

A Bony-Toothed Bird from the Middle Miocene, Chichibu Basin, Japan

By

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Abstract A complete quadrate of the bird order Odontopterygiformes was collected from a Middle Miocene bed in the Chichibu Basin, central Japan. This is the first bony-toothed bird record from the Micoene in Japan. This specimen is identified and described here as the quadrate of *Osteodontornis* sp. which genus is common in the Miocene of North America.

Introduction

The Middle Miocene beds in the Chichibu Basin have been known for abundant fossils of marine vertebrates: sharks, teleostean fishes, sea turtles, sea birds, desmostylids, pinnipeds, whales and dolphins (FUJIMOTO and SAKAMOTO, 1978; ONO, 1983; SAKAMOTO, 1983a, b; UYENO and SAKAMOTO, 1984, 1985). The locality Ohnohara has yielded a large number of marine bird fossils including specimens belonging to the family Sulidae, and the family Phalacrocoracidae of the order Pelecaniformes, and the family Procellariidae of the order Procellariiformes.

Fossils of the Odontopterygiformes in Japan are reported from relatively young formations, continually from the Early Oligocene in Fukushima Prefecture (ONO and HASEGAEA, in preparation), the Middle Miocene in Mizunami Basin (ONO, in prep.), the Middle Miocene in the Chichibu Basin, to the Pliocene in Iwate and Shizuoka Prefectures (ONO, 1980; ONO *et al.*, 1985).

This is the first record of a complete quadrate discovered in Japan, as not even an incomplete one is known from previously reported fossils.

Systematic Description

Order Odontopterygiformes HOWARD, 1957

Family Pseudodontornithidae LAMBRECHT, 1930

Genus *Osteodontornis* HOWARD, 1957

Osteodontornis sp.

(Fig. 1)

Material: A complete right quadrate, NSM PV-18696.

Locality: Tadenuma, Ohnohara, Chichibu City, Saitama Pref. (fig. 1 of ONO,

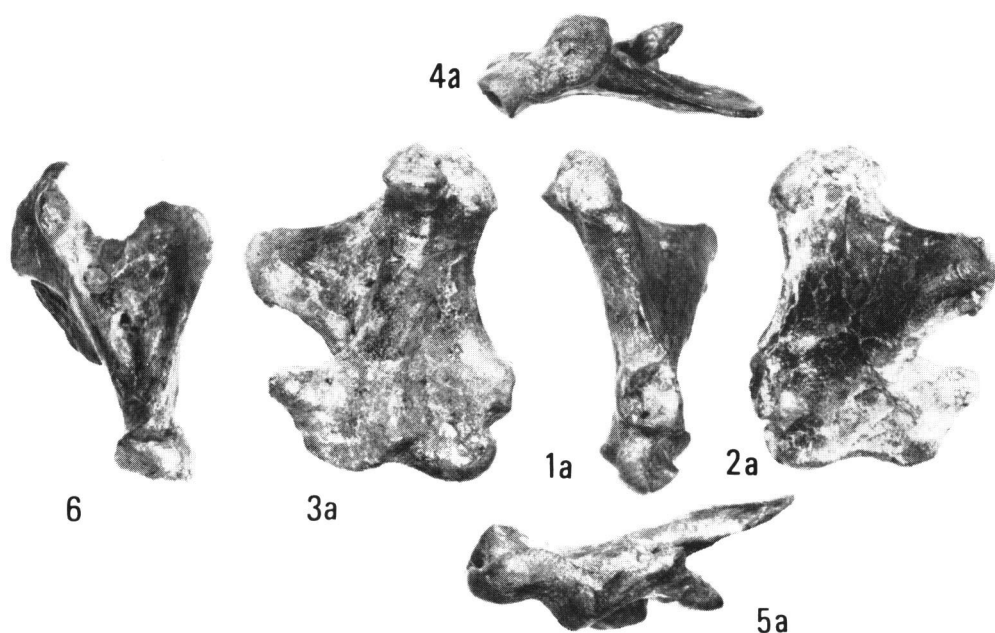


Fig. 1. Photographs and drawings of a quadrate from *Osteodontornis* sp. from the Nagura Formation of the Middle Miocene, Tadenuma, Ohnohara, Chichibu City, Saitama Pref. (NSM PV-18696). Scale (between 1 b and 2 b) indicates 1 cm. 1 a, b, Right lateral view; 2 a and b, anterior; 3 a and b, posterior; 4 a and b, dorsal; 5 a and b, ventral; 6, left medial; 1 c and d, comparative right lateral views of *Odontopteryx toliapica* and *Pseudodontornis longirostris* respectively (after HARRISON & WALKER, 1976). Terminology is that of HARRISON & WALKER (1976), but here proposed abbreviations are as follows: fq, foramen in quadrate; mf, medial facet; ms, main shaft; op, orbital process; pa, pterygoid process; sq, socket for quadratojugal; sa, squamosal articulation; va, ventral articulation.

1983). Collected by Mr. Yukimasa NOMURA in 1984.

Horizon: Silty, fine-grained sandstone layer of the middle member of the Nagura Formation, the Middle Miocene (HYODO, 1986).

Description: Round medial facet (mf) and laterally narrow squamosal articulation (sa) forming an anteroposteriorly oriented, narrow dorsal head. Groove between squamosal articulation and medial facet narrow. Main shaft (ms) extremely slender. Orbital process (op) flattened, blade-like, much broader at base, and directed more medially than anteriorly; foramen on the posterior base and apex rounded. Ventral articulation (va) saddle-shaped with laterally narrow groove; marked postero-lateral slant and medial ridge extending anteriorly..

Pterygoid articulation (pa) dorsomedially oriented. Socket for quadratojugal (sq) deeply rounded with surrounding ridge widely separated from the ridge forming the ventral articulation. Above socket, posterior edge of main shaft almost straight,

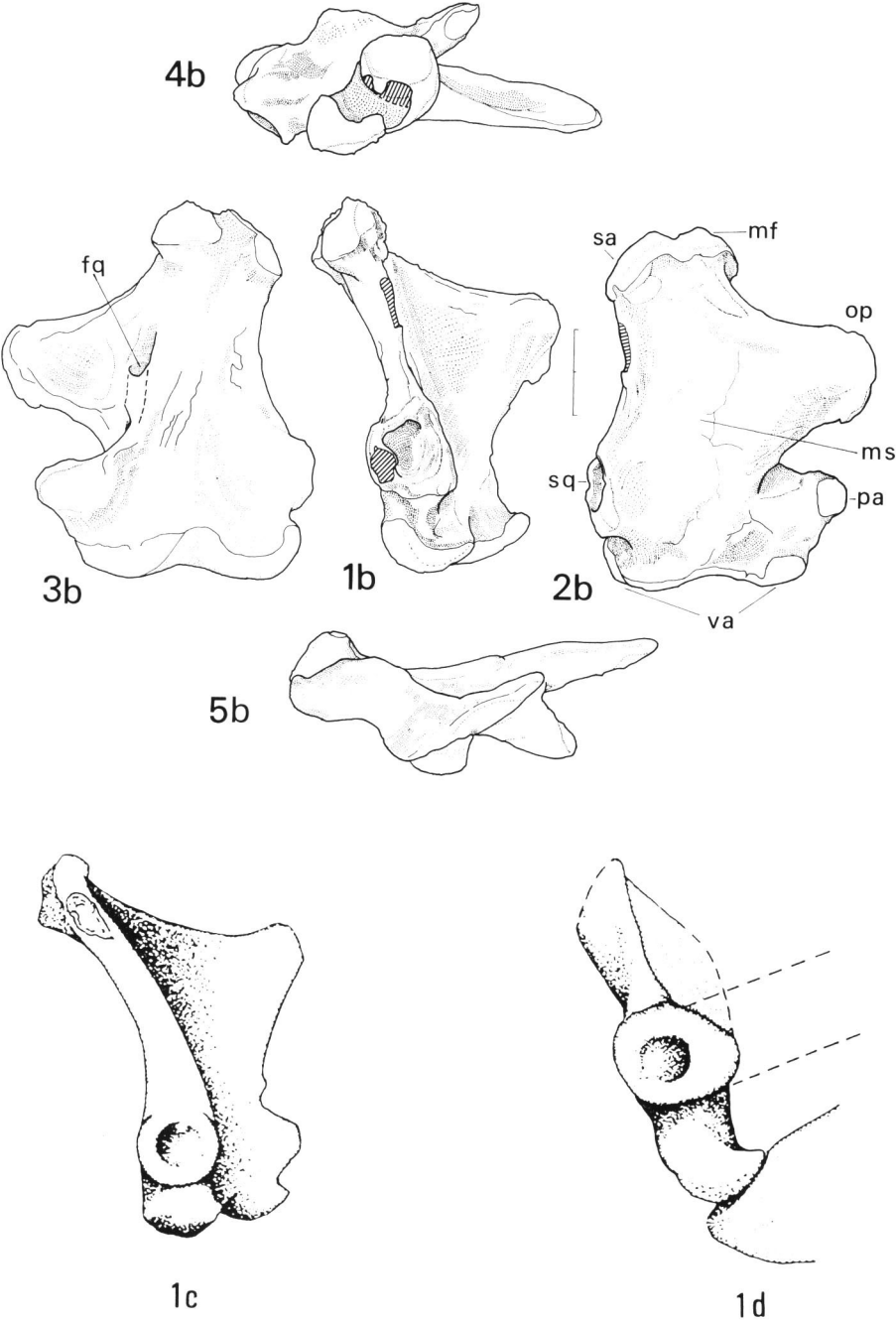


Table 1. Comparative characteristics of the three known fossil quadrates of the odontopterygiform bony-toothed birds.

Characters	Species		
	<i>Osteodontornis</i> sp. (from Chichibu Basin)	<i>Odontopteryx</i> <i>toliapica</i>	<i>Pseudodontornis</i> <i>longirostris</i>
Dorsal head	lateromedially narrow groove narrow	lateromedially narrow groove very broad	unknown
Main shaft	slender	broad	broad
Orbital process	large, directed medially	small, directed anteromedially	unknown
Ventral articulation ridge (anteromedial margin)	upward extends anteriorly	downward extends medially	upward unknown
Pterygoid process	extends dorso- medially	less pronounced dorsomedial extension	unknown
Socket for quadratojugal	intermediately situated	ventrally situated	dorsally situated
Lateral ridge (of main shaft)	relatively straight less thick	curves thick	straight thick
Size	44.6(D) × 40.6(W)	20(D) × 18(W)	2 × that of <i>Odontopteryx</i>
Foramen	single, wide diam.	unknown	unknown

forming a sharp, thin ridge.

Measurements: Depth from dorsal to ventral articulations, 44.6 mm; width from orbital process to quadratojugal socket, 28.1 mm; maximum width across dorsal articulation, 16.8 mm; maximum width across ventral articulation, 27.2 mm; pterygoid articulation to orbital process, 24.6 mm; minimum width of shaft, 6.2 mm; vertical diameter of socket for quadratojugal, 9.4 mm; depth from top of socket to ventral articulation, 18.0 mm.

Comparison

Almost complete quadrates are known only for *Odontopteryx toliapica* and *Pseudodontornis longirostris* of the Odontopterygiformes. No remains have been found for other members of the order. Under these conditions only limited comparisons and very tentative genus identification can be made.

In size, the quadrate of the Chichibu specimen is almost equal to that of *P. longirostris* but twice that of *Odontopteryx toliapica*. The two components, sa and mf, of the Chichibu specimen's dorsal head are separated by a lateromedially narrow groove, whereas that in *Odontopteryx toliapica* is very broad. On the other hand, the main shafts of *Odontopteryx toliapica* and *P. longirostris* are relatively broad, and that of *Osteodontornis* sp. is slender.

In the Chichibu specimen, the orbital process is large and medially projected, but

in *Odontopteryx toliapica*, anteromedially (the angle between the orbital process and main shaft larger in the former), and unknown in the specimen of *P. longirostris*. The ventral articulation, both lateral and medial ridges, turning upward in the Chichibu specimen and in *P. longirostris*, but turning downward in *Odontopteryx toliapica*. Also, the anteromedial tip of this articulation extends anteriorly in *P. longirostris* and *Osteodontornis* sp., but in *Odontopteryx toliapica* it extends medially, in the same direction as the pterygoid articulation. This quadrate lacks the posterolateral part of the articular facets with lower mandible, while these portions are apparent in most Recent birds. This pterygoid articulation is situated more dorsomedially in the Chichibu specimen than in *Odontopteryx toliapica*.

The socket for the quadratojugal is situated most dorsally on the lateral edge in *P. longirostris*, intermedially in the Chichibu specimen and most ventrally in *Odontopteryx toliapica*. This edge is straight in both the Chichibu specimen and *P. longirostris*, while that of *Odontopteryx toliapica* is curved anteriorly. The lateral ridge of the Chichibu specimen is thinner than that of *P. longirostris* and *Odontopteryx toliapica*.

A single, relatively large foramen exists at the posterior base of the orbital process in this specimen, and is quite commonly present in most Recent birds. Regrettably this region of the quadrate is absent in this foramen of *Odontopteryx toliapica* and *P. longirostris* fossils found to date.

The Chichibu specimen decidedly differs from the quadrates of *Odontopteryx toliapica* and *P. longirostris* as shown in Table 1. *Odontopteryx* is known only from the Eocene. Miocene *Odontopterygiformes* number only two genera, *Pseudodontornis* (two species, neither known from Japan) and *Osteodontornis* (monotypic). As this quadrate is definitely not from the former, there is a good chance it is from the latter, but there is no way to confirm that it does not come from a yet undescribed genus. Under these conditions, the author very tentatively places this quadrate as coming from *Osteodontornis*.

Concluding Remarks

According to HARRISON and WALKER (1976), quadrates of the *Odontopterygiformes* show some similarities to those of various Recent birds. *Pelecanus* has a simple lower mandible articulation like this specimen. The general shape of the quadrate in *Odontopteryx* and this specimen is similar to that of pelecaniforms or the larger procellariiforms. Dorsally situated socket for the quadratojugal of *Sula* is similar in position to that of the Chichibu specimen. The ventral articulation of this specimen (*Odontopterygiformes*) is very much similar to that of Recent birds such as *Pelecanus*, indicating it probably had a long lower mandible that made a large angle from the upper one when the beak was opened.

Acknowledgments

I would like to express my sincere gratitude to Mr. Yukimasa NOMURA for collecting this quadrate fossil and giving me a chance to study it. I am also grateful to my colleague Dr. Teruya UYENO and Dr. Ikuo OBATA for giving me helpful advice on this manuscript. The present study was partly supported by a grant-in-aid (No. 62480025) to Teruya UYENO from the Ministry of Education, Science and Culture, Japan.

References

- FUJIMOTO, H. & O. SAKAMOTO, 1978. A preliminary report on *Paleoparadoxia* sp. discovered from the Tertiary system of the Chichibu Basin, central Japan. *Bull. Chichibu Natr. Sci. Mus.*, (18): 1–10.
- HARRISON, O. C. O. & C. A. WALKER, 1976. A review of the bony toothed birds (Odontopterygiformes) with descriptions of some new species. *Tertiary Research special paper*, (2): 1–62, pls. 1–10.
- HYODO, H., 1986. Geology and Paleomagnetism of the Neogene System in the Chichibu Basin, Saitama Prefecture, central Japan. *Geoscience Rept. Shizuoka Univ.*, 12: 115–152.
- ONO, K., 1980. Pliocene tubinare bird from Kakegawa, Shizuoka Prefecture, Japan. *Mem. Natn. Sci. Mus.*, (13): 29–34, pl. 2. (In Japanese with English abstract.)
- , 1983. A Miocene bird (gannet) from the Chichibu Basin, central Japan. *Bull. Saitama Mus. Nat. Hist.*, (1): 11–15. (In Japanese with English abstract.)
- ONO, K., HASEGAWA, Y. & T. KAWAKAMI, 1985. Part VI. First record of the Pliocene bony-toothed bird (Odontopterygiformes) from Japan. *Bull. Iwate Pref. Mus.*, (3): 155–157, pl. 1. (In Japanese.)
- SAKAMOTO, O., 1983 a. A Miocene sea turtle from Chichibu Basin, central Japan. *Bull. Saitama Mus. Nat. Hist.*, (1): 1–10. (In Japanese with English abstract.)
- , 1983 b. On the occurrence of the two skeletons of *Paleoparadoxia tabatai* (TOKUNAGA) from Chichibu Basin, central Japan. *Bull. Saitama Mus. Nat. Hist.*, (1): 17–26. (In Japanese with English abstract.)
- UYENO, T. & O. SAKAMOTO, 1984. Lamnoid shark *Charcharodon* from Miocene beds of Chichibu Basin, Saitama Prefecture, Japan. *Bull. Saitama Mus. Nat. Hist.*, (2): 47–65. (In Japanese with English abstract.)
- , 1985. A scombrid fish of the genus *Scomberomorus* from a Miocene bed in Chichibu Basin, Japan. *Bull. Saitama Mus. Nat. Hist.*, (3): 49–54. (In Japanese with English abstract.)