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RAPID COMMUNICATION

TWO NEW OVIRAPTORIDS (THEROPODA: OVIRAPTOROSAURIA), UPPER CRETACEOUS DJADOKHTA FORMATION, UKHAA TOLGOD, MONGOLIA

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Oviraptorids are unusual theropod dinosaurs known with certainty only from the Upper Cretaceous Djadokhta, Barun Goyot, and Nemegt formations of Mongolia and China (Barsbold et al., 1990; Dong and Currie, 1996). Their skeleton is generally similar to that of other basal coelurosaurians, but their skull is highly specialized in several features—teeth are lacking, the palate is modified such that the ectopterygoid is vertical and the pterygoid is elongate, the external narial region is enlarged, the mandible apparently moved anteroposteriorly at its articulation with the quadrate, and several taxa bear a crest along the dorsal surface of the skull. The poorly preserved holotype of *Oviraptor philoceratops* Osborn 1924, discovered on top of a nest in the Djadokhta Formation at the Flaming Cliffs, was the only specimen known of this family until discoveries in Mongolia by the Russian-Mongolian and Polish-Mongolian expeditions in the 1960s and 1970s. Two monotypic genera of Oviraptoridae and a new species of *Oviraptor* were named and described by Barsbold (1981, 1983, 1986), and other material from these collections was described by Osmólska (1976) and Elzanowski (1999). An oviraptorid skeleton from the Djadokhta Formation of China, also preserved on top of a nest, was described by Dong and Currie (1996).

The Djadokhta Formation preserves one of the richest, most diverse, and well preserved terrestrial vertebrate faunas of the Mesozoic, and Ukhaa Tolgod is the richest site in this formation yet discovered (Dashzeveg et al., 1995; Norell, 1997). Oviraptorids, surprisingly, are one of the most abundant taxa represented at Ukhaa Tolgod; previously reported discoveries include an embryo within an egg (Norell et al., 1994) and an adult sitting on a nest (Norell et al., 1995; Clark et al., 1999). The specimens collected from Ukhaa Tolgod thus far represent two new species, and they are described below.

SYSTEMATIC PALEONTOLOGY

THEROPODA Marsh, 1884
COELUROSAURIA Huene, 1914
OVIRAPTOROSAURIA Barsbold, 1976

Composition—The Oviraptorosauria was erected by Barsbold (1976) to include only the Oviraptoridae, and was later (Barsbold et al., 1990; Padian et al., 1999) expanded to include the Caenagnathidae Sternberg, 1940. Sues (1997) and Makovicky and Sues (1998) revised the taxonomy of Caenagnathidae and referred *Microvenator celer* Ostrom, 1970, to the Oviraptorosauria. A recent analysis (Sereno, 1999) has expanded Oviraptorosauria using ''phylogenetic'' definitions to include the putative relatives *Caudipteryx* Ji et al., 1998 and Therizinosauroidea (Maleev, 1954), but a relationship with Therizinosauroidea is not found in other analyses (e.g., Norell et al., in press).

Family OVIRAPTORIDAE Barsbold, 1976

Type Genus—*Oviraptor* Osborn, 1924.

Composition—Oviraptoridae currently includes four species in three genera: *Oviraptor philoceratops* Osborn, 1924; *O. mongoliensis* Barsbold, 1986; *Ingenia yanshini* Barsbold, 1981; and *Conchoraptor gracilis* Barsbold, 1986.

Geological Distribution—Specimens definitively identified as oviraptorid are known only from the Upper Cretaceous Djadokhta, Barun Goyot, and Nemegt formations of Mongolia and China (Barsbold et al., 1990; Dong and Currie, 1996). The Nemegt Formation overlies the Barun Goyot Formation in some areas, but superpositional relations between the Barun Goyot and Djadokhta formations are not known. The vertebrate fauna of the Barun Goyot Formation was considered indicative of a younger age than that for the Djadokhta Formation (Jerzykiewicz and Russell, 1991), but subsequent discoveries have increased the number of taxa shared between the two formations (Dashzeveg et al., 1995; Gao and Norell, 2000). The ages of these three formations are poorly constrained, but the vertebrate faunas suggest that they are within an interval equivalent to the Campanian to Maestrichtian as defined by marine invertebrates (Lillegraven and McKenna, 1986; Averianov, 1997; Dingus et al., in prep.).

Citipati osmolskae gen. et sp. nov.
(Fig. 1)

Holotype—IGM 100/978, a nearly complete skeleton. The skull, several cervical vertebrae, and the shoulder girdle have been prepared, but most of the postcranial skeleton has not yet been prepared.

Etymology—*Citipati*, from Sanskrit *citi* ''funeral pyre'' + *pati* ''lord'', the lord of cemeteries in Tantric Buddhist tradition, typically depicted as a human skeleton; and to honor Halska Osmólska for her work on oviraptorids and other Mongolian theropod dinosaurs.

Type Locality—Djadokhta Formation at Ankylosaur Flats, Ukhaa Tolgod, Gurvan Tes Somon, Omnogov Aimak, Mongolia. Precise coordinates available to qualified researchers on request.

Referred Specimens—IGM 100/979, a partial skeleton overlying a nest, from Ankylosaur Flats, Ukhaa Tolgod; IGM 100/971, an embryonic skeleton within an egg from Xanadu, Ukhaa Tolgod.

Diagnosis—Differs from all other oviraptorids where known

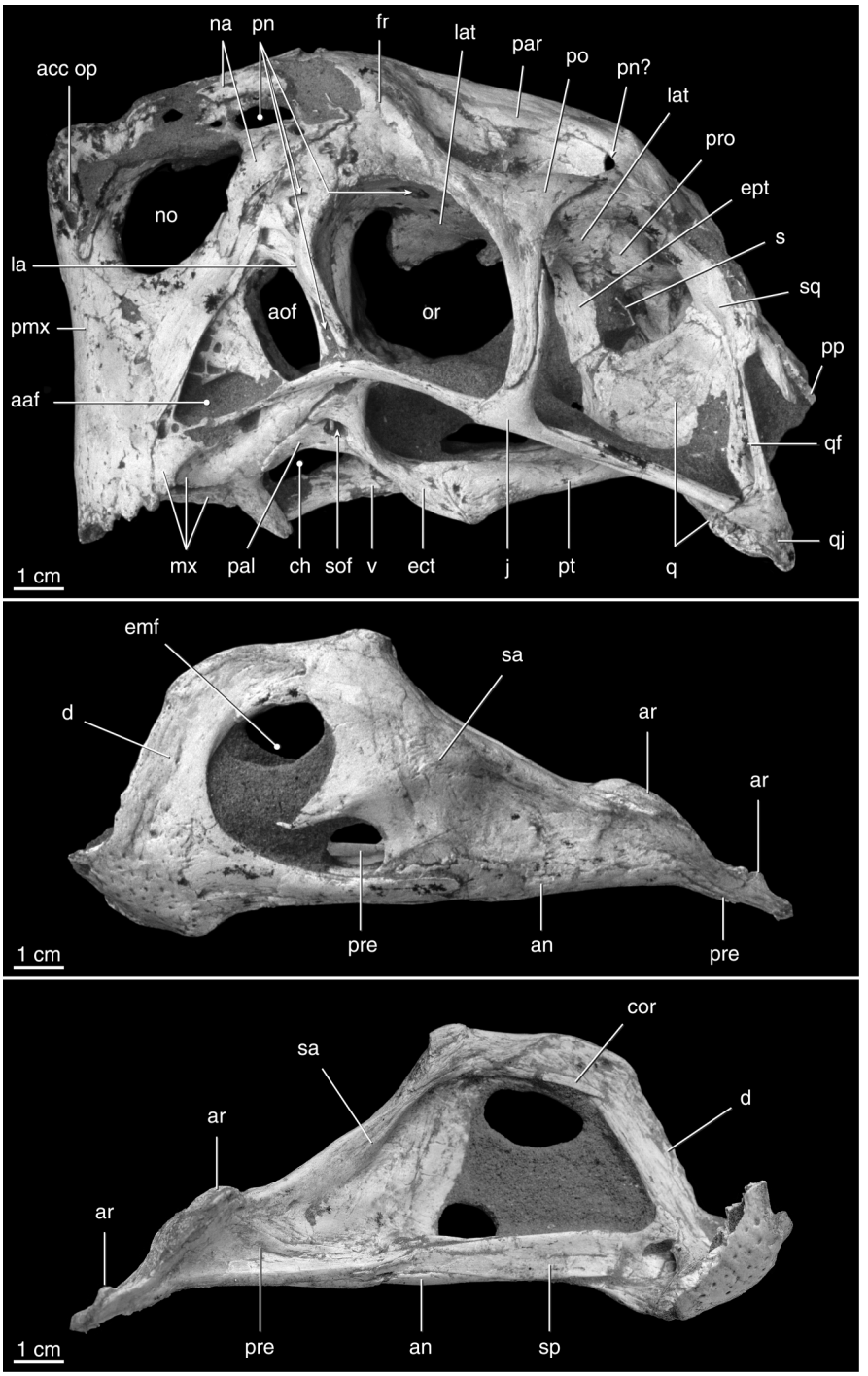

FIGURE 1. Holotype of *Citipati osmolskae*, IGM 100/978. **Top**, skull in left lateral view. **Center**, left lateral view, left mandibular ramus. **Bottom**, left mandibular ramus in medial view. **Abbreviations**: **aaf**, accessory antorbital fenestra; **acc op**, accessory opening into premaxilla; **an**, angular; **aof**, antorbital fenestra; **ar**, articular; **ch**, choana; **cor**, coronoid; **d**, dentary; **ect**, ectopterygoid; **emf**, external mandibular fenestra; **ept**, epipterygoid; **fr**, frontal; **j**, jugal; **la**, lacrimal; **lat**, laterosphenoid; **mx**, maxilla; **na**, nasal; **no**, narial opening; **or**, orbit; **pa**, parietal; **pal**, palatine; **pmx**, premaxilla; **pn**, pneumatic opening; **po**, postorbital; **pp**, paroccipital process; **pre**, prearticular; **pro**, prootic; **pt**, pterygoid; **q**, quadrate; **qf**, quadrate foramen; **qj**, quadratojugal; **s**, stapes; **sa**, surangular; **sof**, suborbital fenestra; **sq**, squamosal; **v**, vomer.

in its anterodorsally sloping occiput and quadrate, a parietal that is much longer along the midline than the frontal and reaches nearly to the level of the anterior end of the orbit, an ascending process of the jugal that is perpendicular to the horizontal ramus rather than extending posterodorsally, an external naris that is nearly circular, an ascending process of the premaxilla that is vertical rather than sloping posterodorsally, cervical vertebrae that are more elongate (approximately twice as long as they are wide), and ischia that form a symphysis distally. Differs from *Conchoraptor* in having a taller and more highly pneumatized nasal, from *Ingenia* in that metacarpal I is not extremely broad, from *Oviraptor philoceratops* in having a shorter skull and

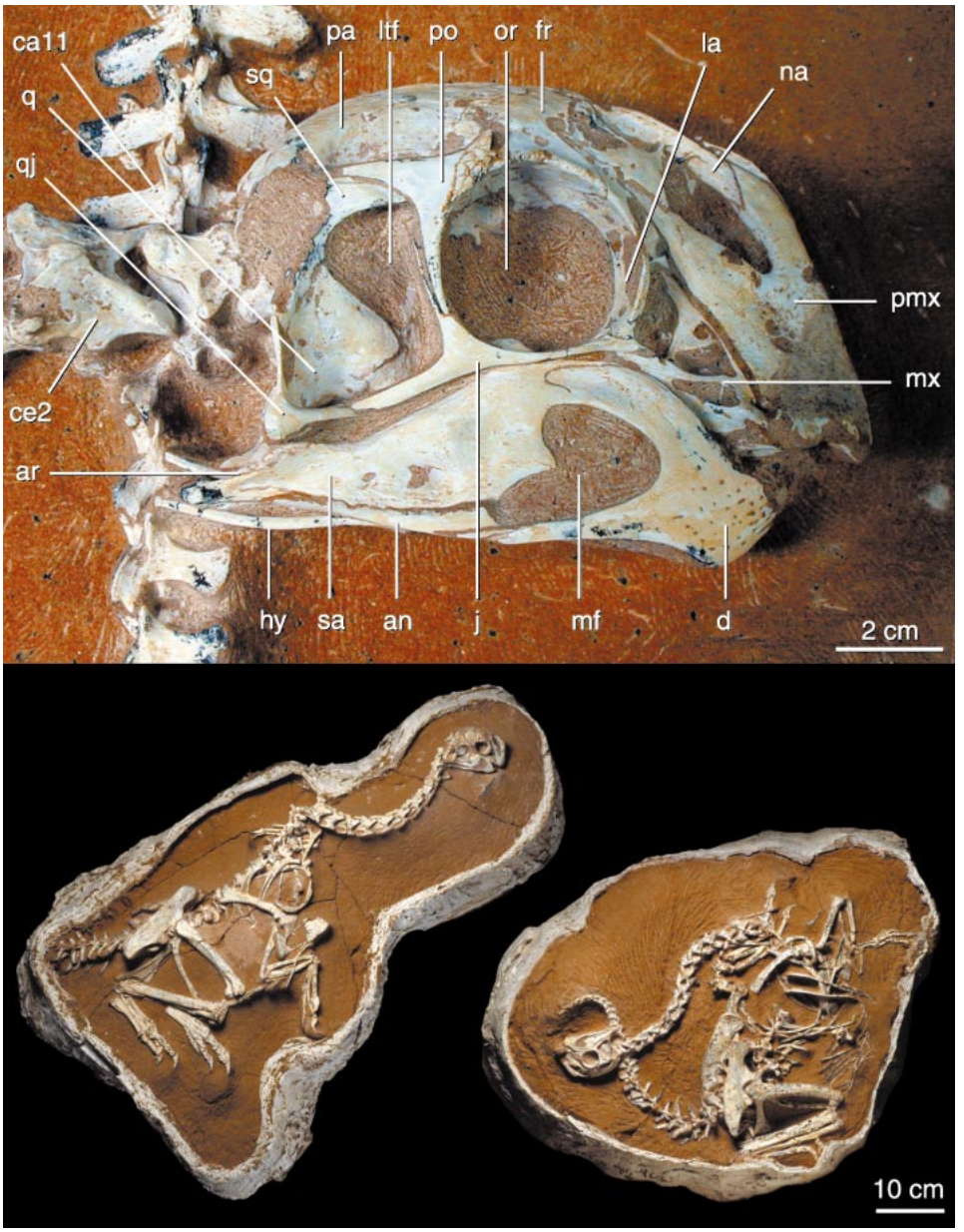

FIGURE 2. *Khaan mckennai*. **Top**, skull of the holotype specimen, IGM 100/1127, in right lateral view. **Below**, holotype, right, and referred specimen, IGM 100/1002, left. **Abbreviations**: **an**, angular; **ar**, articular; **Ca11**, eleventh caudal vertebra; **Ce2**, second cervical vertebra; **d**, dentary; **fr**, frontal; **hy**, ceratohyal; **j**, jugal; **la**, lacrimal; **ltf**, lateral temporal fenestra; **mf**, mandibular fenestra; **mx**, maxilla; **na**, nasal; **or**, orbit; **pa**, parietal; **pmx**, premaxilla; **po**, postorbital; **q**, quadrate; **qj**, quadratojugal; **sa**, surangular; **sq**, squamosal.

mandible and lacking a parietal crest, from *O. mongoliensis* in lacking a convex crest on the frontals and parietals, and from *K. mckennai* in the features listed below. The presence of an epipterygoid and a small coronoid may also be diagnostic. The largest specimens (total midline skull length 17.2 cm) are more than 50% larger than known specimens of *Khaan, Conchoraptor*, and *Ingenia.*

Remarks—A postcranial skeleton preserved on top of a nest, IGM 100/979, is referred to the new species, and was described by Clark et al. (1999). IGM 100/979 is referred to *C. osmolskae,* pending complete preparation of the postcranial skeleton of the holotype, primarily on the basis of its large size and its differences with the skeleton of *Khaan mckennai.* An embryonic skeleton referred to this species was given a preliminary description by Norell et al. (1994), and a detailed description is given by (Norell et al., 2001). It is referred to *Citipati* on the basis of its premaxilla, which is nearly vertical rather than sloping posteriorly as in *Khaan.*

Khaan mckennai gen. et sp. nov.
(Fig. 2)

Holotype—IGM 100/1127, a complete skeleton, slightly disarticulated in the thorax.

Etymology—*Khaan,* Mongolian for ruler, and for Malcolm McKenna, in recognition of his passionate interest in and efforts towards the exploration for fossils in Cretaceous deposits of Mongolia.

Type Locality—Mark's Second Egg, Ukhaa Tolgod, Gurvan Tes Somon, Omnogov Aimak, Mongolia. Precise coordinates available to qualified researchers on request.

Referred Specimens—IGM 100/973 a nearly complete skeleton from Granger's Hill, Ukhaa Tolgod; and IGM 100/1002, a nearly complete skeleton lacking the distal half of the tail, found in close proximity to the holotype at Mark's Second Egg, Ukhaa Tolgod.

Diagnosis—Oviraptorid differing from all other oviraptorids in that metacarpal III is not expanded proximally and does not contact the distal carpals; from *Oviraptor* in lacking a parietal crest, from *Ingenia* in that metacarpal I is not extremely broad; from *Conchoraptor* in that the long axis of the oval narial opening is more horizontally oriented and the nasals are fused, and from *Citipati* in having the dorsal process of the premaxilla projecting posterodorsally rather than being vertical, the occiput is vertical rather than facing posterodorsal, the fused nasals are not as deep posteriorly and pneumatization is less extensive anteriorly, the jugal extends further posteriorly but not as far anteriorly, the posteroventral part of the dentary underlies the angular ventrally rather than overlapping it laterally, and the coronoid eminence of the mandible is not as deep.

Remarks—Previously this taxon was tentatively identified as *Ingenia* (Dingus et al., 1995; Webster, 1996), but preparation of the postcranial skeleton revealed that it lacks the distinctive features of that genus, notably characters of the hand.

DISCUSSION

Citipati osmolskae differs from other oviraptorids mainly in that the dorsal part of the skull is shifted anteriorly. Thus, the occiput and quadrates are anterodorsally oriented (if the braincase is positioned horizontally), and the parietal extends further anteriorly than in other taxa. Its elongate cervical vertebrae may be related functionally to this cranial specialization, and the coincidence of these two features is reminiscent of therizinosaurid theropods (Barsbold and Maryanska, 1990; Clark et al., 1994).

Two features of the holotype of *C. osmolskae* never reported in an oviraptorid are the presence of an epipterygoid in the skull and a coronoid on the mandible. The epipterygoid is mediolaterally flattened and in the typical position between the pterygoid and laterosphenoid. A small, slender coronoid is present on the mandibular ramus along the medial surface of the coronoid process. However, the reported absence of these bones in other oviraptorid specimens may be due to poor preservation.

The narial region of the skull of an oviraptorid previously referred to *O. philoceratops*, IGM 100/42, is similar to that of *C. osmolskae*. In particular, its premaxilla is tall and nearly vertical anteriorly, the pattern of circumnarial pneumatization is similar, and the holotype of *Citipati osmolskae* has an accessory opening anterior to the nares similar to one on IGM 100/42. However, this specimen differs from *C. osmolskae* in several other features—its vomers are not fused, the anterior edge of the premaxilla is concave in lateral view, and its cervical vertebrae are not elongate. This specimen may represent a second species of *Citipati*, pending further study.

The skull of *Khaan mckennai* lacks the specializations of *Citipati* and the dorsal crest of the two species of *Oviraptor*. It is most similar to that of *Conchoraptor*, from which it differs in several features of the narial region. The proximal reduction of its third metacarpal is a distinctive autapomorphy of *K. mckennai*, but otherwise its postcranial skeleton is unspecialized. Free uncinate processes are present interlaced with ribs, corroborating their identification in an incomplete skeleton of *C. osmolskae* (Clark et al., 1999).

The description of these new species brings to six the number of species in this family. Relationships among the genera and species of oviraptorids have not been subjected to phylogenetic analysis, but each species is distinguished by at least one autapomorphy.

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Note added to proof:

Barsbold et al. (2000) described a new species of oviraptorid, *Nomingia gobiensis*, distinguished by its fused distal caudal vertebrae. *Khaan mckennai* lacks this feature, and in both *K. mckennai* and *Citipati osmolskae* (for which the distal caudals are not known) the ischium is not as strongly concave posteriorly as in *N. gobiensis.*

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