



## New data on anatomy of the Late Cretaceous multituberculate mammal *Catopsbaatar*

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**The Gobi Desert is famous for providing one of the worlds best preserved Cretaceous terrestrial faunas, including dinosaurs and mammals. Beginning with the Central Asiatic Expeditions in the 1920s, through the Polish-Mongolian Expeditions in the 1960s–1970s, Soviet-Mongolian Expeditions in 1970s, and finally the Mongolian Academy-American Museum Expeditions in the 1990s–2000s, the number of complete skulls (see Kielan-Jaworowska et al. 2000 for review) of Cretaceous mammals often associated with postcranial skeletons, found in Mongolia increased to several hundred. In addition to these professional expeditions, there have been other types of trips to Mongolia, also aimed at collecting fossils. The Nomadic Expeditions Company in USA organizes one of these, and has made trips to Mongolia since 1996. During the 1999 Nomadic Expedition, a skull associated with parts of the postcranial skeleton of the multituberculate mammal *Catopsbaatar catopsaloides* was found. The specimen is more complete than others previously known of this species and brings new data on multituberculate anatomy and ontogenetic variation. In this note we discuss the new data on the structure of *C. catopsaloides*; the details of its anatomy will be described in subsequent papers by the two first authors.**

The specimen reported in this paper was found on 22 September 1999 by the third author (PJC) during the Nomadic Expedition called “Dinosaurs of the Gobi” in the red beds of Hermiin Tsav (?upper Campanian<sup>1</sup>) at the locality Hermiin Tsav, in the Mongolian part of the Gobi Desert. This locality has been referred to previously as Khermeen Tsav, but we follow the transcription of Mongolian names proposed by Benton (2000). The exact location of the place is 43° 29.717' N, 99° 49.115' E. The specimen has been registered in the Paleontological Center of the Mongolian Academy of Sciences in Ulanbaatar as PM 120/107. It was prepared from the rock by the second author and a technician at the Paleontological Museum in Oslo. The rock surrounding the specimen was soft, but the last layer surrounding every bone, about 1 mm in thickness, was very hard and difficult to remove. The preparation of the skull and

part of the postcranial skeleton took over a year; the remainder of the postcranial skeleton is still being prepared. The specimen is now on loan at the Institute of Paleobiology in Warsaw.

The aim of this note is to present preliminary data on PM 102/107, which includes a complete skull, associated with the mandible and large parts of the postcranial skeleton.

We use abbreviations I, P, M, and i, p, m, for upper and lower incisors, premolars and molars respectively. The institutional abbreviations are: PIN, Paleontological Institute, Russian Academy of Sciences, Moscow; PM, Paleontological Center of the Mongolian Academy of Sciences, Ulaanbaatar; ZPAL, Institute of Paleobiology, Polish Academy of Sciences, Warsaw.

**Background.**—*Catopsbaatar catopsaloides* was originally assigned by Kielan-Jaworowska (1974) to *Djadochtherium* Simpson, 1925; Kielan-Jaworowska and Sloan (1979) transferred it to *Catopsalis* Cope, 1882, but finally Kielan-Jaworowska (1994) erected the genus *Catopsbaatar* for it. The original material of *Catopsbaatar catopsaloides* consists of three skulls. The best preserved is the holotype (ZPAL MgM-I/78), representing an almost complete skull with the mandible, belonging to a juvenile individual, in which the M2 and m2 are still erupting (Kielan-Jaworowska 1974: text-fig. 6, pl. V: 9, pl. XVII: 2, pls. XVIII–XX; Kielan-Jaworowska et al. 2000: fig. 29.11). The two other skulls are less complete. ZPAL MgM-I/79 (preserved without the dentaries) was figured by Kielan-Jaworowska (1974: pl. XXI). Skulls ZPAL MgM-I/78 and 79 have also been figured and discussed by Kielan-Jaworowska et al. (1986: figs. 2 and 3) in relation to their study of the multituberculate endocasts and vasculature. The third skull ZPAL MgM-I/80, associated with fragments of the dentaries, has not been figured.

The fourth *Catopsbaatar* skull (PIN 4537-5) from Hermiin Tsav was found during one of the Russian-Mongolian Expeditions. It was figured by Gambaryan and Kielan-Jaworowska (1995: figs. 2A, 7B), who reconstructed its musculature. The fifth skull from Hermiin Tsav, reported herein, PM 120/107, is by far the most complete of the five known for *C. catopsaloides*; it is associated with two complete dentaries and large fragments of the postcranial skeleton (Figs. 1, 2).

It is not certain whether the caudal vertebrae from Hermiin Tsav (ZPAL MgM-I/171) assigned to *Catopsbaatar catopsaloides* by Kielan-Jaworowska and Gambaryan (1994) belong to this taxon, as the Upper Cretaceous beds of the Gobi Desert also yielded another large multituberculate *Tombaatar* (Rougier et al. 1997).

In 1994, when Kielan-Jaworowska offered a differential generic diagnosis of *Catopsbaatar*, this genus was compared with all

<sup>1</sup> Gradziński et al. (1977) referred to the Baruungoyot Formation and red beds of Hermiin Tsav as ?middle–late Campanian, and have been followed by numerous authors, see Jerzykiewicz (2000) for review. However, Averianov (1997: 244) argued: “The Campanian is [...] a marine stage established in Europe and divided on the basis of ammonites and other marine invertebrates into two substages (Harland et al. 1989). In view of this, the tripartite division of the Campanian in Asia and North America is inappropriate”. We follow Averianov’s objection and refer to the age of the red beds of Hermiin Tsav as ?late Campanian.

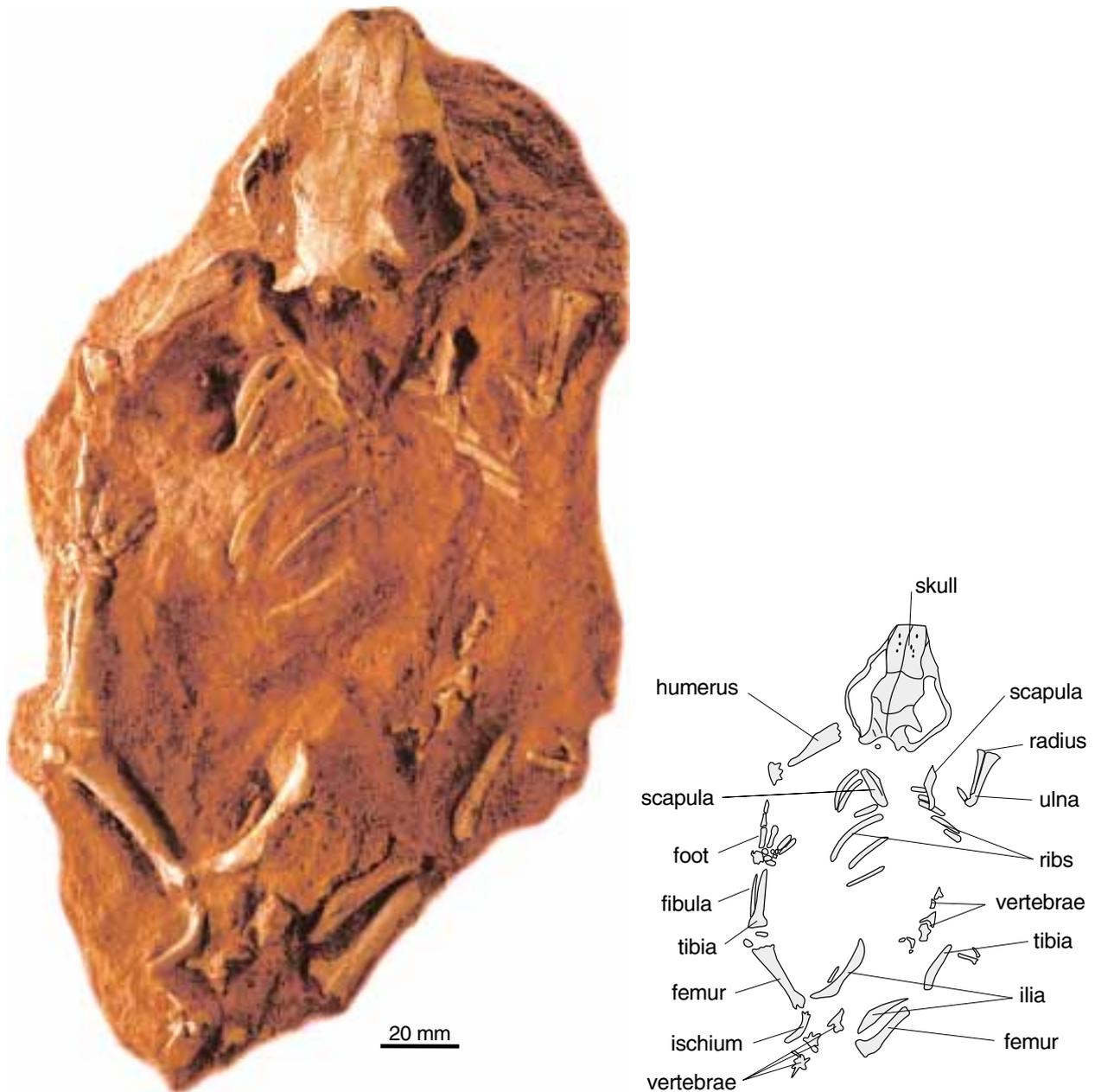


Fig. 1. *Catopsbaatar catopsaloides*, PM 120/107 from Hermin Tsav, Gobi Desert, Mongolia. **A.** The specimen as originally preserved, showing the skull in dorsal view and distorted postcranial skeleton associated with it. **B.** Explanatory drawing for the same.

the genera assigned at that time to the Taeniolabididae Granger and Simpson, 1929. Further investigations by Kielan-Jaworowska and Hurum (1997, 2001) led to erection of the family Djadochtatheriidae, within the superfamily Djadochtatherioidea, (which replaced their suborder Djadochtatheria). The Djadochtatherioidea belong to the suborder Cimolodonta McKenna, 1975.

Three important papers on the skull anatomy of two other djadochtatheriid genera have been published since 1994. Rougier et al. (1997) described an incomplete skull of a new, large djadochtatheriid genus *Tombaatar*, with a single species *T. sabuli*, from the locality of Ukhaa Tolgod in the Gobi Desert. Wible and Rougier (2000) offered a detailed description of the skull of *Kryptobaatar dashzevegi* Kielan-Jaworowska, 1970, based mostly on materials

collected by the Mongolian Academy-American Museum Expeditions at Ukhaa Tolgod and Tögrög Shiree. Smith et al. (2001) described a new species of *Kryptobaatar*, *K. mandahuensis*, from the Bayan Mandahu locality; Bayan Mandahu red beds (equivalent to the Djadokhta Formation), in Inner Mongolia (People's Republic of China), on the basis of several excellently preserved skulls.

**New data provided by PM 120/107.**—The family Djadochtatheriidae includes four genera: *Djadochtatherium* Simpson, 1925; *Kryptobaatar* Kielan-Jaworowska, 1970; *Catopsbaatar* Kielan-Jaworowska, 1994, and *Tombaatar* Rougier et al., 1997. Of these *Kryptobaatar* and *Catopsbaatar* are best known. The specimen of *C. catopsaloides* reported herein belongs to an old individual. Its skull (Fig. 2) is more complete than those previously known, al-

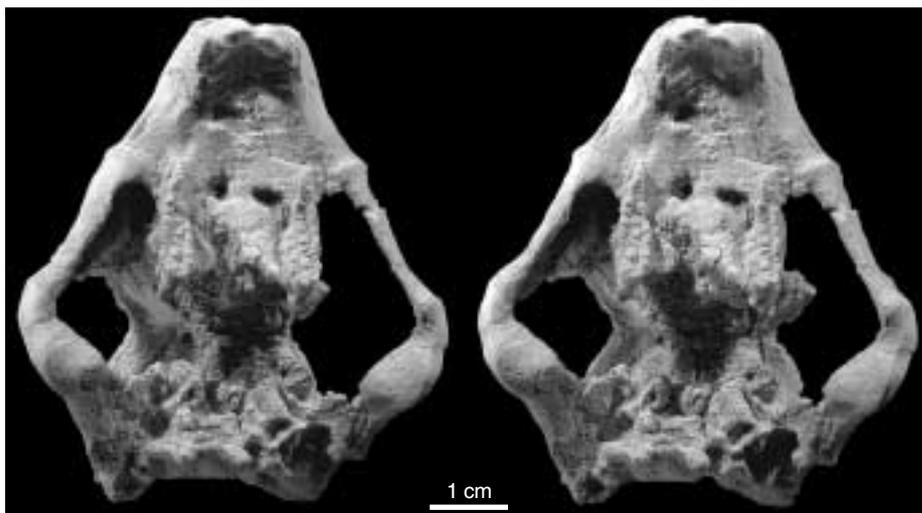


Fig. 2. *Catopsbaatar catopsaloides*, PM 120/107 from Hermin Tsav, Gobi Desert, Mongolia; stereo-photograph of the skull in ventral view.

though the right side of the basicranial region is strongly distorted. Comparison of its structure with other skulls in the ZPAL collection shows a high degree of individual variation. The length of the skull of PM 120/107 is 63 mm, while in the holotype specimen, which belongs to a juvenile individual and which lacks the posterior part, it is estimated as 53 mm. Also the number and distribution of vascular foramina in the nasals vary.

*Catopsbaatar* differs from *Kryptobaatar* and *Djadochtherium* (which is very poorly known) in having three rather than four upper premolars, the P2 being missing, and shares this character with *Tombaatar*. However, the P1 and P3 are proportionally smaller in *Catopsbaatar* than in *Kryptobaatar* and *Tombaatar*, and tend to be worn down and disappear in older specimens. In PM 120/107, of the anterior upper premolars, only a tiny, strongly worn right P3 has been preserved, the left P3 and both P1s being absent, and even their roots are not discernible (Fig. 2). Kielan-Jaworowska and Hurum (1997: fig. 10 I) reconstructed the shape of the naso-frontal suture as V-shaped in *Catopsbaatar*, with frontals deeply inserted between the nasals (as in *Kryptobaatar*). PM 120/107, however, shows that this is not the case (Fig. 1): the middle part of the naso-frontal suture in *Catopsbaatar* is subtransversely directed, showing a greater similarity to that of *Tombaatar* (Rougier et al. 1997: fig. 3). *Catopsbaatar* is only slightly smaller than *Tombaatar*, but differs from it distinctly in having the I3 alveolus formed exclusively by the premaxilla, rather than by both the premaxilla and maxilla, and in having a less prominent postpalatine torus. It also differs from *Tombaatar* (and from *Kryptobaatar*) in having relatively wider and more robust upper and lower molars, with greater numbers of cusps (there are 6:5:4 cusps on M1, 2:3:3 on M2, 4:4 on m1, and 2:2 on m2).

Further, *Catopsbaatar* differs from *Kryptobaatar mandahuensis* Smith et al., 2001 (but not from *K. dashzevegi* Kielan-Jaworowska, 1970; see also Wible and Rougier 2000) in having a straight middle part of the palato-maxillary suture, rather than one that is V-shaped. It differs from *Kryptobaatar* and *Djadochtherium* in having p4 relatively much smaller (shorter), with only three to five apical cusps and a postero-labial cusp, and lacking the ridges. *Catopsbaatar* differs further from *Kryptobaatar* in having the post-orbital process directed postero-laterally rather than transversally, and the lambdoidal crests directed postero-laterally in dorsal view of the skull. Because of this latter feature the posterior margin of the

skull (in dorsal view) is strongly incurved in the middle. One of the most characteristic features of *Catopsbaatar* (which differentiates it not only from *Kryptobaatar* but from all the djadochtherioids in which the zygomatic ridges are known), is a very deep anterior zygomatic ridge, and a small medial zygomatic ridge, the latter forming about a quarter of a circle and adhering the anterior one from behind (Gambaryan and Kielan-Jaworowska 1995: fig. 7B). In all other djadochtherioid taxa these ridges are separated from one another (*contra* Wible and Rougier 2000, who claimed that the two ridges in question are confluent in *Kryptobaatar*, but see Smith et al. 2001: fig. 6, and discussion therein).

The postcranial skeleton preserved in PM 120/107 includes fairly complete fore- and hind limbs (Fig. 1), which were not known previously in *Catopsbaatar* and are seldom preserved in multituberculates. A new character seen in the specimen (which rarely occurs in mammals) is a tiny sesamoid bone in the elbow joint (referred to in birds as the elbow patella; Barnett and Lewis 1958). The sesamoid found in the studied skeleton is not an artifact, as it is preserved in the same place in both right and left elbows. This bone has not been reported previously in any multituberculate skeleton.

We expect that detailed study of the skull and especially of the postcranial skeleton will provide new information on the structure of *Catopsbaatar* and relationships within the Djadochtheriidae.

**Acknowledgements.**—We thank Professors William A. Clemens and Mieczysław Wolsan for helpful comments on an earlier version of this manuscript, Isabel Elio Sainz de Vicuña for skilful preparation, Per Aas for taking the photograph in Fig. 1 and Marian Dziwiński for the photographs in Fig. 2.

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