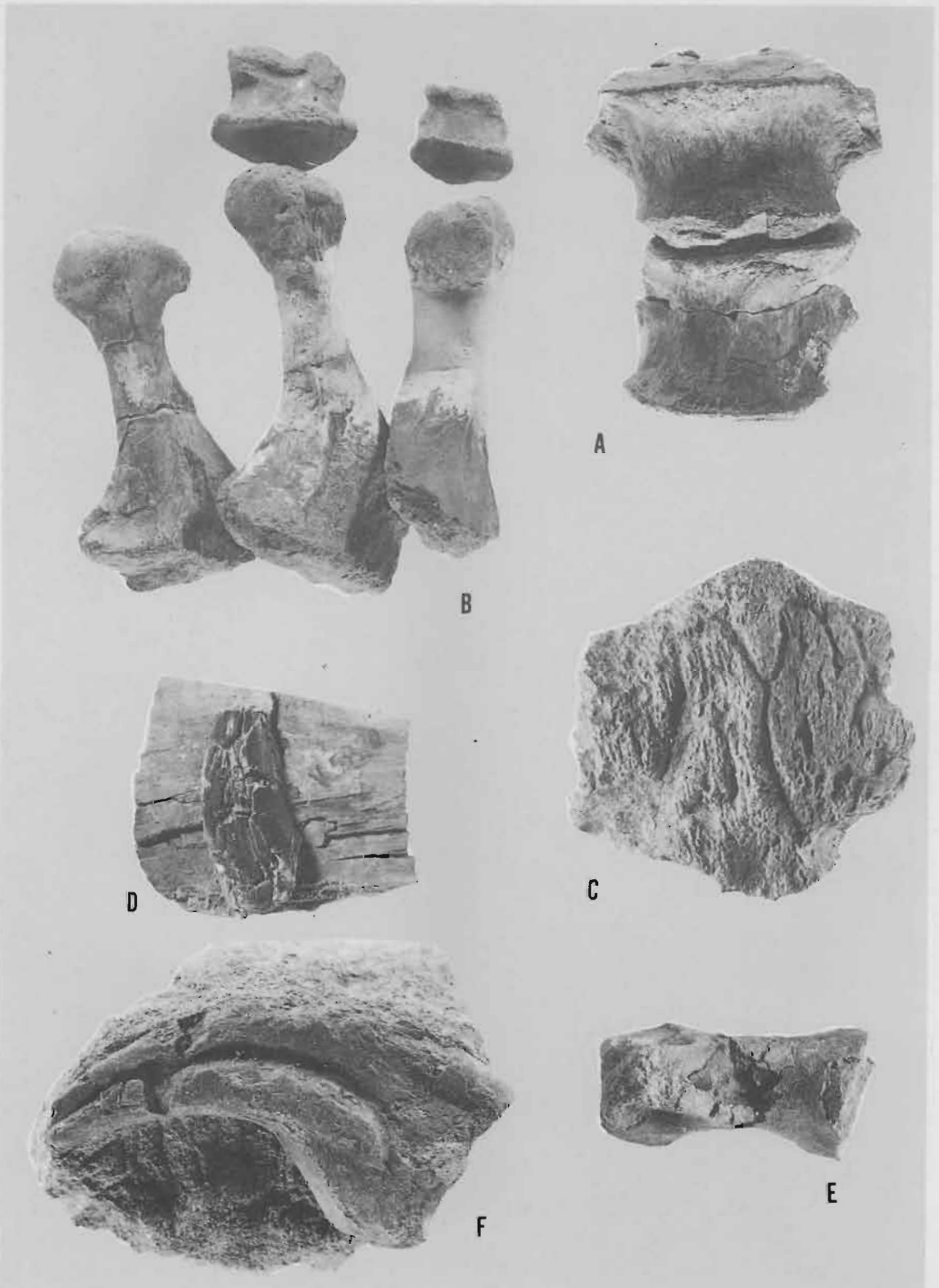
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