636. MARINE FOSSILS FROM THE MONIWA FORMATION ALONG THE NATORI RIVER, SENDAI, NORTHEAST HONSHU, JAPAN, PART 2. PROBLEMATIC FROM THE MONIWA FORMATION*

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Introduction

From the basal part of the marine Moniwa Formation exposed in a cliff facing the Natori River at Moniwa, Sendai City, several peculiar shaped fossils were discovered. The description and discussion of the problematica of unknown systematic position and nature forms the scope of the present article. The peculiar shaped fossils were found at several centimeters above the base of the marine Moniwa Formation in association with such fossils as pelecypods, gastropods, brachiopods, bryozoans and foraminifers. Of the mentioned fossils, the brachiopods from the Moniwa Formation distributed along the Natori River are described in Part 1 of the series of the articles planned to be published on the marine fauna of the formation.

A review of the fossils published previously from the Moniwa Formation, the stratigraphic position of the formation in the geological column of the Sendai area, and remarks on the

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lithology were given in Part 1 of the series and repetition will be omitted at this place. The peculiar shaped fossils are from two localities, each of the basal part of the Moniwa Formation. One locality is the basal part of the formation exposed in the cliff facing the Natori River, south of the Oide Bridge crossing the Natori River and about 250 meters south of the type locality of the formation. This locality yielded three specimens, one complete and two with only half preserved. The complete one is taken as the type specimen. The fourth specimen is from the second locality, which is the basal part of the Moniwa Formation cropping out in the southern cliff of the Aoba Golf Links (under construction), north of Osawa, Sendai City and situated at about 2 kilometers southeast of the locality mentioned above. At both localities, the specimens were found embedded in brownish colored medium-grained sandstone sporadically with granules or pebbles.

The invertebrate fauna found in association with the four specimens mentioned above consisted of Kotorapeckten kagamianus (YOKOYAMA), Nanachiomyts notoensis (YOKOYAMA), Vasticardiun ogurai (OTUKA), Crassatellites sp., Dosinia sp., Parapene cf. nomurae KAMADA, Coptothyris grayi (DAVIDSON), Terebratalia sp., Flabellum sp., abundant balanid specimens and also with gastropods, scaphopods and echinoid spines. Benthonic and planktonic foraminifers and ostracodes were also found in association with the specimens forming the scope of the present article.

The fossils upon which this article is based were evidently exposed on the sea-bottom for some period of time as is judged from the surface of one of the fossils having adhered to it several specimens of bryozoans resembling the genus Actinopora. The bryozoan specimens are somewhat worn, and this suggests that after the bryozoans adhered to the surface of the fossil, it was rolled by aqueous agencies which caused erosion of the surface before burial. The peculiar-shaped fossil is confusing for several reasons, first, forms identical with the present one have not been found through a research of literature bearing on organisms of probable similarity, second, the systematic position of the fossil is difficult to determine because shapes as the present one among marine organisms are not known to the writers, and third, the present record seems to be the first of its kind from the Cenozoic rocks of Japan. For the reasons just mentioned, it seems worthy to describe and discuss the present fossil from the viewpoint of its systematic position and significance in the Moniwa marine fauna.

The Peculiar-shaped Fossil

Occurrence:—Two of the peculiar shaped fossil of elongate narrowly oval outline, and well inflated thin calcareous shell were found in a position parallel with the bedding plane of the Moniwa Formation and two others at an oblique angle. They were found in a medium-grained sandy patch with sporadic granules and pebbles intercalated in the conglomerate facies. As mentioned above they were found in association with pelecyops, gastropods, bryozoans, foraminifers, balanids, echinoid spines, ostracodes and brachiopods, the latter of which formed the first part of the series of articles on the fossil marine fauna. Of these fossils mentioned, the majority of the pelecyops (including all of the scallops) and some of gastro-
pods are thought to have been drifted into the area of their burial. On the other hand, the bryozoans, foraminifers and brachiopods probably lived in or at least very near to the place where they were buried. Thus the fossil fauna represents in part both thanatocoenosis and biocoenosis. From the mode of occurrence of the peculiar-shaped fossil it is suggested that they may have been drifted to the place of their burial either by aqueous or eolian agencies. Their mode of transportation to their place of burial if they did not actually live in the environment where they were found depends upon the nature of the fossil, as will be stated later.

Comparison: The present specimens which are characterized by their elongated shell, thin and smooth calcareous covering, rounded ends and in being well inflated, can be distinguished from such pelecypods as Musculus (Ryenella) cupreus (GOULD), Lithophaga (s.s.) straminea (REEVE), and Lithophaga (Leisolaenus) curta (LISCHKE) all described and illustrated by TAKI (1960, p. 90, pl. 45, figs. 2, 7, 8, respectively), and all which have rounded anterior margin, elongate outline, rather bluntly rounded posterior side and inflated shells, by lacking growth lines or other kinds of external sculpture, not having two valves or shells, more uniform outline, thinner covering and more uniformly inflated shell. Other pelecypods with outline similar to the present fossil can also be distinguished from the fossil by the features mentioned above. Compared with the coprolites described and illustrated by HÄNTZSCHEL, EL-BAZ and AMSTUTZ (1968), the present specimens differ in several important features, such as having no external sculpture so characteristic of the coprolites, more uniform outline and inflation, no note-worthy interior structure of the sediments possessing a thin covering, and showing no evidence of having been sausaged.

Although the eggs of certain Pisces can probably be preserved as fossil, there seem to be none that can be compared in shape, size and external morphology with the present specimen. Most preservable as fossil are probably the eggs of the Selachians (MCCORMICK, ALLEN and YOUNG, 1963) but their shapes are different from the present specimens and thus need not be brought into comparison.

So far as the general shape is concerned, the present specimens show a remote resemblance with such echinoid genera as Echinometra, Fibularia, Lovenia and Brissopsis (NISIYAMA, 1968), but the very thin ectoderm or covering and complete lack of echinoderm structures, serve to easily distinguish the present fossil from the echinoids.

The Aves are well known to have oval shaped eggs with a thin covering and without sculpture on the outer surface although different color patterns exist. The sizes and oval-shaped eggs of the Aves vary with genus and species, and show a remote resemblance with the present specimen now under consideration. If the shape of the present specimen is the original one, then it can be distinguished from the eggs of Aves by being much more elongated and with more narrowly rounded ends. Also since the present specimen was found embedded in sediments in association with Coptothyris grayi miyagiensis HATAI, MASUDA and NODA (1973), pelecypods, gastropods and cirripeds as well as with small bryozoans, such an environment may not be natural for Aves eggs, although there remains of possibility of their being
preserved in marine deposits by accident.

Another possibility for the origin of the elongate-oval fossil under consideration may be that they are nothing but the eggs of the sea turtle. It is well known that sea-turtles crawl up upon the beach to lay their eggs in holes dug in the sand. The eggs are whitish with soft and elastic cover, without noteworthy sculpture. The number of eggs laid by the turtle is numerous as many as about 30-50, and it is quite possible that they could be reworked by aqueous or other agencies to be transported and deposited in the nearshore deposits. By such undertakings it could be possible or probable that fracturing or cracking during the drying and hardening egg-cover would permit penetration or impregnation of sediments into the shell and at the same time, by burial, the shell would be subjected to compression which would result in the fracturing and elongation of the partially elastic calcareous covering. Although the above mentioned process is quite possible, there is no positive data to uphold the view. Another possibility is that the present elongate-oval fossil is a fossilized sea-snake-egg that was either drowned, fractured and impregnated with sandy sediment at the time of continued rise of the sea-level during the transgressive phase that resulted in the deposition of the Moniwa Formation. Also it may be that the snake-egg rolled down from a higher relief to the seashore, and by continued drying the thin and elastic covering gradually hardened and became fractured at several parts, through which sediment flowed-in and filled the chamber. Subsequently the rounded or oval snake eggs by the filling sediments expanded to become elongate-oval in shape and thenafter became buried in the sediments deposited by the transgressing sea. The sea-snake is known for its strong poison, rising to the surface to breathe by its lung, is not a member of the Pisces but that of the Reptile that once lived on the land but latter took to life in water. Thus, just as the land snake, the sea-snake also lays eggs with thin, soft, calcarous, elastic covering of whitish color and probably at or near the shore-line. Therefore, the burial of the snake egg in the shallow water sediments of the basal part of the Moniwa Formation can be expected. Also it is known that the sea-snake lives in warm and shallow water, that is to say, in areas where coral reefs and reef corals exist, thus it is a tropical to subtropical eel-shaped reptile. The thermal conditions during deposition of the Moniwa Formation is judged to have been about subtropical as may be interpreted from the fossil occurring from the formation.

The warm water condition during deposition of the Moniwa Formation is documented by the occurrence of tropical to subtropical foraminifers as Lepidocyclina (Nephrolepidina), molluscs as Trochus, Xenophora, Morum, Cypraea, Conus, Bursa and others among the gastropods, Vasticardium, Venus among the pelecypods, corals as Dendrophyllia and bryozoans besides other fossils.

A comparison of the fossil egg-like specimens under consideration was made with the eggs of the land snake, Elaphe climacophora (Boie), which was captured in July 1937 in the environs of Sendai City. The eggs of the land snake are not spherical or rounded and of ping-pong size as those of the turtle, not ovoid in shape like those of the Aves, but are elongate oval with well rounded ends and equidistantly separated parallel sides, smooth surface of whitish color and with no noteworthy sculpture on
the surface of the thin shell or covering. The snake eggs just mentioned and shown in the annexed illustrations closely resemble the fossil specimens described in the present article, and are of similar size, almost the same shape, have the same or very similar kind of whitish coloration of the shell covering, and have thin covering. Also the orientation of the eggs of *Elaphe climacophora* seem to be at random, some have the longer axis parallel with the ground surface, whereas in others the longer axis may be oblique to nearly vertical to the ground surface, and it seems that the direction of the longer axis of the eggs depends upon ground configuration and degree of coiling of the snake because the eggs are protected in the coils. This remarkable resemblance of the fossil specimens to the Recent ones just mentioned strongly points to or suggests that the fossil ones are the eggs of a snake, and being marine in origin, they are considered to be of a sea-snake of which bones have not yet been discovered from the Moniwa Formation, although they are expected to be found, and in a state quite dismembered because their bones are very thin, weak and easily destroyed by aqueous or other physical and chemical agencies.

Although some assumptions on the nature of the fossil can be given there seems to be no positive evidence for adopting one of the views given above. Regardless of the different views concerning the peculiar fossil, it can be said that a description and illustrations of the fossil should be given as a contribution to the study of problematical fossils. Further, it seems best to give a name to the fossil, which is thought to be the eggs of a sea-snake and thus belongs to the Reptilia, but to what genus or family it belongs is a question should be reserved for another opportunity. Under such consideration, the writers propose the generic and specific name of *Moniopterus japonicus*, n. gen. et n. sp.

**Class Reptilia**

**Order Apodes**

**Suborder Enchelycephali**

**Series Congoidei**

**Family Ophichthyidae**

**Genus Moniopterus, HATAI, MASUDA and NODA, n. gen.**

**Type species:** *Moniopterus japonicus* HATAI, MASUDA and NODA, n. sp.

**Diagnosis:** Elongate-oval, ends rounded, covering thin, calcareous, semipolished, with no external sculpture.

*Moniopterus japonicus* HATAI, MASUDA and NODA, n. sp.

Pl. 50, figs. 2–6

**Type locality and Formation:** Cliff of the Natori River, south of the Oide Bridge, Moniwa, Sendai City, Miyagi Prefecture, Early Mizuho Tō, Moniwa Formation (Moniwan). Three specimens, the best is chosen as the type specimen.

**Description:** Shell elongate-ovate, one end bluntly rounded, other end more narrowly rounded, measuring about 51 mm in length and 20 mm in diameter (Holotype specimen), shell covering thin, calcareous, smooth, semipolished, without external sculpture. The fourth specimen is well preserved except for lacking the very thin and semipolished covering. It measures about 43 mm in length and 21 mm in diameter (Paratype
specimen), of the same shape as the Holotype, with bluntly rounded ends and apparently with smooth surface.

Remarks:—The shell is fractured both longitudinally and transversally at several places and on the surface several worn bryozoans are attached. The bryozoans resemble somewhat the genus Actinopora d’Orbigny, which is said to range from the Cretaceous to Recent (Bassler, 1953, p. 57). The bryozoans in being worn suggest that after becoming attached to the surface covering, and growing to an adult, the host was subjected to rolling on the seabed bottom probably by aqueous agencies, thus explaining the worn condition of the bryozoans. From the fractured thin calcareous shell, it may be assumed that after the yolk and white part of the egg died, the covering gradually hardened and by fracturing due to the overlying sediments during burial and impaction due to transportation from the shell, which may have aided in elongating the originally more globular shape. This process may explain the shape of the fossil, if it was originally globular or rounded during life and the sediments filling the shell.

A comparison with organisms capable of making structures similar to the present fossil have been given in earlier lines of this article and here it may be added that whatever the true nature of the fossil, it is of interest because it forms the first discovery of a probable sea-snake egg from the Cenozoic rocks of Japan.

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References Cited


Explanation of Plate 50

Fig. 1. View of the type locality of *Moniopterus japonicus*. The massive lower part consists of the Takadate Andesite. This is superposed by the conglomeratic facies with medium-grained sandy patches of the basal part of the Moniwa Formation. Note the very irregular boundary between the Takadate Andesite and Moniwa Formation. The sea-snake egg specimens were obtained from the lower part of the Moniwa Formation, about 10 centimeters above the base. Cliff south of the Oide Bridge crossing the Natori River, Sendai City.

Fig. 2. Two broken specimens *in situ*. Locality same as above.

Fig. 3. *Moniopterus japonicus*, n. gen. et n. sp., (×1), Holotype, (IGPS coll. cat. no. 92956), Note fractured parts, thin covering, elongated shape, and adhering bryozoans. Locality same as above.

Figs. 4-6. *Moniopterus japonicus*, n. gen. et. n. sp., (×1), Paratype, (IGPS coll. cat. no. 92957), 4, lateral view of entire specimen. 5, view of rounded end. 6, view of other rounded end. Locality: Southern cliff of the Aoba Golf Links, north of Osawa, Sendai City.

Fig. 7. Photograph of *Elaphe climacophora* (Boie) captured in the environs of Sendai City and placed in a broken beer bottle of which rim can be seen vaguely. This photograph was taken of the snake where it laid eggs during capture. The photograph is slightly enlarged and the morphology of the eggs, their orientation enclosed by the snake and the number laid at a time can be seen. The snake was captured in July 1937.
HATAI, MASUDA, and NODA: Problematica from Moniwa

Plate 50

Images:
1. Photograph of a landscape.
2. Photograph of rock formations.
3-6. Close-up images of rock samples.
7. Photograph of a snake with eggs.