*On Some Species of the Family Nodosariidae found in the Tertiary Formations of the Philippine Islands**

By

Kiyoshi ASANO

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Introduction

Of the numerous families of Cenozoic Foraminifera found in Eastern Asia that claim the attention of palaeontologists, the Nodosariidae is one of the most interesting. Certain species belonging to this family are to be met with exclusively in the Pliocene that is developed on the Pacific side, consequently in none on the Japan Sea side. Besides being fairly large, the surface ornamentation of their walls is also very marked. The writer¹⁾, previously proposed the name of *Robulus-Planularia* fauna for these particular forms of the Japanese Pliocene.

Seeing that the Philippine materials now dealt with in this article comprise some species of the family Nodosariidae from Japan, such as, *Robulus pseudorotulatus*, *Robulus kimituensis*, *Robulus nikobarensis*, *Robulus tibaensis*, *Vaginulina bôso*, and *Planularia japonica*, they seem to be similar to the *Robulus-Planularia* fauna of the Japanese Pliocene²⁾, although not so conspicuous as in Japan, particularly, as they are characterized by the presence of the genera *Operculina*, *Rotalia*, and *Quinqueloculina* rather than by *Robulus-Planularia*. In this respect, the Pliocene Foraminifera from the Philippine Islands is closely related to those from the East Indies³⁾ and Taiwan (Formosa)⁴⁾.

The fossil Foraminifera now in question were collected by Mr. Wataru HASHIMOTO in the Philippine Islands, and kindly submitted to the writer for examination. This collector once gave a list of the Foraminiferal species in a paper that he wrote⁵⁾. The present writer here revises the list and describes some the species.

The fossil-localities treated here are as follows:

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* Transactions of the Palaeontological Society of Japan, No. 153.

1) K. ASANO: 1938, Japanese Fossil Nodosariidae, with Notes on the Frondiculariidae, Sci. Rep., Tôhoku Imp. Univ., Sendai, Japan, 2nd ser., vol. 19, No. 2.

2) K. ASANO: 1939, Pliocene (Upper Mizuho) Foraminifera from Japan, Geol. Soc. Japan, vol. 46, No. 547.

3) H. YABE and K. ASANO: 1937, Contribution to the Palaeontology of the Tertiary Formations of West Java, Part 1, Minute Foraminifera from the Neogene of West Java, Sci. Rep., Tôhoku Imp. Univ., Sendai, Japan, 2nd ser., vol. 19, No. 1.

4) S. HANZAWA: 1932, A List of the Neogene Foraminifera of Taiwan, Taiwan Tigaku Kizi vol. 3.

5) W. HASHIMOTO: 1939, Stratigraphy of the Philippine Islands, Jubilee Pub., Prof. H. YABE, 60th Birthday, vol. 1.

- a) About 4 km east of Sta Cruz, Zambales, Luzon Islands.
Nodosaria raphana (LINNÉ) var., Pl. 11 (7), fig. 1.
Lagenonodosaria scalaris (BATSCH)
Robulus calcar (LINNÉ)
Robulus orbicularis (D'ORBIGNY) var.
Robulus pseudoechinatus n. sp., Pl. 11 (7), fig. 2.
 Formation: Visaya series, Oligocene.
- b) Campana River, Sumagui, Bongabon, Mindoro Islands.
Nodosaria raphana (LINNÉ)
Nodosaria verteblaris (BATSCH), Pl. 11 (7), fig. 4.
Nodosaria verteblaris (BATSCH) var., Pl. 11 (7), fig. 5.
Marginulina philippinensis CUSHMAN, Pl. 11 (7), fig. 3.
Planularia mindoroensis n. sp., Pl. 11 (7), fig. 8.
Robulus rotulatus umbonatus (CUSHMAN)
Robulus orbicularis (D'ORBIGNY)
Robulus iotus (CUSHMAN)
Robulus calcar (LINNÉ)
Robulus kimituensis ASANO
Robulus tibaensis ASANO
Robulus papillosus (FICHTEL and MOLL)
Robulus nikobarensis (SCHWAGER)
Robulus cf. *surugaensis* ASANO
Robulus limbosus (REUSS)
Robulus vortex (FICHTEL and MOLL)
Robulus sumaguiensis n. sp., Pl. 11 (7), fig. 10.
 Formation: Tagalog series, Pliocene.
- c) About 4 km west of Gao-oa, National Road, Ilocos Norte, Northern Luzon.
Planularia japonica ASANO, Pl. 11 (7), fig. 12.
Planularia luzonica n. sp., Pl. 11 (7), fig. 15.
Planularia sp., Pl. 11 (7), fig. 14.
Saracenaria italica DEFRANCE
Robulus orbicularis (D'ORBIGNY)
Robulus limbosus (REUSS)
Robulus submamilligerus (CUSHMAN)
Robulus echinatus (D'ORBIGNY)
Robulus depressus ASANO
Robulus kimituensis ASANO
Robulus pseudorotulatus ASANO
Robulus expansus (CUSHMAN), Pl. 11 (7), fig. 9.
 Formation: Tagalog series, Pliocene.
- d) Near Baag, Ilocos Norte, Northern Luzon.
Nodosaria verteblaris (BATSCH)
Lagenonodosaria scalaris (BATSCH)
Robulus calcar (LINNÉ)
Robulus limbosus (REUSS)
Robulus rotulatus umbonatus (CUSHMAN)
Robulus orbicularis (D'ORBIGNY)
Robulus kimituensis ASANO

Formation : Tagalog series, Pliocene.

e) Malbog, Boac, Marinduque Islands.

Nodosaria raphana (LINNÉ)

Nodosaria insecta SCHWAGER

Nodosaria spirostriolata CUSHMAN

Nodosaria tornata SCHWAGER, Pl. 11 (7), fig. 11.

Nodosaria sp.

Dentalina emaciata REUSS

Dentalina filiformis D'ORBIGNY

Lagenonodosaria scalaris (BATSCH)

Vaginulina spinigera BRADY

Vaginulina legumen elegans D'ORBIGNY

Vaginulina boso ASANO

Saracenaria italica DEFRANCE

Robulus pseudorotulatus ASANO

Robulus submamilligerus (CUSHMAN)

Robulus calcar (LINNÉ)

Robulus nikobarensis (SCHWAGER)

Robulus orbicularis (D'ORBIGNY)

Robulus sumaguensis n. sp.

Robulus kimituensis ASANO

Robulus limbosus (REUSS)

Robulus gibbus (D'ORBIGNY) var., Pl. 11 (7), fig. 13.

Planularia japonica ASANO

Planularia sp.

Before going further the writer wishes to record his great indebtedness to Prof. S. HANZAWA of the Institute of Geology, Tôhoku Imperial University, Japan, under whose supervision the present work was undertaken, for many kind suggestions and corrections. He is also indebted to Mr. W. HASHIMOTO, who kindly placed his specimens at the writer's disposal for examination.

Description of Species

Family Nodosariidae SCHULTZE, 1854

Genus *Robulus* MONTFORT, 1808

Robulus sumaguensis n. sp.

Pl. 11 (7), fig. 10.

Test broadly biconvex, close-coiled; chambers about 10 in last whorl; sutures almost straight with raised ribs, ending in a knob near umbilicus, which shows a central boss of clear shell-substance; periphery almost round, not markedly keeled; aperture radiate with a ventral slit. Diameter about 1.5 mm.

Locality (b), (e), Pliocene.

The umbilical region of the test is similar to that of *Robulus expansus* (CUSHMAN), but differs from it in the broadly rounded periphery.

(Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai, Japan, Catalogue No. 66010)

Robulus pseudoechinatus n. sp.

Pl. 11 (7), fig. 2.

Test biconvex, compressed, closely coiled, about 8 or 9 chambers in last whorl; sutures curved, raised, often with knob-like projections, umbonal region excavated in center, forming a ring of shell-material; periphery with a narrow keel from which projects short spines; apertural face concave, aperture radiate with a slit. Diameter about 1.5 mm.

Locality (a), Oliocene.

The species is easily distinguished from *Robulus calcarata* (CUSHMAN) by its papillate sutures, and from "*Cristellaria echinata* (D'ORBIGNY)" by the features of the umbilicus.

(I. G. P. S. J., Cat. No. 66002)

Robulus expansus (CUSHMAN)

Pl. 11 (7), fig. 9.

1917. *Cristellaria expansa* CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, p. 658.

1921. *Cristallaria expansa* CUSHMAN, Bull. 100, Ibid., p. 236, pl. 46, fig. 2.

This species is endemic to seas adjacent to the Philippine Islands, and has not yet been recorded from other seas. The present specimens closely resemble the figure given by J. A. CUSHMAN with a very wide and thin keel. Diameter about 2.5 mm.

Locality (b), (c), Pliocene. (I. G. P. S. J., Cat. No. 66009)

Robulus gibbus (D'ORBIGNY) var.

Pl. 11 (7), fig. 13.

A variety differing from the type by having a very wide and thin keel, otherwise like the type. Length about 3 mm.

Locality (e), Pliocene. (I. G. P. S. J., Cat. No. 66013)

Robulus papillosus (FICHTEL and MOLL)

Pl. 11 (7), fig. 7.

1884. *Cristellaria papillosa* BRADY, Rep. Roy. Challenger, Zool., vol. 9, p. 553, pl. 70, fig. 16.

1913. *Cristellaria papillosa* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, p. 74, pl. 37, fig. 2.

1921. *Cristellaria papillosa* CUSHMAN, Bull. 100, Ibid., p. 234.

1938. *Robulus papillosus* ASANO, Sci. Rep. Tôhoku Imp. Univ., 2nd. ser., vol. 19, No. 2, p. 200, pl. 24, fig. 5.

This is a beautifully ornamentated species, with beading bosses of the umbonal region. The species seems to be fairly common in Eastern Asia both fossil and recent. Length up to 2.5 mm.

Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66007)

Genus *Nodosaria* LAMARCK, 1812*Nodosaria raphana* (LINNÉ) var.

Pl. 11 (7), fig. 1.

Compare with: *Nodosaria raphana* CUSHMAN, U. S. Nat. Mus., Bull. 100, 1921, p. 210, pl. 37, figs. 5-7.

Differs from *N. raphana* (LINNÉ) in weak constriction of chambers and underpressed sutures of the earlier chambers.

Locality (a), Oligocene. (I. G. P. S. J., Cat. No. 66001)

Nodosaria tornata SCHWAGER

Pl. 11 (7), fig. 11.

1886. *Nodosaria tornata* SCHWAGER, Novara Exp., Geol. Theil, vol. 2, p. 223, pl. 5, fig. 51.

This species, first described from the Tertiary of Car Nikobar, by SCHWAGER, has not yet been found in recent materials. Length about 4 mm.

Locality (e), Pliocene. (I. G. P. S. J., Cat. No. 66011)

Marginulina philippinensis CUSHMAN

Pl. 11 (7), fig. 3.

1921. *Marginulina philippinensis* CUSHMAN, U. S. Nat. Mus., Bull. 100, p. 257, pl. 53, figs. 2, 3.

Type specimen in from Albatross Station D 5220, between Marinduque and Luzon, in 50 fathoms. According to CUSHMAN, the present species is very characteristic of the seas adjacent to the Philippine Islands, but it has not yet been noticed in the fossils. Length about 3 mm.

Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66003)

Genus *Planularia* DEFRANCE, 1824*Planularia japonica* (ASANO)

Pl. 11 (7), fig. 12.

1936. *Lenticulina japonica* ASANO, Jap. Jour. Geol. Geogr., vol. 13, Nos. 3-4, p. 328, pl. 37, fig. 7.

1938. *Planularia japonica* ASANO, Sci. Rep. Tôhoku Imp. Univ., 2nd. ser., vol. 19, No. 2, p. 205, pl. 24, figs. 13, 14; pl. 26, fig. 7.

The species, which is described from the Pliocene of Kamiyasiki, Tarukimura, Ogasa-gun, Sizuoka-ken, Japan, seems to be fairly common in the Pliocene of Japan and the Philippines.

Locality (c) and (e), Pliocene. (I. G. P. S. J., Cat. No. 66012)

Planularia mindoroensis n. sp.

Pl. 11 (7), fig. 8.

Test compressed, slightly longer than broad, becoming loosely coiled in later portion; periphery with several narrow keels; chambers about 8; sutures curved, ornamented with beads;

wall spinose with exogenous materials; aperture radiate, somewhat projecting. Length about 2.5 mm.

Locality (b), Pliocene.

The present form is similar to *P. japonica* (ASANO), but differs from it in the sutures, which are fairly broad and ornamented with prominent beads. Besides, the periphery is decorated with several keels.

(I. G. P. S. J., Cat. No. 66008)

Planularia luzonica n. sp.

Pl. 11 (7), fig. 15.

Test with early portion close-coiled, later tending to uncoiled, periphery acute with distinct keel; chambers elongate, about 10; sutures raised, with thick bands of clear shell-substance; wall smooth, distinctly umbonate; aperture radiate at the peripheral angle of last formed chamber. Length about 4 mm.

Locality (c), Pliocene.

This is a comparatively large species, and its form one of the most distinctive in the present materials; it may easily be distinguished from allied forms.

(I. G. P. S. J., Cat. No. 66015)

Explanation of Plate 11 (7)

- Fig. 1. *Nodosaria raphana* (LINNÉ) var. ×30
Locality (a), Oligocene. (I. G. P. S. J., Cat. No. 66001)
- Fig. 2. *Robulus pseudoechinatus* n. sp. ×30
Locality (a), Oligocene. (I. G. P. S. J., Cat. No. 66002)
- Fig. 3. *Marginulina philippinensis* CUSHMAN ×25
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66003)
- Fig. 4. *Nodosaria verteblaris* (BATSCH) ×25
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66004)
- Fig. 5. *Nodosaria verteblaris* (BATSCH) var. ×30
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66005)
- Fig. 6. *Nodosaria raphana* (LINNÉ) ×25.
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66006)
- Fig. 7. *Robulus papillosus* (FICHTEL and MOLL) ×30
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66007)
- Figs. 8a, 8b. *Planularia mindoroensis* n. sp. ×30
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66008)
- Fig. 9. *Robulus expansus* (CUSHMAN) ×25
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66009)
- Fig. 10. *Robulus sumaguiensis* n. sp. ×25
Locality (b), Pliocene. (I. G. P. S. J., Cat. No. 66010)
- Fig. 11. *Nodosaria tornata* SCHWAGER ×25
Locality (e), Pliocene. (I. G. P. S. J., Cat. No. 66011)
- Fig. 12. *Planularia japonica* (ASANO) ×30
Locality (c), Pliocene. (I. G. P. S. J., Cat. No. 66012)

- Fig. 13. *Robulus gibbus* (D'ORBIGNY) var. $\times 30$
 Locality (e), Pliocene. (I. G. P. S. J., Cat. No. 66013)
 Fig. 14. *Planularia* sp. $\times 25$
 Locality (c), Pliocene. (I. G. P. S. J., Cat. No. 66014)
 Figs. 15a, 15b. *Planularia luzonica* n. sp. $\times 25$
 Locality (c), Pliocene. (I. G. P. S. J., Cat. No. 66015)

(K. ASANO del.)

比律賓群島第三紀層ノドサリデ科の有孔蟲類 (摘要)

浅 野 清

東亞の近生代に屬する有孔蟲類に特に興味ある1科としてノドサリデ科がある。此者は筆者の嚮に發表せる日本産のものに就いて述べた如く、*Robulus-Planularia* フォーナを含有し、鮮新时期時代には可成り特徴のある分布を示し、日本の太平洋岸の同時代のものは、日本海岸の同時代のものより寧ろ南洋方面のフォーナと密接なる關係あることが、既に先年、矢部教授及筆者の研究によるジャワ産のものと比較されて判明したことであるが、今回橋本理學士採集の比律賓産のものと比較して一層根據付けられた。尙有孔蟲フォーナ全體として比律賓群島の第三紀層は、臺灣及ジャワのものと甚だ近似せることを記述したものである。

之等東亞に於けるノドサリデ科有孔蟲類の總括的研究は別に發表の用意があるので、本文に於ては比律賓産のものゝ中に發見されたる本科のリスト及4つの新種を記載し、之等に次の名稱を與へた。

Robulus pseudoechinatus n. sp.*Planularia mindoroensis* n. sp.*Robulus sumaguiensis* n. sp.*Planularia luzonica*