MEMOIRS OF THE COLLEGE OF SCIENCE, UNIVERSITY OF KYOTO, SERIES B,
Vol. XXIII, No. 2, Article 2, 1956.

Molluscan Fauna of the Tsuzuki Group in Kyoto Prefecture, Japan

By

Junji ITOIGAWA

Geological and Mineralogical Institute, University of Kyoto

(Received Sept. 24, 1956)

Abstract

The molluscan fauna of the Miocene Tsuzuki group in Okuyamada, Kyoto Prefecture, Japan, is analysed and the relations to the faunas of the other groups are mentioned. *Tapes* (*Amygdala*) *miyamurensis* n. sp. is described.

Introduction

The Tertiary rocks exposed in a not very wide area of Okuyamada near Kyoto has been designated as the Tsuzuki group as a whole. The area was known as a good fossil-hunting ground and was worked cut by several authors.[4)5)10)12)] Recently, the Tsuzuki group is noted by the researchers as an element of the First Paleo-Setouchi supergroup[9)] (IKEBE, 1951). The stratigraphy was investigated by the Okuyamada research group and the result was reported.[6)]

The present writer is working on the molluscan fauna of the First Paleo-Setouchi supergroup and he has already reported on the fauna of the Mizunami group in the Iwamura basin. The analysis of the molluscan fauna of the Tsuzuki group related to the others of the same supergroup are mentioned in this paper.

He is indebted to Prof. J. MAKIYAMA for his valuable suggestions during the course of this work and English revision.

Paticular acknowledgments are made to the members of the Okuyamada research group, whose invariable encouragement and assistance in sampling made this work possible. Thanks are also due to Dr. T. KURODA and Dr. T. HABE for their informations about the malacology.

Outlines of the geology

The general stratigraphy and lithology, in decending order, are as follows;

5. Tawara tuffaceous Siltstone
   A majority of massive, yellowish and greenish gray, tuffaceous siltstones in alternation with arkose granule conglomerates.

4. Shiodani Sandstone
   Massive, medium to fine-grained sandstones intercalating pebbly conglomerates and fossil beds.
3. Kaya Mudstone
   Mainly massive, tuffaceous, hard, dark gray siltstones intercalating coarse, massive sandstones with fossil beds.
2. Miyamura Sandstone
   Massive, medium to fine-grained sandstones intercalating fossil beds.
1. Kawakami Basal conglomerate
   Alternations of massive, light and yellowish gray siltstones and pebbly conglomerates.

These strata crop out as a east-west strip about 5 km. in length. The geologic structure is synclinal accompanied with a fault of east-west trend. The strata divided into south and north wings by the fault. Three columnar sections are shown in Fig. 1.

The complete faunal list

The following is the complete faunal list of species from the different horizons and assemblages.

Pelecypoda 46
Scaphopoda 1
Gastropoda 22
Total number 69
Number of the determined species and subspecies 47
Number of new species 1

Abbreviations

× : Occurrence of that species
× : Remarkable occurrence of that species
Ms : Miyamura Sandstone
Km : Kaya Mudstone
1 : *Lucinoma-Acila* assemblage (General type)
2 : *Lucinoma-Acila* assemblage occurring in nodules
3 : *Felaniella-Dosinia* assemblage
Ss : Shiodani Sandstone

	Ms	Km			Ss
		1	2	3	
1. *Acila* (*Acila*) *submirabilis* MAKIYAMA	×	**×**	**×**	×	×
2. *Saccella confusa* (HANLEY)	×	**×**	**×**	×	—
3. *Barbatia* (*Savignyarca*) *kubara* ITOIGAWA	×	—	—	—	×
4. *Anadara* (*Scapharca*) cfr. *abdita* MAKIYAMA	—	—	—	—	**×**
5. *Glycymeris cisshuensis* MAKIYAMA	—	—	—	—	**×**
6. *G.* cfr. *derelicta* (YOKOYAMA)	—	—	—	—	×
7. *G.* sp.	—	—	—	—	×
8. *Crenella fornicata* YOKOYAMA	—	×	×	—	×

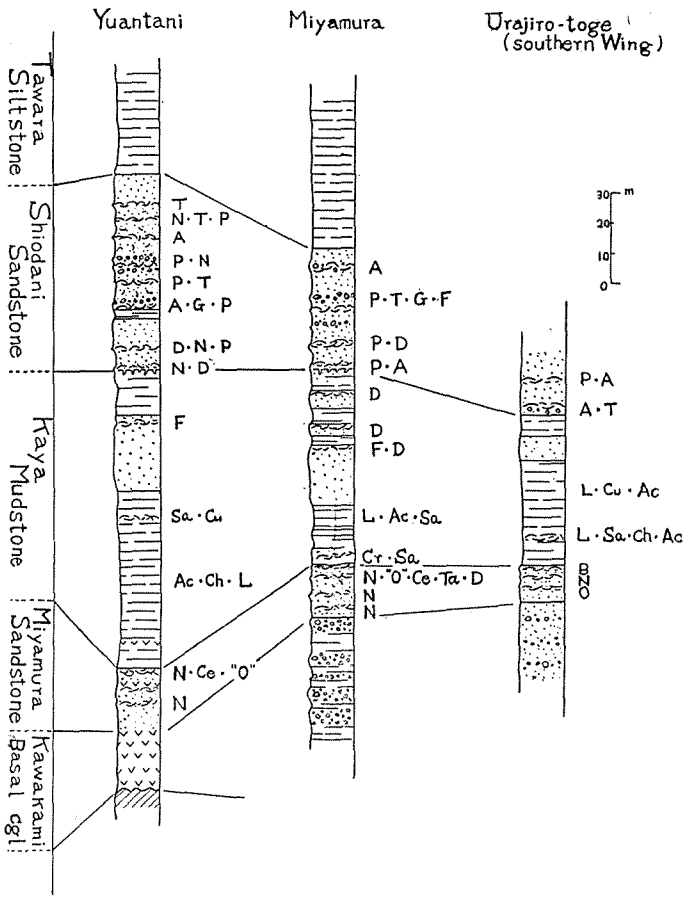


Fig. 1. Columnar sections of the Tsuzuki group
T: *Turritella*, N: *Nipponomarcia*, P: *Protorotella*, A: *Anadara*
G: *Glycymeris*, D: *Dosinia*, F: *Felaniella*, Sa: *Saccella*
Cu: *Cultelus*, Ac: *Acila*, Ch: *Chlamys*, L: *Lucinoma*
Ce: *Cerithium*, "O": "*Ostrea*", Cr: *Crepidula*, Ta: *Tapes*
B: *Balanus*, O: *Ostrea*

		Ms	Km 1	Km 2	Km 3	Ss
9.	*Chlamys egregius* ITOIGAWA	—	×	×	×	—
10.	*Ch. iwamurensis* ITOIGAWA	—	—	—	×	—
11.	*Anomia lischkei* DAUTZENBERG et FISCHER	×	—	—	—	×
12.	*Ostrea* (*Crassostrea*) sp.	×	—	—	—	×
13.	"*Ostrea*" sp.	×	—	—	—	×
14.	*Mitylus* sp.	—	—	—	×	×
15.	*Venericardia siogamensis* NOMURA	×	×	×	×	—

		Ms	Km 1	Km 2	Km 3	S3
16.	*V.* sp. indet.	×	—	—	—	×
17.	*Trapezium modiolaeforme* OYAMA et SAKA	×	—	—	—	—
18.	*Felaniella usta* (GOULD)	×	—	—	×	×
19.	*Luzinoma acutilineata* (CONRAD)	×	×	×	×	—
20.	*Pillucina yokoyamai* (OTUKA)	×	—	—	—	×
21.	*Laevicardium* cfr. *siobarense* (YOKOYAMA)	—	—	×	—	—
22.	*"Cardium" ogurai* OTUKA	×	—	×	—	×
23.	*Callista chinensis* (HOLTEN)	×	—	—	×	×
24.	*Dosinia nomurai* OTUKA	×	—	×	×	×
25.	*D. nagaii* NOMURA	×	—	—	×	—
26.	*D. anguloides* NOMURA	×	—	×	—	×
27.	*Cyclina japonica* KAMADA	×	—	—	×	—
28.	*Mercenaria* sp.	—	—	—	×	—
29.	*Leukoma* sp. indet.	—	—	—	—	×
30.	*Nipponomarcia nakamurai* IKEBE	×	—	—	—	×
31.	*Tapes* (*Amygdala*) *miyamurensis* n. sp.	×	—	—	—	—
32.	*T.* (*Siratoria*) *siratoriensis* OTUKA	×	—	—	—	×
33.	*Mactra* sp.	—	—	—	×	—
34.	*Lutraria* sp. indet.	×	—	—	—	—
35.	*Donax* (*Chion*) sp. indet.	—	—	—	—	×
36.	*Sanguinolaria minoensis* (YOKOYAMA)	×	—	—	—	—
37.	*Macoma tokyoensis* MAKIYAMA	×	×	×	—	×
38.	*M. incongrua* (MARTENS)	×	×	—	—	—
39.	*M. optiva* (YOKOYAMA)	—	×	—	—	—
40.	*Cultelus izumoensis* YOKOYAMA	—	×	×	—	—
41.	*Solen* sp.	×	—	—	—	—
42.	*Anisocorbula venusta elongata* ITOIGAWA	×	—	—	—	—
43.	*Zirphaea subconstricta kotorai* OTUKA	—	—	—	—	×
44.	*Teredo* sp.	—	×	—	—	—
45.	*Thracia* sp.	—	×	×	×	×
46.	*Periploma* sp.	—	×	—	—	—
47.	*Dentalium* sp.	—	×	—	—	×
48.	*Protoroteila yuantaniensis* MAKIYAMA	—	—	—	—	×
49.	*Leptothyra ena* ITOIGAWA	×	—	—	—	—
50.	*Lunella kurodai* ITOIGAWA	×	—	—	—	—
51.	*Turritella s-hataii* NOMURA	×	—	—	×	×
52.	*Batillaria yamanarii* MAKIYAMA	×	—	—	—	—
53.	*Cerithium arcisum* (YOKOYAMA)	×	—	—	—	—
54.	*C.* cfr. *otukai* NOMURA	×	—	—	—	×
55.	*Calyptraea tubura* OTUKA	×	—	—	—	×
56.	*Crepidula jimboana* YOKOYAMA	×	×	×	—	×
57.	*Euspira meisensis* MAKIYAMA	×	—	×	×	×
58.	*Chicoreus* sp.	×	—	—	—	—
59.	*Siphonalia makiyamai* ITOIGAWA	—	—	—	×	×
60.	*S. minuta* ITOIGAWA	×	—	—	—	—

		Ms	Km 1	Km 2	Km 3	Ss
61.	*S.* sp. indet.	×	—	—	—	—
62.	*Nassarius kometubus* OTUKA	×	×	×	—	—
63.	*N.* cfr. *simizui* OTUKA	×	—	×	—	×
64.	*Fulgoraria* sp.	—	×	×	—	—
65.	*Cymatosyrinx* sp. indet.	×	—	—	—	—
66.	*Syrnola* sp.	×	—	—	—	—
67.	*Turbonilla* sp.	×	—	—	—	—
68.	*Eocylichna* sp.	×	—	—	—	×
69.	*E. affabilis* (YOKOYAMA)	×	—	—	—	—
	Echinarachnius minoensis MORISHITA	—	—	—	—	×
	Balanus sp. 1.	×	—	—	—	—
	B. sp. 2.	×	×	—	—	×
	Coral	—	—	—	—	×
	Decapoda	×	—	—	—	—
	Bryozoa	×	—	—	—	—

Faunal analysis of molluscan assemblage

Each member of the strata has remarkable assemblages respectively and their mutual relations are shown in Fig. 2.

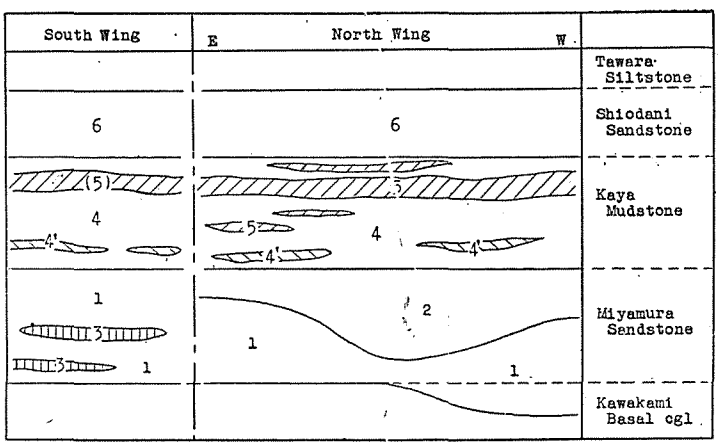


Fig. 2. Diagram to show the relations of the assemblages of the Tsuzuki Group
1. *Nipponomarcia* proper subassemblage, 2. "*Ostrea*"-*Cerithium* subassemblage,
3. *Ostrea-Balanus* subassemblage, 4. *Lucinoma-Acila* assemblage,
5. *Felaniella-Dosinia* assemblage, 6. *Protorotella-Anadara* assemblage

1. Kawakami Basal conglomerate

There are no marine mollusks in this member, except the uppermost part

which gradually changes into the upper Miyamura Sandstone. Therefore, the fossils are considered with the assemblage of the Miyamura Sandstone. The absence of marine form and the features of the lithofacies indicate that a fresh water environment was prevailed at the time when this member was deposited. It was prior to the transgression.

2. Miyamura Sandstone

Nipponomarcia assemblage is the representative of this member. A large quantity of *Nipponomarcia nakamurai* IKEBE occurs crowded in the thin beds. Frequently the beds are only made of the shells of this species. This assemblage may be subdivided into the following three subassemblages.

a) *Nipponomarcia* proper subassemblage
chief elements: *Nipponomarcia nakamurai* IKEBE, *Dosinia nomurai* OTUKA, *Turritella s-hataii* NOMURA etc.

This subassemblage is in the lower portion of the member and more conspicuous towards the west. In the eastern part, however, it is difficult to distinguish it from the following "*Ostrea*"-*Cerithium* subassemblage. The representative species indicate a neritic and sandy environment.

b) "*Ostrea*"-*Cerithium* subassemblage
chief elements: *Nipponomarcia nakamurai* IKEBE, *Dosinia nomurai* OTUKA, *Tapes* (*Amygdala*) *miyamurensis* n. sp., *Turritella s-hataii* NOMURA, *Cerithium ancisum* (YOKOYAMA), *Cerithium* cfr. *otukai* NOMURA, "*Ostrea*" sp., *Euspira meisensis* MAKIYAMA etc.

The lower part of this member contains this subassemblage in general. This is a mixture of neritic, brackish, and adhering forms.

c) *Ostrea* (*Crassostrea*)-*Balanus* subassemblage
chief elements: *Ostrea* (*Crassostrea*) sp., *Balanus* sp. 1.
It is found in the south wing.

These subassemblages occur crowded in layers, bands and patches indicating their allochthonous origin. Only *Nipponomarcia nakamurai* IKEBE seems to be autochthonous, for it is abundant and related to the proper lithofacies. Another species as *Cerithium* and "*Ostrea*" etc. may have been derived from an adjacent biotope. Consequently, it is possible to assume that the Miyamura Sandstone was deposited under an environment between neritic and brackish waters. Some warm sea inhabitants such as *Nipponomarcia*, *Cerithium*, *Batillaria* and *Cyclina* are present, but there is no typical Kurosio (warm current) type species. *Nipponomarcia* assemblage is representing a type of the fauna belong to the Japonic province proper.

3. Kaya Mudstone

The fauna of this member is represented by the *Lucinoma-Acila* and *Felaniella-Dosinia* assemblage.

a) *Lucinoma-Acila* assemblage
chief elements : *Acila submirabilis* MAKIYAMA, *Saccella confusa* (HANLEY), *Chlamys egregius* ITOIGAWA, *Venericardia siogamensis* NOMURA, *Lucinoma acutilineata* (CONRAD), *Cultelus izumoensis* YOKOYAMA, *Crepidula jimboana* YOKOYAMA etc.

This assemblage is general to this member and has two different modes of occurrence. The first mode is the sporadically scattered occurrence and the other is nodulous. In the former case, both the right and left valves of these shells are attached, showing the autochthonous origin in the muddy inland sea bottom. In the latter case, there are other elements such as *Dosinia nomurai* OTUKA, "*Cardium*" *ogurai* OTUKA and *Euspira meisensis* MAKIYAMA etc. These were evidently reworked from nearby biotopes and mixed with the forms *in situ* mentioned above.

b) *Felaniella-Dosinia* assemblage
chief elements : *Felaniella usta* (GOULD), *Dosinia nomurai* OTUKA, *Turritella s-hataii* NOMURA, *Euspira meisensis* MAKIYAMA etc.

This assemblage is found in the medium to coarse-grained sandstones intercalated in the upper part of this member. The subjects of this assemblage are *Felaniella*, *Dosinia* and *Turritella* etc. that are representing a neritic environment. The other elements, derived from the proper biotopes, such as *Acila submirabilis* MAKIYAMA, *Lucinoma acutilineata* (CONRAD) and *Venericardia siogamensis* NOMURA are also included.

These two assemblages are independent to each other. They are consist of the Japonic type species in general. *Acila submirabilis* MAKIYAMA and *Lucinoma acutilineata* (CONRAD) have been considered as belong to the cold water type. However, they are not cold water type but live in a deep water of the Japonic province.

Felaniella usta (GOULD) is an exceptional cold sea species. It is difficult to determine on the basis of the existence of this species whether cold currents were prevailed or not in the basin. The problem will be settled in near future.

4. Shiodani Sandstone

Protorotella-Anadara assemblage represents this member.
chief elements : *Anadara* cfr. *abdita* MAKIYAMA, *Glycymeris cisshuensis* MAKIYAMA, *Dosinia nomurai* OTUKA, *Nipponomarcia nakamurai* IKEBE, *Protorotella yuantaniensis* MAKIYAMA, *Turritella s-hataii* NOMURA, *Crepidula jimboana* YOKOYAMA etc.

These species showing an environment of neritic sandy bottom, compose the shell beds with pebble. It is evident that they have not been under the influence of strong currents, as shown by that they are properly situated in the matrices and there is little effect of wearing on the shells. *Protorotella yuantaniensis* MAKIYAMA, the most abundant species, are scattered in the sandstones indicating

a nearly autochthonous origin. In the silty parts, *Dosinia anguloides* NOMURA, *Crenella fornicata* YOKOYAMA and *Anadara* cfr. *abdita* MAKIYAMA occur.

The Japonic type species have a majority in the assemblage, but for *Protorotella* and *Nipponomarcia* the warm Japonic forms.

It resembles to the *Nipponomarcia* assemblage of the Miyamura Sandstone, but differs from the latter in the following respects.

1) Remarkable occurrence of *Protorotella yuantaniensis* MAKIYAMA
2) Absence of brackish type species as *Cerithium* and others

5. Tawara Siltstone

This member has only floral fossils. It is conceivable that the presences of plant fossils and lignite seams, and the absence of marine fossils, as well as the light colours of the rocks due to the fresh water origin of this member. It may represent the successive stages during the regressive phase.

6. Summary

The analysed assemblages are in a succession as follows (ascending order) ;

Nipponomarcia assemblage (with *Cerithium* and *Ostrea* subassemblages)	Miyamura Sandstone
Lucinoma-Acila assemblage *Felaniella-Dosinia* assemblage	} Kaya Mudstone
Protorotella-Anadara assemblage	Shiodani Sandstone
Floral assemblage	Tawara Siltstone

Fossil fauna and environments

The faunal development can be synthesized from the analysed series in connection with the stratigraphical evidences. Most probably the environment was under the control of fresh water in the beginning when the sediment started to deposit in the newly depressed basin. The Kawakami Basal conglomerate is the product of the first event. The transgression advanced more and more as the basin was expanded. The Miyamura Sandstone was deposited in a shallow neritic environment indicated by the *Nipponomarcia* assemblage. On the other side, brackish environments were common along the margin of the basin. The fauna in this age consists of rich variable forms. Next, the deposition of the Kaya Mudstone took place. This member is represented by the *Lucinoma-Acila* assemblage an indicator of a deep and wide inland salt water of muddy bottom. This assemblage including very common and stable species exhibits the faunal acme. The upper part of the Kaya Mudstone include the *Felaniella-Dosinia* assemblage, an indicator of a neritic sandy environment unlike the muddy bottom of the *Lucinoma-Acila* assemblage. Most probably this assemblage is in a close relation with that of the Shiodani Sandstone and is a foretoken of the coming regression. As a matter of fact, the life tracks discovered in a few horizons

between the Kaya Mudstone and the Shiodani Sandstone tells a beach condition. In the following Shiodani Sandstone, there is the *Protorotella-Anadara* assemblage which is a representative of a neritic sandy environment. The member is the product during the early regressive stage as it is proved to be so by the absence of the brackish form such as *Cerithium* etc. The Tawara Siltstone was deposited under a freshwater environment happened there by regression at its final stage. Apparently the fauna represents a cycle, commencing from the fresh water type, gradually changing upwards into the brackish and neritic types side by side, and then turn into the muddy inland sea type, which is successively followed again by the neritic type and the final fresh-water type. The cycle is parallel to the cycle of sedimentation from transgression to regression corresponding to the development of the basin.

This fauna is a part of the ancient typical Japonic fauna including neither evident Kurosio (warm current) nor Oyasio (cold current) elements. The inland sea was free from the influence of open sea currents. It can be clarified that the Tsuzuki basin was open to the west, as shown by the distribution of the assemblage, such as the *Ostrea-Balanus* subassemblage and the *Felaniella-Dosinia* assemblage.

Comparison and age

This fauna is similar to the faunas of the Mizunami and Ayukawa groups. Compared with the fauna of the Mizunami group in the Iwamura basin mentioned in a previous paper, there are about forty species common to both the faunas, the most remarkable examples are *Nipponomarcia nakamurai* IKEBE, *Dosinia nomurai* OTUKA, *Turritella s-hataii* NOMURA and *Lucinoma acutilineata* (CONRAD) etc. Also the faunal development resembles to that of the Mizunami group, but, it exhibits the complete cycle while the latter is deprived of the final regressive stage. It is a remarkable fact that both include the *Lucinoma-Acila* assemblage consisting of the same contents. This assemblage is found in another groups of the Setouchi geologic region always indicating a muddy bottom of the inland sea.

The existence of the index fossils, i. e. *Nipponomarcia nakamurai* IKEBE, *Protorotella yuantaniensis* MAKIYAMA and *Acila submirabilis* MAKIYAMA, shows that the age of this group is to be the middle Miocence (F_2–F_3).

Unsolved problems

Further studies in connection with the following propositions are now carrying on.

1. Existence of *Felaniella usta* (GOULD), a cold sea form of mollusca.— What is the reason of the single occurrence amid the Japonic fauna akin to temperate fauna?

2. The great number of simple forms such as *Nipponomarcia* and *Protorotella*.—What is meant by the one species shell bed and how it was made?

3. Relationships among the faunal developments.—What sort of mutual relations influenced the development?

Conclusions

1. The fauna consists of 69 species of mollusca.
2. The remarkable assemblages of each member represent the process of the faunal development.
3. The faunal development parallels to that of the basin.
4. The fauna is a Japonic type fauna.
5. This fauna is closely allied to the faunas of the Mizunami and Ayukawa groups.
6. The geologic age is the middle Miocene (F_2–F_3).

Description of the species

Anadara (Scapharca) cfr. abdita MAKIYAMA (Pl. II, figs. 4, 5)

1926. *Arca* (*Anadara*) *abdita* MAKIYAMA, Mem. Coll. Sci. Kyoto Imp. Univ., ser. B, vol. 2, no. 3, p. 152, pl. 12, fig. 11.

Anadara is common in the Shiodani Sandstone member and well preserved. The specimens are closely related to MAKIYAMA's *A. abdita*, a Miocene species of Korea but the dichotomous rib character of *A. abdita* is indistinct in these specimens under examination. *Anadara ninohensis* (OTUKA) 1934 is another allied species. OTUKA distinguished this species from the *A. abdita* MAKIYAMA in having "a broader area of absolete dichotomous ribs on the left anterior and right medial portions". As stated by NOMURA and HATAI,* the ribs of *A. ninohensis* OTUKA vary from dichotomous stage to non-dichotomous one. Generally speaking, the dichotomous feature is not a specific character and it is difficult to distinguished *A. ninohensis* OTUKA from *A. abdita* MAKIYAMA considering the contemporaneousness. The discussion will be postponed until the sufficient material is supplied.

Ostrea (Crassostrea) sp.

This species has the large and thick shell. The large oyster in Japan is *Ostrea gravitesta* YOKOYAMA 1926, Miocene species, and living *O. gigas* THUNBERG 1869. In the description of his species, YOKOYAMA stated the difference of the both as follows; "In general, this shell resembles in shape *Ostrea gigas* THUNB., so frequent in our Tertiary and Quaternary layers. But the thickness of the shell far exceeds that of the latter."

* Jap. Jour. Geol. & Geogr. vol. 13, p. 68, 1936

As a matter of fact, the living *Ostrea gigas* THUNBERG often has a shell of a great thickness and it is impossible to distinguish the two species in feature of thickness of shell. Moreover, the shell form of the Genus *Ostrea* is variable, so it is difficult to determine the specific name of the fossil species. The specific determination is premature at present.

"**Ostrea**" sp. (Pl. III, fig. 6)

This is a thin shell oyster. It falls to the Genus *Ostrea* in its broad sense, but it is unable to determine the exact generic name having no complete example.

Venericardia (Cyclocardia) sp. indet.

1955. *Venericardia (Cyclocardia)* sp. indet., ITOIGAWA, Mem. Coll. Sci. Univ. Kyoto, ser. B, vol. 22, p. 139, pl. 5, fig. 15.

Leukoma sp. indet. (Pl. III, fig. 7)

Shell small, subtrigonal, thick, moderately convex; surface with radial and concentric sculptures; radials strong, wider than interspaces; concentrics strong, slightly lamellated, crossing the radials, reticulated; lunule well-marked, sculptured as well as shell surface; inner margin denticulate; pallial sinus shallow.

Only a specimen is at hand. It differs from *Leukoma marica* (LINNÉ) 1758 in its shell form.

Tapes (Amygdala) miyamurensis n. sp. (Pl. I, figs. 2, 3)

Shell large, ovate, solid, longer than high, moderately inflated; postero-dorsal side gently sloped, descending to truncated posterior end; antero-dorsal margin short, slightly concave connecting with rounded anterior margin; ventral side arched; beak small, prominent, situated at the anterior two-third; surface with concentric growth lines and radiating striae; radials fine, numerous, rugated on the posterior part; concentrics fine, crossing the radials, decussate; lunule narrow, well marked; inner side unkown.

Dimensions: Height, 34.3 mm.; length, 52.4 mm.

Holotype: JC1400001 Paratype: JC1400002 (from 11–1, Kaya)

Occurrence: Kaya (11–1), Miyamura (6–k)

This shell closely allied to *Tapes (Amygdala) japonica* DESHAYES 1854, well known Recent species, but the former has larger and more elongate shell with more posteriorly situated beak. *Tapes (Siratoria) siratoriensis* OTUKA 1934 is another allied species, but it is distinguished from the present species in having a more elongate shell with weak sculpture.

Lutraria sp. indet. (Pl. I, fig. 1)

Shell large, elongate-ovate, longer than high, inflated; dorsal side nearly straight, obtusely angled postero-dorsal side; posterior margin angulated, acutely connecting with arched ventral side; surface with concentric growth lines; inner side unkown.

Only two specimens missing the anterior part are under examination. This shell resembles *Lutraria sieboldi* REEVE 1854, a Recent shell of Japan, but the former has more inflated and larger shell with more arched ventral side and angled ventral margin.

Donax (Chion) sp. indet. (Pl. III, fig. 4)

Shell moderate in size, trigonal, subequilateral; anterior and posterior side straight, truncated; surface with conspicuous radiating ribs and concentric lines; radials obsolete on the posterior part, crossing the concentrics, cancellate; inner margin denticulate.

It is easy to distinguish this species from *Donax (Chion) semigranosus* DUNKER 1877 by having large and regular trigonal shape. Only one right valve are obtained. This form is probably representing a new species, it will be described with a better material in future.

Cerithium cfr. **otukai** NOMURA (Pl. II, figs. 6, 8)

1934. "*Proclava*" aff. *ishiiana*, OTUKA, Bull. Earthq. Res. Inst. Tokyo Imp. Univ., vol. 12, pt. 3, p. 624, pl. 49, figs. 72, 73.

1935. *Cerithium otukai* NOMURA, Saito Ho-on Kai Mus. Res. Bull. no. 6, p. 227, pl. 17, f. 17.

This shell seems to fall the named species, but it differs on a few points as follows;

1. The shell is small.
2. The spiny beads of the subsutural cord number 18 on the last whorl.

It is clarified in future based on more complete specimens.

Siphonalia sp. indet. (Pl. III, fig. 9)

Only a few specimens are at hand.

The shell is fusiform with 11 axial nodes disappearing on the body whorl and fine numerous spiny threads. This shell is similar to *Siphonalia spadiceoides* NOMURA but the present species has a higher turreted shell with more curved columella.

Cymatosyrinx sp. indet.

1955. *Turricula* sp. indet., ITOIGAWA, Mem. Coll. Sci. Univ. Kyoto, ser. B, vol. 22, no. 2, p. 142, pl. 6, f. 24.

Bibliography

1) FUJITA, K. and OGOSE, S. (1950, 1951): Lithologic Classification of the Cenozoic Strata in the Northern Area of Mizunami-machi, Gifu Prefecture, Japan. Jour. Geol. Soc. Japan, **56**, 481-492, **57**, 99-110.

2) FUJITA, K. and the others. (1951): The Osaka Group and the Related Cainozoic Formations. Geological Science, **6**, 49-60.

3) IKEBE, N. (1934): Miocene Strata of the Eastern Part of Koga-gun, Ômi. The Globe, **22**, 110-123.

4) IKEBE, N. (1941): On *Katelysia* (*Nipponomarcia*) *nakamurai* Subgen. et sp. nov., from the Togarian Miocene of Japan. Jap. Jour. Mal., **11**, 49-54.
5) ———— (1949): On the New Locality of *Comptoniphyllum*. Mineralogy and Geology, **3**, 99, 100.
6) ISHIDA, S. and the others. (1954): Cenozoic Formations in Okuyamada, Kyoto Prefecture. Jour. Geol. Soc. Japan, **60**, 160-166.
7) ITOIGAWA, J. (1955): On the Variation of *Katelysia* (*Nipponomarcia*) *nakamurai* IKEBE. Jap. Jonr. Mal. **18**, 176-184.
8) ———— (1955): The Cenozoic Strata in the Iwamura Basin, Gifu Prefecture, Japan. Jour. Geol. Soc. Japan, **61**, 511-517.
9) ———— (1955): Molluscan Fauna of the Mizunami Group in the Iwamura Basin. Mem. Coll. Sci. Univ. Kyoto, B, **22**, 127-143.
10) MAKIYAMA, J. (1925): The Evolution of *Umbonium*. Jap. Jour. Geol. Geogr., **3**, 119-130.
11) OGOSE, S. (1952): On the Mode of Occurrence of Fossils in the Mizunami Group in the Eastern Mino, Japan. Jour. Geol. Soc. Japan, **58**, 477-486.
12) YOKOYAMA, M. (1930): Neogene Shells from Yamashiro. Jour. Fac. Sci. Imp. Univ. Tokyo, II, **2**, 399-403.

Explanation of Plate I

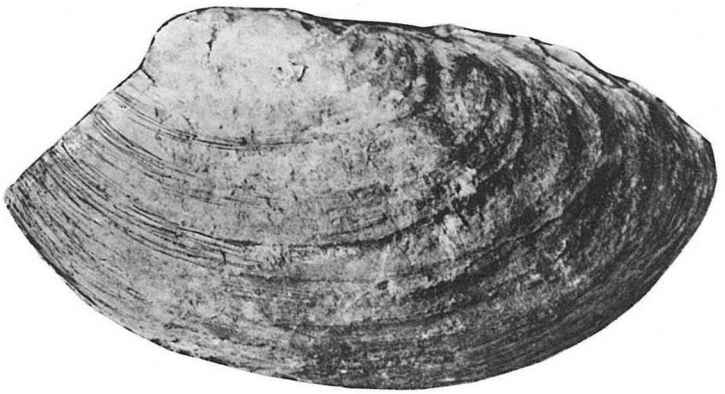
1. *Lutraria* sp. indet., Loc. Miyamura, 6-K.
2. *Tapes* (*Amygdala*) *miyamurensis* n. sp. (Holotype), Loc. Kaya, 11-1.
3. *Tapes* (*Amygdala*) *miyamurensis* n. sp. (Paratype), Loc. Kaya, 11-1.
4. *Nipponomarcia nakamurai* IKEBE, Loc. Kaya, 11-5.
5. *Nipponomarcia nakamurai* IKEBE, Loc. Kaya, 11-5.
6. *Protorotella yuantaniensis* MAKIYAMA, ×2, Loc. Miyamura, 76-2.
7. *Crepidula jimboana* YOKOYAMA, Loc. Miyamura, 6-L.
8. *Felaniella usta* (GOULD), Loc. Miyamura, 97.

Explanation of Plate II

1. *Glycymeris cisshuensis* MAKIYAMA, Loc. Miyamura, 76-1.
2. *Lucinoma acutilineata* (CONRAD), Loc. Ôfuku, 10-1.
3. *Dosinia nomurai* OTUKA, Loc. Miyamura, 97.
4. *Anadara* cfr. *abdita* MAKIYAMA, Loc. Kaya, 63.
5. *Anadara* cfr. *abdita* MAKIYAMA, Loc. Miyamura, 76-3.
6. *Cerithium* cfr. *otukai* NOMURA, ×1.5, Loc. Miyamura, 6-K.
7. *Cerithium ancisum* (YOKOYAMA), ×1.5, Loc. Miyamura, 6-K.
8. *Cerithium* cfr. *otukai* NOMURA, ×1.5, Loc. Ôfuku, 13-1.

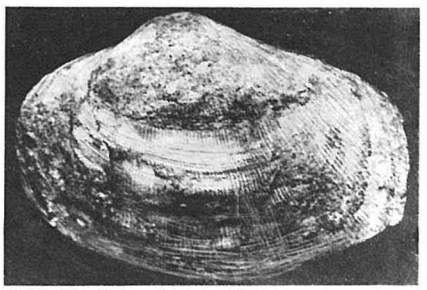
Explanation of Plate III

1. *Chlamys egregius* ITOIGAWA (Paratype specimen from the Iwamura Basin)
2. *Chlamys egregius* ITOIGAWA (Holotype specimen from the Iwamura Basin)
3. *Chlamys iwamurensis* ITOIGAWA, Loc. Miyamura, 97.
4. *Donax* (*Chion*) sp. indet., Loc. Ishizume, 98.
5. *Nassarius* cfr. *simizui* OTUKA, ×1.5, Loc. Ôfuku, 13-1.
6. "*Ostrea*" sp., Loc. 12-1.
7. *Leukoma* sp. indet., Loc. Kaya, 63.
8. *Glycymeris* cfr. *derelicta* (YOKOYAMA), Loc Kaya, 63.
9. *Siphonalia* sp. indet., ×2, Loc. Miyamura, 6-K.
10. *Euspira meisensis* MAKIYAMA, Loc. Ishizume, 98.



1

2

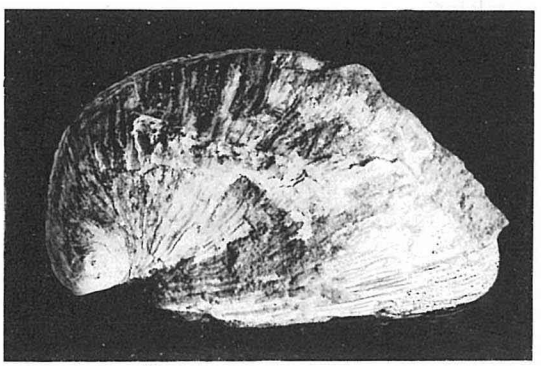


3

4

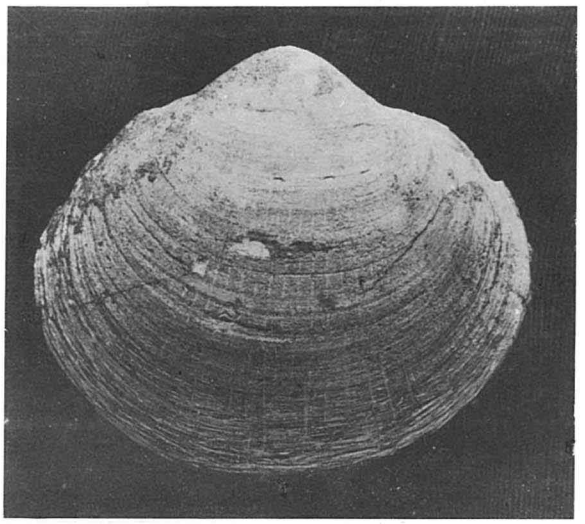
5

6

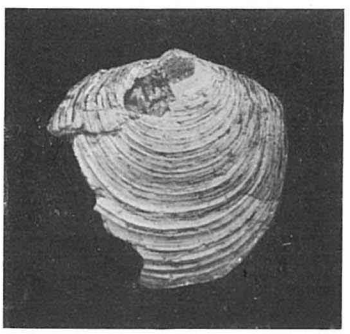


7

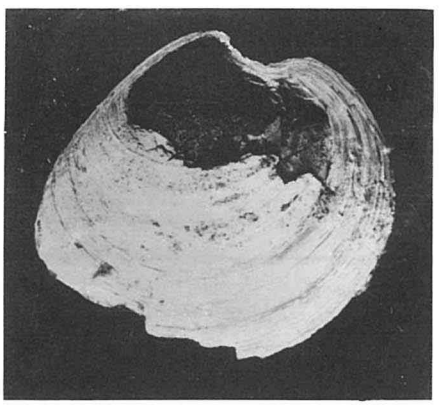
8



1



2



3

4

5

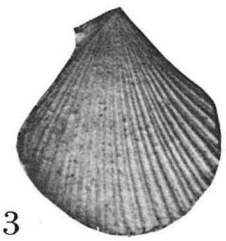
6

7

8

1

2



3

4

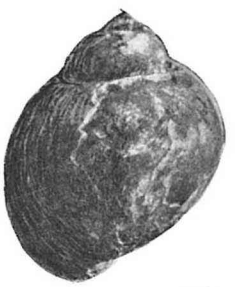
5

6

7

9

8



10