NOTA PALEONTOLOGICA

A fragmentary theropod skull from the Middle Jurassic of Patagonia

Oliver W.M. RAUHUT\footnote{Bayerische Staatsammlung für Paläontologie und Geologie, Richard-Wagner-Straße 10, D-80333 München, Germany, and Museo Paleontológico Egidio Feruglio, Trelew, Argentina. o.rauhut@lrz.uni-muenchen.de}

Introduction

Jurassic dinosaurs from the Southern Hemisphere are still very poorly known, and this is especially true for theropod dinosaurs from the Middle to Late Jurassic. Only four valid taxa are currently known from this period of Gondwana, the Late Jurassic ceratosaur *Elaphrosaurus* from the Tendaguru beds of Tanzania, Africa (Janensch, 1920, 1925), the Middle Jurassic probable abelisauroid *Ozraptor* from western Australia (Long and Molnar, 1998; Rauhut, 2005a), and the Middle Jurassic basal tetanurans *Piatnitzkysaurus* (Bonaparte, 1979, 1986) and *Condorraptor* (Rauhut, 2005b) from the Cañadón Asfalto Formation, Chubut, Argentina. Of these, only *Piatnitzkysaurus* has some cranial material preserved (Bonaparte, 1986; Rauhut, 2004a).

Recent fieldwork in the Middle Jurassic (Callovian) Cañadón Asfalto Formation of Argentina has brought a wealth of new dinosaur material to light (Rauhut and Puerta, 2001; Rauhut et al., 2001), including a poorly preserved fragmentary theropod skull. This specimen was briefly mentioned by Rauhut (2002) as a possible ceratosaur, potentially representing the earliest known representative of this clade. However, further preparation demonstrated that this identification is not correct. The specimen is described and discussed in the present paper.

Institutional abbreviations. MACN, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina; MPEF, Museo Paleontológico Egidio Feruglio, Trelew, Argentina; PVL, Paleontología de Vertebrados, Fundación Miguel Lillo, Tucumán, Argentina.

Geological and palaeontological context

The specimen is derived from a series of strongly silicified limestones that pertain to the Cañadón Asfalto Formation, a unit of lacustrine sediments that mainly crops out along the upper course of the Chubut River (figure 1; Page et al., 1999). In the vicinity of Cerro Cóndor, this formation is dominated by often stromatolitic lacustrine limestones, marls, tuffs, and frequent conglomeratic intercalations (Tasch and Volkheimer, 1970; Cabaleri and Armella, 1999). The age of the formation is usually given as Callovian-Oxfordian (Tasch and Volkheimer, 1970; Page et al., 1999), though most parts of the formation are probably Middle Jurassic in age (Volkheimer, pers. com. 2002). Dinosaurs from the Cañadón Asfalto Formation have first been reported by Bonaparte (1979, 1986).

The specimen was found close to the microvertebrate locality "Queso Rallado", some 4 km WNW of the village of Cerro Cóndor, in a level slightly below the layers that have yielded a rich vertebrate fauna at that site, including amphibians, turtles, lepidosaurs, pterosaurs, sauropod dinosaurs, and mammals (Rauhut et al., 2001, 2002). The same level that yielded the specimen described here also yielded other vertebrate remains, including disarticulated elements of turtles, pterosaurs, and dinosaurs. Dinosaur remains from this site are often partially associated, but strongly compacted and incomplete, as is the case with the current specimen. Apart from the theropods *Piatnitzkysaurus* and *Condorraptor*, dinosaurs are otherwise only represented by sauropods in the Cañadón Asfalto Formation, including the genera *Patagosaurus*, *Volkheimeria*, and an undescribed taxon (Bonaparte, 1986; Rauhut, 2002).

Description

The specimen MPEF 1717 consists of the associated, badly crushed anterior parts of the left and right maxilla, parts of the nasals, and probably the palatines (figures 1-2), although the latter are too poorly preserved to say anything about their morphology.

The maxilla seems to have been rather short and high, although the posterior end of the bone is missing on both sides. The left maxilla has the anterior 142 mm of the alveolar border with seven tooth positions preserved. Thus, under the assumption that...
at least 15 tooth positions were present, as in other basal tetanurans (e.g. Madsen, 1976; Bonaparte, 1986), approximately half of the length of the bone is missing, indicating that the specimen is derived from a medium- to large-sized theropod.

The ascending process of the maxilla is very broad anteroposteriorly, has a steeply sloping anterior border and does not seem to be significantly offset from the anterior end of the maxillary body. The posterior base of the ascending process is situated just posterior to the fifth tooth position. The anterior end of the maxillary body has a simple butt-join for the contact with the premaxilla ventrally, and a well-developed anteromedial process situated at the dorsal corner of the anterior end. A very slight incision halfway between the process and the alveolar border might indicate the subnarial foramen. A narrow, elongate and transversely slightly concave facet runs along the lateral margin of the anterior side of the ascending process, indicating that the premaxilla had a long and slender posterior ascending process that extended for at least the ventralmost 30 mm along the anterior border of the ascending process. The base of the ascending process is approximately 70 mm wide in the right maxilla, 55 of which are covered by the antorbital fossa. The latter expands ventrally to some 20-25 mm above the alveolar border and its ventral border is only defined by a slight swelling on the lateral side. Anteriorly, the margin of the antorbital fossa flexes dorsally at an angle of approximately 90° and meets the anterior margin of the ascending process some 100 mm above the alveolar margin. At the base of the ascending process, the margin of the antorbital fossa is developed as a sheet of bone, which, however, does not overhang the promaxillary foramen as it is the case in many other theropods. Both a promaxillary foramen and maxillary fenestra are present. They are proportionally small, with the maxillary fenestra being less wide anteroposteriorly than the pila interfenestralis between this fenestra and the antorbital opening. The promaxillary foramen is a small, slit-like opening, which is separated from the much larger, oval maxillary foramen by a narrow, but stout pillar of bone.
Several large foramina are present above the tooth row on the lateral side of the maxillary body and some of these continue ventrally with a ventrally widening groove. In medial view, the teeth are held in place by large, pentagonal interdental plates, which are only slightly higher than long and clearly separated from each other. The preserved teeth show a pattern of alternating fully erupted and erupting teeth. The teeth are of moderate size, the largest being approximately as long as the height of the maxillary body below the antorbital fenestra. The teeth are pointed, recurved and have mesiodistally convex medial and lateral sides, without flattened area adjacent to the carinae as they are found in ceratosaurids (Rauhut, 2004b). Marginal serrations are present on the distal and the apical third to half of the medial carina. The denticles are proportionally small and chisel-shaped, with 14 denticles per 5 mm on the distal and 15 denticles per 5 mm on the mesial carina. Downpointing grooves at the bases of the denticles, as they are present in tyrannosaurids, for example (Currie et al., 1990), are absent.

Only what seems to be the anterior end of the right nasal is preserved. The nasal was a large, plate-like bone with a long and posterodorsally rapidly expanding downpointing process along the anterior rim of the ascending process of the maxilla. A large, supranarial depression seems to have been present on the anterior end of its main body, as in Sinraptor (Currie and Zhao, 1994).
Discussion

Although the steeply angled ascending process of the maxilla of MPEF PV 1717 is reminiscent of the situation seen in ceratosaurs (Novas, 1992; Lamanna et al., 2002), several characters reject the original identification of this material as ceratosaurian by Rauhut (2002). The specimen lacks the ceratosaurian synapomorphy of fused interdental plates and any synapomorphy of either ceratosaurids, such as strongly enlarged teeth (Rauhut, 2004b), or abelisauroids, such as striated interdental plates (Carrano et al., 2002). On the other hand, the specimen has a well-developed maxillary fenestra, which represents a tetanuran synapomorphy (Gauthier, 1986; Sereno, 1999; Holtz, 2000; Rauhut, 2003) and can therefore be referred to the Tetanurae. Thus, the oldest ceratosaurs known from South America remain the probable abelisaur Ligabues from the Hauterivian-Barremian La Amarga Formation of Neuquén, Argentina (Bonaparte, 1996; Coria and Salgado, 2000), and the ceratosaurid Genyodectes (Rauhut, 2004b) and an unidentified abelisaurid (Rauhut et al., 2003) from the Barremian-Aptian Cerro Barcino Formation of Chubut, Argentina.

Two taxa of basal tetanurans have been described from the Cañadón Asfalto Formation, Piatnitzkysaurus floresi (Bonaparte, 1979, 1986) and Condro-raptor currumili (Rauhut, 2005b). Cranial material, including maxillae, is only known for Piatnitzkysaurus (Fig. 3; Bonaparte, 1986), whereas Condro-raptor is known only from a fragmentary postcranial skeleton. The material described here differs from Piatnitzkysaurus in several characters. In the latter, the ascending process of the maxilla is not as steeply angled and more strongly convex anteriorly (figure 3; PVL 4073, MACN CH 895; Bonaparte, 1986). Furthermore, the maxillary fenestra of Piatnitzkysaurus seems to be proportionally larger and the promaxillary fenestra is hidden in lateral view by a bony lamina that forms the anterior border of the antorbital fossa (PVL 4073, MACN CH 895). The posterior margin of the ascending process of the maxilla is situated above the eighth tooth position in Piatnitzkysaurus (Fig. 3; Bonaparte, 1986), whereas it is more anterior, above the fifth alveolus, in the present specimen. There is also no indication of the significant inflation of the base of the ascending process that is diagnostic for Piatnitzkysaurus (Rauhut, 2003). A further difference is the lack of downpointing grooves at the bases of the denticles in the teeth of the specimen described here, whereas such grooves are present, though not very well developed, in the preserved teeth of both maxillae and the mandible known for Piatnitzkysaurus (PVL 4073, MACN CH 895; Rauhut, 2005b). Therefore, the specimen cannot be referred to Piatnitzkysaurus and thus represents further evidence for the presence of a second taxon of basal tetanurans in the Cañadón Asfalto Formation. Under the assumption that no more than two medium- to large-sized basal tetanurans were present in the Cañadón Asfalto Formation, the specimen MPEF PV 1717 may be referable to Condro-raptor and might thus represent the first evidence of the cranial anatomy of this taxon.

Acknowledgements

I thank P. Puerta, who found the specimen, and J. Carballido for the excellent preparation of this difficult, poorly preserved material. A. López-Arbarello is thanked for discussions and critical reading of the manuscript, and R. Coria helped with critical comments on the manuscript. The fieldwork was supported by BBC/Horizon and a DAAD fellowship, and this work is part of the German Research Foundation (DFG) project RA 1012/1-1.

References


Recibido: 1 de diciembre de 2004.
Aceptado: 8 de junio de 2006.