A new species of *Ikechosaurus* (Reptilia:Choristodera) from the Jiufutang Formation (Early Cretaceous) of Chifeng City, Inner Mongolia

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Abstract

Ikechosaurus gaoi nov.sp. is based on a fragmentary skeleton from the Jiufutang Formation (Early Cretaceous) of Chifeng City, Inner Mongolia (P.R. China). Its skull differs from that of *I. sunailinae*, from the Laohongdong (Luohandong) Formation of the Ordos Basin, in having larger teeth and sparser tooth arrangement under the orbits; the lower jaw has a triangular shape in cross-section, with a sharp ventral surface; the neck region between the dorsal plate and basal part of the ilium is more contracted; the shaft of femur is more twisted and the boundary between the internal trochanter and the femoral head is clearer. Features of the postcranial skeleton indicate that this animal was perhaps a small, swift runner. Like *Simoedosaurus*, it was probably only semi-aquatic.

Key- words: Chifeng City, Inner Mongolia, Early Cretaceous, *Ikechosaurus*, Champsosauridae.

Résumé

Ikechosaurus gaoi nov. sp. est basé sur un squelette fragmentaire de la Formation de Jiufutang (Crétacé inférieur) de Chifeng City, en Mongolie intérieure (R.P. Chine). Son crâne diffère de celui d'*I. sunailinae*, de la Formation de Laohongdong (Luohandong) du Bassin de l'Ordos, par ses dents plus grandes et plus éparses sous les orbites; la mandibule a une section triangulaire et un bord ventral aigu; la région séparant la plaque dorsale et la partie basale de l'ischion est plus resserrée; le corps fémoral est plus tordu et la limite entre le trochanter interne et la tête fémorale est mieux individualisée. Certains caractères postcrâniens montrent que cet animal était peut-être un petit coureur rapide. Comme *Simoedosaurus*, il était probablement semi-aquatique.

Mots-clés: Chifeng City, Mongolie intérieure, Crétacé inférieur, *Ikechosaurus*, Champsosauridae.

摘要

据产自内蒙古赤峰市，早白垩世九佛堂组不完整的化石骨架，所建立的伊克昭龙一新种—高氏伊克昭龙（*Ikechosaurus gaoi* nov. sp），在以下方面不同于产自内蒙古鄂尔多斯盆地罗汉洞组的孙氏伊克昭龙：眼眶下部具有大的牙齿和稀疏的齿列；下颌腹面尖锐，横截面呈三角形；肠骨背板和基部之间的颈区收缩强烈；股骨主干更加扭曲；股骨头和内转子之间的边界明显。头后骨骼的特征显示了这一动物个体较小，奔跑速度快。与*Simoedosaurus*相类似，它可能为半水生的。

关键词：内蒙古赤峰市。早白垩世，伊克昭龙，鳄龙科。

Introduction

BUFFETAUT (1978) was the first to mention champsosaur material in China, on the basis of a snout fragment from the Otog Qi District in the Ordos Basin, Inner Mongolia. YOUNG (1964) previously referred this specimen to the crocodilian *Eotomistoma*. SIGOGNEAU-RUSSELL (1981a) subsequently revised the material, confirmed BUFFETAUT's interpretation and, on the basis of this specimen, erected the new taxon *Ikechosaurus sunailinae*. Additional specimens of *I. sunailinae* were subsequently discovered at Chabu Sumu and Laolonghuoze (Yikezhao League, Inner Mongolia) during the final fieldwork season of the Sino-Canadian Dinosaur Project (BRINKMAN & DONG, 1993). Chabu Sumu, in Otog Qi District, is probably the type-locality of *Ikechosaurus sunailinae* (BRINKMAN & DONG, 1993). In both localities *Ikechosaurus* specimens have been discovered within the Luohandong Formation of the Zhidan Group (Early Cretaceous: Bureau of Geology and Mineral Resources of Nei Mongol Autonomous Region, 1991). EFIMOV (1983) also reassigned *Tchoiria magna*, one of the *Tchoiria* species described in the Early Cretaceous of Mongolia (EFIMOV, 1975, 1979), to the genus *Ikechosaurus*.

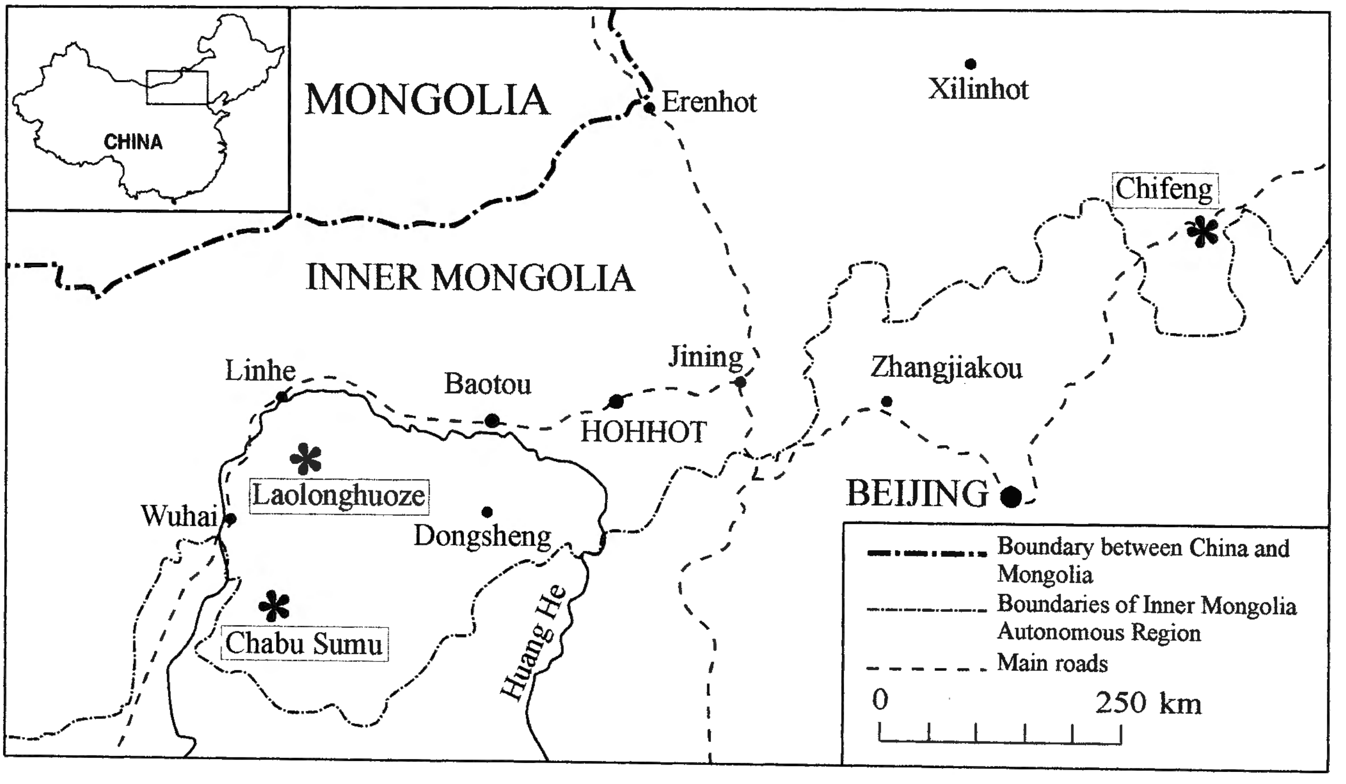

Fig. 1 — Generalized map of the central part of Inner Mongolia, showing the localities where the champsosaur *Ikechosaurus* was discovered.

In 1993, GAO Dian-Min collected the *Ikechosaurus* specimen described herein at Chifeng City, about 900km to the northeast of Hangjin Qi District (Figure 1). This new material was found in the Jiufutang Formation, which forms the lower part of the Early Cretaceous formations in the Chifeng area. The Jiufutang Formation is 140 to 380 m thick and consists of alternating purplish to grayish green conglomerates, sandstones, mudstones and shales, locally with thin coal beds and marls; it contains bivalves, gastropods and the fresh-water fish *Lycoptera davidi*. It is covered by the Fuxin Formation (Bureau of Geology and Mineral Resources of Nei Mongol Autonomous Region, 1991). The presence of *Sinornis santensis* in the Jiufutang Formation, indicates a Valanginian age for this formation (SERENO & RAO, 1992).

Abbreviations: IVPP: Institute of Vertebrate Paleontology and Paleoanthropology (Beijing).

Systematic palaeontology

Class Reptilia
Subclass Diapsida
Suborder Choristodera
Family Champsosauridae COPE, 1877
Genus *Ikechosaurus* SIGOGNEAU-RUSSELL, 1981a

Generic diagnosis: see BRINKMAN & DONG, 1993.

Type species: *Ikechosaurus sunailinae* SIGOGNEAU-RUSSELL, 1981a.

Referred species: *I. magnus* (EFIMOV, 1979); *I. gaoi* nov. sp.

Ikechosaurus gaoi nov. sp.

Holotype: IVPP V11477, a fragmentary skeleton including the crushed skull with lower jaw (V11477-1), dorsal vertebrae with ribs and abdominal ribs (V11477-2), other isolated vertebrae, one complete right ilium (V11477-3), two femora (V1147-4, 5), one complete left radius (V11477-6) and parts of the limb bones.

Locus typicus: Chifeng city, Yikezhao League, Inner Mongolia Province, P.R. China (Figure 1).

Stratum typicum: Jiufutang Formation,? Valanginian, Early Cretaceous (Bureau of Geology and Mineral Resources of Nei Mongol Autonomous Region, 1991).

Derivatio nominis: In honour of GAO Dian-Min, who found the holotype in 1993.

Diagnosis: Marginal teeth sparse under the orbits; sharp ventral edge of the mandible, which is triangular in cross-section; radius about 63% shorter than humerus; anterior process of iliac blade not developed; distinct neck region between acetabulum and iliac blade; in small individual, distinct boundary between internal trochanter and the femoral head; femoral shaft very twisted.

Description

The skull IVPP V11477-1 (Figure 2; Plate 1, Fig. 1) was heavily compressed during fossilization, so that it looks completely crushed. The skull has the same size as IVPP V9611-3, referred by BRINKMAN & DONG (1993) to *Ikechosaurus sunailinae*. The snout is broad and appears relatively long, gradually tapering anteriorly towards its midpoint. Its tip is missing.

Premaxilla: As in *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993) and *Champsosaurus* (see RUSSELL, 1956), but contrary to *Simoedosaurus*, the premaxilla is not strongly swollen and there is no notch between the premaxilla and the maxilla.

Maxilla: The ventral side of the maxilla is partly preserved in IVPP V11477-1. Its surface is sculptured by a thin net of pits and ridges, as in *Ikechosaurus sunailinae* (see SIGOGNEAU-RUSSELL, 1981a). The posterior part of the maxilla enters the border of the suborbital fenestra, as in *I. sunailinae* and in *Champsosaurus*, but unlike in *Simoedosaurus* (see BRINKMAN & DONG, 1993). Nine broken teeth can be observed under the orbital region. Anteriorly to the orbit, nine teeth and nine tooth impressions are preserved. The teeth are rather large, sharp and sparse under the orbits. In *I. sunailinae* and *Simoedosaurus* on the other hand, the teeth are distinctly smaller and more numerous. The teeth are transversely elongated, as observed in *I. sunailinae* and *Simoedosaurus* (EVANS, 1990; BRINKMAN & DONG, 1993), whereas they are more rounded in cross-section in *Champsosaurus*.

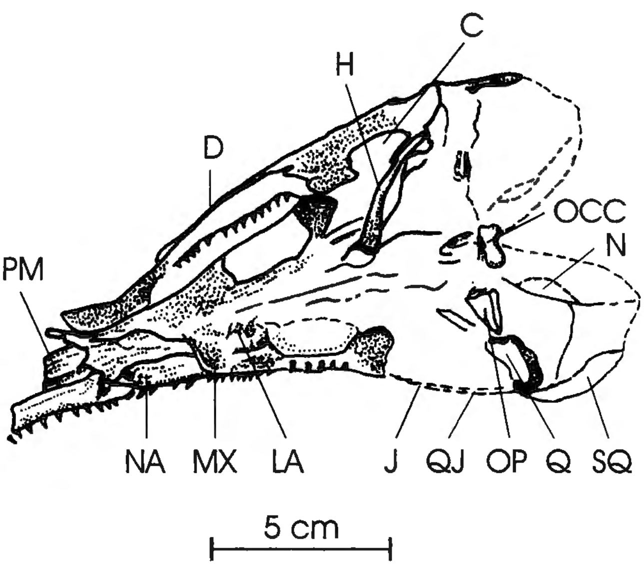

Fig. 2 — Skull of *Ikechosaurus gaoi* (IVPP V11477-1), from the Early Cretaceous of Chifeng City. Dorsal view. Abbreviations: C, coronoid; D, dentary; H, hyoid; J, jugal; LA, lacrimal; MX, maxilla; N, neomorph; NA, nasal; OCC, occipital condyle; OP, opisthotic; PM, premaxilla; Q, quadrate; QJ, quadratojugal; SQ, squamosal.

Nasal: The dorsal surface of the nasal is coarsely striated. It contacts the maxilla laterally. The suture with the premaxilla is unclear.

Lacrimal: The dorsal surface of the left lacrimal is missing and the coarsely striated contact surface for the palatine and the lacrimal canal are consequently exposed. The lacrimal canal is large and extends anteriorly into the olfactory cavity, as also observed in *Champsosaurus* (see RUSSELL, 1956). The important development of the lacrimal canal indicates that *Ikechosaurus gaoi* had a large lacrimal gland.

Squamosal: The ventral and posterolateral portions of the squamosal are preserved. On the underside of the skull, although the parietal and a part of the squamosal are missing, the suture impressions of parietal/squamosal and parietal/neomorph can be seen under the binocular. The broad, smooth plate formed by the squamosal, the quadrate and the neomorph closely resembles that of *Simoedosaurus dakotensis* (see ERICKSON, 1987). The lateral surface of the squamosal is scuptured by small pits, like that of *Ikechosaurus sunailinae*.

Quadratojugal: Only the impression of the left quadratojugal in the surrounding rock can be observed. Thus, the sutures with the jugal, quadrate and squamosal cannot be accurately determined. The lateral margin of the quadratojugal was particularly sharp, as indicated by its deep groove-like impression.

Quadrate: A part of the quadrate is preserved. Its broad dorsal surface is smooth and slightly concave. As in other champsosaurids, the articular condyle for the lower jaw is stout and saddle-shaped, narrow anteroposteriorly and wide mediolaterally. The jaw articulation is located at the level of the occipital condyle, as in *Tchoiria namsarai* (see EFIMOV, 1975) and *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993). It is located posteriorly in *Simoedosaurus* (see ERICKSON, 1987), and far anteriorly in *Champsosaurus* (see RUSSELL, 1956).

Neomorph: One neomorph is partly preserved in IVPP V11477-1. Its anterior suture with the pterygoid remains unclear. There are two shallow grooves on its dorsal surface. Unlike in *Ikechosaurus sunailinae*, the neomorph and the quadrate do not enclose a palatoquadrate foramen.

Pterygoid: A part of the left pterygoid and the nearly complete right one are preserved in IVPP V1147-1. Their dorsal surface is smooth. The interpterygoid vacuity appears particularly narrow, as in *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993); it appears clearly wider in *Champsosaurus* (see RUSSELL, 1956), *Simoedosaurus* (see SIGOGNEAU-RUSSELL & RUSSELL, 1978 and *Tchoiria* (see EFIMOV, 1975). In the Middle Jurassic choristodere *Cteniogenys* EVANS, 1990, the paired pterygoids are not separated from each other. The dorsal surface of the right pterygoid is pierced by a small foramen, that can be interpreted as the foramen for the sixth cranial nerve, as observed in *Champsosaurus* cf. *dolloi* (see SIGOGNEAU-RUSSELL,1979).

Occipital Region: The occipital region is heavily damaged and it is consequently very difficult to discern the different bones in this area. The posterior surface of the occipital condyle bears a medial vertical furrow, as in *Tchoiria namsarai* (see EFIMOV, 1975), *Simoedosaurus* (see Erickson, 1987) and *Ikechosaurus sunailiae* (see BRINKMAN & DONG, 1993). The preserved part of the left opisthotic is sub-triangular in cross-section near the suture with the basisphenoid. The distal border of the opisthotic process is rounded and extends medially and dorsally to the level of the quadrate's articular saddle, as in *Simoedosaurus* (see ERICKSON, 1987).

Mandible: Both dentaries are incomplete. The middle part of the right dentary is preserved and bears 17 crushed teeth on this part. The anterior part of the left dentary is also preserved, bearing 12 complete teeth, but lacks its symphyseal region. Its medial surface is concave while its lateral surface is moderately convex. The dentary is triangular in cross-section, with a sharp ventral edge. The right splenial of IVPP V11477-1 is preserved. It forms a flat, smooth and thin plate covering the medial surface of the dentary. Near the posterior end of the lower jaw, a small triangular bone can be regarded as the right coronoid. The proximal end of the right part of the mandible is heavily damaged, so that the surangular, angular and articular cannot be accurately recognized.

Hyoid: The hyoid is represented by the first ceratobranchial. It is a rod-like bone with a greatly expanded anterior end and a slender posterior end. It closely resembles that of *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993) and *Champsosaurus* (see ERICKSON, 1985).

Cervical vertebrae: Only the right half of one cervical centrum is preserved. According to the relative position of the parapophysis and diapophysis, it can be identified as a mid-cervical vertebra. The parapophysis is small and the contact facet for the neural arch invades the diapophysis facet. A sharp mid-ventral keel is present on the centrum, as in *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993), *Champsosaurus* (see RUSSELL, 1956 and ERICKSON, 1972) and *Simoedosaurus* (see ERICKSON,1987). The posterior articular surface is distinctly concave.

Dorsal vertebrae (Plate 1, Fig. 2): Ten dorsal vertebrae are preserved, including five naturally articulated complete vertebrae, with associated dorsal ribs and gastralia (IVPP V11477-2), and five isolated incomplete vertebrae. They may be regarded as mid-dorsal vertebrae, closely resembling those of *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993). Their ventral surface is rounded and they are longer than wide. Both articular surfaces of the centra are concave, but, unlike *Champsosaurus* (see BROWN,1905) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL,1981b), they do not form a small central cone. The parapophysis and diapophysis are set in the middle of the vertebra, as observed in dorsal vertebrae of *Champsosaurus* (see RUSSELL, 1956) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b), and are fused together and form an "8"-shaped surface. This surface is subdivided into a large upper part and a smaller lower one by the articular surface for the neural arch. The upper part of the surface is rounded. The articular surface for the neural arch is strongly concave, as observed in *Champsosaurus* (see RUSSELL, 1956) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b). The neural arches of the dorsal vertebrae are nearly vertical. They are as antero-posteriorly long as the corresponding centra. Unlike in *Champsosaurus* and *Simoedosaurus*, their tips are not expanded and smooth. The neural canal is higher than wide; a longitudinal blade-like ridge subdivides its floor into two parts, as in *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b).

Ribs: Some ribs are associated with the dorsal vertebrae in IVPP V11477-2. The shafts of the anterior ones are slightly curved backwards, while the posterior ones are nearly straight. Two ridges run along the anterior and posterior surfaces of the shaft. The posterior ridge is larger and sharper than the anterior one. The capitular and tubercular surfaces are confluent, forming an anteroposteriorly compressed "8"-shaped articular head, as described in *Champsosaurus* (see BROWN, 1905). The distal end is less expanded than the proximal one, like in *Ikechosaurus magnus* (see EFIMOV, 1979), *I. sunailinae* (see BRINKMAN & DONG, 1993), *Simoedosaurus* (see RIGOGNEAU-RUSSELL, 1981b) and *Khurendukhosaurus bajkalensis* (see EFIMOV, 1996), but unlike in *Champsosaurus* (see BROWN, 1905 and ERICKSON,1985), where the distal end of the dorsal ribs is as expanded as the proximal one. The cross-section of the distal end is ovoid, like in *Khurendukhosaurus bajkalensis* (see EFIMOV, 1996), with concave surfaces, which may represent cartilaginous attachment with the gastralia.

Gastralia: Abdominal ribs are particularly well-preserved on the right side of IVPP V11477-2, but none is complete. They are much more slender than the dorsal ribs. One gastralium consisted of three elements as in other champsosaurids.

Humerus (Figure 3, Plate 2, Fig. 1): The right humerus, with broken distal end, and the distal end of the left

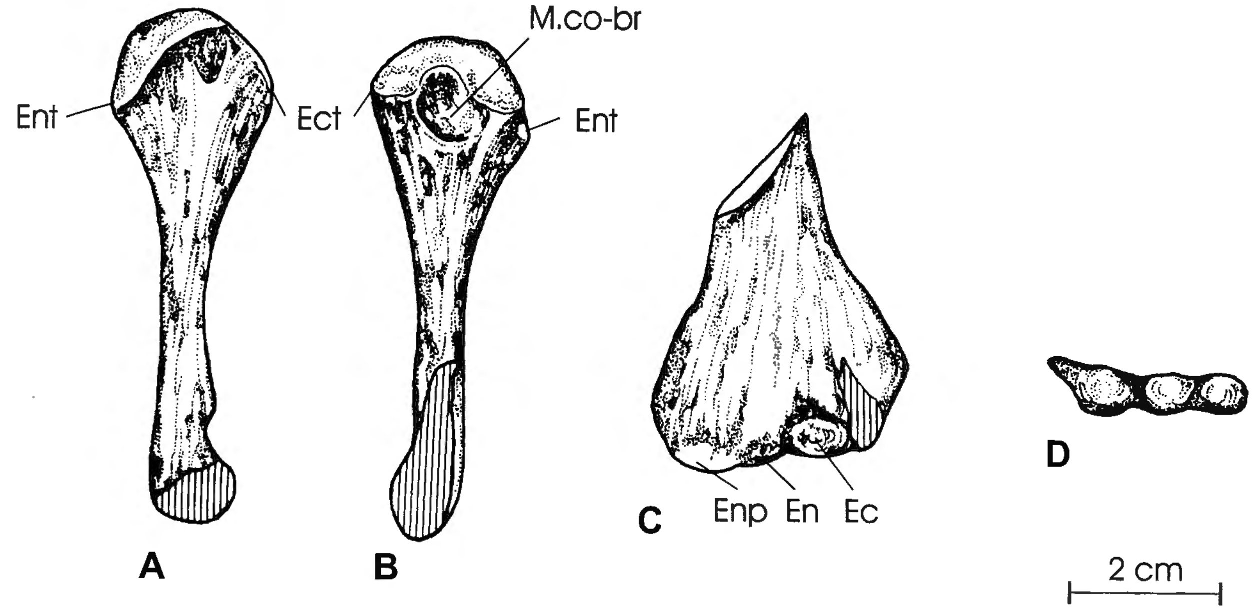

Fig. 3 — Humerus of *Ikechosaurus gaoi* (IVPP V11477), from the Early Cretaceous of Chifeng City. A: proximal part of right humerus in posterior view. B: the same in anterior view. C: ventral view of the distal part of the left humerus. D: the same in distal view. Abbreviations: ec, ectocondyle; ect, ectotuberosity; en, entocondyle; enp, entepicondyle; ent, entotuberosity; M.co-br, *M.coracobrachialis*.

humerus are preserved. The proximal head is mesiolaterally curved and its articular surface is strongly rounded. In posterior view, the coracobrachial fossa forms a depression near the humeral head. This depression, similar to that observed in *Simeodosaurus* (see SIGOGNEAU-RUSSELL, 1981b), marks the insertion area of the *M. coracobrachialis*. The deltopectoral crest is not developed, as observed in both *Champsosaurus natator* and *C.albertensis* (see ERICKSON, 1972). The humeral mid-shaft is triangular in cross-section, whereas it is rather ovoid in *C. natator* (see RUSSELL, 1956). The ectotuberosity and the entotuberosity are set very low on the mesial and lateral sides of the humeral head. The ectotuberosity is distinctly larger than the entotuberosity. The ectotuberosity is not clearly separated from the humeral head. As in *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b), there is a shallow depression between the humeral head and the ectotuberosity. This differs from the condition observed in *Champsosaurus laramiensis*, where the ento-and ectotuberosities are much lower and þoth distinctly separated from the head (see BROWN, 1905). The distal end of the humerus is much more expanded than its proximal end and dorso-ventrally compressed, with a nearly straight articular edge. The entepicondyle, entocondyle and ectocondyle are well-developed and distinct. Among these condyles, the ectocondyle is the largest; the entepicondyle and the entocondyle have the same size. In *Champsosaurus laramiensis*, on the other hand, the three condyles successively increase in size (BROWN, 1905). In *Simoedosaurus*, the entocondyle is the best developed (SIGOGNEAU-RUSSELL, 1981b). Unfortunately, the bone near the ectocondyle is broken, so that it is not possible to assess whether the ectepicondylar groove is entirely closed or not.

Ulna (Figure 4): The proximal end of the right ulna and the distal end of the left one are preserved. Both ends are expanded. The ulna forms a large obtuse olecranon near its proximal end and the olecranon cavity is deep, as in *Champsosaurus laramiensis* (see BROWN,1905) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b). The inner side of the olecranon and the articular trochlea for the humerus form a sigmoid notch at the proximal end of the ulna. As in *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b), the proximal end of the ulna is irregularly quadrangular in cross-section, with a well-developed articular

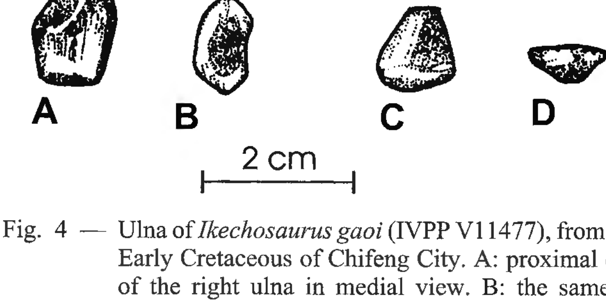

Fig. 4 — Ulna of *Ikechosaurus gaoi* (IVPP V11477), from the Early Cretaceous of Chifeng City. A: proximal end of the right ulna in medial view. B: the same in proximal view. C: distal end of the left ulna in lateral view. B: the same in distal view. Abbreviations: Co, olecranon cavity; Ol, olecranon.

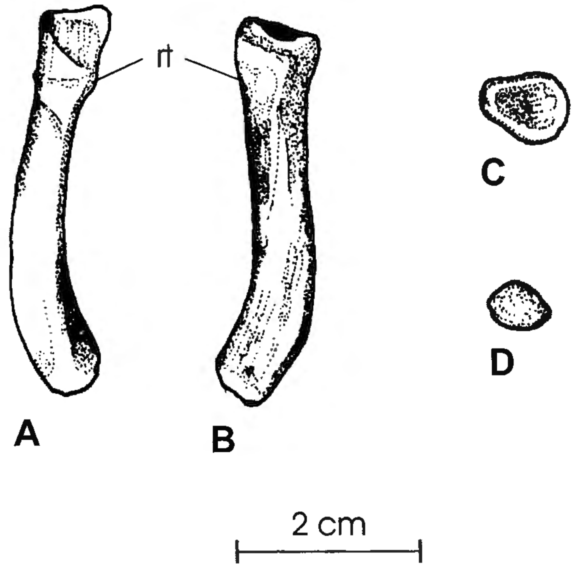

Fig. 5 — Left radius of *Ikechosaurus gaoi* (IVPP V11477-6), from the Early Cretaceous of Chifeng City. A: anterolateral view. B: posteromedial view. C: proximal view; D: distal view. . Abbreviation: rt, radial tuberosity.

facet for the radius; in *Champsosaurus*, on the other hand, it is roughly triangular in cross-section (RUSSELL, 1956). The anterolateral surface of the ulna is slightly convex, while its posteromedial surface is flat. The distal end of the ulna is roughly triangular in cross-section. Its medial side is flattened, whereas a rounded ridge runs along its lateral side, as usually in champsosaurids.

Radius (Figure 5; Plate 2, Fig. 2): The left radius is complete (IVPP V11477-6). It is strongly curved, as in *Champsosaurus* (see RUSSELL, 1956) and *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b). The radius is about 63% the length of the humerus. The radius of *Ikechosaurus gaoi* is therefore proportionally slightly longer than that of *Champsosaurus* (60.3% in *C.laramiensis* and 60.8% in *C.natator*: RUSSELL 1956; ERICKSON,1985), but shorter than that of *Ikechosaurus sunailinae* (67%) and especially than that of *Simoedosaurus* (73.6%: SIGOGNEAU-RUSSELL,1981b). In *I. gaoi* the anterolateral surface of the humeral shaft is smooth with a sharp medial edge, rising from the middle part and disappearing near the distal end. The posterolateral edge is rugose. The posteromedial surface of the shaft is slightly concave with a rounded medial ridge, as in *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b) and *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993). The tuberosity for insertion of the *M. brachialis externus* lies on the posteromedial surface near the proximal end of the radius.

Ilium (Figure 6; Plate 1, Fig. 3): The right ilium (IVPP V11473-3) is nearly complete, but a small part of its dorsal plate is broken. The ilium consists of a basal part and a posteriorly inclined dorsal plate. The dorsal plate forms a weak anterior process and a remarkably elongated posterior process. The medial surface of the dorsal plate is slightly convex. Near its upper margin, short grooves and ridges form a roughened surface, marking the insertion area for the *M. ilio-tibialis*. In medial view, the central part of the dorsal plate is very smooth. Several ridges extend anteroposteriorly on the lower part of the posterior process, forming a roughened surface. Another roughened surface lies near the anterior margin of the anterior process. Both roughened surfaces may respectively represent the insertion areas for the *M. dorsalis caudae* and the *M.dorsalis trunci*, as described in alligators, lizards and *Sphenodon* (see GALTON, 1969). Above the supra-acetabular buttress, the lateral side of the ilium is slightly concave, as seen in *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993). The upper and lower margins of the dorsal plate are nearly parallel to each other. The medial surface of the basal portion is nearly flat, while its lateral surface is strongly concave. The ischial and pubic facets have the same size and form an obtuse angle, as in *I. sunailinae* (see BRINKMAN & DONG, 1993). In *Champsosaurus ambulator*, on the other hand, the ischial facet is much smaller than the pubic one (ERICKSON, 1987). The neck region between the basal portion and the dorsal plate is remarkably constricted, as in *Simoedosaurus* and *Champsosaurus* (see SIGOGNEAU-RUSSELL, 1981b and ERICKSON, 1987). In *I. sunailinae*, on the other hand, the neck region is only slightly constricted. In summary, when compared with that of *I. sunailinae*, the ilium of *I. gaoi* is characterized by a more constricted neck region, a proportionally smaller basal portion and a less developed anterior process of the dorsal plate.

Femur (Figure 7; Plate 2, Fig. 3): Both femora (IVPP V11477-4, 5) are nearly complete. A small part of the proximal end of the right femur is missing, while the proximal end of the left femur is particularly well preserved. The humero-femoral ratio is about 0.77, as in *Champsosaurus gigas* (see ERICKSON, 1972). Both ends are similarly expanded. As in other champsosaurids, the femoral head has no distinct neck region. The femoral shaft is narrower mediolaterally than anteroposteriorly; it is distinctly more twisted than that of *Ikechosaurus su-*

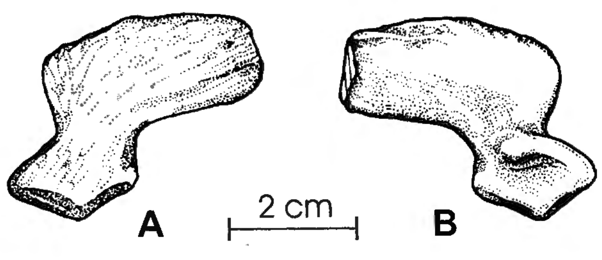

Fig. 6 — Right ilium (IVPP V11477-3) of *Ikechosaurus gaoi*, from the Early Cretaceous of Chifeng City. A: medial view. B: lateral view.

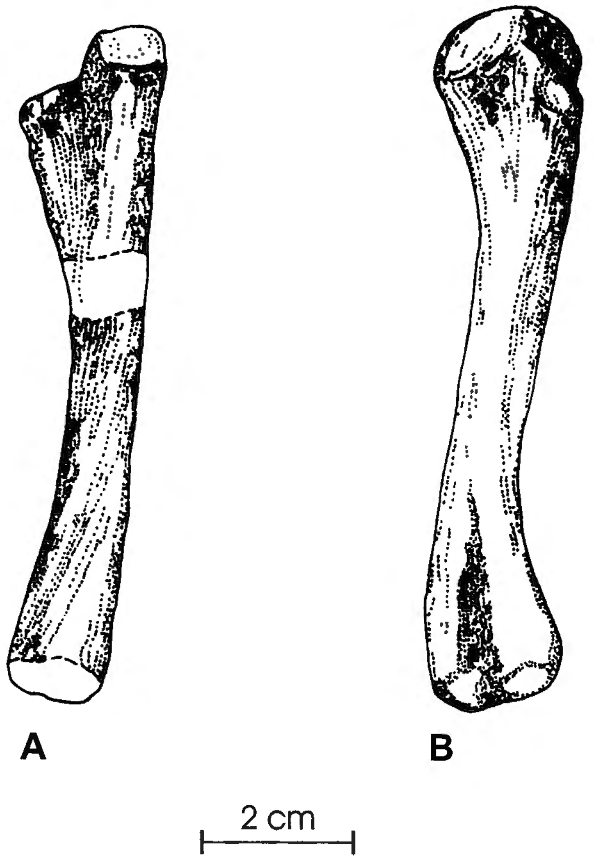

Fig. 7 — Left femur (IVPP V11477-4) of *Ikechosaurus gaoi*, from the Early Cretaceous of Chifeng City. A: anteroventral view. B: posterodorsal view.

nailinae. As usual in champsosaurids, the intertrochanteric fossa forms a prominently concave and coarsely striated surface on the ventral part of the internal trochanter. This area may mark the insertion area for the *M. pubo-ischio-femoralis externus* (ROMER,1927). The internal trochanter is very developed. A small tuberosity under the internal trochanter may represent the trace of the fourth trochanter. The boundary between the internal trochanter and the femur head is distinct through a bridge connecting them, as in *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b, fig. 37). The degree of separation of the internal trochanter with the femoral head shows an important interspecific variation within the genus *Champsosaurus* and is regarded as an important diagnostic character in differentiating the species (ERICKSON, 1972). In small individuals of *I. sunailinae*, the internal trochanter is contiguous with the head, and there is consequently no clear boundary between the head and the internal trochanter. In larger individuals of the same species, the femur has a well-developed internal trochanter, more clearly separated from the femoral head (BRINKMAN & DONG, 1993). Therefore, the degree of separation of the internal trochanter from the head also exists within *Ikechosaurus*; although it appears to be an ontogenetic character, it may be useful to differentiate small individuals of *I. sunailinae* and *I. gaoi*.

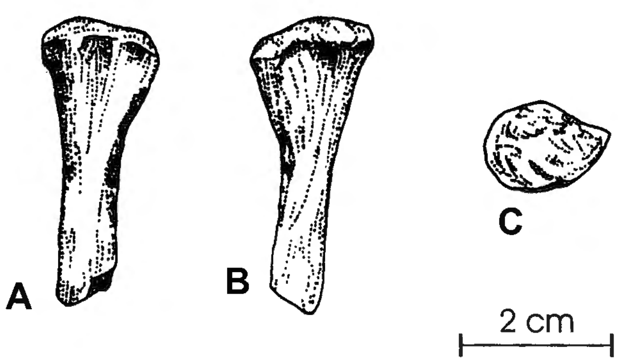

Fig. 8 — Proximal part of the left tibia (IVPP 11477) of *Ikechosaurus gaoi*, from the Early Cretaceous of Chifeng City. A: anterior view. B: posterior view. C: proximal view.

Tibia (Figure 8; Plate 2, Fig. 4): The proximal part of the left tibia is preserved. The proximal end is swollen into a large articular region, oval in cross-section. The cnemial crest is weakly developed near the anterior margin of the proximal head, as in *Champsosaurus* (see ERICKSON, 1972). Just below the cnemial crest, a moderately deep depression appears on the anterolateral surface of the tibial shaft; the anterolateral margin is consequently particularly sharp. The *M. femoro-tibialis* probably inserted along this margin and the cnemial crest, as described in *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b), crocodiles and dinosaurs (GALTON, 1969).

Discussion

The skull IVPP V11477-1 closely resembles that of IVPP V9611-3, referred to *Ikechosaurus sunailinae* (see BRINKMAN & DONG, 1993). Both share the following characters: the snout is long, broad and gradually tapers towards its midpoint; the maxilla is sculptured by a thin net of ridges and pits and enters the border of the suborbital fenestra; there is no constriction between maxilla and premaxilla; the interpterygoid vacuity is particularly narrow; the articular surface of the quadrate is set at the same level as the occipital condyle; the marginal dental alveoli are mediolaterally elongated. In *Champsosaurus*, the snout is proportionally longer and narrower, the maxilla is smooth, the dental alveoli are rounded, the interpterygoid vacuity is larger and the articular surface of the quadrate is set more anteriorly than the occipital condyle. In *Simoedosaurus*, the snout appears shorter and broader, the maxilla is heavily sculptured and does not enter the suborbital fenestra, there is a distinct notch between the maxilla and the premaxilla, the interpterygoid vacuity is larger and the articular surface of the quadrate is set more posteriorly than the occipital condyle. In *Tchoiria*, the snout appears more slender, the teeth have oval bases and the interpterygoid vacuity is larger. These comparisons suggest that IVPP V11477 belongs to the genus *Ikechosaurus*. However, it differs from material previously referred to *I. sunailinae* in the following characters: the maxillary teeth are much sparser under the orbits, the lower jaw is sharper, the radius is slightly shorter in comparison to the humerus, a distinct neck region separates the acetabulum and iliac blade, there is a distinct boundary between the internal trochanter and the head of the femur even in small individuals and the femoral shaft is more twisted. *I. magnus* (EFIMOV,1979), from the Early Cretaceous of Khamareeb Khural (Mongolia), is characterized by its shorter and mediolaterally more widened snout. Because of the very fragmentary state of preservation of the *I. magnus* type material, precise comparisons with *I. gaoi* are currently impossible to establish.

The distinct wide insertion areas for the *M.ilio-tibialis*, *M.dorsalis caudae* and *M. dorsalis trunci* on the ilium may indicate that these muscles, connecting the legs to the trunk, were rather strongly developed, as observed in terrestrial or semi-aquatic reptiles. Moreover, according to ROMER (1956: 372), "considerable variation is seen in the degree of apparent development of the olecranon. In highly specialized aquatic reptiles this may represent a true loss of this structure....". So, the well-developed olecranon of *Ikechosaurus gaoi* and the feature of the ilium may indicate that this animal was not a highly specialized aquatic reptile, although the shape of the skull and the dentition would seem to suggest a piscivorous animal. It may have been terrestrial, like *Simoedosaurus* (see SIGOGNEAU-RUSSELL, 1981b), or a semi-aquatic reptile at best, as established for *Ikechosaurus magnus* (see EFIMOV, 1983). However, this hypothesis is currently highly speculative and needs to be confirmed by detailed sedimentological and paleoecological studies of the type-locality. ERICKSON (1985), on the other hand, regards *Champsosaurus gigas* as a fully-aquatic animal.

The presence of *Ikechosaurus* in both Luohandong and Jiufutang Formations suggests that these formations may be correlated, pending the discovery of more fossils within the Jiufutang Formation.

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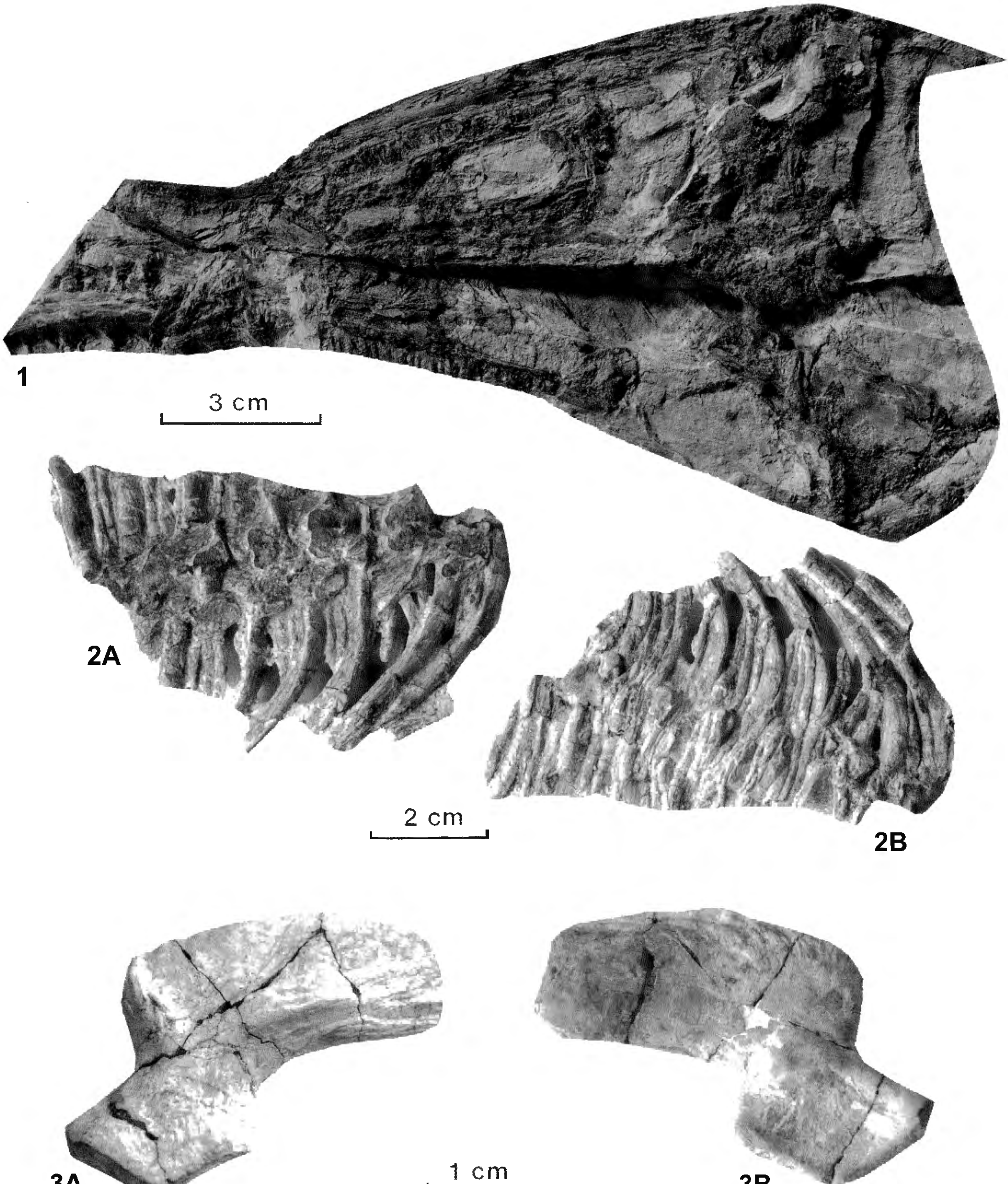
PLATE 1

Holotype of *Ikechosaurus gaoi* (IVPP V11477), from the Early Cretaceous of Chifeng City (Inner Mongolia, P.R. China).
Fig. 1 — Skull (V11477-1) in dorsal view.
Fig. 2 — Dorsal vertebrae with ribs and gastralia (V11477-2) in dorsal (A) and ventral (B) views.
Fig. 3 — Right ilium (V11477-3) in medial (A) and lateral (B) views.

PLATE 2

Holotype of *Ikechosaurus gaoi* (IVPP V11477), from the Early Cretaceous of Chifeng City (Inner Mongolia, P.R. China).
Fig. 1 — Proximal part of right humerus in posterior (A) and anterior (B) views. Distal part of the left humerus in ventral view (C).
Fig. 2 — Left radius (V11477-6) in anterolateral view.
Fig. 3 — Left femur (V11477-4) in anteroventral (A) and posterodorsal (B) views.
Fig. 4 — Proximal part of the left tibia in anterior (A) and posterior (B) views.



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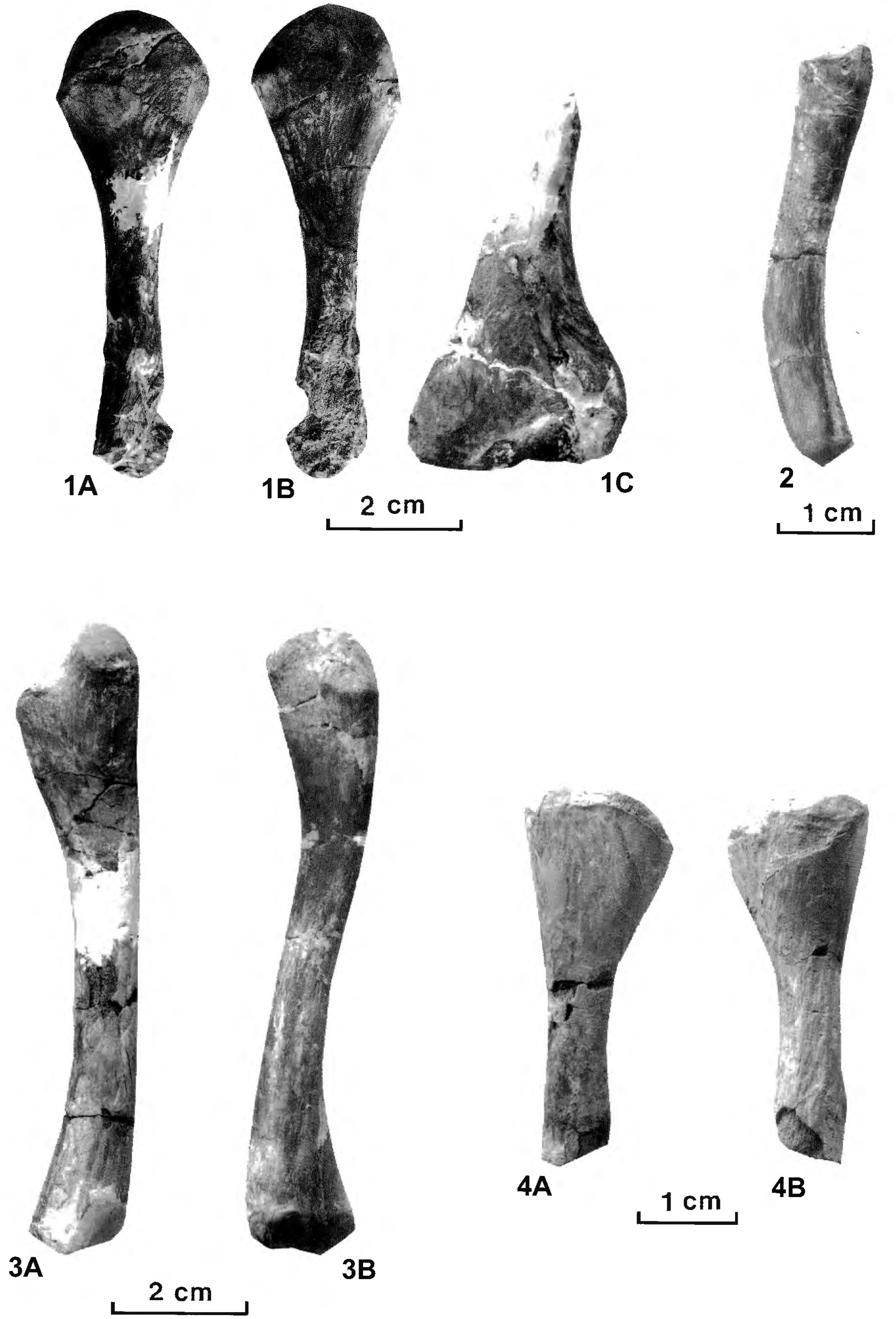

PLATE 2