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The First Carnosaur (Saurischia; Theropoda) from Japan: A Tooth from the Cenomanian Mifune Group of Kyushu

by

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Abstract. A tooth described herein represents the first discovery of an indisputable theropod, in Japan in 1979, which has been followed by late discoveries of dinosaurs in Kyushu and other parts of Japan. The tooth is uniquely characterised by an elongated but very thin crown, which suggests an as yet unrecognized group of theropods.

Introduction

Ever since the discovery of *Nipponosaurus sachalinensis* on the island of Sakhalin (Nagao, 1936), both professional paleontologists and amateur enthusiasts of Japan have scoured the possible dinosaur-bearing strata of the Japanese Archipelago in search of dinosaurian remains. A second discovery was made on Taka-shima island, off Kyushu, the opposite end of the archipelago, in 1962. Identified as an ? edmontosaurid, the specimen was mentioned during a meeting of the Palaeontological Society of Japan (Takai 1962), but has yet to be described.

The first indisputable discovery of dinosaur remains from Kyushu came from the western part of Kyushu, west of Mt. Aso, a famous volcano. A tooth of a mediumsized carnosaur was recovered in 1979 from Kami-Umeki, Mifune-cho, Kamimashiki-gun, Kumamoto Prefecture (130°51′E, 32°42′N) by a six-years old boy, Norio Wasada who was there collecting molluscan fossils with his father, Kousaku Wasada. Norio found a rock containing the tooth and brought it to his father, saying "Dad, it is not a shell. It's something different". The locality is within the lower portion of the Mifune Group of Cenomanian age. The specimen

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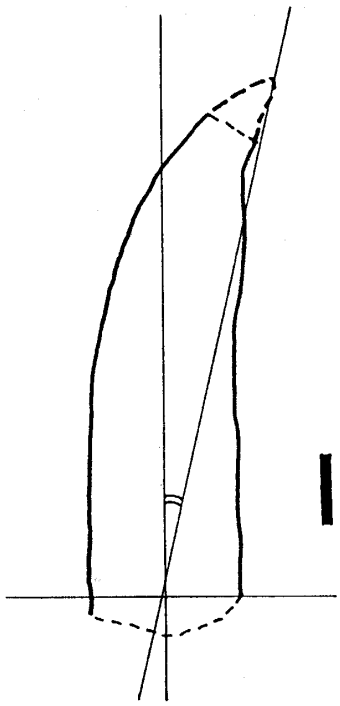

Figure 1: The degree of recurvature

was brought to one of us, Murata, who later forwarded it to Dr. Teruya Uyeno at the National Science Museum. Uyeno took the specimen to Hasegawa who identified it as a theropod tooth. Hasegawa assigned the tooth to Megalosauridae gen. et sp. indet. (Hasegawa and Murata 1981). For the general public, the tooth was given a Japanese name, "Mifune-ryu" : "Mifune", for the name of the geologic unit which yielded the specimen and "ryu" meaning a dragon in Japanese.

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Abbreviations

BMNH: British Museum of Natural History, London, UK.
IVPP: Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, 28, People's Republic of China.
NSM PV: National Science Museum, Tokyo, 169, Japan.
YNUGI: Geological Institute, Faculty of Education, Yokohama National University, Yokohama, 240, Japan.

Geological Setting

YNUGI 10003 was found in Kami-Umeki, Mifune-cho, Kamimashiki-gun, Kumamoto Prefecture. The locality is in a brackish to marine sandstone in the lower section (Cenomanian) of the Mifune Group. The Mifune Group is within a chain of several Cretaceous basins running SW to NE along the Usuki-Yatsushiro Tectonic Line of central Kyushu. There are three major sedimentary packages to the north of the tectonic line, the Goshonoura, Mifune, and Onogawa Groups from west to east. The first two are believed to form a continuous large basin, and the latter is a separate one. The Goshonoura and Mifune groups were reconstructed as a bay stretching from WSW to ENE, representing shallow ocean to inland environments (Matsumoto, 1939).

The Mifune Group overlies the Kiyama metamorphic rocks and the Permian Mizukoshi Fornation. The Mifune Group consists of three formations: the basal, lower, and upper. The basal unit is conglomerates and red sandstones, the lower a neritic and partly brackish sandstone and sandy shale interbedded with coal, and the upper predominantly red silts intercalated with tuffite and sandstone. The Mifune basin sediments are no less than 1500m thick (Matsumoto, 1939). The red beds in the basal and upper formations represent an arid inland basin. The carnosaur tooth came from the lower formation sandstone, where a brackish to shallow marine environment is indicated by the occurrence of *Matsumotoa japonica* and *Pseudoasaphis* sp. (Matsumoto, 1939). The lower formation is dated as mid Cenomanian on the basis of *Inoceramus concentricus* (Tamura *et al.*, 1974) and

Eucalycoceras cf. *spathi* (Matsumoto *et al.*, 1982).

Systematics

Class Reptilia Linnaeus, 1758
Order Saurischia Seeley, 1887
Suborder Theropoda Marsh, 1891
Infraorder Carnosauria Huene, 1920
Family Megalosauridae Huxley, 1869
?Megalosauridae gen. et sp. indet.

Specimen No.: YNUGI-10003
Locality: Kami-Umeki, Mifune-cho, Kamimashiki-gun, Kumamoto Prefecture.
Formation: The lower formation of the Mifune Group.
Age: Cenomanian.
Material: A long-crowned tooth, lacking the root.
Collector: Norio Wasada, 1979

Description

Tooth (Plate 1): Isolated crown of a laterally compressed, slightly recurved tooth with serrated mesial and distal edges. The crown is long, tooth crown heigft (TCH): 72.7mm, and narrow, tooth basal width (BW): 12.3mm. fore-aft basal length (FABL) is 22.5mm. Recurvature is slight (approximately 13°, Figure 1). The fore and after edges are nearly parallel and straight for almost half of the tooth's length. It is only in the distal half of the tooth that curves and tapers. The cross section at the base is nearly oval, lacking the figure 8 cross section noted in *Deinonychus* by Ostrom (1969). The amount of lateral compression suggests that it is a lateral tooth (Figure 2). When viewed along the anterior edge, the tooth appears slightly bowed so that the tip is not only directed distally, but also lingually. The posterior carina appears to divide the tooth into two equal halves, while the anterior carina divides the tooth asymmetrically, the labial half appearing more rounded and the lingual flattened. It suggests that the tooth is from either the left dentary or the right maxilla. The serrations of the anterior carina go far down the tooth, which would make it likely to be maxillary (Philip Currie, personal communication, 1992). The size and shape of the tooth suggest it is from the front half of the right maxilla (Philip Currie, *ibid*). No distinct wear facets are observed.

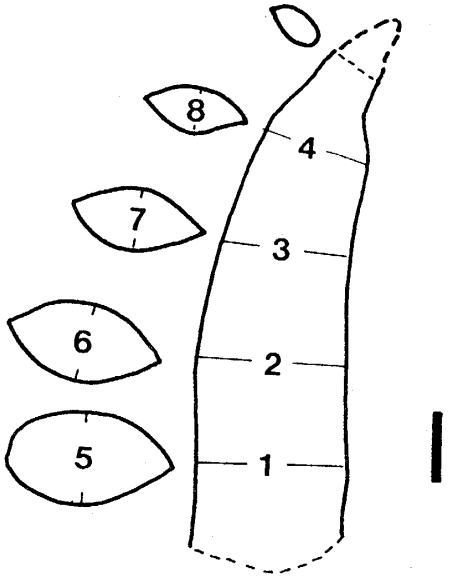

Figure 2: Cross section views of YNUGI 10003. Keys: 1=22.5mm; 2=21mm; 3=18.5mm; 4=14mm; 5=12mm; 6=10mm; 7=9mm; 8=6.5mm.

There are approximately 20 serrations per 5mm along both anterior and posterior edges. The serration counts were made at approximately one third of the way along from the tip on the posterior edge and near the tip on the anterior edge. Chandler (1990) has suggested taking serration counts along the middle of the keels because the denticles tend to be the largest there, but those of the present specimen are more distinct near the tip. Due to the poor preservation of the specimen, a serration count along the middle of the crown was not possible. As both anterior and posterior keels are rather battered, the morphology of denticles is not clear in detail. Along the posterior serrations, blood grooves are clearly seen but crinkles are not distinct.

An unusual character of the tooth is that it possesses an extremely long crown in relation to its lingual-labial width. The tooth basel width/tooth crown height, BW/TCH, ratio is 0.17 in comparison to 0.35 in *Allosaurus* and 0.30 in *Tyrannosaurus* for specimens of similar lengths (Chandler, 1990).

Discussion

There are no described theropod teeth with such a crown to our knowledge. Three comparable specimens are: ?*Megalosaurus bucklandii* (NSM PV 15071), *Megarosaurus hesperis* (BMNH R332), and *Gasosaurus constructus* (IVPP V 7265-3).

The closest morphologically are undescribed teeth with a partial maxilla identified as ?*Megalosaurus bucklandii* (NSM PV15071) from Shanxi Province, China (no stratigraphic data). The crown is 67 mm in TCH; 12 mm in BW; 18 mm in FABL; 12° in recurvature; 0.18 in BW/TCH; 10 serrations per 5 mm (estimated from photos).

The next closest is *Megalosaurus hesperis* (BMNH R332) from the Upper Oolite (Bajocian) of Dorset, England. The second tooth in the right dentary is similar in morphology. Its crown is 34 mm from the tip to the base of the enamel; 11 mm in BW; 15 mm in FABL; 10° in recurvature; 0.32 in BW/TCH. There are approximately 10 serrations per 5 mm.

Gasosaurus constructus (IVPP V7265-3) is from the Middle Jurassic of Dashanpu, Zigong, Sichuan Basin, China (Dong and Tang, 1985). The similarity between *Gasosaurus* and YNUGI 10003 is not perfect: *Gasosaurus* teeth are much smaller; approximately 40 mm in TCH; 8 mm in BW (estimated from photos); 17 mm in FABL; 12° in recurvature; 0.2 in BW/TCH; 14-15 serrations per 5 mm.

We do not think that are enough characters to verify the taxonomic assignment of ?*Megalosaurus bucklandii* (NSM PV 15071). The taxonomic positions of *Magalosaurus hesperis* and *Gasosaurus constructus* are uncertain (Molnar *et al,* 1990) although they are most often classified as megalosaurids. Kurzanov (1989) lists seven families in the infraorder Carnosauria: Megalosauridae, Torvosauridae, Spinosauridae, Streptospondylidae, Abelisauridae, Allosauridae, and Tyrannosauridae. *Megalosaurus hesperis* and *Gasosaurus constructus* are classified as megalosaurids in this scheme. Most of the genera in the Megalosauridae, however, are represented by incomplete materials and possess a mosaic of characters commonly encountered throughout the Carnosauria. Molnar *et al.* (1990) list nine characters to diagnose the Carnosauria. They then subdivide the group into the Allosauridae and Tyrannosauridae, leaving the rest as Carnosauria *incertae sedis*. *Megalosaurus hesperis* and *Gasosaurus constructus* are classified in this last group as a possible carnosaur. Needless to say, none of the nine characters listed is applicable to an isolated tooth like YNUGI 10003.

In a recent review of the theropod dinosaur lateral teeth (Farlow *et al,* 1991), BW/TCH measurments are unavailable, which might have demonstrated the uniqueness of YNUGI 10003. The described specimen shows a departure from the Upper Cretaceous teeth in Farlow *et al.* (1991) in the following measurements: the

relationship between tooth crown height and tooth fore-aft basal length and that between the anterior keel serration density and tooth fore-aft basal length.

Conclusions and Summary

The carnosaur tooth from the lower Upper Cretaceous Mifune Group represents the first indisputable dinosaur from Kyushu* and the first theropod discovered from the Japanese Archipelago.

The tooth is uniquely characterized by an elongated crown. Nothing like it has ever been reported as far as we know. We regard however the present material as insufficient to define a new taxon. We also believe that the practice of giving genus and/or species designations to isolated theropod teeth is untenable. As has been discussed, the systematics of the Carnosauria are yet to be resolved. For these reasons, the specimen is here preliminary classified as ?Megalosauridae gen. et sp. indet. because of its similarity to the teeth of ?*Megalosaurus bucklandii, M. hesperis,* and *Gasosaurus constructus.* We do however have reservation in assigning a late Cretaceous carnosaur to the Megalosauridae, otherwise typically a Jurassic family.

* A tooth from the Lower Cretaceous Kwanmon Group of northern Kyushu has been reported (Okazaki, 1992). It was discovered in 1990 and, therefore, it is the second theropod from Kyushu. The tooth is only a fragmentary portion of the crown, it has an elongated base (FABL=32.9 mm and BL=10.4 mm, Okazaki, 1992), and much finer serrations approximately 30 serrations per 5 mm, estimated from plate 1, OKAZAKI, 1992 (his serration count, p. 88, does not seem to be correct). and is significantly different from YNUGI 10003.

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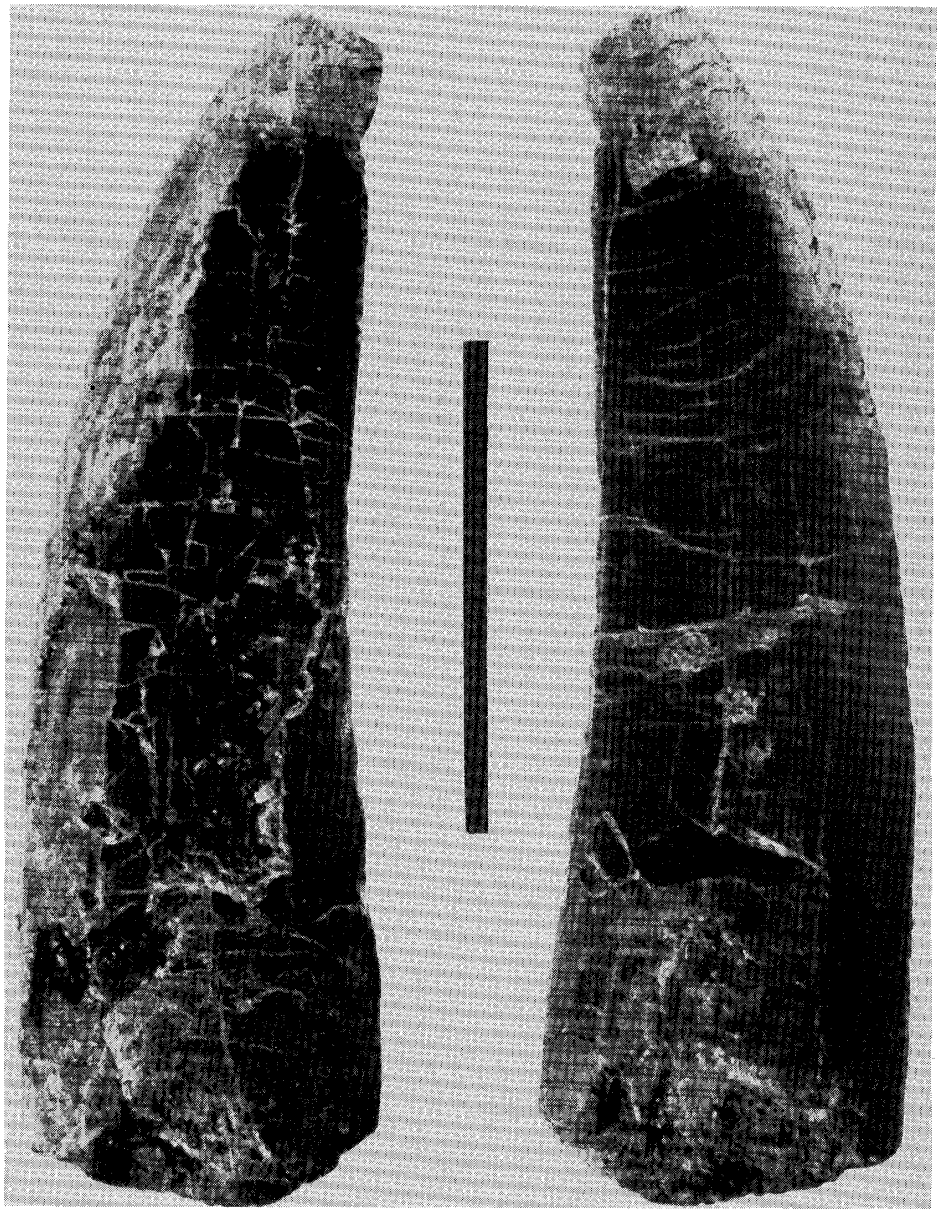

Plate 1. First Carnosaur "Mifune-ryu" ; YNUGI 10003 in labial (left) and lingual (right) views. Scale: 3cm.