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Fossils from Nange, Matsue City

——Molluscan Fossils from Various Localities in Shimane Prefecture, Part 1——

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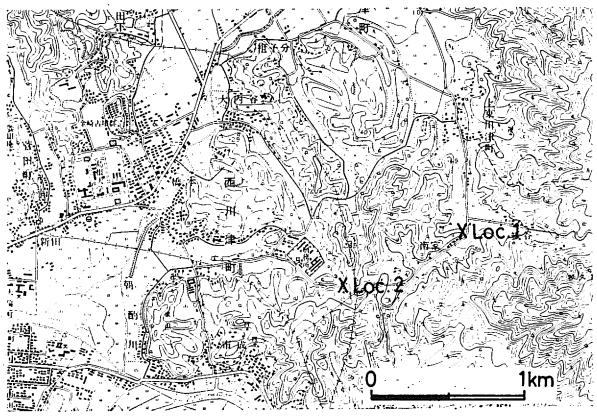
Introduction

Many fossils from various localities in Shimane Prefecture have been deposited in the Department of Geology, Shimane University, but most of them yet remains to be examined. Therefore, the serial work was planned by the present author to identify and illustrate the specimens for further studies. As the Part 1 of the work, the fossils from Nange, Matsue City, are examined. From Nange, about 10 species of molluscs were listed by OTUKA (1938) and NOMURA and HATAI (1939) individually, but they were neither described nor illustrated.

Before the examination, I wish to thank Dr. Junji ITOIGAWA of Nagoya University for his valuable aid in identifying the specimens. A part of this study was supported by the scientific research fund from the Ministry of Education.

Localities and Stratigraphic Position

The fossil localities are shown in Textfig. 1.



Textfig. 1. Map showing the fossil localities.
(Taken from the topographical map "Matsue", 1: 25,000 in scale)

Loc. 1; Road side outcrop at Nange, Kamihigashikawazu-cho, Matsue City. This is the same locality that OTUKA (1938) and NOMURA and HATAI (1939) described.
Loc. 2; Road side outcrop about 300 m SE of Matsue Prison, Nishikawazu-cho, Matsue City. Now, this outcrop is not observable by the artificial constructions.

In both localities, fossils are involved in the basic lapilli or coarse tuff which was called the Kawazu Tuff by MIYAJIMA *et al.* (1972). The Kawazu Tuff Member is estimated to be more than 100 meters thick in this area, and is correlated with the middle part of the Matsue Formation which overlies comformably the Fujina Formation. The Matsue Formation is generally considered to be the latest Miocene in age.

Fossils

Several specimens are well preserved, but the rest are deformed or weathered in various degrees.

The molluscan assemblage is similar in both localities, and they are characterized by abundant occurrence of *Glycymeris* and variable species of Veneridae. The representative species are as follows; *Glycymeris cisshuensis*, *Glycymeris derelicta*, *Glycymeris* sp., *Saxidomus purpuratus*, *Callithaca* sp., *Protothaca* cf. *tateiwai*, and so on. Among the species, *Glycymeris cisshuensis*, *Protothaca* cf. *tateiwai*, *Anadara ogawai* and several species of Pectinids have been regarded as the representatives of the Middle Miocene molluscs in Japan. This fact is inconsistent with the previous view of the stratigraphy. In addition, the fossil assemblages from Nange are different distinctly from those of the Fujina Formation which are characterized by *Macoma optiva*, *Patinopecten kagamianus*, *Cultellus izumoensis*, *Clinocardium shinjiense* etc. (SUEHIRO, 1979; OGASAWARA and NOMURA, 1980); the former can be considered to indicate the coarse grained bottom of warm shallow sea, while the latter seem to be muddy bottom of temperate shallow water environment. Though the problem of these peculiarities of the fossil assemblages should be studied further in detail, the author gives only the remarks on species.

Remarks on Species

1. GASTROPODA

Family ACMAEIDAE

Genus *Acmaea* ESCHSCHOLTZ, 1833
"*Acmaea*" sp.
Pl. I, figs. 7a, b

Measurements in mm. —

DGSU* coll. cat. no.	Locality	Diameter	Height
T1047	Loc. 1	11.0 × ca. 9.5	3.8

Remarks. — Though the specimen is an inner mould, it has no remains of apical hole and anterior slit.

Family TROCHIDAE

Genus *Trochus* LINNÉ, 1758

Trochus sp.
Pl. I, fig. 3

Only a fragment of the body whorl (DGSU coll. cat. no. T1046) was obtained from Loc. 1.

Family TURBINIDAE

Genus *Galeoastraea* HABE, 1958

Galeoastraea sp.
Pl. I, fig. 4

Measurements in mm. —

DGSU coll. cat. no.	Locality	Diameter	Height
T1019	Loc. 1	16.4	17.2

Remarks. — The specimen is characterized by its deep suture between last two whorls and its many, low, blunt axial ridges on the shoulder of last three whorls.

Family TURRITELLIDAE

Genus *Turritella* LAMARCK, 1799

Subgenus *Idaella* KOTAKA, 1959

Turritella (*Idaella*) *tanaguraensis* KOTAKA, 1951
Pl. I, figs. 1, 2

1931. *Turritella* sp., YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo,* vol. 3, no. 2, p. 201, pl. 12, fig. 4.
1936. *Turritella kadonosawaensis,* NOMURA and HATAI, *Saito Ho-on Kai Mus. Res. Bull.,* no. 10, p. 143, pl. 16, figs. 1, 2.
1951. *Turritella tanaguraensis* KOTAKA, *Ibid.,* no. 21, p. 10, pl. 1, figs. 16, 17.
1952. *Turritella tanaguraensis,* IDA, *Rep. Geo . Surv. Japan,* vol. 150, p. 59, pl. 2, figs. 4, 5, pl. 5, fig. 4.
1959. *Turritella* (*Idaella*) *tanaguraensis,* KOTAKA, *Sci. Rep., Tohoku Univ., 2nd Ser.,* vol. 31, no. 2,

* Abbreviation for Department of Geology, Faculty of Science, Shimane University, Matsue

pp. 97–98, pl. 8, figs. 1–9.

1970. *Turritella tanaguraensis*, IWASAKI, *Jour. Fac. Sci., Univ. Tokyo, Sec.* 2, vol. 17, no. 3, p. 413, pl. 5, figs. 7, 8.

1980. *Turritella (Idaella) tanaguraensis*, OGASAWARA and NOMURA, *Prof. S. Kanno Mem. Vol.*, pp. 91–93, pl. 12, figs 7a–11.

Measurements. —

DGSU coll. cat. no	Locality	Diameter	Height	Angle of spire
T1024	Loc. 1	ca. 11.0 mm	—	ca. 15°
T1039	Loc. 2	ca. 10.5 mm	—	ca. 14°

Remarks. — The spiral cords of these specimens are formulated as (. C . B s_1 s_2 A) and (. C . B . s A .) respectively; C and B are prominent and A is weak and rather secondery.

Family NATICIDAE

Naticidae gen. et sp. indet.
Pl. I, figs. 5, 6

A small calcareous operculum (DGSU coll. cat. no. T1048) and a very ill preserved inner mould (DGSU coll. cat. no. T1025) were obtained from Loc. 1.

Family MURICIDAE

Genus *Ocenebra* GRAY, 1847

Ocenebra? sp.
Pl. I, fig. 8

A fragment of body whorl with rounded, somewhat nodulated axial ribs and many irregular spiral cords (DGSU coll. cat. no. T1020; Loc. 1).

2. PELECYPODA

Family ARCIDAE

Genus *Anadara* GRAY, 1847

Subgenus *Anadara* s.s.

Anadara (Anadara) ogawai (MAKIYAMA, 1926)
Pl. I, figs. 9a–10

1926. *Arca (Anadara) ogawai* MAKIYAMA, *Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B,* vol. 2, no. 3, pp. 154–155, pl. 12, fig. 16.
1934. *Arca amicula,* OTUKA, *Bull. Earthq. Res. Inst., Imp. Univ. Tokyo,* vol. 12, pt. 3, p. 609, pl. 47, fig. 20.
1966. *Anadara (Anadara) ogawai,* NODA, *Sci. Rep. Tohoku Univ., 2nd Ser.,* vol. 38, no. 1, p. 97, pl. 4, figs. 12, 14, pl. 7, fig. 11, pl. 8, figs. 4–7, pl. 9, figs. 10, 13, pl. 11, figs. 7, 15.
1967. *Anadara (Anadara) ogawai,* KOTAKA and NODA, *Saito Ho-on Kai Mus. Res. Bull.,* no. 36, pl. 2, figs. 10, 11.
1968. *Anadara (Anadara) ogawai,* NODA and TADA, *Trans. Proc. Palaeont. Soc. Japan, N. S.,* no. 69, p. 199, pl. 22, fig. 19.

Two well preserved specimens were obtained from Loc. 1.

Mesurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth	Length of ligament	Length of teeth	Number of radial ribs
T1018 (left valve)	38.0	24.0	8.9	12.0	18.2	26+
T1040 (right valve)	24.3	20.2	7.3	9.2	16.5	29

Remarks. — The present specimens are characterized by their dichotomous radial ribs and their small beak. They differ from the well known Late Micoene species, *Anad. amicula amicula,* in lacking the beaded structures and in their smaller numbers of radial ribs.

Family GLYCYMERIDAE

Genus *Glycymeris* da COSTA, 1778

Glycymeris cisshuensis MAKIYAMA, 1926
Pl. II, figs. 2–4b

1926. *Glycymeris cisshuensis* MAKIYAMA, *Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B,* vol. 2, no. 3, p. 155, pl. 13, figs. 2, 3.
1928. *Glycymeris cisshuensis,* NAGAO, *Sci. Rep. Tohoku Imp. Univ., 2nd Ser.,* vol. 12, no. 1, p. 29, pl. 2, figs. 1–13, pl. 3, figs. 1–3, pl. 4, figs. 22–25.
1937. *Glycymeris cisshuensis,* NOMURA and HATAI, *Saito Ho-on Kai Mus. Res. Bull.* no. 13, p. 125, pl. 17, fig. 7.
1956. *Glycymeris cisshuensis,* HIRAYAMA, *Sci. Rep. Tokyo Univ. Ed., Sec. C,* vol. 5, no. 45, p. 103.
1960. *Glycymeris cisshuensis,* KANNO, *Japan Soc. Prom. Sci.,* pp. 207–208, pl. 31, figs. 34–35.
1960. *Glycymeris cisshuensis,* ARAKI, *Bull. Lib. Arts Dep., Mie Univ., Spec. Vol.,* no. 1, p. 79, pl. 5, figs. 7a–8.
1962. *Glycymeris cisshuensis,* KAMADA, *Spec. Pap., Palaeont. Soc. Japan,* no. 8, pl. 3, figs. 1–3.
1963. *Glycymeris cisshuensis,* OKAMOTO and NAKANO, *Geol. Rep., Hiroshima Univ.,* no. 12, p. 538, pl. 57, figs. 1a–3.
1970. *Glycymeris cisshuensis,* IWASAKI, *Jour. Fac. Sci., Univ. Tokyo, Sec.* 2, vol. 17, pt. 3, p. 393, pl. 4, figs. 6, 7.

1974. *Glycymeris cisshuensis,* ITOIGAWA in ITOIGAWA, SHIBATA and NISHIMOTO, *Bull. Mizunami Fossil Mus.,* no. 1, pp. 57–58, pl. 5, figs. 1–5.

Several well preserved specimens were obtained from both localities.

Measurements in mm. —

DGSU coll. cat. no.	Loc.	Length	Height	Depth	Length of ligament	Length of teeth
T1003 (right valve)	Loc. 1	70.0	61.3	19.3	24.5	53.0
T1004 (right valve)	Loc. 1	60.5	62.6	ca. 20.0	22.0	42.5
T1005 (right valve)	Loc. 1	74.0	66.0	21.0	32.8	54.5
T1050 (right valve)	Loc. 2	62.4	63.0	ca. 19.0	—	—
T1051 (conjoined)	Loc. 2	81.9	71.6	47.5/2	—	—

Remarks. — This species is characterized by its large and thick hinge plate with several strong hooked teeth on each side. The examined specimens are classified into two types of shell features; transversely ovate type and suborbicular type. The latter may be a deformed one.

Glycymeris derelicta (YOKOYAMA, 1928)
Pl. I, figs. 15a–16b, Pl. II, figs. 1a, b

1928. *Pectunculus derelictus* YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec.* 2, vol. 2, pt. 7, p. 361, pl. 69, fig. 1.
1935. *Glycymeris derelicta,* NOMURA and ZINBO, *Saito Ho-on Kai Mus. Res. Bull.,* no. 6, p. 157, pl. 15, figs. 1, 2.
1959. *Glycymeris derelicta,* CHINZEI, *Jour. Fac. Sci., Univ. Tokyo, Sec.* 2, vol. 12, pt. 1, p. 122, pl. 11, figs. 12–15.

Many well preserved specimens were obtained from both localities.

Measurements in mm. —

DGSU coll. cat. no.	Loc.	Length	Height	Depth	Length of ligament	Length of teeth
T1013 (conjoined)	Loc. 1	33.2	33.6	17.0/2	—	—
T1014 (left valve)	Loc. 1	34.5	36.6	10.3	16.0	23.2
T1038 (left valve)	Loc. 2	37.0	37.0	9.3	13.3	24.5
T1049 (right valve)	Loc. 2	38.6	37.8	8.1	14.7	24.3

Remarks. — This species was reported from the Pliocene of the Higashiyama oil field, Niigata Prefecture by YOKOYAMA, the Miocene Yanagawa formation, Fukushima Prefecture by NOMURA and ZINBO and the Pliocene Sannohe Group, Iwate Prefecture by CHINZEI. The present specimens resemble the last two specimens in having more

rounded dorsal margin and denser radial striae than YOKOYAMA's type. However, the present ones are not so unequilateral in outline as CHIZEI's specimen, and have the stronger rib-like radial sculpture.

Glycymeris sp.
Pl. II, figs. 11–14

Many well preserved specimens were obtained from both localities, of which ten specimens were examined.

Measurements in mm. —

DGSU coll. cat. no.	Loc.	Length	Height	Depth	Length of ligament	Length of teeth
T1008 (left valve)	Loc. 1	18.9	18.4	ca. 5.3	—	—
T1009 (left valve)	Loc. 1	36.0	34.2	9.4	—	—
T1010 (left valve)	Loc. 1	22.3	21.9	—	8.0	15.4
T1011 (right valve)	Loc. 1	34.3	33.3	8.5	12.7	21.1
T1012 (left valve)	Loc. 1	34.3	30.0	ca. 7.3	—	—
T1035 (left valve)	Loc. 2	33.0	31.0	8.3	12.5	20.8
T1036 (right valve)	Loc. 2	26.0	22.8	5.5	7.0	16.0
T1037 (left valve)	Loc. 2	34.4	30.0	8.0	12.3	22.8
T1052 (conjoined)	Loc. 2	35.2	33.7	ca. 20.0/2	—	—
T1055 (right valve)	Loc. 2	36.8	34.5	11.2	8.4	ca. 16.0

Remarks. — It is one of the most abundant molluscs of the Nange fauna. The specimens resemble *G. derelicta* in having rather distinct rib-like radial sculptures, but differ therefrom in their transversely elongated outline and somewhat thin test.

Family MYTILIDAE

Genus *Modiolus* LAMARCK, 1799

Subgenus *Modiolus* s.s.

Modiolus (*Modiolus*) *modiolus difficilis* KURODA *et* HABE, 1950
Pl. III, fig. 1

1965. *Modiolus difficilis*, KASENO and MATSUURA, *Sci. Rep., Kanazawa Univ.*, vol. 10, no. 1, pl. 6, fig. 18.
1980. *Modiolus difficilis*, OGASAWARA and NOMURA, *Prof. S. Kanno Mem. Vol.*, pl. 9, fig. 10.

Two ill preserved specimens were obtained from Loc. 2.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth
T1001 (right valve)	90.0+	ca. 42.0	ca. 27.0
T1043 (left valve)	28.0	19.5	ca. 12.0

Family PECTINIDAE

Genus *Chlamys* (BOLTEN) RÖDING, 1798

Subgenus *Chlamys* s.s.

Chlamys (*Chlamys*) cf. *otukae* MASUDA and SAWADA, 1961
Pl. III, figs. 3, 4

1961. *Chlamys otukae* MASUDA and SAWADA, *Jap. Jour. Geol. Geogr.*, vol. 32, no. 1, p. 19, pl. 4, figs. 1–5.
1962. *Chlamys* (*Chlamys*) *otukae*, MASUDA, *Sci. Rep. Tohoku Univ., 2nd Ser.*, vol. 33, no. 2, p. 182, pl. 19, figs. 13, 14, pl. 21, fig. 12.

An ill preserved specimen (DGSU coll. cat. no. T1016) and a fragmental specimen (DGSU coll. cat. no. T1030) were obtained from Loc. 1 and Loc. 2 respectively.

Remarks. — Though the specimens are imperfect, they are compared with that species by their characteristic radial ribs which are divided into two subequal riblets at the ventral margin and intercalary threads between radial ribs.

Subgenus *Mimachlamys* IREDALE, 1929

Chlamys (*Mimachlamys*) cf. *kaneharai* (YOKOYAMA, 1926)
Pl. III, fig. 2

1926. *Pecten kaneharai* YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec.* 2, vol. 1, no. 4, p. 135, pl. 18, fig. 1, pl. 19, figs. 1, 2, 5–9.
1931. *Pecten kaneharai*, YOKOYAMA, *Ibid.*, vol. 3, no. 4, p. 203, pl. 13.
1936. *Pecten* (*Chlamys*) *kaneharai*, NOMURA and HATAI, *Saito Ho-on Kai Mus. Res. Bull.*, no. 10, p. 119, pl. 13, figs. 3, 4.
1937. *Pecten* (*Chlamys*) *kaneharai*, NOMURA and HATAI, *Ibid.*, no. 13, p. 127, pl. 18, figs. 1, 2.
1940. *Chlamys kaneharai*, NOMURA and ONISHI, *Jap. Jour. Geol. Geogr.*, vol. 17, nos. 3–4, p. 187, pl. 18, fig. 8.
1956. *Chlamys kaneharai*, MASUDA, *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 22, p. 176, pl. 28, figs. 1–7.
1956. *Chlamys kaneharai*, SHIBATA, *Ibid.*, no. 23, p. 230, pl. 32, figs. 5a–6.
1962. *Chlamys* (*Mimachlamys*) *kaneharai*, MASUDA, *Sci. Rep. Tohoku Univ., 2nd Ser.*, vol. 33, no. 2, p. 187, pl. 20, fig. 7, pl. 22, figs. 8–10, pl. 26, figs. 11, 12.
1966. *Chlamys kaneharai*, UOZUMI, FUJIE and MATSUI, *Jour. Fac. Sci., Hokkaido Univ., Ser.* 4, vol. 13,

no. 2, p. 172, pl. 14, figs. 3a, b.

1970. *Chlamys kaneharai,* IWASAKI, *Jour. Fac. Sci., Univ. Tokyo, Sec.* 2, vol. 17, pt. 3, p. 396, pl. 6, figs. 7, 8.

1974. *Chlamys kaneharai,* HATAI, MASUDA and NODA, *Saito Ho-on Kai Mus. Res. Bull.,* no. 43, pl. 4, figs. 3, 4.

A weathered and somewhat deformed right valve was obtained from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth	Apical angle
T1000	ca. 68.5	79.0	ca. 12.0	ca. 65°

Remarks. — The present specimen resembles very much *C.* (*M.*) *kaneharai* obtained from the Lower and Middle Miocene of Northeast Honshu in its size and shell form. The latter has distinct, imbricated, elevated radial ribs, while in the case of the present specimen such characterstics are obscured by its ill preservation.

Genus *Placopecten* VERRILL, 1897

Subgenus *Placopecten* s.s.

Placopecten (*Placopecten*) cf. *protomollitus* (NOMURA, 1935)

Pl. III, fig. 5

1935. *Pecten* (*Pecten*) *protomollitus* NOMURA, *Saito Ho-on Kai Mus. Res. Bull.,* no. 6, p. 41, pl. 6, fig. 3.

1953. *Placopecten protomollitus,* MASUDA, *Trans. Proc. Palaeont. Soc. Japan, N. S.,* no. 12, pl. 8, fig. 8.

1962. *Placopecten* (*Placopecten*) *protomollitus,* MASUDA, *Sci. Rep. Tohoku Univ., 2nd Ser.,* vol. 33, no. 2, p. 193, pl. 20, fig. 3, pl. 22, figs. 15, 16.

1964. *Placopecten protomollitus,* MIZUNO, *Bull. Geol. Surv. Japan,* vol. 15, no. 10, p. 162, pl. 1, figs. 16, 17.

1966. *Placopecten protomollitus,* MASUDA, *Trans. Proc. Palaeont. Soc. Japan, N. S.,* no. 64, pl. 35, fig. 7.

An imperfect right valve was obtsined from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth	Apical angle
T1023	48.0	49.0	—	110°

Remarks. — Such characteristics as fine, unequal, round-topped radial ribs and threads of this specimen suggest that they are compared with the above species.

Placopecten sp.
Pl. III, fig. 6

A fragmental specimen of a large valve (DGSU coll. cat. no. T1007) was obtained from Loc. 1. The surface is rather eroded.

Remarks. — Numerous fine, somewhat beaded, round-topped radial ribs are observable on the surface. The interspace of each radial rib is rather wide.

Family VENERIDAE

Genus *Chione* MEGERLE von MUHLFELD, 1811

"*Chione*" sp.
Pl. IV, figs. 6a, b

Partly broken conjoined valves were obtained from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth
T1028	34.7	29.4	17.2/2

Remarks. — The general character indicates that the specimen belongs to the genus *Chione*, but such peculiar shape of the specimen has been unknown in this genus. The specimen also allies to the genus *Securella*, of which several fossil species were illustrated by KANNO (1960), but differs from them in the dorsal character.

Genus *Protothaca* Dall, 1902

Protothaca cf. *tateiwai* (MAKIYAMA, 1926)

1926. *Chione tateiwai* MAKIYAMA, *Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B,* vol. 2, no. 3, p. 153, pl. 13, figs. 5, 6.
1936. *Protothaca tateiwai,* NOMURA and HATAI, *Saito Ho-on Kai Mus. Res. Bull.,* no. 10, p. 126, pl. 14, figs. 7, 8.
1964. *Protothaca tateiwai,* MIZUNO, *Bull. Geol. Surv. Japan,* vol. 15, no. 10, pl. 4, fig. 1.
1970. *Protothaca tateiwai,* IWASAKI, *Jour. Fac. Sci., Univ. Tokyo, Sec.* 2, vol. 17, pt. 3, p. 409, pl. 1, figs. 5–7.

Slightly deformed, isolated two valves were obtained.

Measurements in mm. —

DGSU coll. cat. no.	Locality	Length	Height	Depth
T1015 (left valve)	Loc. 1	33.9	28.1	10.4
T1054 (left valve)	Loc. 2	38.3	30.5	11.2

Remarks. — The present specimens are somewhat elongated transversely compared with the MAKIYAMA's type and NOMURA and HATAI's illustrations.

Protothaca sp.
Pl. V, figs. 2a–3

Weathered two isolated right valves and an inner mould were obtained from both localities.

Measurements in mm. —

DGSU coll. cat. no.	Locality	Length	Height	Depth
T1031 (right valve)	Loc. 1	31.0	32.7	12.0
T1053 (right valve)	Loc. 1	27.8	29.6	10.0
T1032 (inner mould)	Loc. 2	(28.8)	(32.5)	(9.3)

Remarks. — The present specimens also resemble *Cyclocardia* in outline, but the former is clearly distinguishable from the latter by its weak radial ribs and by lacking the strong crenulation on their inner margin. The dentition of them shows the character of *Protothaca*.

Genus *Callithaca* DALL, 1902

Callithaca sp.
Pl. IV, figs. 1a, b, Pl. V, figs. 2–3b, 5a, b

Several weathered specimens were obtained from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Heght	Depth
T1002 (right valve)	ca. 63.0	54.7	19.0
T1033 (right valve)	64.8	55.0	ca. 16.0
T1034 (inner mould)	(65.0)	(53.5)	—
T1044 (left valve)	53.2	48.1	14.5

Remarks. — The present specimens resemble *Callithaca adamsi*, the Pliocene to Recent species in Japan, but they are distinguishable therefrom by the shallow and somewhat pointed pallial sinus.

Genus *Pitar* RÖMER, 1857

Subgenus *Pitarina* JUKES-BROWN, 1913

Pitar (*Pitarina*) cf. *semeliformis* SHUTO, 1960
Pl. IV, figs. 7a–c

1960. *Pitar* (*Pitarina*) *semeliformis* SHUTO, *Mem. Fac. Sci., Kyushu Univ., Ser. D.* vol. 9, no. 3, pp. 135–136, pl. 14, figs. 1, 3, textfig. 3–A.

A single right valve was obtained from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth
T1029	34.8	26.0	13.5

Remarks. — The peculiar form of the present specimen is similar to that of *Pitar* (*Pitarina*) *semeliformis* from the lowest member of the Miyazaki Group. But the features of the hinge plate somewhat differ eachother.

Genus *Phacosoma* JUKES-BROWN, 1912

Phacosoma cf. *japonicum* (REEVE, 1850)
Pl. V, figs. 1a–c

An imperfect and somewhat deformed right valve were obtained from Loc. 1.

Measurements in mm. —

DGSU coll. cat. no.	Length	Height	Depth
T1027	45.8	48.2	14.5

Remarks. — The specimen is deformed and probably more inflated than the original shape. The hinge plate of the specimen seems to be larger and more stout than that of Recent *Phacosoma japomicum*. It also resembles "*Dosinia*" *nomurai*, a well known Miocene species, but can be distinguish therefrom by its higher and more rounded shell.

Genus *Callista* POLI, 1791

Subgenus *Callista* s.s.

Callista (*Callista*) *chinensis* (HOLTEN, 1803)
Pl. V, figs. 1a, b.

DGSU coll. cat no. T1042; Loc. 1. An imperfect right valve.

Genus *Saxidomus* CONRAD, 1837

Saxidomus purpuratus (SOWERBY, 1852)
Pl. IV, figs. 2–5b, Pl. V, fig. 4

Several imperfect and somewhat deformed specimens were obtained from both localities.

Measurements in mm. —

DGSU coll. cat. no.	Locality	Length	Height	Depth
T1006 (left valve)	Loc. 1.	67.1	50.0	ca. 14.0
T1017 (left valve)	Loc. 1	68.0	45.3	(16.4)
T1026 (right valve)	Loc. 1	69.0	—	17.0
T1045 (left valve)	Loc. 1	—	ca. 47.3	16.4
T1056 (fragment)	Loc. 2	—	—	—

3. BRACHIOPODA

Genus *Coptothyris* JACKSON, 1916

Coptothyris grayi (DAVIDSON, 1852)
Pl. V, figs. 6a–8d

1939. *Coptothyris grayi*, HATAI, *Jub. Pub. Comem. Prof. H. Yabe's 60th Birthday*, pp. 99–118, pl. 8.

Two eroded dorsal valves (DGSU coll. cat. no. T1012, T1022) and a conjoined valves (DGSU coll. cat no. T1041) were obtained from Loc. 1.

References

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Explanation of Plate I

(All figures in natural size)

Figs. 1, 2. *Turritella* (*Idaella*) *tanaguraensis* KOTAKA
Fig. 1, DGSU coll. cat. no. T1024, Loc. 1; fig. 2, DGSU coll. cat. no. T1039, Loc. 2.

Fig. 3. *Trochus* sp.
DGSU coll. cat no. T1046, fragment of body whorl, Loc. 1.

Fig. 4. *Galeoastraea* sp.
DGSU coll. cat no. T1019, Loc. 1.

Figs. 5, 6. Naticidae gen. et sp. indet.
Fig. 5, DGSU coll. cat. no. T1048, calcareous operculum, Loc. 1; fig. 6, GSSM coll. cat. no. T1025, inner mould, Loc. 1.

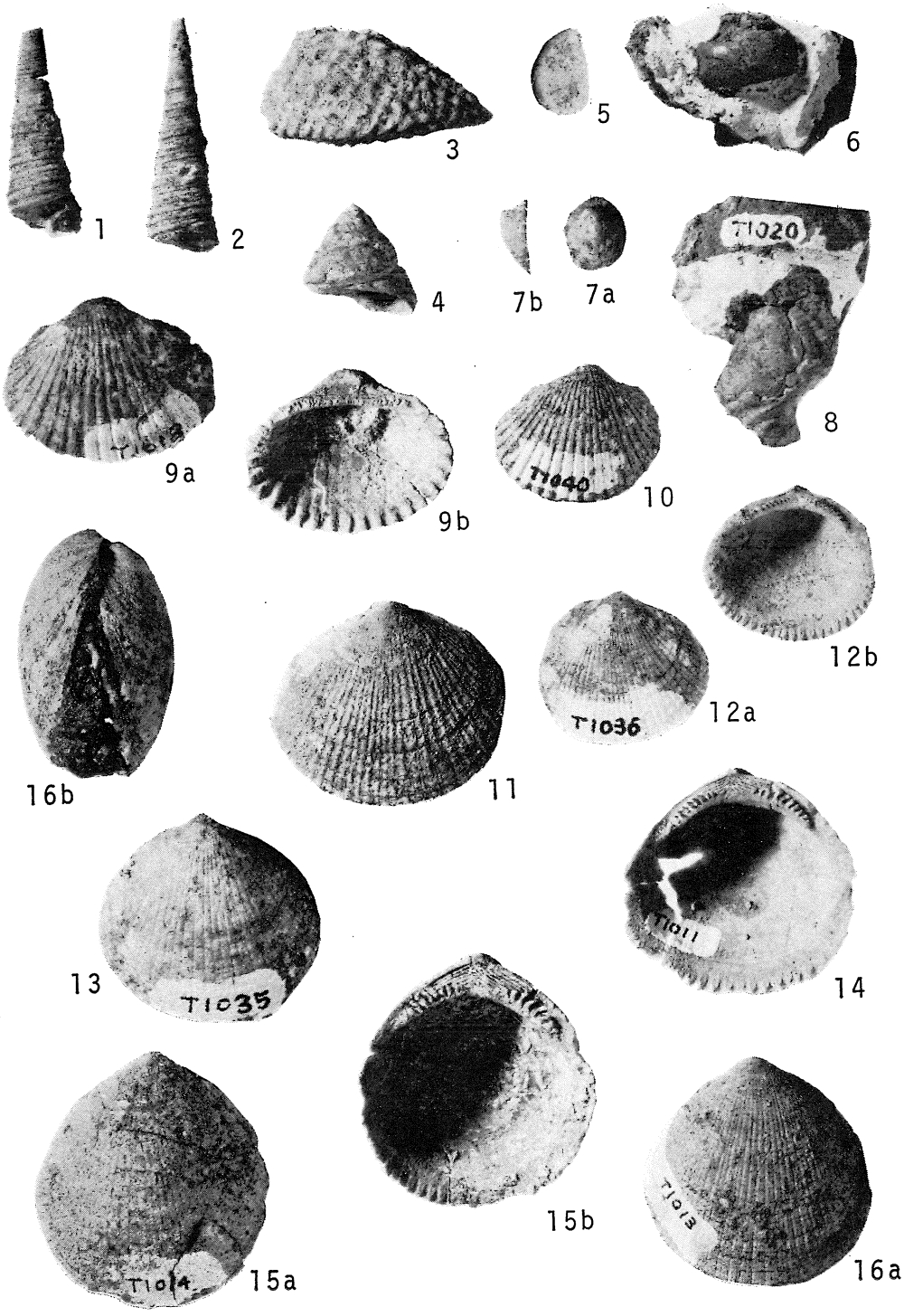
Figs. 7a, b. "*Acmaea*" sp.
DGSU coll. cat. no. T1047, inner mould, Loc. 2; fig. 7a, plan; fig. 7b, lateral view.

Fig. 8. *Ocenebra*? sp.
DGSU coll. cat no. T1020, fragment of body whorl, Loc. 1.

Figs. 9a–10. *Anadara* (*Anadara*) *ogawai* (MAKIYAMA)
Figs. 9a, b, DGSU coll. cat. no. T1018, left valve, Loc. 1; fig. 10, DGSU coll. cat. no. T1040, right valve, Loc. 1.

Figs. 11–14. *Glycymeris* sp.
Fig. 11, DGSU coll. cat. no. T1012, left valve, Loc. 1; figs. 12a, b, DGSU coll. cat. no. T1036, right valve, Loc. 2; fig. 13, DGSU coll. cat. no. T1035, left valve, Loc. 2; fig. 14, DGSU coll. cat. no. T1011, right valve, Loc. 1.

Figs. 15a–16b. *Glycymeris derelicta* (YOKOYAMA)
Figs. 15a, b, DGSU coll. cat. no. T1014, left valve, Loc. 1; figs. 16a, b, DGSU coll. cat. no. T1013, left valve and posterior view, Loc. 1.

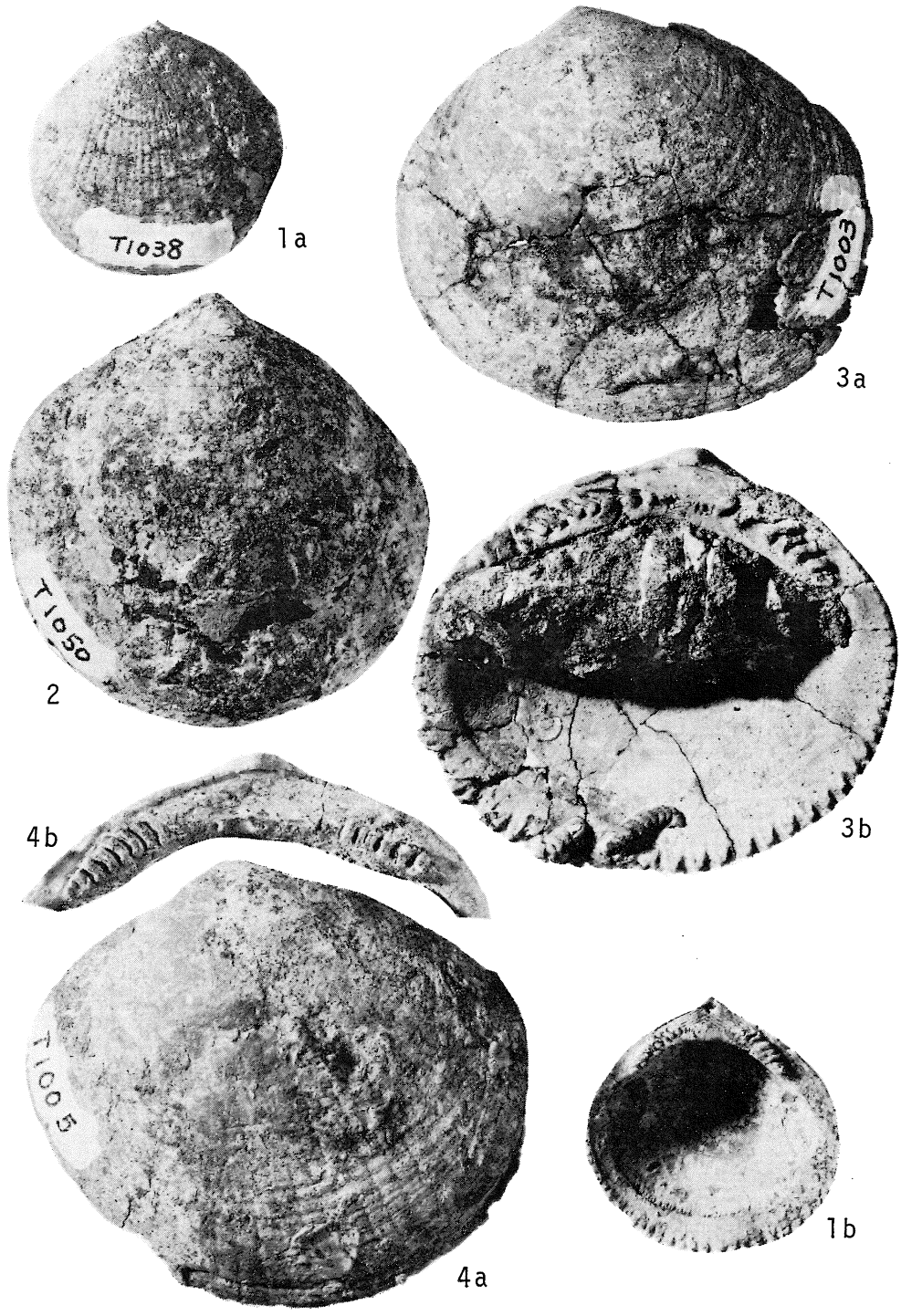

1
2
3
4
5
6
7b
7a
T1020
8
9a
9b
T1040
10
12b
16b
11
T1036
12a
13
T1035
T1011
14
T1014
15a
15b
T1013
16a

Explanation of Plate II

(All figures in natural size)

Figs. 1a, b. *Glycymeris derelicta* (YOKOYAMA)
DGSU coll. cat. no. T1038, left valve, Loc. 2.

Figs. 2–4b. *Glycymeris cisshuensis* MAKIYAMA
Fig. 2, DGSU coll. cat. no. T1050, right valve, Loc. 2; figs. 3a, b, DGSU coll. cat. no. T1003, right valve, Loc. 1; figs. 4a, b, DGSU coll. cat. no. T1005, right valve, Loc. 1.


T1038
1a
T1003
3a
T1050
2
3b
4b
T1005
4a
1b

Explanation of Plate III

(All figures in natural size)

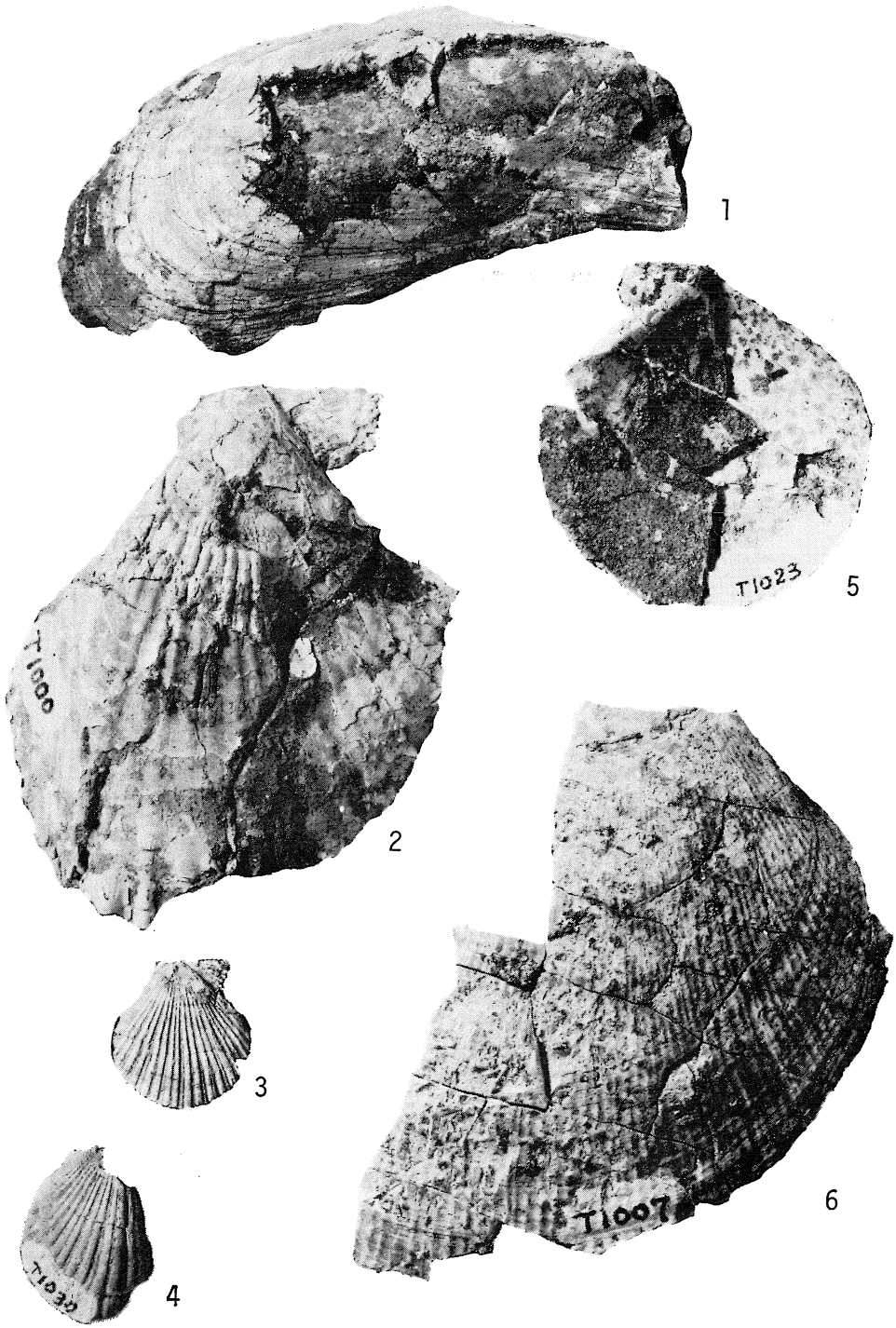
Fig. 1. *Modiolus* (*Modiolus*) *modiolus difficilis* KURODA *et* HABE
DGSU coll. cat. no. T1001, right valve, Loc. 2.

Fig. 2. *Chlamys* (*Mimachlamys*) cf. *kaneharai* (YOKOYAMA)
DGSU coll. cat. no. T1000, right valve, Loc. 1.

Figs. 3, 4. *Chlamys* (*Chlamys*) cf. *otukae* MASUDA and SAWADA
Fig. 3, DGSU coll. cat. no. T1016, right valve, Loc. 1; fig. 4, DGSU coll. cat. no. T1030, fragment of left valve, Loc. 2.

Fig. 5. *Placopecten* (*Placopecten*) cf. *protomollitus* (NOMURA)
DGSU coll. cat. no. T1023, interior view of right valve, Loc. 1.

Fig. 6. *Placopecten* sp.
DGSU coll. cat. no. T1007, fragment of large left valve, Loc. 1.


1
T1023
5
T1000
2
3
4
T1007
6

Explanation of Plate IV

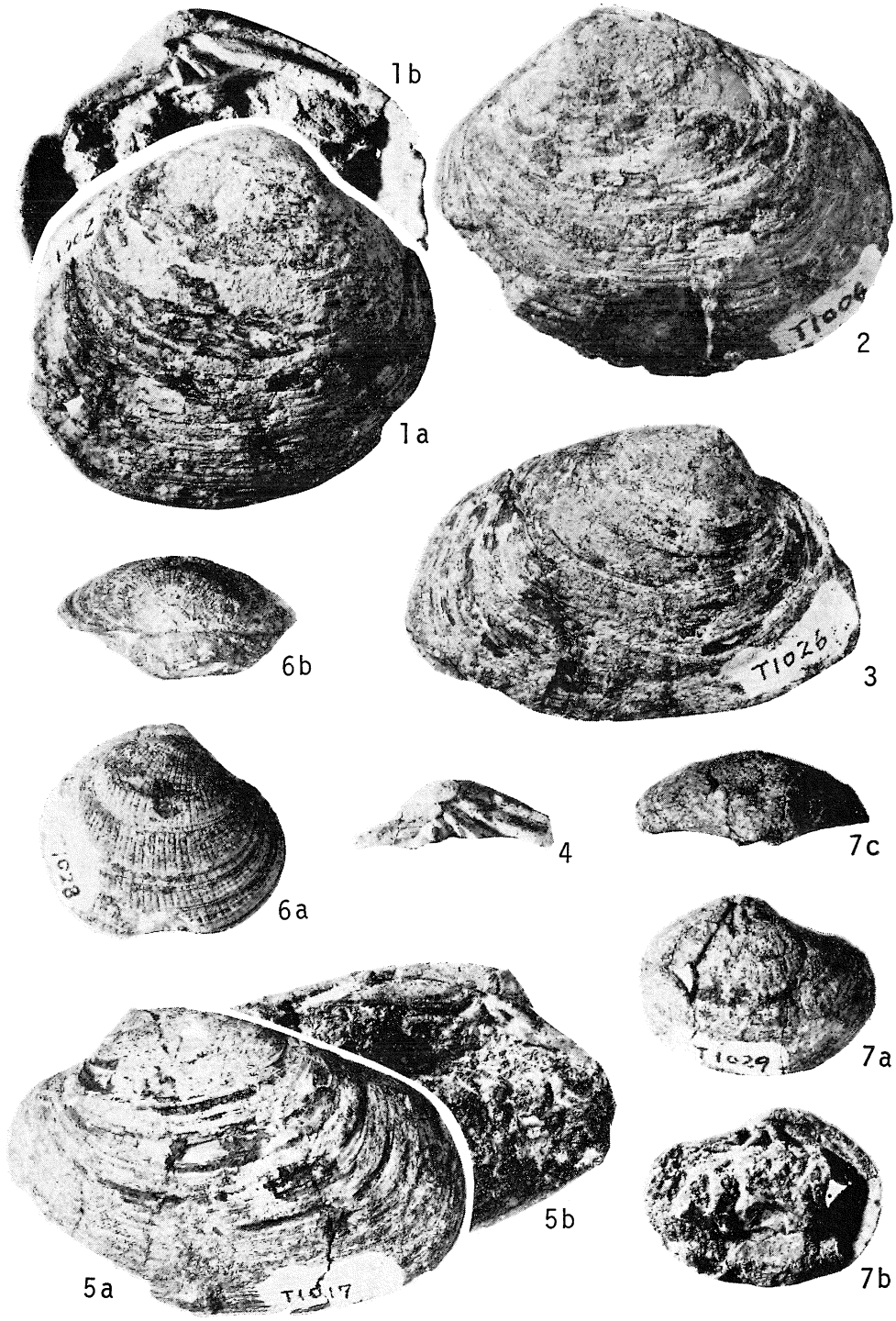
(All figures in the natural size)

Figs. 1a, b. *Callithaca* sp.
DGSU coll. cat. no. T1002, right valve, Loc. 1.

Figs. 2–5b. *Saxidomus purpuratus* (SOWERBY)
Fig. 2, DGSU coll. cat. no. T1006, left valve, Loc. 1; fig. 3, DGSU coll. cat. no. T1026, right valve, Loc. 1; fig. 4, DGSU coll. cat. no. T1056, hinge plate of right valve, Loc. 2; figs. 5a, b, DGSU coll. cat. no. T1017, Loc. 1.

Figs. 6a, b. "*Chione*" sp.
DGSU coll. cat. no. T1028, Loc. 1; fig. 6a, right valve; fig. 6b, dorsal view.

Figs. 7a–c. *Pitar* (*Pitarina*) cf. *semeliformis* SHUTO
DGSU coll. cat. no. T1029, Loc. 1; fig. 7a, right valve; fig. 7b, interior view; fig. 7c, dorsal view.


1b
1a
2
T1006
6b
3
T1026
6a
4
7c
7a
T1029
5b
5a
T1017
7b

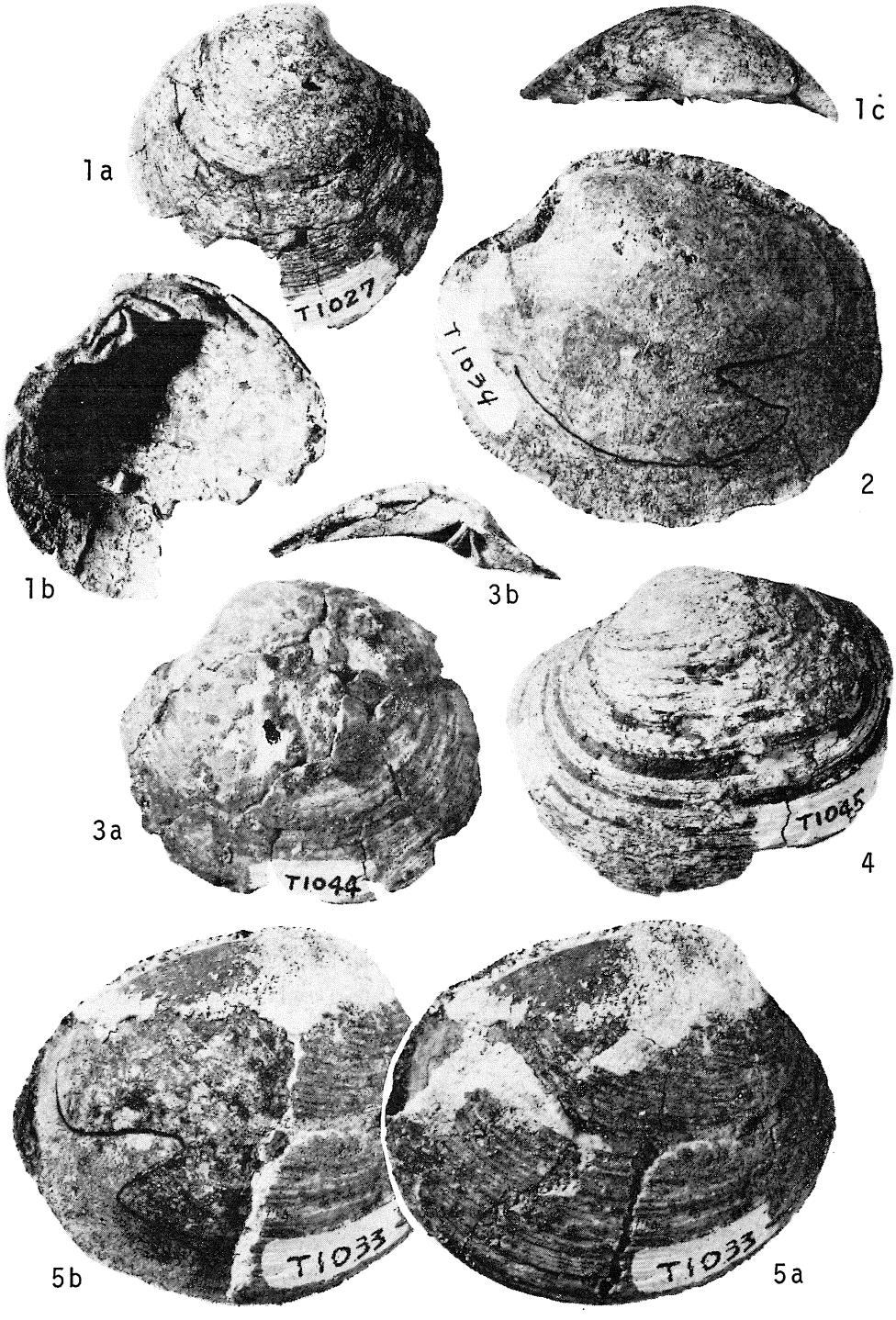
Explanation of Plate V

(All figures in natural size)

Figs. 1a–c. *Phacosoma* cf. *japonicum* (REEVE)
DGSU coll. cat. no. T1027, Loc. 1; fig. 1a, right valve; fig. 1b, interior view; fig. 1c, dorsal view.

Figs. 2a–3b, 5a, b. *Callithaca* sp.
Fig. 2, DGSU coll. cat. no. T1034, inner mould of left valve, Loc. 1; figs. 3a, b, DGSU coll. cat. no. T1044, left valve, Loc. 1; figs. 5a, b, DGSU coll. cat no. T1033, right valve, Loc. 1.

Fig. 4. *Saxidomus purpuratus* (SOWERBY)
DGSU coll. cat no. T1045, left valve, Loc. 1.


1a
T1027
1c
T1034
2
1b
3b
3a
T1044
T1045
4
5b
T1033
T1033
5a

Explanation of Plate VI

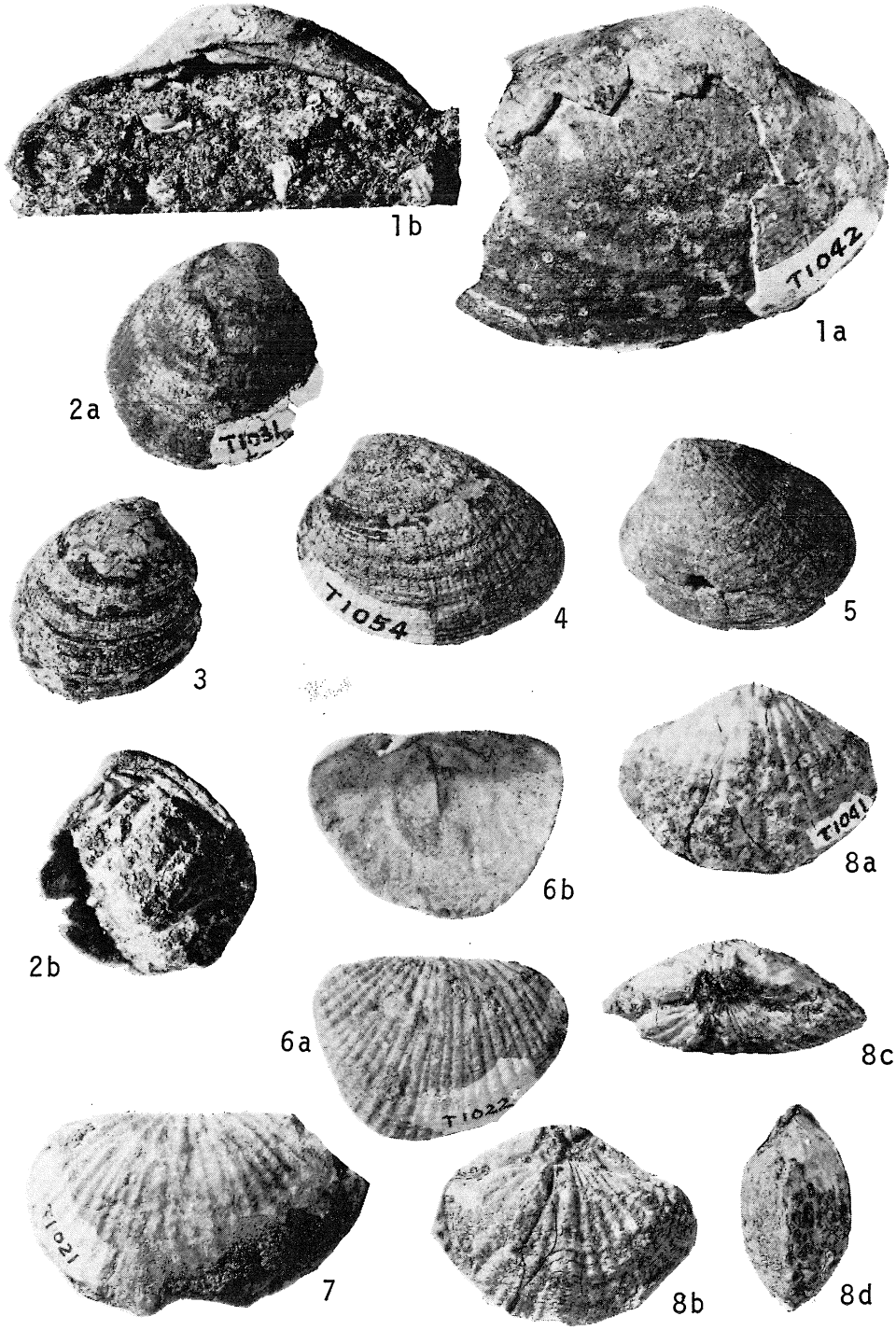
(All figures in natural size)

Figs. 1a, b. *Callista* (*Callista*) *chinensis* (HORTON)
DGSU coll. cat. no. T1042, right balve, Loc. 1.

Figs. 2a–3. *Protothaca* sp.
Figs. 2a, b DGSU coll. cat. no. T1031, right valve and interior view, Loc. 1; fig. 3, DGSU coll. cat. no. T1053, right valve, Loc. 2.

Figs. 4, 5. *Protothaca* cf. *tateiwai* (MAKIYAMA)
Fig. 4, DGSU coll. cat. no. T1054, left valve, Loc. 2; fig. 5, DGSU coll. cat. no. T1015, left valve, Loc. 1.

Figs. 6a–8d. *Coptothyris grayi* (DAVIDSON)
Figs. 6a, b, DGSU coll. cat. no. T1022, Loc. 1; fig. 7, DGSU coll. cat. no. T1021, Loc. 1; figs. 8a–d, DGSU coll. cat. no. T1041, Loc. 1.


1b
T1042
1a
2a
T1051
T1054
4
5
3
2b
6b
T1041
8a
6a
T1022
8c
T1021
7
8b
8d