473. A CRETACEOUS TRIGONID FROM THE MIocene
MISAKI FORMATION IN THE MIURA PENINSULA.
KANJIgAWA PREFECTURE*

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Introduction

It is well known that trigonids were abundant and had wide distribution during the Mesozoic Era, especially the Jurassic and Cretaceous. However, during the Cenozoic Era only a few descendants have been found in Australia and they range from Tertiary to Recent.

In 1952, a trigonid fossil was collected by Mr. Jiro Usui with other Miocene fossils from a single locality and horizon of the Misaki Formation, at the southernmost part of the Miura Peninsula. The writer had an opportunity to study this specimen under the instruction of Prof. Kotora HATAI. The aim of this work is to determine whether the specimen can be considered to be a Miocene species or whether it should be interpreted as derived from an unexposed formation of Cretaceous age.

The writer here expresses his sincere thanks to Professor Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University, for the opportunity to study the interesting specimen and for his kind instruction throughout this work. Acknowledgements are due to Dr. Hiroshi OZAKI of the Natural Science Museum in Tokyo for his kind suggestions and deep interest concerning the occurrence of the trigonid shell.

Occurrence

The specimen was collected by Usui from a calcareous sandstone bed situated at the east side of the Misaki harbour, Misaki-cho, Miura City, Kanagawa Prefecture (Fig. 1). According to Usui (1952), "... at the boundary between the upper and lower parts of the Misaki Formation, at about 200 meters east of the inlet of the Misaki harbour, there are intercalated calcareous sandstone beds. The calcareous beds are considered to correspond to the limestone beds near Misaki which have been studied by YOSHIWARA (1902). At the outcrops east of the Misaki harbour, calcareous conglomeratic sandstone alternates with medium to fine grained
A well-preserved isolated valve of a trigonid from the compact, yellowish colored, fossiliferous sandstone of the Neogene age, situated on the eastern side of the Misaki harbor is of interest. According to Prof. K. HATAI of the Institute of Geology and Paleontology, Tohoku University, who sponsored J. Usui's graduation thesis in the field and laboratory, the molluscan shell was found from a sandstone containing abundant remains of small Ostrea, fragments of balanids and other pelecypods. The small oysters are well preserved and some even retain their original coloration, whereas the fragments of balanids and other pelecypods were more or less with faded original coloration, some even showing evidence of wear due to aqueous agencies. The trigonid shell, however, is rather well preserved, showing its external sculpture in detail and the interior features could be observed after cleaning with a hand-drill. However, the sandstone adhering to the trigonid shell is different from that in which it was found.

From the same bed, Usui collected other fossils as Chlamys miureensis YOKOYAMA, Chlamys n. sp., Dentalium yokoyamai MAKIYAMA, Balanus rostratus HOEK, Odonthocrathus-like corals, Bryozoa etc., and concluded its geologic age to be Middle or Lower Miocene upon the evidence of the fossils and also from the stratigraphic consideration.

From where the trigonid shell came and how it was embedded in the Neogene sandstone is problematical. It could have been drifted with other materials by rafting and deposited after the raft was destroyed by rottening, possibly it could have been washed out by disintegration of an erratic which may have been fossiliferous, because of the small size and thick shell of the trigonid it is evident that its resistance against foreign agencies would be strengthened, and it seems that there may be other agencies which could have brought the trigonid shell to its site of deposition. Whatever the answer be, it is evident that the trigonid shell was collected from a fossiliferous sandstone of Neogene age, and the true explanation for the occurrence must be reserved.
Paleontological and Geological Notes

Because of the importance in stratigraphy and abundant occurrences as well as large variety of forms, studies on the trigonids have begun early in the history of the molluscs, and many workers have attempted to classify the genus *Trigonia* into finer divisions. AGASSIZ in 1841 divided the genus into eight sections, namely, Scaphoidae, Clavellatae, Quadratae, Scabrae, Undulatae, Costatae, Glabrae and Pectinatae. This classification was adopted with some modification and additions by subsequent workers. LYCETT (1872-79) investigated in detail the Jurassic and Cretaceous trigonids of England and classified them into eight sections, added the new section Byssiferae to those previously recognized by AGASSIZ except Pectinatae. STOLICZKA (1871) divided the genus into six groups in his study of Indian trigonids. Several authors, on the other hand, subdivided *Trigonia* s. lat. generically. After BAYLE's *Miotherrella* (1878) and COSSMAN's *Eotrigonia* and *Neotrigonia* (1912) were proposed, modern workers like VAN HOEPEN (1929), CRICKMAY (1932), COX (1952) and others erected new genera and subgenera. In COX's scheme of classification the Trigonidae are restricted to *Trigonia* s. lat. and classified into 23 genera and 11 subgenera. Recently KOBAYASHI (1954) and others studied the Mesozoic trigonids of Japan and adjacent countries and proposed a systematic classification of the trigonids.

The specimen of Scabrae-type trigonid treated in this article, having wing-shaped, very inequilateral outline and opisthogyrous umbo, obviously belongs to the subfamily Pterotrighoniinae. This subfamily is in a position far from the subfamily Neotrigoniinae KOBAYASHI (1954), the known post-Cretaceous trigonids, which consists only of two genera, *Neotrigonia* and *Eotrigonia*. The subfamily Pterotrighoniinae was proposed by VAN HOEPEN (1929) and it included six genera. Recently KOBAYASHI and NAKANO (1957) re-examined the subfamily and classified it into three genera and one subgenus, namely genus *Pterotrigonia* VAN HOEPEN, subgenus *Rinetrigonia* VAN HOEPEN, genus *Scarbrotrigonia* DIETRICH and genus *Acanthotrigonia* VAN HOEPEN. The present specimen differs from *Acanthotrigonia* and *Scarbrotrigonia* in the arrangement of costellae on the area. It is assigned to *Pterotrigonia* s. str. in many characters as described later, being distinguishable from the subgenus *Rinetrigonia* in not having discrepant costae on the flanks. In Japan *Pterotrigonia* s. str. is well represented by seven species from the Cretaceous formation (KOBAYASHI and NAKANO, 1957, 1958, NAKANO, 1960). The present specimen of the trigonid shell from the Miocene Misaki Formation is closely related to *P. hokkaidoana* (YEHARA) as described later, though it seems to be an immature form.

As mentioned above, the present specimen is morphologically a typical *Pterotrigonia* s. str. which is cosmopolitan in the Lower to "Middle" Cretaceous of the eastern hemisphere excluding Australia. "Middle" to Upper Cretaceous of North and South America, and Europe (NAKANO and NUMANO, 1961). None of its members, however, have been reported from Post-Cretaceous deposits of any country. Although the present specimen was collected from a marine formation of Miocene age, it seems to be more reasonable to consider
that the specimen was derived from a Cretaceous deposit rather than to interpret it as a relict species.

*Pterotrigonia hokkaidoana* is widely distributed in the Lower and "Middle" Cretaceous rocks in Japan (KOBAYASHI and NAKANO, 1957, 1958, NAKANO, 1960). The occurrence of *P. hokkaidoana* from Cretaceous formations nearest to Misaki, is the Sanchu graben in the Kanto massif (YABE, NAGAO and SHIMIZU, 1926), about 120 km northwest of Misaki. Another fossil locality of Cretaceous age which yielded trigonids similar to the present one is the Choshi peninsula, about 130 km northeast of Misaki, from where *P. pocilliformis* (YOKOYAMA) has been reported (YAMANE, 1921) (Fig. 2).

Judging from the degree of the preservation of the specimen, it seems possible that it may have been reworked from some Cretaceous deposits not so remote from Misaki. Therefore, it is inferred that there may have been exposed Cretaceous deposits bearing such fossils as *Pterotrigonia* near Misaki during the Miocene Epoch.

**Description**

Subfamily Pterotrigoninae

VAN HOEPEN, 1929

Genus *Pterotrigonia* VAN HOEPEN, 1929

*Pterotrigonia cf. hokkaidoana* (YEHARA)

(YEHARA)

Pl. 37, figs. 1-3.

Compared with:


1931. *Trigonia hokkaidoana* YEHARA, Trigonidae from Japan, p. 15-17, text-fig.


**Description**:—Shell small in size, sub-crescentic, inflated anteriorly, produced and slightly attenuated posteriorly; anterior margin rounded, passing gradually into gently arcuate ventral one; siphonal margin rounded; dorsal margin

![Fig. 2. Localities of the Cretaceous formations which yielded *Pterotrigonia* (A, B), and the Cretaceous and the unknown Mesozoic or Paleogene formations (a, b) in the Kanto region.](image-url)

A: Sanchu graben.
B: Choshi.
a: Kobotoke Formation.
b: Mineoka Formation.
long and concave. Umbo small, prominent, opisthogyrous, and pointed at a fourth from the anterior end. Carinae obsolete except near umbo. Escutcheon broad, slightly depressed, with about 10 tuberculate transverse costellae; costellae arranged more closely near umbo. Area narrow and raised, narrower anteriorly but wider posteriorly, provided with a few transverse costellae in early stage; median furrow shallow, not so distinct. Flank with 15, tuberculate diagonal costae; four near umbo concentric; next six on most inflated part, slightly curved and oblique anteriorly; last five straight and oblique posteriorly.

Length 24 mm. Height 15 mm.

Remarks:—The specimen described here is a right valve and fairly well preserved. Its ventral margin and some costae on the most inflated part of the flank are broken. It seems to be an immature form because of its small size, so therefore it may have nearly indistinct median furrow and rather few costae.

*P. hokkaidoana* is very similar to *P. pociliformis* (YOKOYAMA), but the former is distinguishable from the latter in its tall and subcrescentic to trigonal outline and more numerous costae on the flank. The present specimen has not so many costae as the typical *P. hokkaidoana*, but the intercostal spaces of it are narrow as in *P. hokkaidoana*. It is comparable with *Pterotrigonia hokkaidoana* (YEHARA) in many features. Especially it resembles to the syntype of fig. 2 (YEHARA, 1915, pl. 1) except for the narrower umbo and the larger size of the latter. On the other hand, the present specimen is more related with the syntype of YEHARA (pl. 37, figs. 4a and 4b) which was collected from the same locality but different horizon, as that of the specimens illustrated in figs. 1 and 2 (YEHARA, 1915, pl. 1), in its outline and costal arrangements.

The specimen in fig. 5 illustrated by YEHARA (1915, pl. 1) has been questioned by authors and sometimes even regarded as another species. KOBAYASHI and NAKANO (1957) considered that it resembles *P. pociliformis yamanokamiensis* KOBAYASHI and NAKANO from its elongate and rostrate outline. While NAKANO and NUMANO (1961) stated that it is similar to certain *P. brevicula* (YEHARA) rather than the typical *P. hokkaidoana* from its narrow area and sinuation on the ventral part. However, from the writer's observation on the syntype of *Trigonia hokkaidoana* YEHARA preserved in the Institute of Geology and Paleontology, Tohoku University, the specimen illustrated in fig. 5 (YEHARA, 1915, p. 1) is poor in preservation, and its postero-ventral margin is slightly broken as seen in the figure, therefore it is not adequate to argue the taxonomic position of the specimen merely from its vague outline.

*P. hokkaidoana* is widely distributed in the Lower and “Middle” Cretaceous formations in Japan (NAKANO, 1960). Although *Pterotrigonia* has been known to extend up to the late Cretaceous in North America and New Zealand, none of its members are known from the Tertiary and the later deposits of the world.

Occurrence:—Calcareous conglomeratic sandstone which yields abundant molluscan shells, the uppermost part of the Lower Misaki Formation, at the east side of the Misaki harbour, Misaki-cho, Miura City, Kanagawa Prefecture. The geologic age of the Misaki Formation is considered to be Middle of Lower Miocene.
IGPS coll. cat. no. 85720.

References


— and — (1958) : The Lower and Middle Cretaceous Trigonians in Wakayama, Oita and Kumamoto Prefectures. West Japan. Ibid., Vol. 29, Nos. 1-3, p. 139-152, pls. 11-12.


Explanation of Plate 37

1a-c. Right valve (×3). Misaki Formation (Miocene). Misaki-cho, Miura City, Kanagawa Pref. IGPS coll. cat. no. 83720.
2a-b. Same specimen in natural size.
3. Teeth of the same specimen (×5).

Figs. 4-5. *Pterotrignia hokkaidoana* (YEHARA).
4a-b. Right valve (×1), syntype; not illustrated by YEHARA. Lower *Astarte* Zone. Hiraiga 1, Miyako City, Iwate Pref. IGPS coll. cat. no. 4225.
5. Right valve (×1), syntype; the same specimen in fig. 1 illustrated by YEHARA (1915, pl. 1). *Cucullaea* Zone. Hiraiga 1, Miyako City, Iwate Pref. IGPS coll. cat. no. 4335.

Figs. 6-7. *Pterotrignia pocilliformis* (YOKOYAMA).
6. Internal mould of a right valve (×1). Nagasaki quarry, Choshi City, Chiba Pref. IGPS coll. cat. no. 35064.
7. Clay cast of a left valve (×1). So-yama, Kureta-cho, Nangoku City, Kochi Pref. IGPS coll. cat. no. 22072.
MATOBA: Trigonid from Misaki Formation

Plate 37

KUMAGAI photo.