Introduction and Acknowledgements

During my geological studies in the area surrounding Tsu City, Mie Prefecture, I have been fortunate in obtaining a large collection of fossil molluscs, some foraminifers and others. Some molluscs among of them being considered to represent undescribed forms will be treated in this article. All of the fossils are now preserved in the collection of the Geology Department, Faculty of Liberal Arts, Mie University, and those treated in the present article are from the Isshi group, whose stratigraphical sequence is shown in Table 1.

Table 1. Stratigraphical sequence of the Isshi group developed in the area west of Tsu City, Mie Prefecture

<table>
<thead>
<tr>
<th>Formation names</th>
<th>General lithological characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yakuōji</td>
<td>Alternation of sandstone and siltstone (more or less tuffaceous) intercalating thin tuff in the upper part, alternation of sandstone and siltstone (more or less fleshy type) and 5-10 meters thick black siltstone in the lower part.</td>
</tr>
<tr>
<td>Chaya</td>
<td>Massive sandstone intercalating siltstone layers, alternation of sandstone and siltstone at places.</td>
</tr>
<tr>
<td>Kaisekizan</td>
<td>Alternation of sandstone and tuffaceous siltstone intercalating tuff in the upper part, dark mudy sandstone with sandy siltstone in the lower part.</td>
</tr>
<tr>
<td>Furutaike</td>
<td>Arkose sandstone intercalating thin conglomerate beds of gneiss and granite. Thin coal seam.</td>
</tr>
<tr>
<td>Kongōbō</td>
<td>Alternation of conglomerate and sandstone, cobble to boulder size conglomerate of gneiss and granite in sandstone matrix.</td>
</tr>
</tbody>
</table>

* Received Dec. 15, 1958; read June 6, 1958.
Unfortunately there are no descriptive works on the fossil marine mollusca from the Isshi group in Mie Prefecture but K. Takimoto (1935) listed the molluscan fossils from the group and J. Yamada (1958) reported the molluscan fossils from the Kaisekizan formation in the southern part of the same group. Therefore, although a full account of the fossil marine molluscs will be given at another opportunity, it is thought that the descriptions of some of the species considered to be new to science will facilitate the studies of other molluscan paleontologists in Japan and also serve to suggest the kind of fauna occurring from the Miocene deposits in the area west of Ise Bay, Mie Prefecture.

The molluscan fauna from the Miocene series (Isshi group) developed in the area west of Tsu City comprise a typical warm water assemblage, a characteristic feature of the early Miocene marine fauna of Japan. This kind of fauna is widespread, being known from Hokkaido in the north, from where it ranges southwards to the tip of the main island of Japan. Everywhere throughout this area, the early Miocene molluscan fauna contains warm water species, although it is evident that the number of typically subtropical or warm temperate forms decrease with the increase in latitude, and vice versa.

The Miocene series as represented in the present area is thought to include only the early Miocene in a two-fold division of the series. It may be correlated with deposits in other areas containing such molluscs as Glycymeris cisshuensis Makiyama, Gl. idensis Kanno, Lima yagenensis Otuka, Periploma yokoyamai Makiyama, Joanisiella meisensis Makiyama, Dosinia chikuzenensis Nagao, Soletellina minoensis Yokoyama, Turritella s-hataii Nomura, besides others, which also occur in the present area.

Here I wish to thank Professor Kotora Hatai of the Department of Geology, Faculty of Education, Tohoku University, for his kind advice concerning the present work. I also thank Professors Shōshito Hanzawa and Kiyoshi Asano of the Institute of Geology and Paleontology, Tohoku University, for their kindness during my research in that Institute.

Descriptions of the New Species

Family Mytilidae

Genus Musculus Röding, 1798

Musculus hataii ARAKI, n. sp.

Plate 18, Figure 1.

Description:—Shell rather large, measuring about 40 mm in length, 25 mm in height and about 10 mm in depth of a right valve. Elongate-subquadrate in outline, dorsal and ventral borders nearly parallel with one another; anterior and posterior sides rounded, the anterior more narrowly than the posterior, rather inflated with thin shell, obscurely provided with fine radial threads or striae on posterior and anterior sides of shell, the whole with fine concentric growth lines. Beak swollen, inturned, directed forwards: obscure but wide depressed area extending from behind beak to middle to posterior part of ventral margin.

Remarks:—This new species resembles Musculus laewigatus (Gray) figured by T. Habe (1955, pl. 4, figs. 12, 13) from Hokkaido, but can be distinguished therefrom by the more prominent beak, less flaring posterior side of the shell, more equally parallel dorsal and ventral margins, and by the less distinct radial striae.
Locality and geological formation:—Roadside cliff at about 300 meters northwest of Onohira, Gei-no-chō, Age-gun, Mie Prefecture. Kaisekizan formation. Miocene.

Depository:—Geology Department, Mie University.

Family Periplomatidae

Genus Periploma Schumacher, 1817

Periploma mitsuganoense

ARAKI, n. sp.

Plate 18, Figures 2a. 2b.

Description:—Shell moderate in size, rather long, more or less rounded, subquadrate in outline, inequivalve, the right deeper and better preserved than the left; anterior and posterior borders rounded, the latter more broadly than the former; ventral border broadly rounded, rather sharply passing into anterior one but gradually into the posterior; beaks small, pointed, directed anteriorly. Umbonal region slightly swollen; anterior dorsal border narrowly rounded angulation; surface provided with periodic undulating and interstitial finer concentric growth lines, of which those of the latter are obscure; ill-defined blunt ridge extending from in front of beak towards antero-ventral corner, becoming obscure near mid-region. Length about 43 mm, height about 34 mm, depth of intact valves about 10.5 mm.

Remarks:—This species has been compared with Periploma besshoense (YOKOYAMA, 1924), P. yokoyamai MAKIYAMA (MAKIYAMA, 1934), P. pulchellum HATAI and NISIYAMA (HATAI and NISIYAMA, 1949), P. ovata KURODA and HORIKOSHI (KURODA and HORIKOSHI, 1952), and P. otohimeae HABE (HABE, 1952), and was found to differ from each of the mentioned ones by the size of the shell, outline, angularity of the anterior half of the shell, and by the growth lines being periodically undulating and having obscure interstitial ones.

Besides the holotype specimen there are several paratypes, but the majority are more or less fractured or deformed, but still retain the specific characters above described.


Depository:—Geology Department, Mie University.

Family Carditidae

Genus Venericardia Lamarck, 1801

Venericardia funayamensis

ARAKI, n. sp.

Plate 18, Figure 3.

Description:—Shell rather large, measuring 45.5 mm in length, 42 mm in height and about 16 mm in depth of a right valve. Subquadrate in outline, longer than high, moderately convex; beak small, pointed, directed forward, umbonal region not much swollen; pos- tero-dorsal border long, rather straight, and forming with broadly rounded ventral border a rather sharp but rounded angulation; antero-dorsal side rounded, gradually merging into ventral border with large angulation. Surface with about 22 radial ribs, which are much broader than their narrow valley-like interspaces; radial ribs broadly
rounded, sharply descending into narrow V-shaped interspaces, crossed with concentric growth lines. Eroded shell surface with radial ribs as squarely rounded elevations about equal to or a little narrower than their flat-bottomed interspaces. Hinge-teeth and other internal features inaccessible.

Remarks:—This new species is easily distinguished from Venericardia siogamensis Nomura (1935, pl. 17, figs. 8-11), a Miocene species originally described from Siogama City, Miyagi Prefecture, by the shape of the shell which is more trigonal: the number and type of radial ribs in the two species are about the same, but the size and shape of the shell are quite different.

Locality and geological formation:—Road cutting on road leading from Funayama to Kozahara, Misato-mura, Age-gun, Mie Prefecture. Kaisekizan formation. Miocene.

Depository:—Geology Department, Mie University.

Family Veneridae

Genus Cyclina Deshayes, 1849

Cyclina kamadae ARAKI, n. sp.

Plate 18. Figures 4a. 4b.

Description:—Shell large in size, a little longer than high, subcircular. Antero-dorsal border broadly expanded, the postero-dorsal roundly sloping into posterior side which is well rounded. Anterior side rounded, well expanded. Ventral margin rather sharply rounded with fine crenulations on its inner border. Shell rather thin, provided with fine concentric growth lines and periodic coarse ones. Beak small, pointed, incurved, directed anteriorly. Sinus and muscular impressions obscured. Height 50.5 mm, length about 53.5 mm, depth of a right valve about 15 mm.

Remarks:—This new species resembles Cyclina (Cyclinorbis) lunulata Makiyama (1926, pl. 13, fig. 1) from the Miocene of North Korea, but may be distinguished therefrom by the more expanded anterior side, weaker concentric sculpture, more arched antero-dorsal border and less straight posterior border. Cyclina japonica Kamada (1952, pl. 15, figs. 1a-b, 2, 4) from the Miocene of Gifu Prefecture, differs from the present one by the shape of the shell.

The specific name is given in honor of Mr. Yasuhiko Kamada of the Nagasaki University, who had particular interest in the species of the genus Cyclina.

Locality and geological formation:—Small cliff at the paddy-field situated at about 200 meters northwest of Bessho, Misato-mura, Age-gun, Mie Prefecture. Furutaike sandstone. Miocene.

Depository:—Geology Department, Mie University.

Family Dentalidae

Genus Dentalium Linne, 1758

Dentalium misatoensis ARAKI, n. sp.

Plate 18. Figures 5a. 5b.

Description:—Shell generally large, measuring more than 75 mm in length and exceeding 9 mm in diameter, test heavy. Shell nearly straight, only slightly curved, gently tapering. Apertural and apical extremities broken. Smooth throughout, only with weak concentric growth rings. Shell of under surface with undulating rings.

Remarks:—This species more or less resembles Dentalium weinkauffi Dunker figured by Hirase (1932, pl. 3, fig.), a
common Recent shell of Japan and also occurring as fossil from the Pliocene to younger deposits of Japan. However, in Dunker's species there are longitudinal striae at the apical part, whereas they are not developed in the present new species, and the shell of the present specimens is thicker.

This is a common species in the present area where it occurs in association with many other molluscs of the genera Venericardia, Turritella, Euspira and encrusting calcareous algae.

**Locality and geological formation:**
Road cutting on road leading from Funayama to Kozahara, Funayama, Misato-mura, Age-gun, Mie Prefecture (Holotype). Roadside cliff at the western side of Nakamura, Hisai-chô, Isshi-gun, Mie Prefecture. Both of the Kaisekizan formation. Miocene.

**Depository:** Geology Department, Mie University.

### Family Volutidae

**Genus Fulgoraria SCHEMACHER, 1817**

*Fulgoraria hirasei yanagidaniensis*

**ARAKI, n. subsp.**

**Plate 18. Figure 6.**

**Description:** The present subspecies resembles *Fulgoraria hirasei* Sowerby figured by Smith (1942, pl. 10, fig. 78) in general features, but can be distinguished therefrom by the narrower shell, more twisted canal, more narrowly spaced longitudinal ridges which extend nearly over the body whorl as mere striations, and by the concentric striae being apparently stronger. The curvature of the shoulder is more expanded. Height about 71 mm, maximum diameter of body whorl about 18 mm.

**Remarks:** Unfortunately the features of the aperture remain unknown owing to the covering of the matrix and also the youngest whorls could not be extracted from the matrix.

**Locality and geological formation:** Small cliff near the temple of Yanagidani, Misato-mura, Age-gun, Mie Prefecture (Holotype). Kaisekizan formation. 200 meters north of Kubo on road leading from Kubo to Shibukuro in the western part of Tsu City. Mie Prefecture. Yakuoji formation. Both Miocene.

**Depository:** Geology Department, Mie University.

### Family Neptuneidae

**Genus Ancistrolepis DALL, 1894**

*Ancistrolepis trochoides miensis*

**ARAKI, n. subsp.**

**Plate 18, Figures 7a, 7b, 8.**

**Description:** This new subspecies resembles *Ancistrolepis trochoides* Dall (1921, pl. 9, fig. 5; Suzuki, 1935) in general shape of the shell and in the possession of spiral cords which are much narrower than their interspaces and which often contain one or two intercalary threads. However, the present one differs from Dall's species in having eight spiral cords on the body whorl. three in the adult on the penultimate and in young specimens only two on the penultimate and one on the second whorls. The whorls are less shouldered, more rounded, and the spiral cords rarely accompany with intercalary threads. Height 40 and 22 mm, maximum diameters of body whorl 26 and 16 mm respectively for two specimens (Cotype).

**Remarks:** *Neptunea omntrai* Otuka (1940, pl. 11, figs. 5, 6) from the Miocene
deposits in Teshio Province. Hokkaido, more or less resembles the present sub-
species, but can be distinguished from
it by the narrower and higher shell,
less recurved canal, and by the number
and strength of both spiral cords and
intercalary threads.

Locality and geological formation:—
200 meters north of Kubo on road lead-
ing from Kubo to Shibukuro in the
western part of Tsu City, Mie Prefec-
ture. Yakuōji formation. Cliff of the southern slope of Kaisekizan, Sakakihara,
Hisai-cho, Isshi-gun, Mie Prefecture.
Kaisekizan formation. Both Miocene.

Depository:—Geology Department, Mie
University.

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Explanation of Plate 18

(All figures in natural size)

Fig. 1. Musculus hataii ARAKI, n. sp. Holotype. Loc.: Roadside cliff at about 300 meters
northwest of Onohira, Geino-cho, Age-gun, Mie Prefecture. Kaisekizan formation.

Figs. 2a, 2b. Periploma mitsuganoense ARAKI, n. sp. Holotype. Loc.: Tsuzumi Pass, Mitsugano,
Hakusan-cho, Isshi-gun, Mie Prefecture. Kaisekizan formation. 2a, view of the
right valve. 2b, view from the dorsal border.

Fig. 3. Venericardia funayamensis ARAKI, n. sp. Holotype. View of the right valve. Loc.: 
Road cutting on road leading from Funayama to Kozahara, Misato-mura, Age-gun,
Mie Prefecture. Kaisekizan formation.

Figs. 4a, 4b. Cyclina kamadae ARAKI, n. sp. Holotype. 4a, view of the right valve. 4b, view of
the same from the beak. Loc.: Small cliff at the paddy-field situated at about 200
meters northwest of Bessho, Misato-mura, Age-gun, Mie Prefecture. Furutaike
sandstone.

Figs. 5a, 5b. Dentalium misatoensis ARAKI, n. sp. Holotype. 5a, lateral view. 5b, cross sec-
tion of the aperture. Loc.: Road cutting on road leading from Funayama to Kozahara,
Misato-mura, Age-gun, Mie Prefecture. Kaisekizan formation.

Fig. 6. Fulgoraria hirasei yanagidaniensis ARAKI, n. subsp. Holotype. Although the apical
part is not fully exposed, the characters are of subspecific value. Loc.: Small cliff
near the temple of Yanagidani, Misato-mura, Age-gun, Mie Prefecture. Kaisekizan
formation.

Figs. 7a, 7b, 8. Ancistroplepis trochoides miyazis ARAKI, n. subsp. Cotype. 7a, back view of
7b, which is the front view. 8, fractured specimen showing the features of the
younger whorls. Loc.: Cliff of the southern slope of Kaisekizan, Sakakihara, Hisai-
cho, Isshi-gun, Mie Prefecture. Kaisekizan formation.
ARAKI: Miocene Mollusca from Mie

Plate 18

Kumagai Photo.
372. Marine Miocene Mollusca from Mie Prefecture

Pal., vol. 23, no. 1, pp. 87-94. 2 pls.


