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Dinosaurs of Romania

Dinosaures de Roumanie

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Abstract

The dinosaurs of Romania are exclusively Cretaceous. Lowermost Cretaceous dinosaurs come from a bauxite mine in the Bihor county (northwest Romania) that has yielded thousands of disarticulated bones. Uppermost Cretaceous dinosaurs have been known from the Haţeg Basin (south Transylvania) since the end of the 19th century, mostly as bone concentrations ('fossiliferous pockets'); more recently, nests with dinosaur eggs, including hatchlings, have been found in Haţeg. Although separated by a ca 60 Myr gap, the two dinosaur faunas from Romania share some common features: predominance of ornithopods, absence of large theropods (substituted in the case of the Maastrichtian Haţeg assemblage by several small theropods), and, in general, the small size of the individuals (dwarfism). These aspects seem to be explained by the isolated island habitat of both assemblages. ***To cite this article: D. Grigorescu, C. R. Palevol 2 (2003) 97–101.***

Résumé

Les dinosaures de Roumanie sont connus exclusivement au début et à la fin du Crétacé. Les dinosaures du début du Crétacé proviennent d'une mine de bauxite du département de Bihor (Nord-Ouest de la Roumanie), qui a fourni des milliers d'os désarticulés. Les dinosaures du Crétacé final sont connus depuis la fin du XIX^{e} siècle dans le bassin de Haţeg (Sud de la Transylvanie), particulièrement dans des zones de concentration d'os (« poches fossilifères ») ; plus récemment, des nids avec des œufs de dinosaures et des os de juvéniles ont été trouvés à Haţeg. Même si elles sont séparées par un hiatus d'environ 60 Ma, les deux faunes de dinosaures de Roumanie possèdent des caractéristiques communes : la prédominance des ornithopodes, l'absence de grands théropodes (remplacés dans le Crétacé terminal de Haţeg par un ensemble de petits théropodes) et, en général, la taille très petite des individus. Ce cas de nanisme, commun aux deux faunes, semble être lié à des conditions d'isolement dans les îles dans lesquelles les deux associations de dinosaures ont vécu. ***Pour citer cet article : D. Grigorescu, C. R. Palevol 2 (2003) 97–101.***

Keywords: dinosaurs; Romania; Cretaceous

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1. Introduction

Dinosaurs are known from Romania at both ends of the Cretaceous period: in the Lowermost Cretaceous, bauxite deposits of the Western Carpathians and in the Uppermost Cretaceous fluvio-lacustrine deposits of the Haţeg Basin and other regions of southern and western Transylvania (Fig. 1).

The discovery of dinosaur bones in a bauxite mine at Cornet, near Oradea (Bihor County) was made accidentally by two miners in 1978 during ore exploitation. Almost at the same time, research in the already known Uppermost Cretaceous dinosaur-bearing deposits from the Haţeg Basin were restarted by Dan Grigorescu, after an interruption of more than 60 years, since Franz Nopcsa's work in the region.

2. The Earliest Cretaceous dinosaurs of Romania

The bauxite deposits at Cornet have yielded ca 10 000 bones and bone fragments, mainly from ornithopod dinosaurs and rarer pterosaurs. Evidence of small carnivorous dinosaurs and birds was also reported, but at least some of the bird remains are questionable. The bones are concentrated in a 3-m-thick lens of a brown-red, structureless bauxite rich in calcite and coarse detrital material. Most of the bones are found in a 0.6-m-thick band from the middle part of this lens, known in the mining geology of the region as 'lens 204' [18]. This is one of the several hundred bauxite lenses in the Western Carpathians that have been exploited for aluminium. According to its geometric position between two cycles of marine limestones (the underlying one of Tithonian-Early Berriasian age, the overlying one of Early Barremian age, the latter being preceded by brackish-water limestones with cerithid gastropods suggesting a Hauterivian age), the age of the fossiliferous bauxite is between Middle Berriasian and Upper Valanginian [6].

The bauxite in the region represents the weathering products of the Tithonian limestones uplifted at the end

Fig. 1. Map of Romania, showing the main localities that provided dinosaurs remains: Cornet and Cochirleni (Early Cretaceous) and Haţeg Basin (Latest Cretaceous).

Fig. 1. Carte de Roumanie, avec les plus importants sites fossilifères renfermant des dinosaures : Cornet et Cochirleni (Crétacé inférieur) et bassin de Haţeg (Crétacé final).

of the Jurassic. The material evolved diagenetically from a 'terra-rosa' type of sediment, washed into the fissures and caves of the karst relief formed during subaerial exposure of the limestones. Most of the bones are abraded and their sizes are generally uniform, evidence for considerable transport by streams before concentration in the karstic voids. Of the ten thousand bones 65% are vertebrae, phalanges and metapodials and only 10% are fragments of long limb bones, skulls and teeth; the remaining 25% are undetermined remains.

Bone fossilization in bauxite is very rare in the world; a similar case is known from Hungary at Boszorkány hegy, where a crocodilian tooth and a few bone fragments were found in a Mid-Cretaceous (Albian) bauxite [17]. The removal of bones from the hard bauxite matrix is very difficult and time-consuming. Most of the bone preparation was done mechanically using vibrating needle drills, because chemical treatments by acids were fruitless.

The material was studied and presented in several papers by T. Jurcsák and co-workers E. Popa and E. Kessler, all from the Museum in Oradea [10–16] and by D. Patrulius et al. [20], and by F. Marinescu [19]; E. Posmoşanu-Tallodi is preparing a doctoral thesis on the ornithopods from Cornet.

The bone assemblage from Cornet is dominated by ornithopod dinosaurs, represented by a small species of a camptosaurid and the dryosaurid *Valdosaurus* [2]. Previously Jurcsák and Kessler [11] identified specimens of *Hypsilophodon* and *Valdosaurus* as well as the iguanodontids *Iguanodon* and *Vectisaurus*. Patrulius et al. [20] assigned the ornithopod remains to *Camptosaurus* and *Iguanodon*; later, Marinescu [18] created, on the basis of the material studied by Patrulius et al., a new species of iguanodontid, *Bihariosaurus bauxiticus*, which is regarded as a *nomen nudum*, because it lacks the diagnostic characters of this family [2].

Other dinosaurs in the assemblage include a nodosaurid ankylosaur, represented by an armour spine, a few flattened metapodials, and a small, undetermined theropod. The only unequivocal remains of this are two sharp ungual phalanges from a small predator. The isolated theropod teeth that are common in many dinosaur-bearing deposits are missing, but traces of carnivore activity are obvious in the form of tooth marks present on several vertebrae and phalanges [21].

The presence of theropods in the Early Cretaceous of Romania is better documented by a well-preserved, large dinosaur tooth, found in the opposite corner of Romania, at Cochirleni (Fig. 1). The tooth was included in marine limestones of Valanginian age. It was identified as *Megalosaurus dunkeri* Kohen by Simionescu [22].

The second most frequent group in the bauxite from Cornet, after the ornithopods, is that of the pterosaurs. The 'flying reptiles' seem to be represented by three taxa, but the only identified genus is *Dsungaripterus*, known otherwise only from China [2,12]. A fragment of its snout suggests a skull length of 0.4 m. while the estimated wingspan is ca 3 m, smaller than the Chinese specimens. The other two pterosaurs are tentatively assigned to *Gallodactylus* and to an unidentified ornithocheirid. The humeri are very small (50–60 mm in length), suggesting wingspans of 0.7–1 m, smaller than other Early Cretaceous pterosaurs.

Scientific interest in the faunal assemblage from Cornet is increased by the supposed bird remains. These were studied by Kessler [13] and Kessler and Jurcsák [14–16], who identified, on the basis of a few limb bones, three species: *Archaeopteryx sp.*, *Palaeocursornis biharicus*, a flightless ratite and *Eurolimnornis corneti*, a grebe-like bird. The avian identification of the corresponding bones is still controversial for some authors, but some others have supported it [3]. If the identification of bird specimens is correct, the avifauna from Cornet is very important, because it includes three bird taxa from the Early Cretaceous, a time otherwise known for its rare avian record; among these three species, two might represent the oldest palaeognath (*Palaeocursornis biharicus*) and the oldest neognath *(Eurolimnornis corneti)*.

3. The Latest Cretaceous dinosaurs of Romania

The first known discovery of dinosaurs in Romania precedes by 82 years the finds from the Lowermost Cretaceous bauxite deposits of western Carpathians. This was made by the younger sister of Franz Nopcsa, the well-known palaeontologist, on the family estate from the Haţeg county. Although he was not the first discoverer, Franz Nopcsa studied for most of his life the dinosaurs and other associated fossil vertebrates in the Uppermost Cretaceous fluvio-lacustrine deposits of Haţeg and of other regions of Transylvania. The

fossiliferous deposits were assigned by Nopcsa to the latest stage of the Cretaceous, considered until the early 1960s to be the Danian, which afterwards became the first stage of the Tertiary.

The dinosaurs in the Nopcsa's palaeontological list [19], with subsequent revisions, include two sauischians: a sauropod (*Magyarosaurus dacus*) and a theropod (*Megalosaurus hungaricus*) and three ornithischians: two ornithopods (*Rhabdodon priscus*, apparently related to iguanodontids, and a duck-billed dinosaur *Telmatosaurus trans sylvanicus*) together with a nodosaurid ankylosaur (*Struthiosaurus transylvanicus*). Other reptiles in Nopcsa's list from Transylvania include turtles (*Kallokibotion bajazidi*), crocodilians (*Allodaposuchus precedens*), and a small pterosaur (cf. *Ornithodesmus*).

After the long gap that followed Nopcsa's studies in Transylvania, research in the last 20 years has added new taxa, including dinosaurs, but mostly other fossil vertebrates, including representatives of all major vertebrate clades from fishes to mammals, the last ones represented by different species of multituberculates. The newly discovered dinosaurs are the small theropods. Nopcsa's presumed predator *Megalosaurus hungaricus* was not confirmed, but instead, several types of small theropods were identified, including some taxa that were previously described as birds from Nopcsa's collection housed in the Museum of Natural History in London: *Elopteryx nopcsai* [1], *Bradycneme draculae* and *Heptasteornis andrewsi* [9]. Other small theropod remains were found more recently in the Haţeg Basin; they consist mainly of isolated teeth. Based on their morphology, several distinct taxa were recognized: a velociraptorine dromaeosaurid and a peculiar small theropod (*Euronychodon*) with sharp, unserrated carinae on the tooth margins [5]. To avoid further possible confusion, the taxa were not named so far. As a general remark, the diversity of the small theropods in the Haţeg fauna seems to substitute for the absence of a large predator at the top of the food pyramid.

By far, the most spectacular discoveries of the last two decades in the Haţeg Basin were the clutches with dinosaur eggs and some diagnostic remains of one of the largest pterosaurs in the world.

The first dinosaur eggs were found in 1988 in Tuştea within the middle member of the Densuş–Ciula Formation, a distinct lithostratigraphic unit among the dinosaur-bearing deposits of the Haţeg Basin [7,8]. Four to six subspherical eggs, up to 18 cm in diameter, apparently disposed in curved rows, were found in each one of the few, closely spaced nests. The eggshell microstructure, their thickness, external and internal morphologies correspond to the *Megaloolithidae* Zhao parafamily. A few fragments of limb bones from hatchlings of the hadrosaurid *Telmatosaurus trans sylvanicus* were found within the nest area. Recently, several clutches with similar dinosaur eggs were also discovered within the other lithostratigraphic unit of the non-marine Maastrichtian from the Haţeg Basin, the Sânpetru Formation.

The giant pterosaur in a 'world of dwarf dinosaurs', as the assemblage of dinosaurs from Haţeg is surnamed, is represented by a fragmentary humerus and large skull bones: the occiput and part of the palate, including parts of the right pterygoid, quadrate, quadratojugal and jugal, with the typically pterosaurian helical jaw articulation. The remains were found at Vălioara within the middle member of the Densuş–Ciula Formation. The humerus dimensions suggest that the wingspan was of at least 12 m, equal to if not larger than that of *Quetzalcoatlus northropi*. The skull was about 50–cm wide at the level of the jaw articulation, which by comparison with other pterosaur skulls suggests a total length of about 3 m – one of the largest skulls in any non-marine vertebrate. According to Buffetaut, Grigorescu and Csiki [4], the pterosaur represents a new taxon of the Azhdarchidae family – *Hatzegopteryx thambema.* The robustness of the bones was counterbalanced by a peculiar inner structure, in which the elongated empty spaces were separated from one another by a dense network of extremely thin bony trabeculae. This bone microstructure was probably the key element in making flight possible.

4. Some common aspects of the two assemblages with dinosaurs from the Cretaceous of Romania

Although the two assemblages of dinosaurs from the Cretaceous of Romania are separated by a long gap of ca 60 Myr, they share some interesting common features. (1) Remains of ornithopod dinosaurs far outweigh those of all the other taxa in both assemblages; specifically the undetermined camptosaurid and *Valdosaurus* dominated the Cornet fauna, while the primitive ornithopod *Rhabdodon* (which at the beginning was also assigned by Nopcsa to camptosaurids) and the

hadrosaurid *Telmatosaurus*, together with the sauropod *Magyarosaurus* were the most common elements in the Haţeg fauna. (2) Large theropods are missing in both assemblages. The rarity of theropod remains is extraordinary in the case of the Cornet fauna, where only two phalanges among the 10 000 isolated bones from the bauxite deposits were assigned to small theropods. As regards the Haţeg fauna, the relatively large number of small theropods, including a velociraptorine dromaeosaurid and a euronychodontid(?), seems to replace the top predator at the top of the food pyramid [5]. (3) The dinosaur individuals of the two faunas were dwarfs, regardless of the taxonomic group to which they belong. As a few examples, the camptosaurid from Cornet had a body mass of one third or one quarter of other family members from Europe or North America [2], while the Latest Cretaceous hadrosaur *Telmatosaurus* from Haţeg was only about one-tenth of the body mass of typical hadrosaurs from elsewhere [23]. Dwarfing as a biological phenomenon is a common feature for tetrapods living on islands [24]. According to palaeogeographic reconstructions, both faunas lived on large islands of the northern Tethys, which emerged during the regression phases from the end of the Jurassic and from the end of the Cretaceous, respectively.

References

[1] C.W. Andrews, On some bird remains from the Upper Cretaceous of Transylvania, Geol. Mag 5 (1913) 193–196.

[2] M.J. Benton, E. Cook, D. Grigorescu, E. Popa, E. Tallodi, Dinosaurs and other tetrapods in Early Cretaceous bauxite–filled fissures, northwestern Romania, Palaeogeogr. Palaeoclimatol. Palaeoecol 130 (1997) 275–292.

[3] W.J. Bock, P. Bühler, Nomenclature of the Cretaceous birds from Romania, Cretac. Res 17 (1996) 509–514.

[4] E. Buffetaut, D. Grigorescu, Z. Csiki, A new giant pterosaur with a robust skull from the latest Cretaceous of Romania, Naturwissenschaften 89 (2002) 180–184.

[5] Z. Csiki, D. Grigorescu, Small theropods from the Late Cretaceous of the Haţeg Basin (Western Romania) - an unexpected diversity at the top of the food chain, Oryctos 1 (1998) 87–104.

[6] D. Grigorescu, Nonmarine Cretaceous of Romania, in: N.J. Mateer, Pei-Ji Chen (Eds.), Aspects of Nonmarine Cretaceous Geology, China Ocean Press, Beijing, 1993, pp. 142–164.

[7] D. Grigorescu, M. Şeclăman, D.B. Norman, D.B. Weishampel, Dinosaur eggs from Romania, Nature 346 (6283) (1990) 417.

[8] D. Grigorescu, D. Weishampel, D. Norman, M. Şeclăman, M. Rusu, A. Baltreş, V. Teodorescu, Late Maastrichtian dinosaur eggs from the Haţeg Basin (Romania), in: K. Carpenter, K.F. Hirsch, J.R. Horner (Eds.), Dinosaur eggs and babies, Cambridge University Press, Cambridge, UK, 1994, pp. 75–87.

[9] Harrison C.J.O., Walker C.A., The Bradycnemidae, a new family of owls from the Upper Cretaceous of Romania, Paleontology 18 (3) (1975) 563–570.

[10] T. Jurcsák, Occurrences nouvelles des sauriens mésozoiques de Roumanie, Vertebr. Hung. 21 (1982) 175–184.

[11] T. Jurcsák, E. Kessler, The Lower Cretaceous paleofauna from Cornet, Bihor county, Romania, Nymphaea 21 (1991) 5–32.

[12] T. Jurcsák, E. Popa, Pterosaurians from the Cretaceous of Cornet, Romania, in: W.E. Reif, F. Westphal (Eds.), Third Symposium on Mesozoic Terrestrial Ecosystems, Short Papers, Attempto, Tübingen, Germany, 1984, pp. 117–118.

[13] E. Kessler, Lower Cretaceous birds from Cornet, Romania, in: W.E. Reif, F. Westphal (Eds.), Third Symposium on Mesozoic Terrestrial Ecosystems, Short Papers, Attempto, Tübingen, Germany, 1984, pp. 119–121.

[14] E. Kessler, T. Jurcsák, Fossil birds remains in the bauxite from Cornet (Pădurea Craiului Mountains, Romania). 75 years of the Laboratory of Paleontology, University of Bucharest, Romania, Special Volume, 1984, pp. 129–134.

[15] E. Kessler, T. Jurcsák, Fossil bird remains in the bauxite from Cornet (Bihor county, Romania), Trav. Mus. Hist. Nat. Grigore Antipa, Bucharest 25 (1984) 393–401.

[16] E. Kessler, T. Jurcsák, New contributions to the knowledge of Lower Cretaceous bird remains from Cornet (Romania), Bucharest, Trav. Mus. Hist. Nat. Grigore Antipa 28 (1986) 290–295.

[17] M. Kretzoi, J. Noszky, Saurius fog a bakonyi bauxitképzödményböl, Földt. Közl. 81 (1951) 333.

[18] F. Marinescu, Lentila de bauxită 204 de la Brusturi-Cornet (jud.Bihor), zăcământ fosilifer cu dinozauri, Ocrotirea Naturii şi Mediului înconjurator 33 (1989) 125–133.

[19] F. Nopcsa, On the geological importance of the primitive reptilian fauna in the Uppermost Cretaceous of Hungary, Quart. J. Geol. Soc. Lond. 74 (1923) 100–116.

[20] D. Patrulius, F. Marinescu, A. Baltreş, Dinosauriens ornithopodes dans les bauxites néocomiennes de l'unité de Bihor (monts Apuseni), Anuarul Institutului de Geologie şi Geofizică al României 59 (1983) 109–117.

[21] E. Posmoşanu, E. Cook, Vertebrate taphonomy and dinosaur paleopathology from a Lower Cretaceous bauxite-filled fissure, North-West Romania, Oryctos 3 (2000) 39–51.

[22] I. Simionescu, Megalosaurus aus der Unterkreide der Dobrogea (Rumänien), Zentralbl. Mineral. Geol. Paläontol 21 (1913) 111–112.

[23] D.B. Weishampel, D.B. Norman, D. Grigorescu, The dinosaurs of Transylvania: island biogeography in the Late Cretaceous, Natl Geogr. Res. & Explor. 7 (2) (1991) 196–215.

[24] M. Williamson, Island Populations, Oxford University Press, Oxford UK (1981).