Molluscan Assemblage from the Late Pliocene Ananai Formation, Kochi Prefecture, Southwest Japan

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土佐湾東岸に分布する上部鮮新統穴内累層産軟体動物化石群集

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(要　旨)

従来から多数の軟体動物化石が産出することで知られている高知県土佐湾東岸の新第三紀層のうち，今回，穴内累層から171種の軟体動物化石(腹足類 84種，堀足類 2種，斧足類 85種，新種 *Siphonalia kannoi*, *Siphonalia kozai*, *Paphia tonohamaensis* を含む) を採集した．化石を採集した場所は高知県安田町唐浜にある小渓谷 (Fig. 1) で，ここでは渓谷沿いに含化石層を側方に数百メートルにわたって追跡することができる．上部は礫岩層，中・下部は中粒砂岩層からなり，中粒砂岩層には，粗粒砂岩層がレンズ状に挟在している．これらの地層はいずれも軟体動物化石を産出する．化石の多くは異地性の産状を示すが，*Paphia*, *Clementia* など殻が比較的破損しやすい種でも合殻のままで産出することがある．化石は浅海帯生息種が圧倒的に多いが，下部浅海帯生息種が少数含まれる．また，暖海生息種が多いが，亜熱帯生息種も含まれており，このことは本層が堆積した後期鮮新世にはかなり高水温の古環境のあったことを示唆するものである．

(Abstract)

Molluscan fossils are described from the Ananai Formation of the Tonohama valley where formation is composed of gravel and medium-grained sand intercalating with coarse-grained sand beds.

The geologic age of the Ananai Formation seems to be the Early or Middle Pliocene, and is correlated with the Kakegawa Group in Shizuoka Prefecture and the Miyazaki Group in Miyazaki Prefecture, Kyushu.

The molluscan assemblage includes 171 species of mollusks that consist of 84 species of gastropoda, 2 species of scaphopoda and 85 species of pelecypoda. Among them, 2 species of gastropoda, *Siphonalia kannoi* and *Siphonalia kozai* and 1 species of pelecypoda, *Paphia* (*Paphia*) *tonohamaensis* are identified as new species. This assemblage is characterized by consisting of rather shallow bottom dwellers who lived in medium- to coarse-grained sand in warm to tropical waters.

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Introduction

The Tonohama Group was named by Y. Otuka (1931) for the marine strata that is sporadically exposed along the east coast of Tosa Bay. The group is known for its fossiliferous strata and has been studied by many geologists and paleontologists.

Previous to Otuka's study, Yokoyama (1926 b) and Yokoyama (1929 b) reported 6 species and 46 species of mollusks tentatively. In 1937, Nomura reported 214 molluscan fossils without pictures with the exception of several new species.

Recently, the writers collected a large number of mollusks from the Ananai Formation of the Tonohama Group.

In these mollusks, some characteristic species are included as shown in Table 1. Then, the writers wish to describe these characteristic molluscan fossils.

All specimens described in this paper are deposited in Department of Earth Sciences, Naruto University of Education.

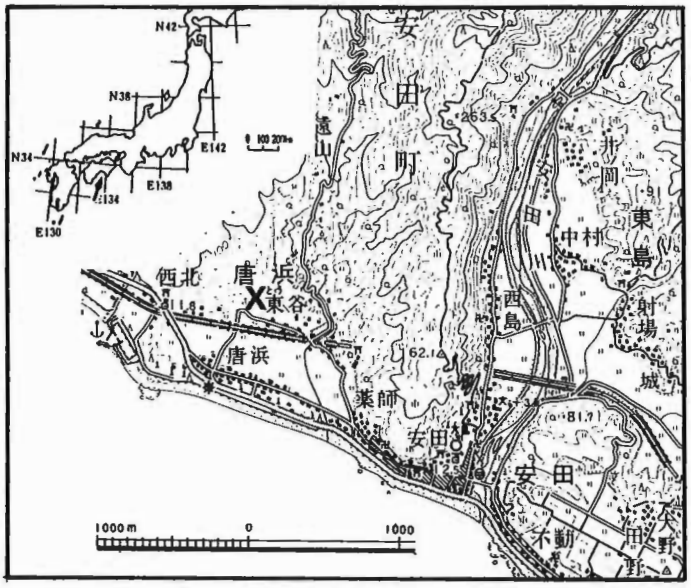


Fig. 1. Fossil locality.

Acknowledgments

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Table. 1. List of the Molluscan fossils from Tonohama valley

Gastropoda	Gr	mS	cS	Frq.
1. *Elegidion quadriradiata* (Reeve)		○	○	f
2. *Lischkeia alwinae* (Lischke)		○		r
3. *Tristichotrochus aculeatus* (Sowerby)		○		r
4. *Angaria distorta* (Linnē)			○	r
5. *Cocculina nipponica* Kuroda and Habe		○	○	f
6. *Turritella* (*s. s.*) *perterebra* Yokoyama		○		r
7. *Terebralia palustris* (Linnē)	○	○	○	c
8. *Cerithium* (*Proclava*) aff. *C.* (*P.*) *pfefferi* Dunker		○		f
9. *Bittium urashimanum* Nomura and Niino		○		f
10. *Hipponix* (*Malluvium*) cf. *H.* (*M.*) *lissus* (E. A. Smith)		○	○	c
11. *Amalthea conica* Schumacher	○	○	○	c
12. *Calyptraea yokoyamai* Kuroda		○	○	c
13. *Tugurium exutum* (Reeve)	○	○	○	c
14. *Tugurium* cf. *T. extum* (Reeve)		○		r
15. *Cypraea* sp.	○			r
16. *Glossaulax didyma* (Röding)		○	○	c
17. *Cryptonatica janthostomoides* Kuroda and Habe		○		c
18. *Polinices sagamiensis* Pilsbry		○	○	c
19. *Semicassis bisulcata pila* (Reeve)		○		f
20. *Phalium* sp.		○		r
21. *Turritriton kiiensis* (Sowerby)		○		f
22. *Cymatium* (?) sp.		○		r
23. *Tonna luteostoma* (Küster)		○	○	c
24. *Tonna allium* (Dillwyn)		○		f
25. *Siphonochelus japonicus* (A. Adams)		○		f
26. *Indomitrella lischkei* (Smith)		○	○	c
27. *Babylonia* (*s.s.*) *elata* (Yokoyama)		○		f
28. *Siphonalia kannoi* n. sp.		○	○	f
29. *Siphonlia kozaii* n. sp.		○	○	f
30. *Siphonalia yabei* Nomura		○		c
31. *Nassaria* (*s. s.*) *acuminata gendingaensis* (Martin)		○	○	c
32. *Nassarius* (*Hinia*) *caelatus dainitiensis* (Makiyama)		○	○	c
33. *Reticunassa* cf. *R. spurca* (Gould)		○		f
34. *Fusinus perplexus* (A. Adams)		○		f
35. *Granulifusus matsumotoi* Shuto		○		f
36. *Granulifusus dualis* (Yokoyama)		○		f
37. *Phos nipponicus* Nomura		○	○	c
38. *Comitas* (*Fusiturricula*) *habei* Shuto		○		f
39. *Ancilla* (*Baryspira*) *albocallosa okawai* (Yokoyama)		○	○	f
40. *Olivella fulgurata* (Adams and Reeve)		○		f
41. *Oliva* sp. 1		○		r
42. *Oliva* sp. 2		○		r
43. *Strigitella* cf. *S. decurtata* (Reeve)		○		c
44. *Lyria* (*Paralyria*) *mizuhonica mizuhonica* Shuto		○		f
45. *Cancellaria pristina* Yokoyama		○		c
46. *Cancellaria spengleriana* (Deshayes)		○		f
47. *Trigonostoma* cf. *T. nana* Ozaki		○		f
48. *Cleobula quercina* (Lightfoot)		○		f
49. *Cleobula* sp.			○	r
50. *Virgiconus* cf. *V. virgo* (Linnē)			○	f
51. *Parviconus tuberculosus* (Tomlin)		○		r
52. *Conus* sp. 1		○		r
53. *Conus* sp. 2		○		r
54. *Conus* sp. 3		○		r
55. *Conus* sp. 4		○		r
56. *Conus* sp. 5		○		r
57. *Conus* sp. 6		○		r
58. *Orthosurcula soyamaruae takanabensis* Otuka		○		f
59. *Tomopleura nevia* (Philippi)		○		f
60. *Mangelia* (*Guraleus*) *tabatensis* Tokunaga		○	○	c
61. *Clathurella* (*Etremopha*) sp.		○		f
62. *Paradrillia nivalioides* (Yokoyama)		○	○	f
63. *Paradrillia patruelis* (Smith)		○	○	f
64. *Lophiotoma* (*Lophioturris*) *leucotropis* (Adams and Reeve)		○	○	f
65. *Spirotropis subdeclivis* Yokoyama		○		f
66. *Ancystrosyrinx pulcherrissima* Kira		○		r
67. *Micantapex* (*Parabathytoma*) *lühdorfi* (Lischke)		○		f
68. *Gemmula* (*s. s.*) sp.		○		f
69. *Elaeocyma* (*Spendrilla*) *braunsi* (Yokoyama)		○		f
70. *Myurella* (*Triplostrephanus*) *naumanni* (Yokoyama)		○		f
71. *Actaeopyramis eximia* (Lischke)		○	○	f
72. *Syrnola* sp.		○	○	f
73. *Odostomia* sp.		○	○	f
74. *Punctoterebra* (*Brevimyurella*) *lischkei* (Dunker)		○		f
75. *Turbonilla* (*s. s.*) sp.		○		f
76. *Turbonilla* (*Pyrgiscus*) cf. *T.* (*P.*) *optiva* Nomura		○		f
77. *Laeviscala angusta* (Dunker)		○		r
78. *Ringicula* (*Ringiculina*) *doliaris* (Gould)		○	○	f
79. *Retusa* (*Coleophysis*) *minima* (Yokoyama)		○	○	c
80. *Pyrunculus phialus* (A. Adams)		○		c
81. *Architectonica perspectiva* (Linnē)		○		r
82. *Architectonica maxima* (Philippi)		○		r
83. *Architectonica* sp.		○		r
84. *Solariaxis* sp.		○		r
Scaphopoda				
85. *Antalis weinkauffi* (Dunker)	○	○	○	c
86. *Striodentalium tosaensis* (Habe)		○	○	f

Pelecypoda				
87. *Ennucula nipponica* (Smith)		○		r
88. *Acila* (*s. s.*) *divaricata* (Hinds)	○	○	○	v
89. *Acila* (*Truncacila*) sp.		○		f
90. *Saccella* (*s. s.*) *confusa* (Hanley)		○		f
91. *Cucullaea granulosa* Jonas		○		f
92. *Arca* (*s. s.*) *boucardi* Jousseaume		○	○	f
93. *Barbatia* (*Ustularca*) cf. *B.* (*U.*) *fusca* (Solander)		○	○	f
94. *Barbatia* (*Ustularca*) *stearnsi* (Pirsbry)		○	○	f
95. *Barbatia* (*s. s.*) *reticulata* (Gmelin)		○	○	f
96. *Barbatia* (*s. s.*) sp.		○	○	f
97. *Barbatia* (*Acar*) *plicatum* (Dillwyn)		○	○	f
98. *Hawaiarca uwaensis* (Yokoyama)		○		f
99. *Bathyarca kyurokusimana* (Nomura and Hatai)		○		f
100. *Anadara* (*Scapharca*) *suzukii* (Yokoyama)	○	○	○	a
101. *Anadara* (*Scapharca*) *shizuokaensis* Noda		○		f
102. *Anadara* (*Tosarca*) *tosaensis* Noda			○	f
103. *Anadara* (*Hataiarca*) sp.			○	f
104. *Anadara* sp.		○	○	f
105. *Glycymeris vestita* (Dunker)	○	○	○	a
106. *Glycymeris rotunda* (Dunker)	○	○	○	a
107. *Oblimopa japonica* (A. Adams)		○	○	a
108. *Oblimopa* cf. *O. japonica* (A. Adams)		○	○	c
109. *Modiolus* (*s. s.*) *modiolus difficilis* (Kuroda and Habe)		○		r
110. *Modiolus* (*s. s.*) *elongatus* (Swainson)		○		r
111. *Septifer* sp.		○		r
112. *Atrina* (*Servatrina*) *pectinata japonica* (Linñe)		○		r
113. *Polynemamussium intuscostatum* (Yokoyama)		○		f
114. *Amussiopecten praesignis* Yokoyama	○	○	○	a
115. *Pecten* (*Notovola*) *albicans* (Schröter)			○	r
116. *Chlamys* (*s. s.*) *satowi* Yokoyama		○	○	f
117. *Aequipecten vesiculosus* (Dunker)		○	○	c
118. *Patinopecten* (*Mizuhopecten*) *tokyoensis* (Tokunaga)			○	r
119. *Spondylus barbatus* Reeve		○	○	f
120. *Limatula* (*s. s.*) *vladiostokensis* Scalato		○		f
121. *Limatula* (*Stabilima*) *strengei* (Sowerby)		○		f
122. *Ctenoides lischkei* (Lamy)		○		f
123. *Ctenoides* cf. *C. lischkei* (Lamy)		○		r
124. *Lima zushiensis* Yokoyama		○		r
125. *Lima* cf. *L. quantoensis* Yokoyama		○		f
126. *Anomia chinensis* Philippi		○	○	f
127. *Ostrea denselamellosa* Lischke	○	○	○	c
128. *Bathytormus foveolatus* (Sowerby)		○		f
129. *Crassatellites tosana* Nomura		○	○	c
130. *Basterotia gouldi* (A. Adams)		○	○	f
131. *Cardita leana* Dunker		○	○	f
132. *Pleuromeris pygmaea* Kuroda and Habe		○	○	f
133. *Venericardia* (*Megacardita*) sp.		○		f
134. *Venericardia* (*Megacardita*) *panda* (Yokoyama)		○		a
135. *Corbula tosana* Yokoyama		○	○	v
136. *Pitar* (*Pitarina*) sp.		○		r
137. *Dosinorbis* (*Phacosoma*) *japonicus* (Reeve)		○		f
138. *Ventricolaria foveolata* (Sowerby)		○	○	f
139. *Callista* (*s. s.*) *chinensis* (Holten)		○		f
140. *Gomphina veneriformis* (Lamarck)		○		r
141. *Paphia* (*s. s.*) aff. *P.* (*s. s.*) *exilis* Shuto		○		f
142. *Paphia* (*s. s.*) sp.		○		r
143. *Paphia* (*s. s.*) *schnelliana* (Dunker)		○		f
144. *Paphia* (*s. s.*) *tonohamaensis* n. sp.		○		r
145. *Clementia* (*s. s.*) *papyracea* Gray		○		v
146. *Placamen tiara* (Dillwyn)			○	r
147. *Veremolpa mindanensis* (Smith)		○	○	c
148. *Cycladicama cumingii* (Hanley)		○		c
149. *Alvenius ojianus* (Yokoyama)		○	○	f
150. *Bellucina civica* (Yokoyama)		○	○	f
151. *Pillucina* (*s. s.*) *pisidium* (Dunker)		○	○	f
152. *Lucinoma annulata* (Reeve)		○	○	f
153. *Lucinoma* sp.		○	○	r
154. *Divaricella* aff. *D. soyoae* Habe		○		r
155. *Vasticardium burchardi* (Dunker)	○	○	○	a
156. *Nemocardium* (*Keenaea*) *samarangae* (Makiyama)		○		c
157. *Fulvia mutica* (Reeve)		○		c
158. *Lutraria* (*Psammophila*) *arcuata* Reeve		○		r
159. *Oxperas* (*s. s.*) *bernardi* (Pilsbry)		○		r
160. *Gari anomala* (Deshays)		○		r
161. *Merisca* (*Pistris*) *subtruncata* (Hanley)		○		f
162. *Moerella* (?) sp.		○		c
163. *Angulus* aff. *A. vestalioides* (Yokoyama)		○		c
164. *Ensiculus cultellus* (Linnê)		○		r
165. *Solen* (*s. s.*) *strics* Gould		○		r
166. *Solen* (*Ensisolen*) *roseomaculatus* Pilsbry		○		r
167. *Panopea japonica* A. Adams		○		f
168. *Myadora fluctuosa* Gould		○	○	c
169. *Thracia* sp.		○	○	c
170. *Thraciopsis transmontana* (Yokoyama)		○		r
171. *Nipponoclava gigantea* (Sowerby)	○	○	○	a

Gr: gravel bed, mS: medium sand bed, cS: coarse sand bed,
Frq.: frequency, r: rare, f: few, c: common, a: abundant,
v: very abundant

Brief note on the geology around the fossil locality

The Tonohama Group is unconformably overlain by the Pleistocene terrace deposits and unconformably covers the Paleogene or the Mesozoic strata. The Tonohama Group is subdivided into three formations; the Nobori Formation, the Nahari Formation and the Ananai Formation, in ascending order (Katto *et al.*, 1980).

According to Katto *et al.* (1980), the Ananai Formation in which the present molluscan assemblage is included consists of medium- to coarse-grained sand beds that are intercalated with coarse-grained sandstone or gravel beds.

Around the Tonohama valley, the strata are unconsolidated and can be subdivided into two sedimentary facies, namely medium-grained sand bed (with intercalations of coarse-sand beds) and gravel bed (with granule pebble), in ascending order.

Fossil occurrence

The molluscan fossils were collected from the valley side and valley floor of the Tonohama valley, about 500 m north of Tonohama, Yasuda-cho, Aki-gun, Kochi Prefecture.

Molluscan fossils occurred from the medium-grained sand and gravel beds, and intercalating coarse sand beds. Most molluscan fossils are sporadically scattered in those beds. Though most bivalves occur sporadically, such species as *Acila* (*s. s.*) *divaricata*, some species of the genus *Anadara*, *Oblimopa*, *Corbicula*, *Paphia* and *Clementia* are collected as intact valves and *Cryptonatica janthostomoides* is with its operculum. Considering the fossil occurrence, these mollusks seem to have been transported from their original habitat places, which were not so far from the present fossil locality.

The most abundant fossils are rather euneritic and mesoneritic zone dwellers such as *Elegidion*, *Terebralia*, *Cryptonatica*, *Polinices*, *Cypraea*, *Nassarius*, *Conus*, *Dosinorbis*, *Paphia* and *Clementia*. In particular, the following subneritic and bathyneritic dwellers such as *Lischkeia alwinae*, *Parviconus tuberculosus*, *Elaeocyma braunsi*, *Ennucula nipponica*, *Polynemamussium intuscostatum*, *Aequipecten vesiculosus*, *Lima zushiensis*, *Ventricolaria foveolata*, *Bellucina civica* and *Keenaea samarangae* are included. The shells of those species are fresh and not eroded. These facts show that this is a mixed assemblage. However, explanations of how this mixed assemblage was built up are unknown.

Moreover, this assemblage includes a rather large number of *Terebralia* that is usually found in tropical regions.

Correlation and geologic age

Correlation of the Late Neogene strata that are distributed on the Pacific coast of southwest Japan has long been attempted by many geologists, *e. g.*, Makiyama (1925), Nomura (1937), Masuda (1962), Kotaka (1959). Recently, Tsuchi (1961) discussed exact

correlation of Kakegawa Group with the Miyazaki and Tonohama Groups, and he correlated the Suchian strata (the middle part of the Kakegawa Group) with the upper part of Takanabe Formation (uppermost part of the Miyazaki Group) and Tonohama Group because they included the following common species as; *Venericardia panda*, *Turritella pertrebra*, *Babylonia elata*, *Lyria mizuhonica*, *Chlamys satowi*, *Amussiopecten praesignis*, *Cancellaria pristina* and *Nassarius caelatus dainitiensis*. And he pointed out that these three strata include the following common tropical elements such as; *Amussiopecten praesignis*, *Chlamys satowi*, *Venericardia panda*, *Turritella perterebra*, *Babylonia elata*, and *Cancellaria pristina*. Noda (1965, 1966) established *Anadara suzukii-Anadara castellata* Zone and correlated the strata which include *Anadara suzukii* and *A. castellata*, in Nakoshi Sandstone in Okinawa Prefecture, Takanabe Formation of the Miyazaki Group in Miyazaki Prefecture, Ananai Formation of the Tonohama Group in Kochi Prefecture, Nango Sand and Mud Alternation, Hosoya Siltstone, Tenno Sandstone and Dainichi Sandstone of the Kakegawa Group, and Kozan Facies of the Takazan Formation and Takuran Formation of the Miaoli Group in Formosa.

About age of the Ananai Formation, Katto *et al.* (1953) considered it as Middle or Early Pliocene, Tsuchi (1961) as Middle Pliocene, Noda (1965, 1966) as Early Pliocene judging from the viewpoint of the molluscan fauna, but Katto *et al.* (1980) pointed out the possibility of it being N 24 (Upper Pliocene) of the foraminifera zone (Banner and Blow, 1965). As described above, there are many opinions about the geologic age of the Ananai Formation, thus it can also remain indefinite in this paper.

Systematic Paleontology

Phylum Mollusca
Class Gastropoda

Family Trochidae
Subfamily Gibbulinae
Genus *Lischkeia* Fischer, 1878

Lischkeia alwinae (Lischke, 1871)
(Pl. 27, Fig. 2)

1971. *Lischkeia alwinae*, Kuroda, Habe and Oyama, p. 43 (in Japanese), p. 29 (in English), pl. 9, figs. 4, 5.
1988. *Lischkeia alwinae*, Noda, 1988, p. 32, pl. 5, fig. 11.

Remarks:-The characteristic figures are as follows; tuberculus spiral rows at middle part of each whorl forming shoulder or edge, tuberculus nodules numbering about 23 on body whorl, slightly strong nodulose spiral rows above and beneath the suture, flattish base with 10 spiral striations. The present living species seems to be a dweller of fine sand

bottoms from 100 m to 300 m deep and is distributed south of Boso Peninsula.

Family Angariidae
Genus *Angaria* Röding, 1798

Angaria distorta (Linné, 1758)
(Pl. 31, Fig. 14)

1961. *Angaria distorta*, Habe, p. 12, pl. 6, fig. 23.
1986. *Angaria distorta*, Springsteen and Leobrera, p. 38, pl. 6, fig. 3.

Remarks:-The living species is distributing in a littoral zone and coral reef of south of Okinawa Islands.

Family Turritellidae
Genus *Turritella* Lamarck, 1799
Subgenus *Turritella s. s.*

Turritella (*Turritella*) *perterebra* Yokoyama, 1923
(Pl. 27, Fig. 5)

1923. *Turritella perterebra* Yokoyama, p. 11, pl. 2, fig. 35.
1927. *Turritella perterebra*, Makiyama, p. 68.
1959. *Turritella* (*Turritella*) *perterebra*, Kotaka, p. 63, pl. 1, figs. 1-7.
1966. *Turritella* (*Turritella*) *perterebra*, Aoki, p. 255, pl. 31, fig. 1.
1986. *Turritella* (*Turritella*) *perterebra*, Kotaka, pl. 11, fig. 12.

Remarks:-The present species was originally described by Yokoyama (1923). This fossil species is known from the Pliocene strata in southwest of Japan. The writers collected only one specimen from the area. The surface of the whorls of the species ornamented with about seven primary spirals and irregular secondaries.

Family Potamididae
Genus *Terebralia* Swainson, 1840

Terebralia palustris (Linné, 1767)
(Pl. 27, Figs. 12-17)

1963. *Terebralia palustris*, Oyama, *Telescopium*・*Terebralia*, figs, 4-6.
1967. *Terebralia palustris*, Habe and Kosuge, p. 25, pl. 7, fig. 25; p. 123, pl. 45, fig. 19.
1977. *Terebralia palustris*, Linder, pl. 12, fig. 3.
1985. *Terebralia palustris*, Abbot and Dance, p. 68.

Description:-Shell medium in size and turreted in form with more than thirteen whorls; outline of shell more or less straight; suture linear, distinct; whorls sculptured with about twenty faint spiral striations of which on the upper part of whorl are more distinct; arched and faint growth lines run axially forming decussate connecting with spiral rows; body and parietal whorls are ornamented with more or less ten, longitudinally and bluntly elongated nodules separated by shallow valley of equal breadth; a varix on left side of body whorl; aperture ovate oblique to the axis of shell; base convex ornamented with obvious growth lines and 3-4 spiral ribs of which the internal ones strong; columellar covered with callous deposit forming the siphonal canal which is short and twisted to left. Shell coloured fulvous.

Remarks:-A large number of specimens were collected. This is one of the tropical species which is distributed in Philippine Islands and west Pacific regions.

Family Cerithiidae
Genus *Cerithium* Bruguiére, 1789
Subgenus *Proclava* Thiele, 1929

Cerithium (*Proclava*) aff. *C.* (*P.*) *pfefferi* Dunker, 1877
(Pl. 27, Fig. 6)

Compared with:
1957. *Cerithium* (*Proclava*) *pfefferi*, Oyama, Cerithium (1), figs. 1, 2.
1958. *Cerithium* (*Proclava*) *pfefferi*, Oyama, Cerithium (2), fig. 5.
1971. *Cerithium* (*Proclava*) *pfefferi*, Hayasaka and Oki, p. 9, pl. 1, figs. 12a, b.

Description:-Shell medium, turreted in form; whorls sculptured with three spiral threads of which the lowest is strongest, 2-3 secondary spiral riblets in each interspace, and ornamented with eight longitudinally elongated tubercles; two varices on both sides of an aperture.

Remarks:-An incompleted specimen was examined.

Family Hipponicidae
Genus *Hipponix* DeFrance, 1819
Subgenus *Malluvium* Melvill, 1906

Hipponix (*Malluvium*) cf. *H.* (*M.*) *lissus* (E. A. Smith, 1894)
(Pl. 28, Fig. 4)

Compared with:
1988. *Hipponix* (*Malluvium*) *lissus*, Noda, p. 39, pl. 5, figs. 19a, b.

Description:-Shell of small size, limpet-like, large body whorl, and aperture trumpet-like which is roundly ovate, more or less elongated posteriorly; spire small, closely

appressed, coiled, and composed of three; suture linear. Surface smooth excepting growth lines.

Remarks:-The present specimen is similar to the Recent species *Hipponix* (*Malluvium*) *otohimeae* (Habe, 1961), but the former has more circular periphery.

Family Xenophoridae
Genus *Tugurium* Fischer, 1880

Tugurium exutum (Reeve, 1843)
(Pl. 28, Figs. 1, 2)

1953. *Onustus exutus*, Habe, p. 179, text-figs. 7, 8.
1971. *Tugurium exutum*, Kuroda, Habe and Oyama, p. 139 (in Japanese), p. 92, (in English), pl. 20, figs. 1, 2.

Description:-Shell of medium to large size, thin, rounded at base, low conical; apex central, elevated; whorls weakly inflated. Surface ornamented with oblique, fine, countless, rugose striations; suture indistinct, base flattish with curved growth lines which are reached to inside of umbilicus, which opened and cone-shaped. Apical angle is about 105°.

Remarks:-A large number of specimens are collected from this formation but almost of them are broken.

Tugurium cf. *T. exutum* (Reeve, 1843)
(Pl. 27, Fig. 9)

Compared with:
1953. *Onustus exutus*, Habe, p. 179, text-figs. 7, 8.
1971. *Tugurium exutum*, Kuroda, Habe and Oyama, p. 139 (in Japanese), p. 92 (in English), pl. 20, figs. 1, 2.

Description:-Shell small, low conical, thick, nearly circular in outline; apex posterior, elevated. Surface ornamented with many fine radiating striations and growth lines numbering about 80 on the body whorl.

Family Cypraeidae
Genus *Cypraea* Linné, 1758

Cypraea sp.
(Pl. 27, Fig. 11)

Description:-Shell ovate, typical *"Cypraea"* form, ovately cylindrical; aperture narrow, linear; teeth marked on both sides of lip.

Family Naticidae
Subfamily Naticidae
Genus *Cryptonatica* Dall, 1892

Cryptonatica janthostomoides Kuroda and Habe, 1949
(Pl. 28, Figs. 3, 6, 8)

1964. *Cryptonatica janthostomoides*, Shuto, p. 289, 290, pl. 42, fig. 11; pl. 43, figs. 1-3, 5.
1971. *Cryptonatica janthostomoides*, Kuroda, Habe and Oyama, p. 173 (in Japanese), p. 115 (in English), pl. 19, figs. 1, 2.

Remarks:-A shell specimen with an operculum is examined. Two grooves run along the margin of the operculum.

Family Cassidae
Genus *Semicassis* Mörch, 1852

Semicassis bisulcata pila (Reeve, 1848)
(Pl. 29, Fig. 1)

1971. *Semicassis bisulcata pila*, Kuroda, Habe and Oyama, p. 200 (in Japanese), p. 132 (in English) pl. 35, figs. 1, 2.

Remarks:-The characteristic features of this species are, 1) ovate and conical whorls, 2) decussate spirals excepted for body whorl, 3) large body whorl with about 25 primary spirals which is rather flat-topped, wider than interspace, 2-3 intercalaing spirals only on the upper part of each whorl.

Genus *Phalium* Link, 1807

Phalium sp.
(Pl. 29, Fig. 3)

Description:-Shell of medium size, elongated oval, with 7-8 whorls which are conical in form, body whorl large; whorls weakly swollen. Surface ornamented with fine spiral, encounted about 35 on body whorl and about eight on parietal whorl; spirals formed decussate crossing with growth lines; about three spirals beneath suture being conspicuous with wider interspaces in which intercalaries developed. Suture indistinct; two strong varices developed on body whorl, one at outer lip and another located 180° from the former varix. Aperture elongated, outer lip thick, inside of outer lip denticulated, columellar margins covered with callus deposit; several irregular plications developed on columellar margin.

Remarks:-The present species related to the Recent species *Bezoardicella decussata* (Linné), but the latter differs from the former by having an elongated shell, regular columellar folds, coarser decussations and no callus deposit.

Family Cymatiidae
Genus *Cymatium* [Röding, 1798]

Cymatium (?) sp.
(Pl. 31, Fig. 17)

Description:-Shell medium in size, moderately elongated ovoid-fusiform with high whorls, more than seven, separated by well-marked and more or less wavy sutures. Body whorl large, occupying 60% of shell height, of which surface angulated by seven distinct longitudinal round-topped nodules at a little above the middle; shoulder more or less concave; just below suture swollen, ornamented with numerous spirals which are flat-topped and separated by very narrow but sharp interspaces; on parietal whorl, nodules located at a little below the middle, spirals on the nodules become broader. Aperture elongated ovoid-fusiform, inner and columellar lips smooth and callous; canal moderate, narrowly opened and slightly recurved.

Family Tonnidae
Genus *Tonna* Brünnich, 1772

Tonna allium (Dillwyn, 1817)
(Pl. 31, Fig. 16)

1929. *Dolium costatum*, Yokoyama (b), p. 13, pl. 7, fig. 2.
1960. *Tonna allium*, Makiyama, pl. 114, fig. 2.

Remarks:-This species characterized by having, 1) large and rather thin shell, 2) globular and well-swollen shell separated by appressed sutures, 3) body whorl with about 25 spirals and one intercalary, primary spiral of rather flat-topped which is located on only upper part of the whorl, 4) rounded shoulder, 5) short canal and fasciole which are recurved and ornamented with spirals as well as on body whorl.

Family Buccinidae
Subfamily Babyloniinae
Genus *Babylonia* Schlüter, 1838
Subgenus *Babylonia s. s.*

Babylonia (*Babylonia*) *elata* (Yokoyama, 1923)
(Pl. 28, Fig. 11)

1962. *Babylonia* (*Babylonia*) *elata*, Shuto, p. 43, 44, pl. 6, figs. 7, 8; pl. 7, fig. 14.

Remarks:-The characteristic features of the present species are, 1) almost glabrous surface, 2) regularly rounded whorls, 3) markedly concaved shoulder on the grown individual, 3) large pseudoumbilicus being present on the base, 4) fasciole developed markedly around the pseudoumbilicus.

Subfamily Photinae
Genus *Siphonalia* A. Adams, 1863

Siphonalia kannoi n. sp.
(Pl. 29, Fig. 6)

Description:-Shell medium in size, moderately elongated ovoid-fusiform; spire high, whorls more than six, separated by well-marked sutures; body whorl large occupying about 70% of the shell in height, angulated by rows of about ten distinct longitudinal round-topped nodules of which interspaces being wider a little above the middle, shoulder moderately sloping excepting for just below the suture; surface below the suture more or less swollen and ornamented by about seven spirals which are narrower than interspaces in which developed one intercalary; surface below the angulations more or less smooth, about ten yellow-brown colored spiral lines run from the shoulder to the snout; shoulder of parietal whorl ornamented by several spirals; periphery sculptured by rows of about ten longitudinal nodules; surface below the angulations almost smooth; surface of younger whorls wholly ornamented by rows of weak and elongate longitudinal nodules reaching to upper and lower sutures; surface below the periphery vertical. Aperture elongated fusiform of which both ends acute; outer lip rounded, inside of outer lip sculptured by about twenty crenulations; inner and columellar lips smooth and calloused; canal short, strongly recurved leftbackwards, fasciole remarkable.

Remarks:-The present new species related to *Siphonalis signa* (Reeve) (Kira, 1954, p. 67, pl. 26, fig. 16), but it can be distinguished from the latter by having higher spire and finer spiral striae on the whorls.

Holotype:- NT90-28

Measurements (in mm) :-Specimen NT90-28 (Holotype), Height 43.7, diameter 22.2.

Siphonalia kozaii n. sp.
(Pl. 29, Fig. 5)

Description:-Shell rather medium in size, ovoid-fusiform with relatively low conical spire; whorls more than six separated by distinct groove-like suture, much shorter than height of aperture; surface ornamented with fine, flat-topped spirals, and axials. Whorls are angulated a little above the middle; longitudinal ribs not extending to upper part of whorl, as wide as interspaces. Shoulder is moderately sloping and more or less concave at

the middle on all whorls; body whorl large occupying more than 3/4 of the shell, about eleven round-topped longitudinal nodules at periphery, about forty spirals from snout to periphery and about twelve spirals from periphery to upper suture; surface just below suture swollen ring-like; parietal whorl with about eleven longitudinal nodules and 13-15 spirals below periphery and about twelve spirals above periphery; spirals on young whorls becoming indistinct. Aperture large, semi-elliptical and extending to the end of the canal which is short and vertical; inner surface of the outer lip with about ten small plicae.

Remarks:-The present new species is somewhat related to *Siphonalia tonohamaensis* Nomura (Nomura, 1937, p. 87, pl. 6, figs. 3a, b) in outline from the same locality as this species, but the present new species can be distinguished therefrom by having a large number of spirals, and a short and vertical canal. This species is also related to *Siphonalia tonohamaensis delicatula* Shuto (Shuto, 1962, p. 40-41, pl. 7, figs. 6, 7), but the present species differs from the latter by having finer and a larger number of spirals. The present species resembles *Siphonalia cassidariaeformis* (Reeve), now living around Honshu, Kyushu and Korean Peninsula, but the former can be distinguished therefrom by having a fewer number of longitudinal ribs which are round-topped and prominent.

Holotype:-NT90-29

Measurements (in mm) :-Specimen NT90-29 (Holotype), Height 31.1, diameter 22.2

Siphonalia yabei Nomura, 1937
(Pl. 29, Figs. 7, 8)

1937. *Siphonalia yabei* Nomura, p. 87, 88, pl. 6, figs. 6a, b.

Remarks:-This species was originally reported by Nomura in 1937 from the Tonohama Formation. The following characters are equivalent to Nomura's description. 1) sharply shouldered lower three whorls, 2) body whorl ornamented by ten marked plicae which are lost at the base and the parietal one by twelve plicae, 3) very distinct spirals.

Family Nassariidae
Genus *Nassaria* Link, 1809
Subgenus *Nassaria s. s.*

Nassaria (*Nassaria*) *acuminata gendingaensis* (Martin, 1906)
(Pl. 29, Fig. 4)

1962. *Nassaria* (*Nassaria*) *acuminata gendingaensis*, Shuto, p. 45-47, pl. 6, figs 6, 11, 12; pl. 7, fig. 11; pl. 9, figs. 1, 7; text-figs. 7-9.

Remarks:-The present species is similar to *Benthindsia magnifica* (Lischke) (Kuroda *et al.*, 1971, p. 261, pl. 45, fig. 2), but the species is distinguished from *Benthindsia magnifica* in the following features.

The present species is less in size, and has lower spire of large apical angle, more roundly convexed whorls, and definite and strong three angulations on the periphery surface. Surface is wholly ornamented with distinct, round-topped primaries, secondaries and a few tertiaries. The axial plicae are prominent and reach to the upper suture, but on *Benthindsia magnifica*, they are moderate and hardly reach to the upper suture.

Genus *Nassarius* Dumeril, 1806
Subgerus *Hinia* Leach, 1847

Nassarius (*Hinia*) *caelatus dainitiensis* (Makiyama, 1927)
(Pl. 30, Fig. 1)

1927. *Nassarius* (*Hinia*) *caelatus dainitiensis* Makiyama, p. 122, 123, pl. 5, figs. 17, 18.

Remarks:-This subspecies was originally described by Makiyama from the Pliocene Kakegawa Group in Shizuoka Prefecture. The characteristic features of the subspecies are similar to Recent species *Nassarius* (*Hinia*) *caelatus* but this subspecies differs from the living species by having a distinctly canaliculate suture.

Genus *Reticunassa* Iredale, 1936

Reticunassa cf. *R. spurca* (Gould, 1860)
(Pl. 31, Fig. 15)

Compared with:
1971. *Reticunassa spurca*, Kuroda, Habe and Oyama, p. 268-269 (in Japanese), p. 175 (in English), pl. 47, figs. 17-19.

Description:-Shell small, ovate with a tall acute spire and a large body whorl, surface sculptured with five to six spiral ribs forming nodules with 18 to 20 axial ribs; aperture missed.

Family Faciolariidae
Subfamily Fusininae
Genus *Fusinus* Rafineasque, 1815

Fusinus perplexus (A. Adams, 1864)
(Pl. 30, Fig. 5)

1971. *Fusinus perplexus*, Kuroda, Habe and Oyama, p. 280, 281 (in Japanese), p. 183 (in English), pl. 51, fig. 3.
1988. *Fusinus perplexus*, Noda, p. 47, pl. 12, figs. 19a, b.

Remarks:-The present species is characterized by the following features. Shell is with 5-6 whorls which are sharply carinated at the periphery by about twelve plicae. Shoulder is almost flat and moderately sloping. Surface below the periphery is vertical. The Body whorl is ornamented with about eight round-topped primary spirals and secondaries. The canal is very long and narrowly open.

Genus *Granulifusus* Kuroda and Habe, 1952

Granulifusus matsumotoi Shuto, 1958
(Pl. 30, Fig. 6)

1958. *Granulifusus matsumotoi* Shuto, p. 257, 258, pl. 36, figs. 3, 4, 7, 8, text-figs. 1c, d.

Description:-Shell moderately medium in size, thick, fusiform with high spire; the post nuclear whorls six in number; three primary spirals of almost equal size at the first whorl, but on the remaining the uppermost primary spiral becomes weak so that the profile of the whorls bi-angulate. On the penultimate whorl, secondaries about ten above the upper granulation and about five between angulations and below the lower angulation five spirals which are relatively regular. Spirals crossing with fine growth lines and formed granulations; interspaces ornamented by tertiaries. Axial plicae ten to twelve on each whorl; suture appressed and wavy.

Granulifusus dualis (Yokoyama, 1929)
(Pl. 30, Fig. 8)

1929. *Fusus dualis*, Yokoyama (b), p. 12, pl. 7, fig. 5.
1958. *Granulifusus dualis*, Shuto, p. 254-256, pl. 37, figs. 5, 6, 10-12.

Description:-Shell moderately medium in size rather thin and fusiform with high spire; the post nuclear whorls are five in number; three primary spirals appear at the first and second whorls, but on the lower whorls; upper two primary spirals as weak as secondaries. On the penultimate whorl, secondaries fifteen between the angulation and upper suture and ten between the angulation and lower suture. Axial plicae ten to twelve on each whorls. Suture distinct and groove-like.

Genus *Phos* Montfort, 1810

Phos nipponicus Nomura, 1937
(Pl. 30, Fig. 2)

1937. *Phos nipponicus* Nomura, p. 86, pl. 6, figs. 13a, b.

Description:-Shell small and elongated fusiform with eight whorls which are ornamented with longitudinal plicae and spirals; they crossing one another and forming reticulated sculptures. Twenty plicae on body whorl and fifteen on penultimate. Spirals flat-topped composed of primaries, secondaries and tertiaries. Body whorl ornamented with about twelve primaries and penultimate ornamented with about seven primaries. Suture more or less wavy. Aperture elongately ovate; inner surface of outer lip crenated reflecting outer spirals. Columellar margin straight and vertical. Canal moderately short and somewhat broad. Siphonal peak slightly recurved.

Genus *Comitas* Finlay, 1926
Subgenus *Fusiturricula* Woodring, 1926

Comitas (*Fusiturricula*) *habei* Shuto, 1961
(Pl. 32, Fig. 18)

1961. *Comitas* (*Fusiturricula*) *habei* Shuto, p. 95, 96, pl. 7, figs. 15, 19; pl. 9, fig. 1, text-figs. 5, 6.

Description:-Shell medium in size and elongated spindle-shaped with ten whorls; surface ornamented with about twelve oblique round-topped longitudinal short ribs which are strong at the periphery; 3-5 spiral broad cords below the periphery, and fine, numerous spirals above the periphery; aperture elongated ovate: angulated faintly at the anal sinus on the outer lip; inner surface of outer lip and columellar margin smooth; canal long, narrowly opened and somewhat zwisted.

Family Olividae
Subfamily Ancillinae
Genus *Ancilla* Lamark, 1799
Subgenus *Baryspira* Fischer, 1883

Ancilla (*Baryspira*) *albocallosa okawai* Yokoyama, 1923
(Pl. 30, Fig. 7)

1923. *Ancilla okawai* Yokoyama, p. 7, pl. 1, figs. 4-7.
1926. *Ancilla okawai*, Yokoyama (a), p. 365.
1929. *Ancilla okawai*, Yokoyama (b), p. 10.
1959. *Ancilla* (*Baryspira*) *albocallosa okawai*, Shuto, p. 170, 171, pl. 14, figs. 4, 11.

Description:-Shell medium in size, solid, bomb-shaped; upper whorls covered by callus; apex rather acute; body whorl large, shoulder blunt; aperture wide and long; columellar margin folded strongly.

Subfamily Olivellinae

Genus *Oliva* Bruguière, 1789
Subgenus *Oliva s. s.*

Oliva (*Oliva*) sp. 1
(Pl. 31, Fig. 10)

Description:-Shell medium sized, cylindrically elongated ovate; spiral low, surface smooth.

Remarks:-A single ill-preserved specimen is at hand. Columellar and outer lips are eroded out.

Oliva (*Oliva*) sp. 2
(Pl. 31, Fig. 13)

Description:-Shell medium sized, cylindrically broaded ovate, spiral low, surface with growth lines.

Remarks:-A single ill-preserved specimen is at hand. Columellar and outer lips are eroded out. The shell of this species is more or less bigger than that of sp. 1.

Family Mitridae
Subfamily Mitrinae
Genus *Strigitella* Swainson, 1840

Strigitella cf. *S. decurtata* Reeve, 1844
(Pl. 30, Fig. 4)

Compared with:
1954. *Strigitella* (non *Strigatella*: Tryon (1879-1898)) *decurtata*, Kira, p. 85, pl. 33, fig. 9.

Description:-Shell of medium size, fusiform, spire conic with four unswollen whorl; body whorls large, occupied about three-fourth in height of spire with four wide spiral ribs beneath suture and seven spiral ribs on base; suture deep and distinct; periphery roundly curved and smooth; penultimate whorl with seven spiral striations and 24 longitudinal ribs. Aperture rather large, about two-third atitude of shell; outer lip slightly curved, thick, inside crenated by about 16 slender, fine teeth; inner lip covered by callus with about ten columellar folds.

Family Volutidae
Subfamily Volutinae
Genus *Lyria* Gray, 1847
Subgenus *Paralyria* Shuto, 1962

Lyria (*Paralyria*) *mizuhonica mizuhonica* Shuto, 1962
(Pl. 30, Fig. 13)

1927. *Lyria mizuhonica* Makiyama, p. 76, pl. 3, figs. 12, 13.
1962. *Lyria* (*Paralyria*) *mizuhonica mizuhonica* Shuto, p. 71, pl. 12, figs. 11, 12.

Remarks:-According to Shuto (1962), two forms of *Lyria* (*Paralyria*), *Lyria* (*Paralyria*) *mizuhonica* Makiyama and *Volųta koyuana* (Yokoyama) are very closely allied each other and are different delicately in the spiral ornamentation which in *mizuhonica*, consists of only the obsolete striations. And he considered *"Voluta" koyuana* is a subspecies of *L. mizuhonica*. This subspecies characterized by having several obsolete and fine striations on the surface below suture and base.

Family Cancellariidae
Genus *Cancellaria* Lamarck, 1799

Cancellaria pristina (Yokoyama, 1923)
(Pl. 30, Fig. 9)

1923. *Mitra pristina* Yokoyama, p. 8, pl. 1, figs. 8-12.
1927. *Cancellaria pristina*, Makiyama, p. 85, pl. 4, figs. 3, 4.

Description:-Shell of medium size, thin; whorls about eight roundly convex; 17 flat-topped spirals and one or two spirals striations in each spiral, and twenty axials crossing with spirals and forming cancellate sculpture on body whorl. Parietal whorl and higher whorls ornamented with about seven spirals and 15 axials. Aperture elongated semi-ellipse; outer lip broadly arched; inner surface of outer lip smooth; columellar margin with thin callus and two marked folds.

Genus *Trigonostoma* Blainville, 1827

Trigonostoma cf. *T. nana* Ozaki, 1956
(Pl. 30, Fig. 3)

Compared with:
1956. *Trigonostoma nana* Ozaki, p. 2, pl. 1, fig. 5.

Description:-Shell of thick and solid, ovate in outline with large body whorl and low conical spires; suture narrowly grooved; body whorl ornamented with about thirty flat-topped spirals, one or two spiral striations in each interspaces of the spirals crossing with round-topped axials, and forming cancellate sculpture. Aperture ovate; columellar margin covered by callus and folds weakly developed.

Family Conidae
Genus *Cleobula* Iredale, 1930

Cleobula quercina (Lightfoot, 1786)
(Pl. 31, Fig. 3)

1967. *Cleobula quercina*, Habe and Kosuge, p. 94, pl. 37, fig. 8.
1977. *Conus* (*Cleobula*) *quercina*, Linder, p. 84, pl. 49, fig. 18.

Description:-Shell solid with slightly convex whorls: spires low but young spire prominented; body whorl swollen beneath the shoulder; general outline slightly convex; surface with fine spiral thread and growth lines.

Cleobula sp.
(Pl. 31, Fig. 11)

Description:-Shell medium with about ten whorls, spire flat but young spire more or less elevated; general outline somewhat convex. Whorls ornamented with two strong impressed grooves; area just above the suture slightly carinated. Surface of the body whorl sculptured by spiral ribs and colored by 16-17 rows of brown square patches. Aperture narrow linear, obliquely parallel-sided.

Remarks:-Coloration of this specimen is nearly similar to that of a Recent species *Lithoconus litteratus* (Linné) but the present species belongs to genus *Cleobula* as described above.

Genus *Virgiconus* Cotton, 1945

Virgiconus cf. *V. virgo* (Linné, 1758)
(Pl. 31, Figs. 1, 2)

Compared with:
1954. *Virgiconus virgo*, Kira, p. 37, pl. 37, fig. 10.
1960. *Virgiconus virgo*, MacNeil p. 125.
1977. *Virgiconus virgo*, Linder, p. 85, pl. 49, fig. 1.

Description:-Shell large with about ten whorls, slightly convex in outline; area beneath the shoulder of body whorl swollen; surface between sutures ornamented with 4-6, fine spiral threads. Aperture narrow, linear, obliquely parallel-sided.

Remarks:-The present species closely resembles a Recent species *Virgiconus virgo* (Linné) living south of Kii Peninsula. However specific distinction is impossible for disappearance of their coloration.

Genus *Conus* Linnē, 1758

Conus sp. 1-6
(Pl. 31, Figs. 4-7, 9, 12)

Remarks:-Several specimens of the genus *Conus* are in our collection. However, their specific determination are difficult owing to extinction of surface coloration.

Family Turridae
Genus *Clathurella* Carpenter, 1857
Subgenus *Etremopha* Oyama, 1955

Clathurella (*Etremopha*) sp.
(Pl. 32, Fig. 6)

Description:-Shell small, fusiform, rather thick. Spire towered with seven whorls. Sculpture of young whorls consists of several axial ribs and two spiral threads which increase in number by age, eight on the penultimate whorl; axials 14 on the penultimate whorl, two of them especially strong. Axials strong on the periphery and faint above the periphery. Body whorl rather small. Umbilicus closed. Aperture narrow; outer lip thin, a heavy varix a little distant from margin; Anal notch U-shaped being on the shoulder touching to the varix; inner lip thin with callus and a node near the posterior end. Cannal short.

Subfamily Turriculinae
Genus *Gemmula* Weinkauff, 1875
Subgenus *Gemmula s. s.*

Gemmula (*Gemmula*) sp.
(Pl. 32, Figs. 10, 15)

Description:-Shell medium, fusiform, rather thin; spire high and conic. Protoconchs two and their surface smooth. Spire consisting of six whorls which are swollen. Peripheral keel with tubercles and subsutural band appears on the young whorls, suture groove-like; tubercules nodulose numbered 10-12 on body whorl; two spiral ribs developed both side of the keel, and four, wide and flat-topped spiral ribs on the base. Body whorl with comparatively long siphonal canal occupied half height of shell. Outer lip thin and collumellar margin smooth.

Genus *Myurella* Hinds, 1845
Subgenus *Triplostrephanus* Dall, 1908

Myurella (*Triplostrephanus*) *naumanni* (Yokoyama, 1920)
(Pl. 32, Fig. 17)

1961. *Myurella* (*Triplostrephanus*) *naumanni*, Shuto, p. 144, pl. 10, figs. 5,6.

Description:-Shell rather small, drill-formed; subsutural band consisting of two series of small longitudinal granulous ribs; canal short and zwisted.

Family Pyramidellidae
Subfamily Pyramidellinae
Genus *Syrnola* A. Adams, 1860

Syrnola sp.
(Pl. 32, Fig. 16)

Description:-Shell small, translucent white; spire high and conical with 7 whorls in number; whorls moderately inflated, but shouldered; suture distinct. Surface smooth and polished with faint growth lines, but a strong groove below the suture. Aperture ovate; outer lip roundly curved and thin; columellar margin slightly oblique with a fold at the upper part.

Subfamily Odostominae
Genus *Odostomia* Fleming, 1813

Odostomia sp.
(Pl. 32, Fig. 12)

Description:-Shell very small, ovately elongate-conic, milk-white; test thin; whorls five, smooth and shining fairly, convex, slightly shouldered at summit, separated by constricted sutures; body whorl large, longer than spire. Sculpture of fine growth lines only. Aperture anteriorly rounded and produced, fine eight denticles within, a fold at columellar insertion. Umbilicus rather large, shallow.

Family Terebridae
Subfamily Turboninae
Genus *Turbonilla* Risso, 1826
Subgenus *Turbonilla s. s.*

Turbonilla (*Turbonilla*) sp.
(Pl. 32, Fig. 14)

Description:-Shell small, slender, high; test moderately thick; post-nuclear whorls twelve, shouldered at summit of a whorl. Sculpture of nearly vertical, rounded riblets, as wide as their interspace extending from summit of a whorl to lower suture, numbered twenty on the last whorl; interspace ornamented by more than 20 spiral threads which extinct on the vertical riblets. Base short, with spiral threads. Aperture quadrate.

Subgenus *Pyrgiscus* Monterosato, 1884

Turbonilla (*Pyrgiscus*) cf. *T.* (*P.*) *optiva* Nomura, 1937
(Pl. 32, Fig. 19)

Compared with:
1937. *Turbonilla* (*Pyrgiscus*) *optiva* Nomura, p. 73, pl. 14, figs. 76a, b.

Description:-Shell rather small, elongate-conic; test moderately thick; nuclear whorls more than two, globose, smooth; spire whorls eight, convex around middle, not shouldered at summit, separated by well-marked sutures. Surface marked by strong axial ribs and spiral striae; axial ribs almost vertical, 14 on body whorl; interspace wide, flat and a half time wider than ribs. Aperture missed.

Family Architectonicidae
Genus *Architectonica* (Röding, 1798)

Architectonica sp.
(Pl. 32, Fig. 27)

Description:-Shell small, thin, solid, low conical with five whorls and swollen base; spire of 5 whorls and flat side; protoconch 1 and 1/2 whorls, smooth, polished, sunk in the flat teleconch. Surface with 6-7 spiral cords of which below the suture one being the strongest, the second above the suture; cords crossed by growth lines forming granules. Body whorl with periphery marginated by two strong beaded rims; base with six spiral cords which is stronger nearing to umbilicus and strongly crenulated cord on the border of umbilicus which is deeply perforated.

Genus *Solariaxis* Dall, 1892

Solariaxis sp.
(Pl. 32, Fig. 26)

Description:-Shell small, lenticular with six whorls, low conical; protoconch smooth and polished. Surface of whorls with six spiral cords crossed by growth lines forming granules among which the lowermost and the uppermost ones broad and strongly beaded. Spiral cord on the periphery of body whorl strong and more or less keeled; base of body whorl weakly convex and with seven spiral cords crossed by growth lines forming strong granules. Umbilicus deeply and widely perforated with a slightly overhanging beaded rim. Aperture rounded.

Class Scaphopoda

Family Dentalidae
Genus *Antalis* H. and A. Adams, 1857

Antalis weinkauffi (Dunker, 1877)
(Pl. 33, Fig. 2)

1920. *Dentalium weinkauffi*, Yokoyama, p. 102, pl. 6, figs. 19-21.
1926. *Dentalium weinkauffi*, Yokoyama(a), p. 365.
1929. *Dentalium weinkauffi*, Yokoyama(b), p. 10.
1971. *Dentalium weinkauffi*, Kuroda, Habe and Oyama, p. 488 (in Japanese), p. 307 (in English), pl. 65, figs. 12, 13.
1977. *Dentalium weinkauffi*, Ogasawara, pl. 17, figs. 11, 12.

Remarks:-This species is characterized by having an elongated tube, slender rather thick and solid shell with about 18 round flat-topped longitudinal ribs which are almost disappeared on the apertural end. Deep notch is developed on the convex side of the apex.

Genus *Striodentalium* Habe, 1964

Striodentalium tosaensis (Habe, 1963)
(Pl. 32, Fig. 20)

1977. *Striodentalium tosaensis*, Habe, p. 334.

Remarks:-This species characterized by having a slender and small-sized shell with 11 longitudinal ribs, without intercalated ribs.

Class Pelecypoda

Family Nuculidae
Genus *Acila* H. and A. Adams, 1858
Subgenus *Acila s. s.*

Acila (*Acila*) *divaricata* (Hinds, 1843)
(Pl. 33, Fig. 5)

1954. *Acila* (*Acila*) *divaricata*, Aoki, p. 32, pl. 1, fig. 14.
1960. *Acila divaricata*, Tanaka, p. 134, fig. 5.
1961. *Acila divaricata*, Iwai, pl. 1, fig. 6.
1973. *Acila* (*Acila*) *divaricata*, Oyama, p. 75, pl. 20, fig. 25.
1980. *Acila* (*Acila*) *divaricata*, Noda, p. 65, pl. 1, figs. 5, 10a, b.
1988. *Acila* (*Acila*) *divaricata*, Noda, p. 63, pl. 16, fig. 19.

Remarks:-This species is rather common in the Tonohama Formation. A large number of well-preserved specimens of conjoined shell were collected.

Subgenus *Truncacila* Schenk, in Grant and Gale, 1931

Acila (*Truncacila*) sp.
(Pl. 33, Fig. 4)

Description:-Shell subovated, inequilateral; posterior dorsal margin short, obliquely truncated. Beak small, adjacent, directed backwards, situated at about the posterior fifth. Anterior dorsal margin gently sloping, slightly convex; posterior end angulate forming an angle about 95°, anterior end rounded: ventral margin regularly arched, slightly sinuated near the posterior end. Lunule obsolete, escutcheon very large, semicircular, circumscribed by a rounded ridge. Surface sculptured by divaricating oblique thread.

Family Cucullaeidae
Genus *Cucullaea* Lamarck, 1801

Cucullaea granulosa Jonas, 1846
(Pl. 34, Fig. 10)

1926. *Cucullaea concamerata* Yokoyama (a), p. 360, pl. 41, fig. 2.
1929. *Cucullaea concamerata*, Yokoyama (b), p. 17, pl. 8, fig. 2.
1937. *Cucullaea granulosa*, Nomura, p. 71.
1954. *Cucullaea granulosa*, Kira, p. 123, pl. 44, fig. 9.

Remarks:-This species occurs abundantly in the formation also in the Satsuka Bed in Dainichi area, Shizuoka Prefecture. This species is living around central and western Japan and in the China Sea (Yokoyama, 1929).

Family Arcidae
Subfamily Arcinae

Genus *Arca* Linné 1758
Subgenus *Arca s. s.*

Arca (*Arca*) *boucardi* Jousseaume, 1894
(Pl. 34, Figs. 3, 4, 7)

1961. *Arca boucardi*, Hayasaka, p. 24, pl. 2, figs. 1-5.
1966. *Arca* (*Arca*) *boucardi*, Noda, p. 55, 56, pl. 6, figs. 12, 19.
1966. *Arca* (*Arca*) *miurensis* Noda, p. 57, pl. 12, figs. 11, 14, 15.
1971. *Arca boucardi*, Kuroda, Habe and Oyama, p. 518 (in Japanese), p. 326 (in English), pl. 68, figs. 10-12.

Description:-Shell elongated ovate; anterior end rounded; posterior one long, truncated obliquely; surface ornamented with fine radial ribs crossing with fine concentric growth line; depressed area sculptured with rather thick radial ribs and fine growth lines; ligamental area rather narrow, faint v-shaped.

Genus *Barbatia* Gray, 1842
Subgenus *Barbatia s. s.*

Barbatia (*Barbatia*) sp.
(Pl. 34, Fig. 2)

Description:-Shell small in size, inequilateral, longer than high, elongately quadrate with posterior strongly depressed area along the posterior side extending from beak to posterior ventral corner; dorsal margins nearly straight; anterior end roundly produced; posterior end produced, obliquely truncated; ventral margin straight, parallel to dorsal margins. Beak rather low, prosogyrate, incurved. Surface with a large number of radial ribs which are distinct at posterior depressed area. Ligamental area low triangle of II type of Noda (1966). Hinge line nearly straight, teeth rather strong, ventrally convergent, about ten on anterior side and 12 on posterior side in number.

Subgenus *Ustularca* Iredale, 1938

Barbatia (*Ustularca*) cf. *B.* (*U.*) *fusca* (Solander, 1789)
(Pl. 33, Figs. 9, 12)

Compared with:
1966. *Barbatia* (*Ustularca*) *fusca*, Noda, p. 64, 65, pl. 1, figs. 1-6, 15, 16; pl. 10, figs. 11, 12; table 33.

Description:-Shell medium in size, inequilateral, ovately elongated in outline, slightly

wide posteriorly, moderately inflated with rounded anterior end; posterior end elongately rounded continuing to both ends without any angulation; ventral margin slightly sinuated. Beak small, prosogyrate anteriorly and nearly touching. Surface ornamented with radial ribs, about 110 at the margin, concentric minute growth lines crossing with radial ribs and make fine nodulose on the radial ribs. Hinge line nearly straight; teeth moderately large at extremities, very small medially; anterior teeth about 25, the posterior ones about 30. Ligamental area narrow, sculptured with three distinct chevron-shaped grooves. Interior margin smooth.

Subgenus *Acar* Gray, 1857

Barbatia (*Acar*) *reticulata* (Gmelin, 1792)
(Pl. 33, Fig. 10)

1966. *Barbatia* (*Acar*) *reticulata*, Noda, p. 69, 70, pl. 2, figs. 8-13, 23, 24.

Remarks:-This species is characterized by having a rounded shell and not shouldered profile. The present species has rather strong surface sculpture which is coarser on the anterior and posterior part than that of the middle part. Ventral sinus is small.

Subfamily Anadarinae Reinhart, 1835
Genus *Anadara* Gray, 1847
Subgenus *Scapharca* Gray, 1847

Anadara (*Scapharca*) *suzukii* (Yokoyama, 1926)
(Pl. 33, Figs. 7, 15)

1926. *Arca suzukii* Yokoyama (a), p. 368, pl. 42, figs. 6, 7.
1951. *Anadara* (*Dilvarca*) *suzukii*, Oyama, pl. 6, fig. 13.
1965. *Anadara* (*Scapharca*) *suzukii*, Noda, p. 100, pl. 10, figs. 3-7.
1966. *Anadara* (*Scapharca*) *suzukii*, Noda, p. 111, pl. 8, fig. 2.

Remarks:-This species was originally described by Yokoyama in 1926, from the present Formation, in Kochi Prefecture. Subsequently this species was reported by several workers from the Pliocene in Shizuoka, Kochi, and Okinawa. The specimens are rather well-preserved and several ones are conjoined and occur abundantly in the formation.

Anadara (*Scapharca*) *shizuokaensis* Noda, 1965
(Pl. 33, Fig. 6)

1965. *Anadara* (*Scapharca*) *shizuokaensis* Noda, p. 11, pl. 9, fig. 20.

Description:-Hinge line straight, ligamental area large and triangular with five incised chevrons; surface provided with 35-36 radial ribs which are narrower than their interspaces in width; ribs in anterior part of disk of left valve bifurcated weakly.

Subgenus *Tosarca* Noda, 1965

Anadara (*Tosarca*) *tosaensis* Noda, 1965
(Pl. 33, Fig. 14)

1965. *Anadara* (*Tosarca*) *tosaensis* Noda, p. 105, pl. 11, figs. 11-13.
1966. *Anadara* (*Tosarca*) *tosaensis*, Noda, p. 123, pl. 11, fig. 3.

Remarks:-The present species has following features such as surface provided with about 42-43 radial ribs which are squarish in cross section each with 4-8 fine but clear grooves on their top, squarish interspaces, narrower than ribs and regularly close and wrinkled growth lines on surface. This species is more or less related to the Recent species *Anadara antiquata* which is living south of Ryukyu, but the former differs from the latter by having a more trapezoidal form and more numbered radial ribs. *Anadara amicula* from the Pliocene Shigarami Formation in Nagano Prefecture is another allied species, but it can be distinguished from the present one by having less numbered radial ribs.

Subgenus *Hataiarca* Noda, 1966

Anadara (*Hataiarca*) sp.
(Pl. 33, Fig. 13)

Compared with:
1965. *Anadara* (*Scapharca* ?) sp., Noda, p. 101. pl. 10, figs. 8, 9.
1966. *Anadara* (*Hataiarca*) sp., Noda, p. 122, pl. 2, fig. 16.

Description:-Shell of moderate in size, rather thick, trapezidal in outline, moderately inflated, radially sculptured; beak rather small, curved inward and slightly forwards; anterior margin rounded making obtuse angle with dorsal margin; ventral margin broadly rounded; posterior side obliquely produced. Surface ornamented with 20-21 radial ribs, strongly developed, subquadrate in cross section, flat-topped and wider than that of interspaces; posterior depressed area which extends from beak to ventral corner divided with 5-6 smooth, flat topped and narrow radial ribs. Ligament triangular depressed, hinge-line narrow and straight. Inner margin strongly and deeply crenated.

Remarks:-A single left valve was examined. Characters of the present species are undoubtedly assigned to the species of the Pliocene Ananai Formation reported by Noda (1965). According to Noda, the species resembles *Anadara granosa bisenensis* but differs in having a posterior depressed area, and is also similar to *Anadara takaoensis* but this species

distinguished from the latter by having depressed area along the posterior side.

Anadara sp.
(Pl. 34, Fig. 5)

Description:-Shell small in size, inequilateral, longer than high, roundly quadorate, thick. Dorsal margin nearly straight, anterior margin shorter than that of posterior; anterior end very short and slightly produced; posterior end elongate, rounded; ventral margin broadly rounded and slightly arcuated; umbonal area swollen. Beak situated anteriorly and incurved. Surface ornamented with strong 26 round-topped ribs which are narrower than their interspaces in width and granulated slightly strong in anterior area. Interspaces incised with concentric growth lines. Ligamental area narrow, trigonal of IV type of Noda (1966); ligamental grooves faint, parallel to hinge line, teeth ventrally convergent of II type of Noda. Inner surface smooth, but strongly crenated at inner ventral margin.

Family Glycymerididae
Subfamily Glycymeridinae
Genus *Glycymeris* da Costa, 1778
Subgenus *Glycymeris s. s.*

Glycymeris (*Glycymeris*) *vestita* (Dunker, 1977)
(Pl. 34, Fig. 16)

1926. *Pectunculus vestitus*, Yokoyama (a), p. 366.
1954. *Glycymeris* (*Glycymeris*) *vestita*, Ozaki, Fukuta and Ando, p. 168, pl. 28, figs. 17a, b.
1961. *Glycymeris* (*Glycymeris*) *vestita*, Hayasaka, p. 28, pl. 2, figs. 13a, b.
1977. *Glycymeris* (*Glycymeris*) *vestita*, Matsuura, pl. 11, fig. 27.
1977. *Glycymeris* (*Glycymeris*) *vestita*, Habe, p. 45.
1986. *Glycymeris* (*Veletuceta*) *vestita*, Matsukuma, p. 91, pl. 5, fig. 4.

Remarks:-This species is characterized by having rather thin, ovately rounded shell and rather smooth surface but is ornamented with faint radial ribs and concentric lines.

Glycymeris (*Glycymeris*) *rotunda* (Dunker, 1882)
(Pl. 34, Fig. 15)

1952. *Glycymeris rotundae*, Makiyama, p. 31, pl. 1, fig. 7.
1962. *Glycymeris rotunda*, Hayasaka, pl. 45, figs. 8a-9b.
1971. *Glycymeris rotunda*, Kuroda, Habe and Oyama, p. 532 (in Japanese), p. 336 (in English), pl. 71, fig. 6.
1977. *Glycymeris* (*Glycymeris*) *rotunda*, Habe, p. 45.

1986. *Glycymeris* (*Glycymeris*) *rotunda*, Matsukuma p. 89, pl. 6, figs. 14, 15.

Remarks:-Features of this species are, 1) shell is rather thick, solid, rounded in form but more or less produced posteriorly, 2) surface is smooth but ornamented faintly with fine radial ribs and concentric lines.

Family Limopsidae
Genus *Oblimopa* Iredale, 1939

Oblimopa cf. *O. japonica* (A. Adams, 1863)
(Pl. 34, Fig. 14)

Compared with:
1926. *Limopsis chitaniana* Yokoyama(a), p. 361, pl. 39, figs. 11, 12.
1954. *Oblimopa japonica*, Kira, p. 125, pl. 45, fig. 1.
1971. *Oblimopa japonica*, Kuroda, Habe and Oyama, p. 538 (in Japanese), p. 340 (in English), pl. 71, fig. 12.
1977. *Oblimopa japonica*, Habe, p. 49, pl. 9, figs. 3, 8, 9.
1977. *Limopsis* (*Oblimopa*) *forskalii*, Matsuura, pl. 8, fig. 29.
1980. *Oblimopa japonica*, Noda, p. 77, 78, pl. 1, figs. 4a, b, 11a, b, 12.
1988. *Oblimopa japonica*, Noda, p. 66, pl. 16, fig. 24.

Description:-Shell medium for the genus, subcircular in outline, nearly equilateral. Surface with a large number of radial striae formed decussate sculpture crossing with obvious concentric ribs. Teeth ten on anterior side and twelve on posterior side.

Remarks:-The present species is more or less similar to *Oblimopa japonica*, but has a more circular shell in outline.

Family Pinidae
Genus *Atrina* Gray, 1847
Subgenus *Servatrina* Iredale, 1939

Atrina (*Servatrina*) *pectinata japonica* (Linnē, 1758)
(Pl. 35, Fig. 2)

1971. *Atrina* (*Servatrina*) *pectinata japonica*, Kuroda, Habe and Oyama, p. 556 (in Japanese), p. 353 (in English), pl. 78, figs. 2-4.
1989. *Atrina* (*Servatrina*) *pectinata japonica*, Okumura and Koyanagi, p. 74, pl. 8, figs. 5, 6.

Remarks:-Only a single rather ill-preserved specimen was examined.

Family Mytilidae

Genus *Septifer* Récluz, 1848

Septifer sp.
(Pl. 35, Fig. 1)

Description:-Shell of ovate trigonal, expanded posteriorly; posterior ventral margin rounded. Surface ornamented with fine divergent radial ribs.

Remarks:-The specimen does not be specified owing to its ill-preservation.

Family Amusiidae
Subfamily Propeamussiinae
Genus *Polynemamussium* Habe, 1951

Polynemamussium intuscostatum (Yokoyama, 1920)
(Pl. 36, Fig. 7)

1920. *Pecten intuscostatum* Yokoyama, p. 156, 157, pl. 13, figs. 9a, b, 10a, b.
1961. *Pecten intuscostatum*, Habe, p. 173, pl. 53, fig. 5.
1962. *Pecten intuscostatum*, Masuda, p. 155, 156, pl. 18, figs. 7a, b, 8a, b.
1971. *Polynemamussium intuscostatum*, Kuroda, Habe and Oyama, p. 579 (in Japanese), p. 369 (in English), pl. 79, figs. 18-21.
1973. *Polynemamussium intuscostatum*, Oyama, p. 83, pl. 33, figs. 1-3.
1977. *Polynemamussium intuscostatum*, Habe, p. 78.

Remarks:-The species is characterized by having a small, thin, orbicular and flat shell and straight hinge line. Surface of the left valve has fine concentic growth lines and inner surface has radial ribs.

Genus *Amussiopecten* Sacco, 1897

Amussiopecten praesignis (Yokoyama, 1922)
(Pl. 36, Fig. 1)

1922. *Pecten* (*Ammusium*) *praesignis* Yokoyama, p. 1, pl. 5, figs. 1-3.
1926. *Pecten* (*Ammusium*) *praesignis*, Yokoyama (a), p. 357, pl. 40, figs. 1, 2; pl. 41, fig. 1.
1955. *Ammusiopecten praesignis*, Shuto, p. 103-104, pl. 17, figs. 1, 3.
1957. *Ammusiopecten praesignis*, Akiyama, p. 33, pl. 7, figs. 5, 6.
1962. *Ammusiopecten praesignis*, Masuda, p. 226, pl. 27, figs. 4, 5.
1973. *Ammusiopecten praesignis*, Kanno and Chung, pl. 30, fig. 11.
1973. *Ammusiopecten praesignis*, Hayasaka, p. 101, 102, pl. 6, fig. 5.
1980. *Ammusiopecten praesignis*, O'Hara and Ito, p. 131, 132, pl. 14, figs. 5-7; pl. 15, figs. 1-5.
1981. *Ammusiopecten praesignis*, Masuda and Ogasawara, pl. 2, fig. 4.

1988. *Ammusiopecten praesignis*, Noda, p. 69, pl. 17, fig. 12.

Remarks:-This species occurs abundantly in the Formation. The shells are fairly well-preserved and some of them are conjoined. This species is the representative element of the Tonohama molluscan assemblage.

Family Pectinidae
Genus *Pecten* Müller, 1776
Subgenus *Notovola* Finlay, 1926

Pecten (*Notovola*) *albicans* (Schröter, 1802)
(Pl. 36, Fig. 11)

1920. *Pecten laqueatus* Yokoyama, p. 160, pl. 14, figs. 9, 10.
1954. *Pecten* (*Notovola*) *albicans*, Kira, p. 134, pl. 48, fig. 3.
1962. *Pecten* (*Notovola*) *albicans*, Masuda, p. 201, 202, pl. 23, fig. 9.
1971. *Pecten* (*Notovola*) *albicans*, Kuroda, Habe and Oyama, p. 577 (in Japanese), p. 368 (in English), pl. 81, figs. 1-3.
1973. *Pecten* (*Notovola*) *albicans albicans*, Oyama, p. 85, pl. 33, figs. 9-11; pl. 34, figs. 8, 11.
1977. *Pecten* (*Notovola*) *albicans*, Ogasawara, p. 95, pl. 8, figs. 4, 6, 7a, b, 9.
1977. *Pecten* (*Notovola*) *albicans*, Habe, p. 89, pl. 14, fig. 10.

Remarks:-An incomplete and small left shell is in our collection. The surface is ornamented with about ten radial ribs which are round-topped, narrower than their shallow interspaces. Ears are rather large and equal. Hinge line is straight.

Subfamily Chlamydinae
Genus *Chlamys* [Röding, 1798]
Subgenus *Chlamys s. s.*

Chlamys (*Chlamys*) *satowi* (Yokoyama, 1928)
(Pl. 36, Figs. 4, 5)

1928. *Pecten* (*Chlamys*) *satowi* Yokoyama, p. 94, pl. 13, figs. 13, 14; pl. 14, fig. 2.
1960. *Gloripallium satowi*, Shuto, p. 119, pl. 12, fig. 5.
1962. *Chlamys satowi*, Masuda, p. 189, pl. 19, figs. 18, 19; pl. 22, fig. 14.

Remarks:-The present species is characterized by such features as an orbicular shell which are provided with 25-26 round-topped radial ribs and their accompanied imbricated radial threads. According to Masuda (1962), the geological range of this species is the Early Pliocene.

Genus *Aequipecten* Fischer, 1886

Aequipecten vesiculosus (Dunker, 1877)
(Pl. 36, Figs. 2, 3, 6, 9)

1920. *Pecten vesiculosus*, Yokoyama, p. 154, pl. 13, figs. 11-13.
1954. *Cryptopecten vesiculosus*, Kira, p. 128, pl. 50, fig. 1.
1960. *Cryptopecten vesiculosus*, Shuto, p. 123, pl. 13, fig. 3.
1962. *Aequipecten vesiculosus*, Masuda, p. 191, pl. 24, fig. 7; pl. 25, fig. 7.
1967. *Cryptopecten vesiculosus*, Habe and Kosuge, p. 134, pl. 50, figs. 12, 13.
1968. *Aequipecten vesiculosus*, O'Hara, pl. 3, figs. 6a, b.
1971. *Cryptopecten vesiculosus*, Kuroda, Habe and Oyama, p. 574 (in Japanese), p. 366 (in English), pl. 79, figs. 1-7.
1973. *Aequipecten vesiculosus*, Hayasaka, p. 102, pl. 6, fig. 3.
1973. *Aequipecten* (*Cryptopecten*) *vesiculosus*, Oyama, p. 85, pl. 34, figs. 1-3.
1977. *Cryptopecten vesiculosus*, Habe, p. 84.
1978. *Aequipecten vesiculosus*, Aoki and Baba, fig. 27.
1988. *Cryptopecten vesiculosus*, Mizuno and Amano, pl. 14, figs. 10, 15.
1988. *Cryptopecten vesiculosus*, Okumura, p. 41, pl. 13, figs. 6, 9-11.
1988. *Cryptopecten vesiculosus*, Noda, p. 68, pl. 17, figs. 6a, b, 13.

Remarks:-A single large conjoined spesimen and rather small two left and a right valves were examined. Masuda (1962) suggested that the specimens of the present species are divisible into the Tertiary and the Recent or Pleistocene types. The specimens collected from the formation have imbricated intercalary threads between radial ribs which are nearly equal to interspaces in width, and their accompanied radial threads on both sides are fainter compared with those of the Pleistocene ones. These specimens are inconsistent with both types.

Subfamily Patinopectinae
Genus *Patinopecten* Dall, 1897
Subgenus *Mizuhopecten* Masuda, 1963

Patinopecten (*Mizuhopecten*) *tokyoensis* (Tokunaga, 1906)
(Pl. 36, Fig. 10)

1920. *Patinopecten tokyoensis*, Yokoyama, p. 158, pl. 14, figs. 7, 8.
1958. *Patinopecten* (*Patinopecten*) *tokyoensis*, Ozaki, p. 117, pl. 20, fig. 7.
1962. *Patinopecten* (*Patinopecten*) *tokyoensis*, Masuda, p. 211, pl. 25, fig. 4, pl. 27, fig. 8.
1977. *Patinopecten* (*Patinopecten*) *tokyoensis*, Habe, p. 91.
1988. *Patinopecten* (*Mizuhopecten*) *tokyoensis*, Okumura, p. 42, pl. 14, figs. 1, 2.

Remarks:-A single juvenile shell is at hand. The present species is known from the Late Pliocene to the Pleistocene strata of Hokkaido, Akita, Chiba, Kanagawa, Shizuoka and Kagoshima Prefectures and Tokyo Metropolis. This is probably the first report from this formation.

Family Spondylidae Gray, 1826
Genus *Spondylus* Linné, 1758

Spondylus barbatus Reeve, 1856
(Pl. 35, Fig. 3)

1971. *Spondylus barbatus*, Kuroda, Habe and Oyama, p. 567 (in Japanese), p. 361 (in English), pl. 80, figs. 3, 4.

Remarks:-A single left valve of a rather small size is obtained. The general characters of surface sculpture are closely equal to those of *Spondylus barbatus* which is living in Pacific coastal waters of Japan south of Boso Peninsula.

Family Limidae
Genus *Limatula*
Subgenus *Stabilima* Iredale, 1939

Limatula (*Stabilima*) *strengei* (Sowerby, 1872)
(Pl. 37, Fig. 2)

1971. *Limatula* (*Stabilima*) *strengei*, Kuroda, Habe and Oyama, p. 589 (in Japanese), p. 377 (in English), pl. 83, fig. 10.

Description:-Shell small, convex, thin, ventrally produced, equilateral; beak more or less prominent, located at center of short hinge line. Surface of the middle part of shell ornamented with about 20 radial ribs which are nodulose and narrower than width of their interspaces, both side of shell with almost smooth surface. Inner surface smooth.

Genus *Ctenoides* Mörch, 1853

Ctenoides lischkei (Lamy, 1930)
(Pl. 37, Fig. 1)

1954. *Ctenoides japonica*, Kira, p. 129, pl. 52, fig. 6.
1971. *Ctenoides lischkei*, Kuroda, Habe and Oyama, p. 584, 585 (in Japanese), p. 373 (in English), pl. 83, fig. 6.
1977, *Ctenoides lischkei*, Habe, p. 102, pl. 19, figs. 12, 13.

Remarks:-The species has a small, longitudinally elongated ovate and equilateral shell. The surface is ornamented with very fine radial ribs which are straight and no nodulose and have equal width on the whole surface.

Ctenoides cf. *C. lischkei* (Lamy, 1930)
(Pl. 37, Fig. 6)

Compared with:

1954. *Ctenoides japonica*, Kira, p. 129, pl. 52, fig. 6.
1971. *Ctenoides lischkei*, Kuroda, Habe and Oyama, p. 584, 585 (in Japanese), p. 373 (in English), pl. 83, fig. 6.
1977, *Ctenoides lischkei*, Habe, p. 102, pl. 19, figs. 12, 13.

Description:-Shell rather medium for the genus, longitudinally elongated ovate in shape, somewhat inflated; posterior dorsal margin roundly concaved; anterior slope straight. Surface with about 60 radial ribs which are fine and round-topped with very wide interspace.

Remarks:-A single specimen which is more or less eroded is at hand. Species name determination is postponed owing its ill-preservation.

Genus *Lima* Bruguière, 1797
Subgenus *Lima s. s.*

Lima (*Lima*) *zushiensis* Yokoyama, 1920
(Pl. 37, Fig. 3)

1954. *Lima zushiensis*, Ozaki, p. 16, pl. 9, figs. 4-5.
1960. *Lima* (*Lima*) *zushiensis*, Kanno, p. 227, pl. 33, figs. 8, 9.
1971. *Lima zushiensis*, Kuroda, Habe and Oyama, p. 581 (in Japanese), p. 370 (in English), pl. 82, fig. 1.
1973. *Lima* (*Lima*) *zushiensis*, Shikama, pl. 17, figs. 7, 8.

Remarks:-The surface is sculptured with about 30 strong radial ribs which are squamated.

Lima cf. *L. quantoensis* Yokoyama, 1920
(Pl. 37, Fig. 4)

Compared with:

1920. *Lima quantoensis* Yokoyama, p. 150, 151, pl. 12, fig. 11.
1973. *Lima quantoensis*, Shikama, pl. 17, fig. 9.
1977. *Lima quantoensis*, Habe, p. 101.

Description:-Shell small, longitudinal ovate, moderately convex; anterior margin straight; posterior end rounded; ventral margin arched, anterior auricle lacked. Surface with 55-60 fine radial ribs.

Remarks:-This species was first reported from the Pliocene Koshiba Formation in Kanagawa Prefecture by Yokoyama in 1920. According to his description, anterior margin is nearly straight and posterior margin is broadly rounded. Surface is ornamented by more than 50, fine bifurcated ribs.

Family Anomiidae
Genus *Anomia* Linné, 1758

Anomia chinensis Philippi, 1849
(Pl. 35, Fig. 7)

1954. *Anomia chinensis*, Kira, p. 132, pl. 47, fig. 8.
1969. *Anomia chinensis*, Hayasaka, p. 42, pl. 2, figs. 3a, b.
1971. *Anomia chinensis*, Kuroda, Habe and Oyama, p. 590 (in Japanese), p. 378 (in English), pl. 84, figs. 12-14.
1973. *Anomia cytaeum*, Oyama, p. 88, pl. 28, figs. 2, 3, 6.
1977. *Anomia chinensis*, Matsuura, pl. 10, fig. 19.
1977. *Anomia chinensis*, Habe, p. 97, pl. 18, figs. 3, 4.

Remarks:-Two small sized specimens are obitained. Chracters of the present specimens are equal to those of the Recent species *Anomia chinensis*.

Family Crassatellidae
Genus *Bathytormus* Stewart, 1930

Bathytormus foveolatus (Sowerby, 1870)
(Pl. 35, Fig. 8)

1927. *Crassatellites yagurai* Makiyama, p. 38, pl. 2, figs. 1-4.
1929. *Crassatellites oinouyei*, Yokoyama(a), p. 89, pl. 13, figs. 1-3.
1929. *Crassatellites yagurai*, Yokoyama(b), p. 15, 16, pl. 8, fig. 3.
1977. *Bathytormus foveolatus*, Habe, p. 163, pl. 30, figs. 12, 13.

Remarks:-The characteristic features of the present species are, 1) a transversely elongated ovate shell with narrow posterior, 2) a more or less prominent beak, 3) a blunt ridge running from beak to postero-ventral corner, 4) surface ornamented only with concentric ribs, 5) layer beneath surface with radial ribs. The species is living south of Formosa as pointed out by Tan (1936).

Genus *Crassatellites* Krüger, 1823

Crassatellites tosana Nomura, 1937
(Pl. 35, Fig. 13)

1937. *Crassatellites tosana* Nomura, p. 81, 82, pl. 6, figs. 8a-9b.

Remarks:-This species is relatively frequent in the Formation. It was first reported from Tonohama by Nomura (1937). It resembles somewhat *Indocrassatella oblongata* (Yokoyama) which is living from Boso Peninsula to Kyushu, but it deffers from *I. oblongata* by having a more trigonal shell.

Family Carditidae
Genus *Pleuromeris* Conrad, 1863

Pleuromeris pygmaea Kuroda and Habe, 1951
(Pl. 36, Fig. 12)

1961. *Venericardia* (*Pleuromeris*) *pygmaea*, Habe, p. 178, pl. 55, fig. 11.
1971. *Pleuromeris pygmaea*, Kuroda, Habe and Oyama, p. 603 (in Japanese), p. 387 (in English), pl. 87, fig. 9.

Remarks:-This species is characterized by having a quadrate-ovate shell with prominent beak and more or less strong 15 radial ribs with granulations.

Subfamily Venericardiinae
Genus *Venericardia* Lamarck, 1801
Subgenus *Megacardita* Sacco, 1899

Venericardia (*Megacardita*) *panda* (Yokoyama, 1926)
(Pl. 37, Fig. 13)

1926. *Cardita panda* Yokoyama (a), p. 355, pl. 39, figs. 1, 2.
1927. *Venericardia panda*, Makiyama, p. 40, 41, pl. 2, figs. 15, 16.
1929. *Cardita panda*, Yokoyama (b), p. 11.
1957. *Venericardia* (*Megacardita*) *panda*, Shuto, p. 81, pl. 22, fig. 14.
1966. *Venericardia panda*, Aoki, pl. 31, figs. 11a, b.

Remarks:- A great number of conjoined well-preserved specimens are collected. The present species is also reported from Miyazaki, Kochi (Nobori Formation) and Shizuoka Prefectures. Okumura, the senior author has several spesimens of the present species collected from the Oiso Formation (Kanagawa Pref.).

Venericardia (*Megacardita*) sp.
(Pl. 36, Fig. 13)

Description:-Shell small, thin, fairly convex, transversely ovate, longer than high, subequilateral. Beak nearly central on position, pointed, prosogyrous; anterior dorsal margin short, broadly rounded; posterior dorsal margin longer than antero-dorsal margin, nearly straight; anterior end rounded; posterior one broadly rounded, ventral margin arched. Lunule deeply depressed, cordate in outline. Surface sculptured with about 25 radial ribs with granulations, quadrate in section, as wide as interspaces. Hinge well-developed with two strong cardinals radiating from beneath the beak; anterior cardinal small, elongated triangle, posterior one very long and slender; ventral margin of inner surface strongly crenated.

Family Corbulidae
Subfamily Corbulinae
Genus *Corbula* Bruguiére 1797

Corbula tosana Yokoyama, 1929
(Pl. 39, Fig. 11)

1929. *Corbula tosana* Yokoyama(b), p. 15, pl. 8, fig. 1.

Remarks:-The present species was first reported from Tonohama by Yokoyama, in 1929. It was unknown from another area. The perfectly preserved specimens of this species are comparatively frequent in the formation. This species resembles a Recent species *Anisocorbula erythrodon,* however the present species are a little longer and thicker. Right valves are higher and thicker than the left one as shown in pl. 39, fig. 11.

Family Veneridae
Genus *Pitar* Römer, 1857
Subgenus *Pitarina* Jukes-Brown, 1913

Pitar (*Pitarina*) sp.
(Pl. 39, Fig. 7)

Description:-Shell rather small in size, ovate in outline; beak curved forwards and situated anteriorly; anterior dorsal margin nearly straight and passing into a narrowly rounded anterior end; posterior dorsal margin, posterior end and ventral margin forming a continuous arc. Surface sculptured by lines of growth. Lunule and escutcheon obscure. Hinge of a left valve consisting of a heavy anterior lateral and three cardinals; the middle one strong, the posterior slender, lamellae-like. Inner surface smooth.

Subfamily Venerinae
Genus *Ventricolaria* Keen, 1954

Ventricolaria foveolata (Sowerby, 1853)
(Pl. 39, Figs. 4, 8)

1926. *Chione sasinaeformis* Yokoyama (b), p. 368, pl. 42, fig. 3.
1926. *Venus foveolata*, Yokoyama (b), p. 368, pl. 42, figs. 1, 2.
1929. *Chione sasinaeformis* (b), Yokoyama, p. 10.
1954. *Ventricolaria foveolata*, Kira, p. 160, pl. 57, fig. 15.
1966. *Ventricoloidea foveolata*, Aoki, p. 255, pl. 31, fig. 9.
1970. *Venus foveolata*, Hayasaka and Hashimoto, p. 20, pl. 1, fig. 8.
1971. *Ventricolaria foveolata*, Kuroda, Habe and Oyama, p. 659 (in Japanese), p. 428 (in English), pl. 93, fig. 11.
1977. *Ventricolaria foveolata*, Habe, p. 246, pl. 51, fig. 1.
1980. *Venus* (*Ventricoloidea*) *foveolata*, Noda, p. 90, pl. 3, figs. 12a, b.
1988. *Venus* (*Ventricoloidea*) *foveolata*, Noda, p. 76, pl. 19, fig. 19.

Remarks:-One perfectly preserved conjoined and a left imperfect specimens were collected. This Recent species was reported from the Pliocene Ananai Formation by Yokoyama in 1926, and from the Pliocene Nobori Formation by Aoki in 1966.

Subfamily Tapetinae
Genus *Paphia* Röding, 1798
Subgenus *Paphia s. s.*

Paphia (*Paphia*) *schnelliana* (Dunker, 1866)
(Pl. 38, Figs. 3, 4, 6, 11, 12)

Description:-Shell rather large for the genus, ovate in outline; antero-dorsal margin short, concave, posterior dorsal margin broadly rounded, longer about two times of antero-dorsal one, anterior margin narrowly rounded continuing to a arched ventral margin; posterior end broadly rounded. Lunule elongated shallow separated by lirae, concentric ribs developed in the lunule area. Surface ornamented with concentric, rather dense, irregular, growth lines which are flat-topped, wide, separated by shallow interstitials.

Remarks:-The present species is characterized by having short concaved antero-dorsal margin and long nearly straight postero-dorsal one.

Paphia (*Paphia*) *tonohamaensis* n. sp.
(Pl. 38, Figs. 1, 2)

Description:-Shell large, elongated ovate in outline; antero-dorsal margin somewhat

concave; postero-dorsal one longer than anterior one and nearly straight; anterior margin rounded and continuing to a gently rounded ventral margin without any angulation; posterior end somewhat obliquely subtruncated. Umbo prominent, situated anteriorly one-fourth of the shell length. Lunule distinct, elongated, bounded by angulation near the umbo. Exterior surface ornamented with irregularly divided concentric ribs; interstitials fine and shallow. Internal surface unknown.

Remarks:-This species somewhat resembles *Paphia* (*Paphia*) *takanabensis* Shuto, 1957 (p. 155, pl. 12, fig. 18) from the Miyazaki Group. However, compared with the latter, this new species has a more prominent umbo, subtruncated posterior end and greatly rounded ventral margin. This species is also closely related to *Paphia* (*Paphia*) *schnelliana* (Dunker), now living south of Boso Peninsula, but the former can be distinguished therefrom by having a more elongate form, a prominent beak and irregular surface ornamentation.

Holotype:-NT90-138

Measurements (in mm) :-Specimen NT90-138 (Holotype), Length 78.1, height 49.2, thickness 27.3 (conjoined) (Fig. 1 and fig. 2 are same individual.)

Paphia (*Paphia*) aff. *P.* (*P.*) *exilis* Shuto, 1957
(Pl. 38, Figs. 5, 8, 9)

Compared with:
1957. *Paphia* (*Paphia*) *exilis* Shuto, p. 140, fig. 1.

Description:-Shell rather small, transversely elongated ovate in outline; antero-dorsal margin concave; posterior one nearly straight, longer than anterior one; anterior end narrowly rounded; posterior end greatly rounded; both ends continuing to the ventral margin without any angulation; ventral margin straight in the central part. Lunule distinct and elongate; escutcheon lanceolate. Surface ornamented with concentric ribs which are flat-topped, regularly, continuous and numbering about 100 between the umbo and the middle part of ventral margin. Interstitials shallowly incised. Inner surface unknown.

Remarks:-The present species is more or less similar to *Paphia* (*Paphia*) *exilis* Shuto in outline collected from the Miyazaki Group in Kyushu. However our specimens have coarser consentric ribs than that of *P.* (*P.*) *exilis* on their exterior surface.

Paphia (*Paphia*) sp.
(Pl. 38, Figs. 7, 10)

Description:-Shell medium to large, ovate in outline and transversely elongate; antero-dorsal margin concave, shorter than postero-dorsal margin which is nearly straight; anterior end narrowly rounded, posterior end roundly curved; ventral margin broadly arched and curved to anterior and posterior ends. Lunule distinct, elongate; escutcheon lanceolate and defined with edge. Surface ornamented with concentric ribs which are flat-topped, regular, continuous and separated by narrow and shallow interstitials. Concentric

ribs very fine and close near umbo but broader in middle and outer part of disk. Inner surface unknown.

Remarks:-The present species resembles *Paphia* (*Paphia*) *amabilis* which is living in south of Boso Peninsula but the former differs from the latter by having more broadly arched ventral margin and rounded posterior end.

Subfamily Clementinae
Genus *Clementia* Gray, 1842
Subgenus *Clementia s. s.*

Clementia (*Clementia*) *papyracea* (Gray, 1825)
(Pl. 37, Figs. 12, 14, 17, 18)

1926. *Clementia vatheleti*, Yokoyama (a), p. 366.
1929. *Clementia vatheleti*, Yokoyama (b), p. 10.
1960. *Clementia papyracea*, Shuto, p. 140, 142, pl. 13, figs. 3-11, pl. 15, fig. 15.
1965. *Clementia vatheleti*, Kaseno and Matsuura, pl. 16, figs. 5, 6.
1971. *Clementia vatheleti*, Kuroda, Habe and Oyama, p. 663 (in Japanese), p. 431 (in English), pl. 94, fig. 7.
1971. *Clementia* (*Clementia*) *vatheleti*, Noda, p. 42, pl. 7, fig. 13.
1976. *Clementia papyracea*, Ogasawara, p. 54-55, pl. 3, figs. 19-22.
1977. *Clementia* (*Clementia*) *vatheleti*, Habe, p. 274, pl. 56, fig. 9.
1977. *Clementia vatheleti*, Matsuura, pl. 9, fig. 10.
1982. *Clementia* (*Clementia*) *papyracea*, Kanno, O'Hara and Caagusan, p. 89.
1988. *Clementia vatheleti*, Okumura, p. 46, pl. 16, fig. 11.

Remarks:-This species is characterized by having a rather large, thin and moderately swollen shell, prosogyrous beak and strong and regularly spaced concentric folds on surface. Lunule is indistinct. A number of well-preserved specimens are at hand. Most specimens are represented as intacted ones, though shells of this species are very fragile. The present species is very variable in its shell form. Some specimens are rather orbicular and longitudinally elongated, while others are trigonal higher shell. Genelally speaking, the juvenile has orbicular and the adult has elongate or higher shell. It is impossible to distinguish *Clementia vatheleti* Mobille from *C. papyracea* by our materials.

Family Ungulinidae
Genus *Cycladicama* Valencienes, 1854

Cycladicama cumingii (Hanley, 1844)
(Pl. 35, Fig. 12)

1937. *Taras cumingii*, Nomura, p. 72.

1954. *Joannisiella nomurai*, Kira, p. 149, pl. 53, fig. 32.
1965. *Joannisiella cumingi*, Kaseno and Matsuura, pl. 11, fig. 8.
1967. *Cyclodicama cumingii*, Habe and Kosuge, p. 145, pl. 54, fig. 1.
1969. *Cyclodicama cumingii*, Shikama and Maejima, pl. 7, fig. 15.
1971. *Cyclodicama cumingii*, Masuda and Shibata, pl. 4, fig. 3.
1971. *Cycladicama cumingii*, Kuroda, Habe and Oyama, p. 605 (in Japanese), p. 388 (in English), pl. 87, figs. 15.
1977. *Cyclodicama cummingii*, Ogasawara, p. 111, pl. 11, fig. 17.
1977. *Cycladicama cummingii*, Habe, p. 134, pl. 24, figs. 13, 14.

Remarks:-A single conjoined specimen was collected. The general shape and concentric ribs are similar to those of *Cycladicama cumingii* which was reported from this Formation by Nomura (1937) named as *Taras cumingii* (Hanley).

Family Lucinidae
Subfamily Lucininae
Genus *Lucinoma* Dall, 1901

Lucinoma sp.
(Pl. 37, Fig. 10)

Description:-Shell small, thin, flattened, quadrangular ovate in outline; beak almost central, nearly prosogyrous, prominent; anterior margin rather short, as long as posterior one, concave; posterior margin straight; anterior end rounded continuing to rounded ventral margin without any angulation; posterior end strongly and vertically truncated. Surface ornamented with numerous, equally spaced, concentric narrow ribs, about 100 in number, anterior side of disc more or less lamellated. Inner surface with numerous radial striations.

Remarks:-This is considered as a juvenile specimen of the genus *Lucinoma*.

Subfamily Divaricellinae
Genus *Divaricella* Martens, 1880

Divaricella aff. *D. soyoae* Habe, 1951
(Pl. 37, Fig. 8)

Compared with:
1961. *Divaricella soyoae*, Habe, p. 125, pl. 56, fig. 25.
1977. *Divaricella soyoae*, Habe, p. 129, pl. 25, fig. 1.

Description:-Shell small in size, swollen, rotundate in outline. Surface with numerous, flat-topped, strong, divaricating oblique ribs; divaricated line approximately centered; interspace rather deep, squarish, narrower than width of ribs; ribs and interspaces cut by

concentric growth lines. Margin crenulated justing exterior surface ribs. Two cardinal and lateral teeth on the hinge line.

Remarks:-A single small specimen is at hand. Its characteristic surface ornamentation shows that it belongs to the present genus.

Family Cardiidae
Subfamily Trachycardiinae
Genus *Vasticardium* Iredale, 1927

Vasticardium burchardi (Dunker, 1877)
(Pl. 37, Fig. 20)

1971. *Vasticardium burchardi*, Kuroda, Habe and Oyama, p. 620 (in Japanese), p. 399 (in English), pl. 89, fig. 4.
1973. *Acrosterigma* (*Vasticardium*) *burchardi*, Oyama, p. 99, 100, pl. 42, figs. 9a, b.
1977. *Trachycardium* (*Vasticardium*) *burchardi*, Habe, p. 165, pl. 32, figs. 1, 2.
1977. *Vasticardium burchardi*, Matsuura, pl. 4, fig. 3.

Remarks:-This species is comparatively abundant from the Formation. Surface is sculptured by about 43 strong radial ribs.

Subfamily Protocardiinae
Genus *Nemocardium* Meek, 1876
Subgenus *Keenaea* Habe, 1951

Nemocardium (*Keenaea*) *samarangae* (Makiyama, 1934)
(Pl. 39, Fig. 2)

1920. *Cardium modestum*, Yokoyama, 1920, p. 128, 129, pl. 9, figs. 12, 13.
1934. *Cardium* (*Nemocardium*) *samarangae* Makiyama, p. 143.
1954. *Nemocardium* (*Keenaea*) *samarangae*, Kira, p. 154, pl. 55, fig. 9.
1960. *Nemocardium* (*Keenaea*) *samarangae*, Shuto, p. 214, pl. 25, figs. 1-6, 19, 23, 24.
1971. *Nemocardium* (*Keenaea*) *samarangae*, Kuroda, Habe and Oyama, p. 624 (in Japanese), p. 402 (in English), pl. 88, figs. 11,12.
1973. *Nemocardium* (*Keenaea*) *samarangae*, Ogasawara, pl. 12, fig. 15.
1977. *Keenaea samarangae*, Habe, p. 171, pl. 31, fig. 11.
1988. *Nemocardium* (*Keenaea*) *samarangae*, Okumura, p. 46, pl. 15, fig. 7.

Remarks:-The species is characterized by a circular and well-inflated shell with distinct radial ribs on the surface, being spinose, tuberculate on the posterior area.

Subfamily Laevicardiinae

Genus *Fulvia* Gray, 1853

Fulvia mutica (Reeve, 1844)
(Pl. 37, Figs. 16, 19; Pl. 39, Fig. 1)

1926. *Cardium muticum*, Yokoyama (a), p. 366.
1929. *Cardium muticum*, Yokoyama (b), p. 11.
1954. *Fulvia mutica*, Kira, p. 210, pl. 72, fig. 2.
1971. *Fulvia mutica*, Kuroda, Habe and Oyama, p. 621 (in Japanese), p. 400 (in English), pl. 72, fig. 2.
1973. *Fulvia mutica*, Oyama, p. 100, pl. 42, figs. 7, 8.
1977. *Fulvia mutica*, Matsuura, pl. 13, fig. 20.
1977. *Fulvia mutica*, Habe, p. 174, pl. 32, figs. 11, 12.

Remarks:-This species is characterized by having a thin, inflated and orbicular shell. The surface is ornamented by about 40 radial ribs.

Family Mactridae
Subfamily Mactrinae
Genus *Oxyperas* Mörch, 1853
Subgenus *Oxyperas s. s.*

Oxyperas (*Oxyperas*) *bernardi* (Pilsbry, 1904)
(Pl. 40, Fig. 1)

1971. *Oxyperas bernardi*, Kuroda, Habe and Oyama, p. 670 (in Japanese), p. 437 (in English), pl. 95, figs. 1, 2.
1973. *Oxyperas bernardi*, Oyama, p. 108, pl. 48, figs. 11, 12.
1977. *Oxyperas* (*Oxyperas*) *bernardi*, Habe, p. 182, pl. 35, fig. 2.
1977. *Oxyperas bernardi*, Matsuura, pl. 9, fig. 19.

Remarks:-The present species has a transversely elongated, triangular and compressed shell of which beak is small, prosogyrous. The anterior end is rounded passing into the broadly rounded ventral margin. Surface is ornamented with rough and distinct growth lines.

Family Gariidae
Genus *Gari* Schumacher, 1817

Gari anomala (Deshays, 1855)
(Pl. 39, Fig. 19)

1961. *Gari anomala*, Habe, p. 135, pl. 61, fig. 4.
1971. *Gari anomala*, Kuroda, Habe and Oyama, p. 676 (in Japanese), p. 442 (in English), pl. 97, fig. 13.
1977. *Gari anomala*, Habe, p. 219.

Remarks:-This species characterized by having, 1) a rounded anterior end and a strongly truncated posterior end, 2) numerous fine striations which run obliquely on exterior surface.

Family Tellinidae
Genus *Merisca* Dall, 1900
Subgenus *Pistris* Thiele, 1934

Merisca (*Pistris*) *subtruncata* (Hanley, 1844)
(Pl. 39, Fig. 17)

1971. *Merisca* (*Pistris*) *subtruncata*, Kuroda, Habe and Oyama, p. 688 (in Japanese), p. 451 (in English), pl. 99, fig. 21.
1973. *Merisca* (*Pistris*) *subtruncata*, Oyama, p. 112, pl. 53, figs. 7, 8.
1977. *Merisca* (*Pistris*) *subtruncata*, Habe, p. 198.

Remarks:-This species occurs rarely in the Formation. The characteristic features of the species are subtrigonal outline and a blunt ridge which runs from beak to a postero-ventral corner.

Family Tellinidae
Subfamily Tellinae
Genus *Moerella* Fischer, 1887

Moerella (?) sp.
(Pl. 39, Figs. 10, 13)

Description:-Shell small in size, compressed, elliptical ovate; anterior dorsal margin long, nearly straight; posterior dorsal margin shorter than anterior one; anterior end broadly rounded, posterior end produced; posterior portion of ventral margin rather straight. Surface with fine growth lines. Inner surface and hinge unknown.

Genus *Angulus* Megerle von Möhlfeld, 1811

Angulus aff. *A. vestalioides* (Yokoyama, 1920)
(Pl. 39, Figs. 14-16, 20)

Compared with:

1920. *Tellina vestalioides* Yokoyama, p. 114, pl. 7, fig. 25.

1971. *Angulus vestalioides*, Kuroda, Habe and Oyama, p. 639 (in Japanese), p. 455 (in English), pl. 99, fig. 9.

Remarks:-This species commonly occurs from the Formation. Characteristic features of the present species are, 1) shell small to medium in size, thin and elongate ovate in form, flatened, 2) beak located posteriorly, 3) anterior dorsal margin longer than posterior dorsal margin, slightly concave, 4) posterior end truncated, 5) ventral margin more or less straight, 6) surface smooth.

Family Cultellidae
Genus *Ensiculus* H. Adams, 1860

Ensiculus cultellus (Linnē, 1758)
(Pl. 40, Fig. 5)

1971. *Cultellus philippianus*, Kuroda, Habe and Oyama, p. 702 (in Japanese), p. 462 (in English), pl. 102, fig. 2.

1977. *Ensiculus cultellus*, Habe, p. 229, pl. 48, figs. 9, 10.

Remarks:-This species is rare in the Formation. The characteristic features of this species are an elongated, narrowly bladed shell which has paralleled dorsal and ventral margins, rounded anterior and posterior ends and slightly concaved dorsal margin.

Family Solenidae
Genus *Solen* Linnē, 1758
Subgenus *Solen s. s.*

Solen (*Solen*) *strictus* Gould, 1861
(Pl. 40, Fig. 9)

1954. *Solen strictus*, Kira, p. 177, pl. 62, fig. 7.

1958. *Solen strictus*, Ozaki, p. 134, pl. 22, fig. 27.

1971. *Solen* (*Solen*) *strictus*, Kuroda, Habe and Oyama, p. 698 (in Japanese), p. 458 (in English), pl. 101, figs. 2, 3.

1973. *Solen strictus*, Oyama, p. 115, pl. 54, fig. 1.

1977. *Solen* (*Solen*) *strictus*, Habe, p. 227, pl. 48, figs. 1, 2.

Remarks:-The present species is characterized by having a medium subcylindrical shell of which dorsal and ventral margins are straight and parallel, and anterior end is obliquely truncated.

Family Hiatellidae
Genus *Panopea* Menard, 1807

Panopea japonica A. Adams, 1850
(Pl. 40, Figs. 2, 7)

1960. *Panope japonica*, Kanno, p. 312, pl. 45, figs. 1a, b.
1971. *Panopea japonica*, Kuroda, Habe and Oyama, p. 709 (in Japanese), p. 467 (in English), pl. 10, fig. 10.
1977. *Panopea japonica*, Matsuura, pl. 10, fig 2.
1977. *Panope japonica*, Ogasawara, p. 128, pl. 17, fig. 10.
1983. *Panope japonica*, Amano, p. 58, pl. 7, fig. 13.
1989. *Panopea japonica*, Okumura and Koyanagi, p. 77, pl. 9, fig. 7.

Remarks:-The young specimen shown in fig. 7 is assigned to a specimen collected from Sagami Bay.

Family Thraciidae
Genus *Thracia* Sowerby, 1823

Thracia sp.
(Pl. 37, Fig 15)

Description:-Shell small, thick, inflated, quadrangular in outline; antero-dorsal margin, anterior and ventral margins forming a circular arc; posterior end broad, truncated vertically; posterior dorsal margin slightly straight, incrassate. Beak elevate. Surface ornamented with numerous concentric growth lines, a blunt ridge running from beak to a corner of ventral and posterior margins. Primary teeth edentulous. Inner margin crenulated.

Family Clavagellidae
Genus *Nipponoclava* Smith, 1976

Nipponoclava gigantea (Sowerby, 1888)
(Pl. 40, Fig. 8)

1926. *Aspergillum giganteum*, Yokoyama(b), p. 368, pl. 12, figs. 1, 2.
1954. *Penicillus* (*Foegia*) *giganteus*, Kira, p. 168, pl. 62, fig. 25.
1977. *Nipponoclava giganteum*, Habe, p. 313, pl. 66, fig. 3.

Remarks:-Several imperfect specimens are at hand. The present species is relatively frequent in the Formation.

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Plate 27

Fig. 1. *Elegidion quadriradiata* (Reeve), NT90-1, m. × 4
Fig. 2. *Lischkeia alwinae* (Lischke), NT90-2, m. × 1.0, p.138
Fig. 3. *Tristichotrochus aculeatus* (Sowerby), NT90-3, m. × 5
Fig. 4. *Bittium urashimanum* Nomura and Niino, NT90-9, m. × 4
Fig. 5. *Turritella* (*Turritella*) *perterebra* Yokoyama, NT90-6, m. × 0.9, p.139
Fig. 6. *Cerithium* (*Proclava*) aff. *pfefferi* Dunker, NT90-8, m. × 2, p.140
Fig. 7. *Calyptraea yokoyamai* Kuroda, NT90-12, c. × 1.3
Fig. 8. *Cocculina nipponica* Kuroda and Habe, NT90-5, c. × 2
Fig. 9. *Tugurium* cf. *T. exutum* (Reeve) NT90-14, m. × 1.8, p.141
Fig. 10. *Amalthea conica* Schumacher, NT90-11, c. × 3
Fig. 11. *Cypraea* sp., NT90-15, g. × 1.0, p.141
Figs. 12–17. *Terebralia palustris* Linné, 12: NT90-7-1, c. × 0.7, 13: NT90-7-2, c. × 1.0, 14: NT90-7-3, m. × 0.8, 15: NT90-7-4, g. × 1.1, 16: NT90-7-5, m. × 0.9, 17: NT90-7-6, c. × 1.0, p.139

m: medium sand bed, c: coarse sand bed, g: gravel bed.

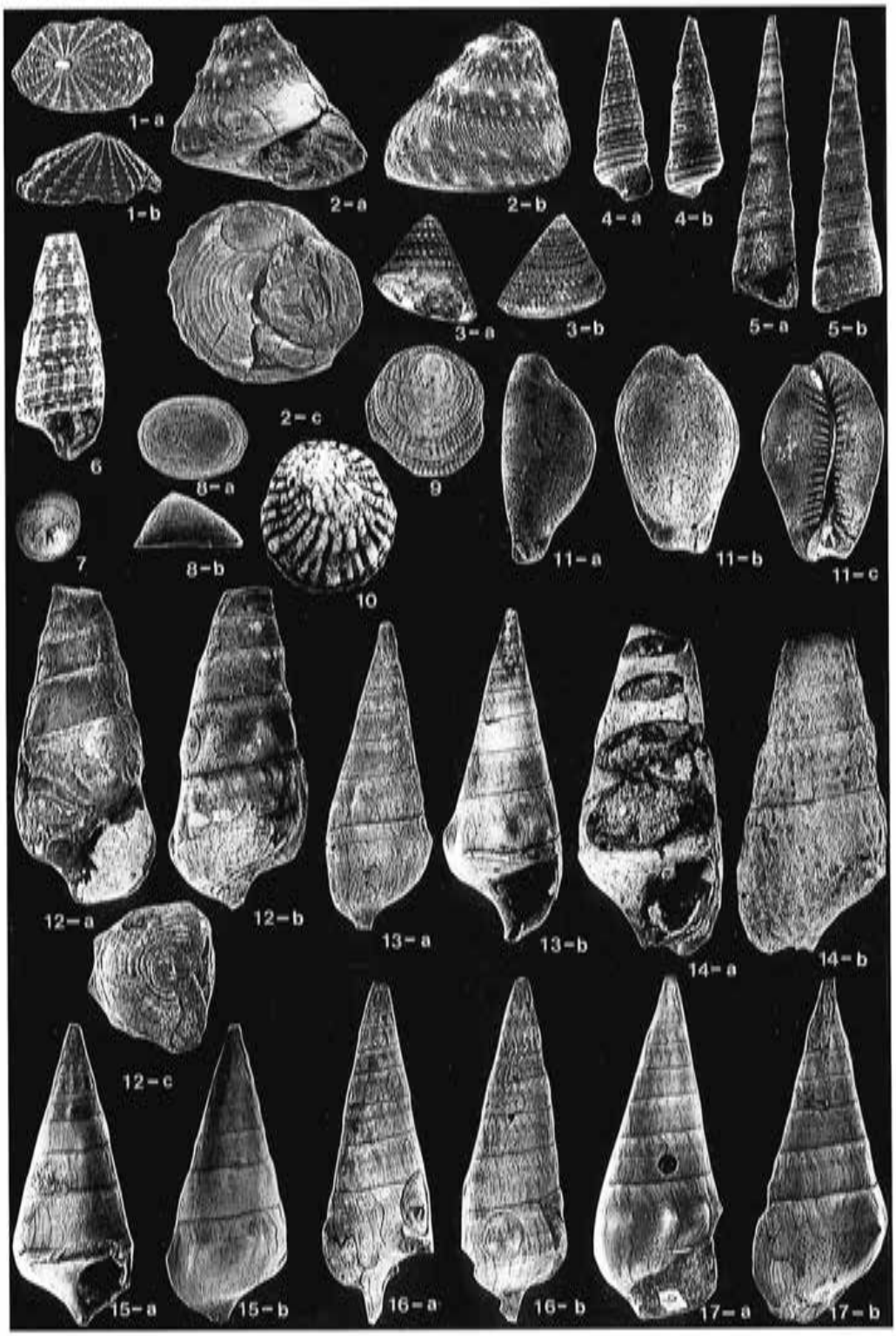

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Plate 28

Figs. 1, 2. *Tugurium exutum* (Reeve), 1: NT90-13-1, m. × 1.5, 2: NT90-13-2, m. × 0.7, p.141

Figs. 3, 6, 8. *Cryptonatica janthostomoides* Kuroda and Habe, 3: NT90-17-1, m. × 1.4, 6: NT90-17-2, × 1.0, 8: NT90-17-3, × 1.0, p.142

Fig. 4. *Hipponix* (*Malluvium*) cf. *H.* (*M.*) *lissus* (E. A. Smith), NT90-10, c. × 2, p.140

Fig. 5. *Glossaulax didyma* (Röding), NT90-19, c. × 0.9

Fig. 7. *Polinices sagamiensis* Pilsbry, NT90-18, c. × 0.8

Fig. 9. *Siphonochelus japonicus* (A. Adams), NT90-25, m. × 6

Fig. 10. *Indomitrella lischkei* (Smith), NT90-26, c. × 4

Fig. 11. *Babylonia* (*Babylonia*) *elata* (Yokoyama), NT90-27, m. × 0.8, p.143

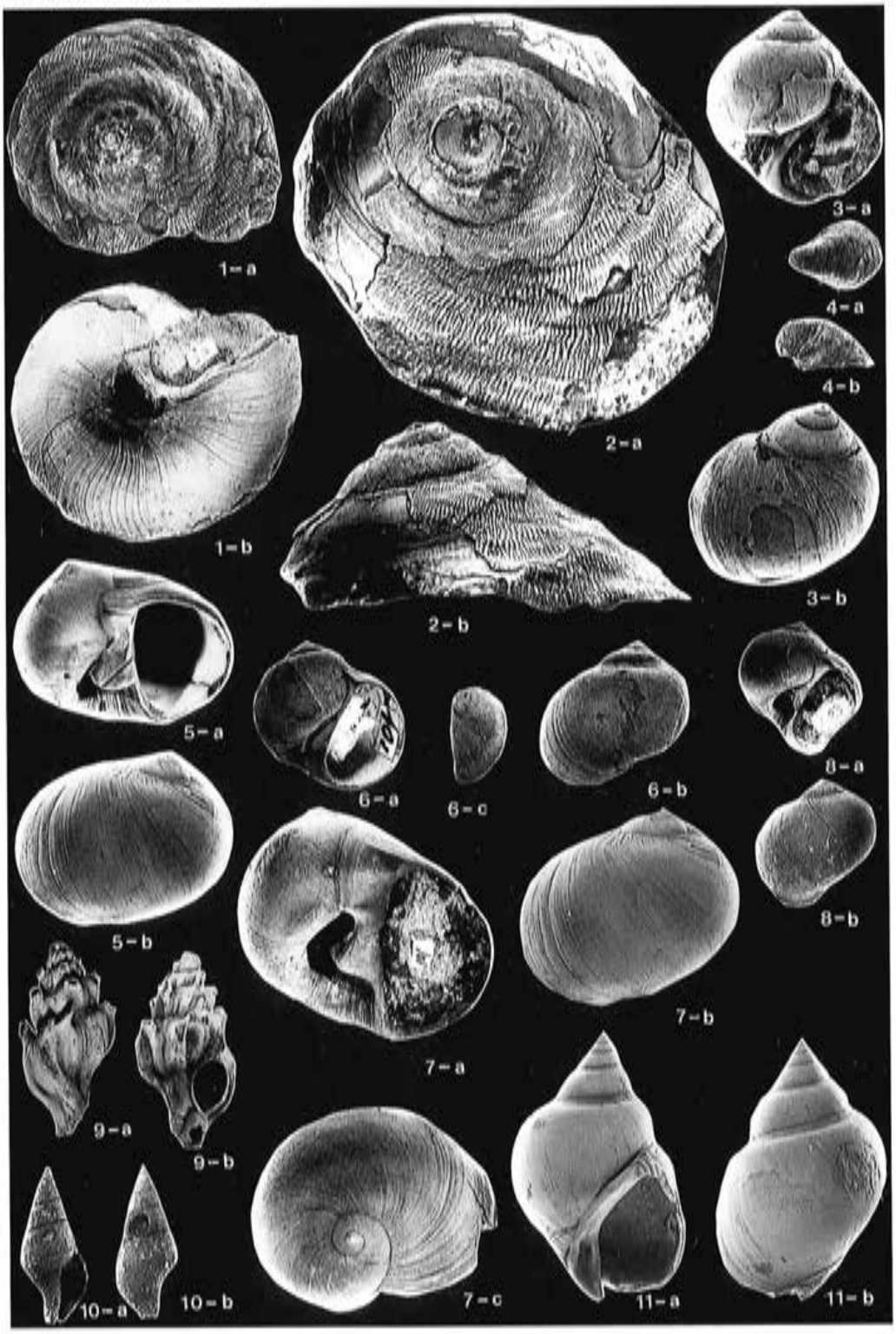

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Plate 29

Fig. 1. *Semicassis bisulcata pila* (Reeve), NT90-19, m. × 0.9, p.142
Fig. 2. *Turritriton kiiensis* (Sowerby), NT90-21, m. × 0.9
Fig. 3. *Phalium* sp., NT90-20, m. × 1.1, p.142
Fig. 4. *Nassaria* (*Nassaria*) *acuminata gendingaensis* (Martin), NT90-31, c. × 1.1, p.145
Fig. 5. *Siphonalia kozaii* n. sp. NT90-29, c. × 1.1, p.144
Fig. 6. *Siphonalia kannoi* n. sp., NT90-28, c. × 1.0, p.144
Figs. 7, 8. *Siphonalia yabei* Nomura, 7: NT90-30-1, m. × 1.0, 8: NT90-30-2, m. × 1.1, p.145
Fig. 9. *Tonna luteostoma* (Küster), NT90-23, m. × 0.9

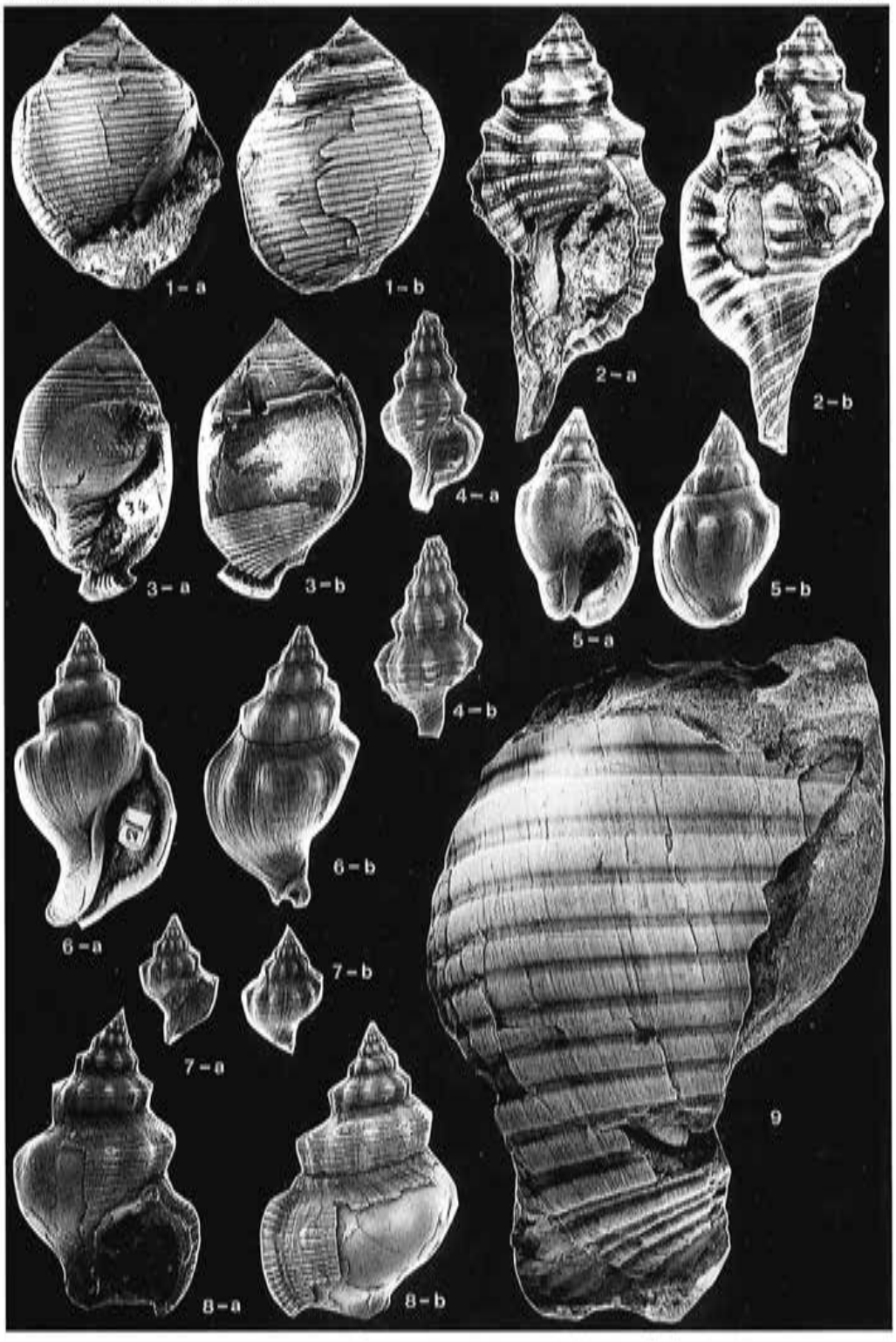

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Plate 30

Fig. 1. *Nassarius* (*Hinia*) *caelatus dainitiensis* (Makiyama), NT90-32, c. × 0.8, p.146
Fig. 2. *Phos nipponicus* Nomura, NT90-37, c. × 1.1, p.147
Fig. 3. *Trigonostoma* cf. *T. nana* Ozaki, NT90-46, m. × 1.0, p.150
Fig. 4. *Strigitella* cf. *S. decurtata* (Reeve), NT90-42, m. × 1.3, p.149
Fig. 5. *Fusinus perplexus* (A. Adams), NT90-34, m. × 0.9, p.146
Fig. 6. *Granulifusus matsumotoi* Shuto, NT90-35, m. × 1.3, p.147
Fig. 7. *Ancilla* (*Baryspira*) *albocallosa okawai* (Yokoyama), NT90-39, c. × 1.0, p.148
Fig. 8. *Granulifusus dualis* (Yokoyama), NT90-36, m. × 2.4, p.147
Fig. 9. *Cancellaria* (*Merica*) *pristina* (Yokoyama), NT90-44, m. × 1.1, p.150
Fig. 10. *Cancellaria* (*Sydaphera*) *spengleriana* (Deshayes), NT90-45, m. × 1.0
Fig. 11. *Mangelia* (*Guraleus*) *tabatensis* Tokunaga, NT90-54, c. × 6
Fig. 12. *Olivella fulgurata* (Adams and Reeve), NT90-40, m. × 2.4
Fig. 13. *Lyria* (*Paralyria*) *mizuhonica mizuhonica* Shoto, NT90-43, m. × 0.9, p.150
Fig. 14. *Micantapex* (*Parabathytoma*) *lithdorfi* (Lischke), NT90-61, m. × 1.1
Fig. 15. *Ringicula* (*Ringiculina*) *doliaris* Gould, NT90-72, c. × 6
Fig. 16. *Lophiotoma* (*Lophioturris*) *leucotropis* (Adams and Reeve), NT90-58, c. × 3

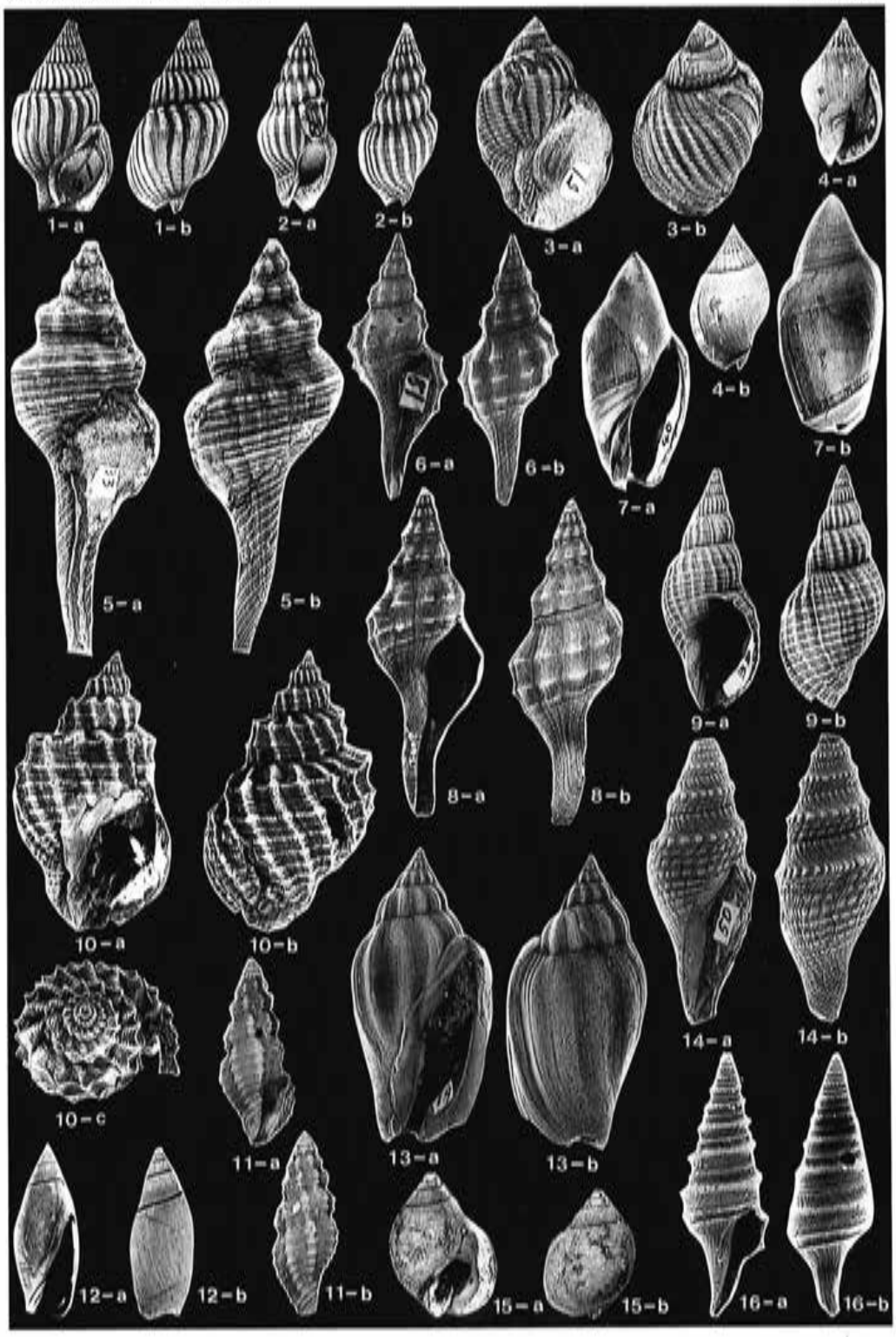

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Plate 31

Figs. 1, 2. *Virgiconus* cf. *V. virgo* (Linné), 1: NT90-49-1, c. × 0.9, 2: NT90-49-2, c. × 0.9, p.151
Fig. 3. *Cleobula quercina* (Lightfoot), NT90-47, m. × 0.8, p.151
Fig. 4. *Conus* sp. 1, NT90-51-1, g. × 0.9, p.152
Fig. 5. *Conus* sp. 2, NT90-51-2, g. × 0.9, p.152
Fig. 6. *Conus* sp. 3, NT90-51-3, g. × 1.1 p.152
Fig. 7. *Conus* sp. 4, NT90-51-4, g. × 1.1, p.152
Fig. 8. *Parviconus tuberculosus* (Tomlin), NT90-50, c. × 4.5
Fig. 9. *Conus* sp. 5, NT90-51-5, g. × 1.1, p.152
Fig. 10. *Oliva* sp. 1, NT90-220, c. × 1.0, p.149
Fig. 11. *Cleobula* sp., NT90-42, c. × 0.9, p.151
Fig. 12. *Conus* sp. 6, NT90-51-6, c. × 1.0, p.152
Fig. 13. *Oliva* sp. 2, NT90-41-1, g. × 1.1
Fig. 14. *Angaria distorta* (Linné), NT90-4, c. × 1.0, p.139
Fig. 15. *Reticunassa* cf. *R. spurca* (Gould), NT90-33, m. × 3.5, p.146
Fig. 16. *Tonna allium* (Dillwyn), NT90-24, xm. 0.9, p.143
Fig. 17. *Cymatium* (?) sp., NT90-22, m. × 1.3, p.143

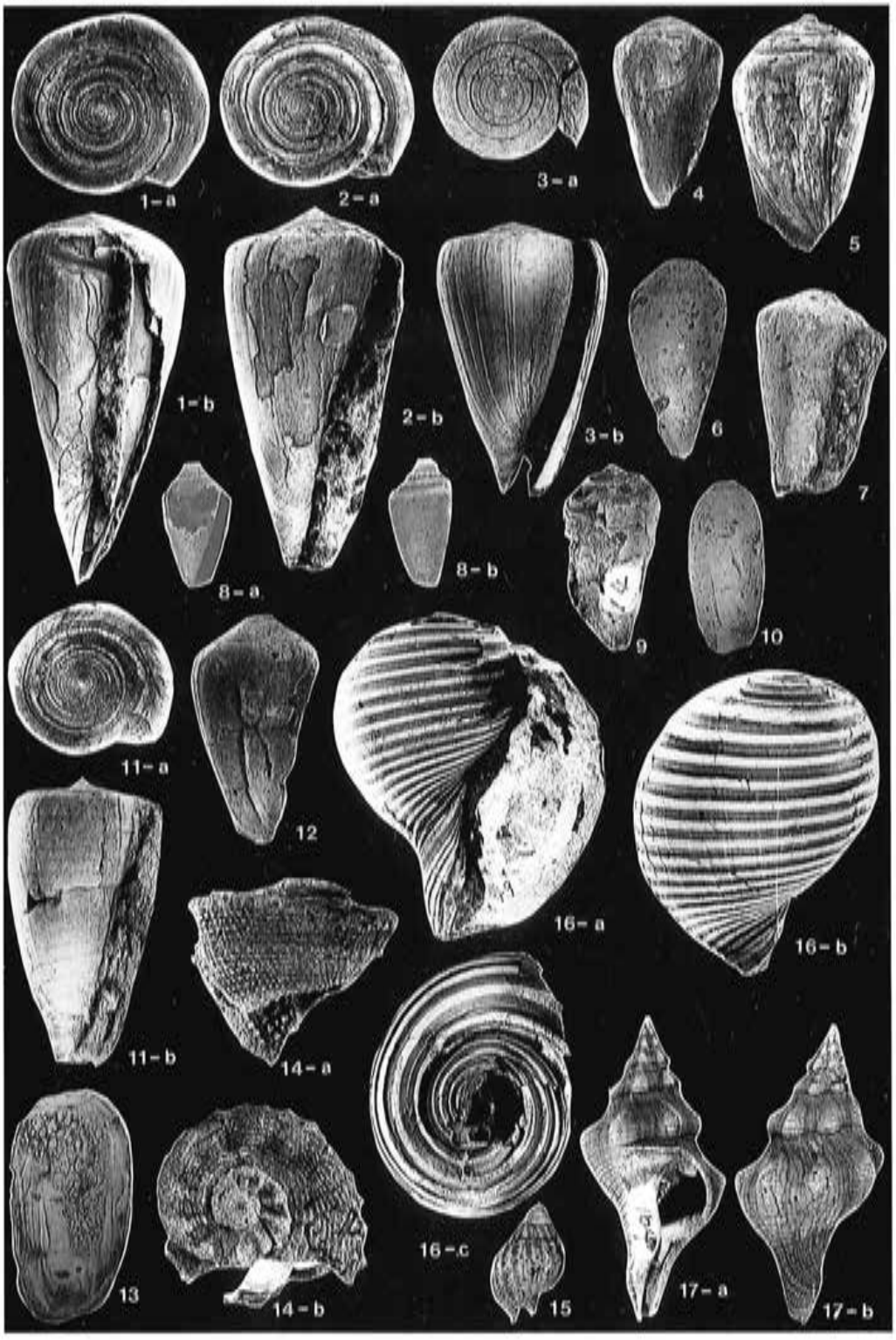

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Plate 32

Fig. 1. *Orthosurcula soyomaruae takanabensis* Otuka, NT90-52, m. × 1.2
Fig. 2. *Spirotropis subdeclivis* Yokoyama, NT90-59, m. × 1.2
Fig. 3. *Ancystrosyrinx pulcherrissima* Kira, NT90-60, m. × 3
Fig. 4. *Tomopleura nevia* (Philippi), NT90-53, m. × 4
Fig. 5. *Elaeocyma* (*Spendrilla*) *braunsi* Yokoyama, NT90-63, m. × 2
Fig. 6. *Clathurella* (*Etremopha*) sp., NT90-55, m. × 4, p.152
Fig. 7. *Paradrillia nivalioides* (Yoloyama), NT90-56, c. × 6
Fig. 8. *Actaeopyramis eximia* (Lischke), NT90-65, c. × 3
Fig. 9. *Paradrillia patruelis* (Smith), NT90-57, c. × 3
Figs. 10, 15. *Gemmula* (*Gemmula*) sp., 10: NT90-62-1, m. × 3, 15: NT90-62-2, m. × 1.4, p. 152
Fig. 11. *Punctoterebra* (*Brevimyurella*) *lischkei* (Dunker), NT90-68, c. × 4
Fig. 12. *Odostomia* sp., NT90-67, c. × 9, p.153
Fig. 14. *Turbonilla* (*Turbonilla*) sp., NT90-69, m. × 4, p.154
Fig. 16. *Syrnola* sp., NT90-66, c. × 5, p.153
Fig. 17. *Myurella* (*Triplostrephanus*) *naumanni* (Yokoyama), NT90-64, m. × 2, p.153
Fig. 18. *Comitas* (*Fusiturricula*) *habei* Shuto, NT90-38, m. × 1.7, p.148
Fig. 19. *Turbonilla* (*Pyrgiscus*) cf. *T.*(*P.*) *optiva* Nomura, NT90-70-1, m. × 3, p.154
Fig. 20. *Striodentalium tosaensis* (Habe), NT90-80, c. × 1.9, p.155
Fig. 21. *Coleophysis* (*Sulcoretusa*) *minima* (Yamakawa), NT90-73, c. × 7
Fig. 22. *Pyrunculus phialus* (A. Adams), NT90-74, m. × 8
Fig. 23. *Laeviscala angusta* (Dunker), NT90-71, × 8
Figs. 24, 25. *Architectonica maxima* (Philippi), 24: NT90-78-1, m. × 3, 25: NT90-78-2, m. × 1.4
Fig. 26. *Solariaxis* sp., NT90-78, m. × 5, p.154
Fig. 27. *Architectonica* sp., NT90-77, m. × 5, p.154

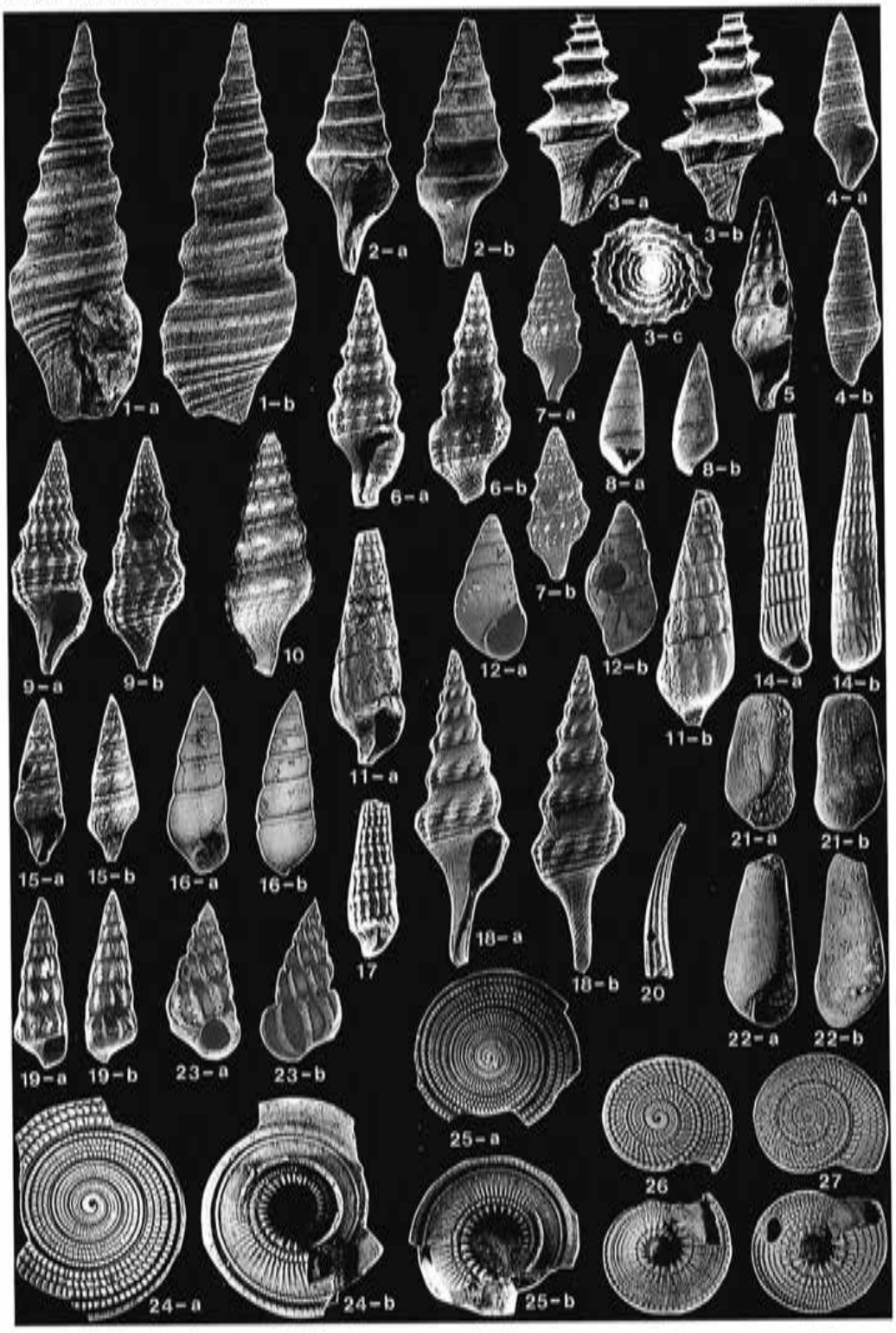

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Plate 33

Fig. 1. *Architectonica perspectiva* Linné, NT90-75, m. × 1.1
Fig. 2. *Antalis weinkauffi* (Dunker), NT90-79, c. × 0.7, p.155
Fig. 3. *Ennucula nipponica* (Smith), NT90-81, m. × 1.8
Fig. 4. *Acila* (*Truncacila*) sp., NT90-83, c. × 2.2, p.156
Fig. 5. *Acila* (*Acila*) *divaricata* (Hinds), NT90-82, c. × 1.0, p.156
Fig. 6. *Anadara* (*Scapharca*) *shizuokaensis* Noda, NT90-85, m. × 0.8, p.158
Figs. 7, 15. *Anadara* (*Scapharca*) *suzukii* Yokoyama, 7: NT90-94, c. × 1.0, 15: NT90-4, c. × 0.9, p.158
Fig. 8. *Saccella* (*Saccella*) *confusa* (Hanley), NT90-84, m. × 2
Fig. 9, 12. *Barbatia* (*Ustularca*) cf. *fusca* (Solander), 9: NT90-87-1, c. × 3, 12: NT90-87-2, m. × 1.0, p.157
Fig. 10. *Barbatia* (*Barbatia*) *reticulata* (Gmelin), NT90-89, c. × 1.1 p.158
Fig. 11. *Barbatia* (*Acar*) *plicatum* (Dillwyn), NT90-91-1, c. × 3
Fig. 13. *Anadara* (*Hataiarca*) sp., NT90-97, m. × 0.9, p.159
Fig. 14. *Anadara* (*Tosarca*) *tosaensis* Noda, NT90-96, m. × 0.9, p.159

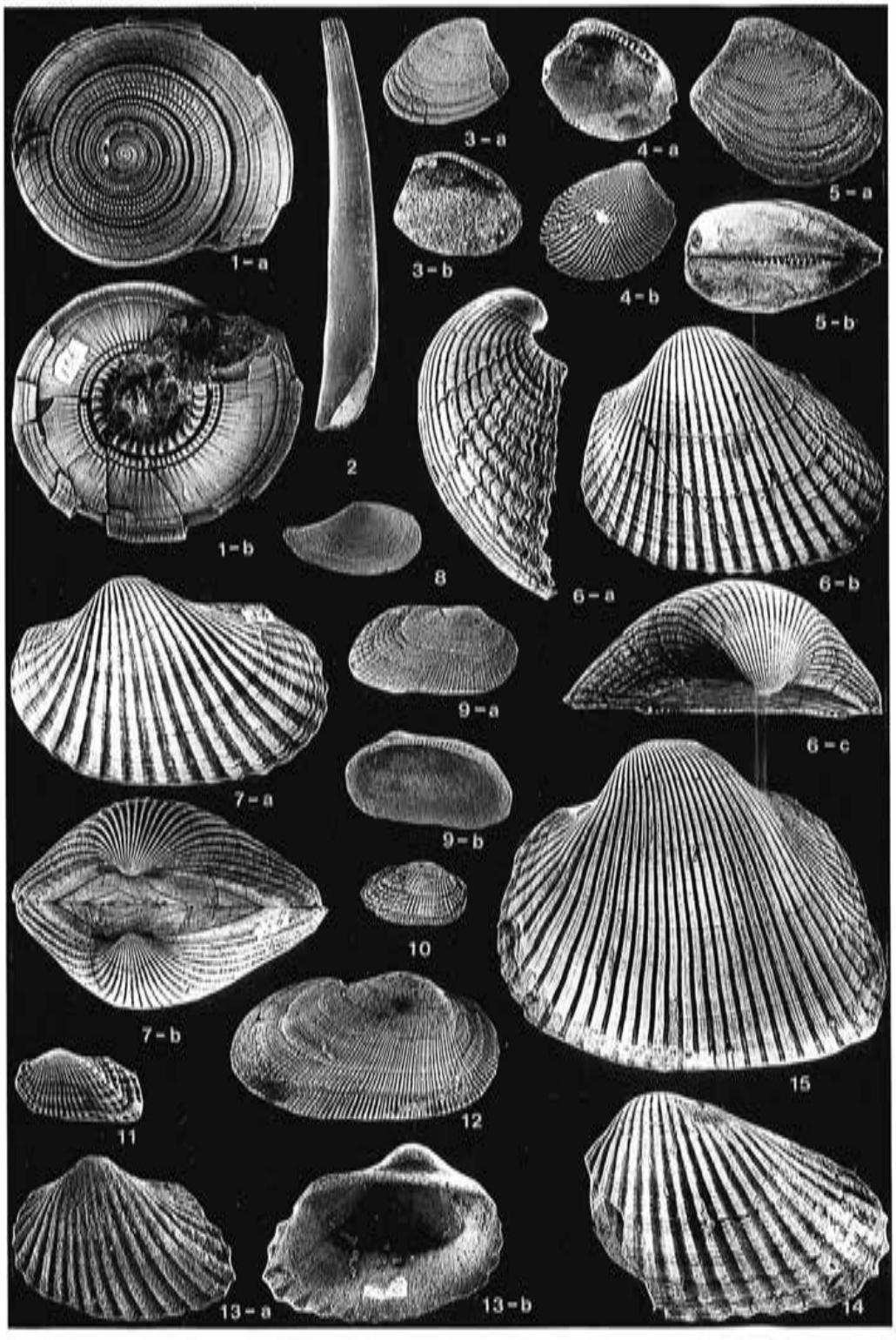

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Plate 34

Fig. 1. *Hawaiarca uwaensis* Yokoyama, NT90-92, c. × 2
Fig. 2. *Barbatia* (*Barbatia*) sp., NT90-90, c. × 4, p.157
Figs. 3, 4, 7. *Arca* (*Arca*) *boucardi* Jousseaume, 3: NT90-86-1, m. × 3, 4: NT90-86-2, c. × 1.6, 7: NT90-86-3, c. × 4, p.157
Fig. 5. *Anadara* sp., NT90-207, c. × 3, p.160
Fig. 6. *Bathyarca kyurokusimana* Nomura and Hatai, NT90-93, c. × 4
Fig. 8. *Barbatia* (*Ustularca*) *stearnsi* (Pirsbry), NT90-88, c. × 6
Fig. 9. *Barbatia* (*Acar*) *plicatum* (Dillwyn), NT90-91-2, c. × 3
Fig. 10. *Cucullaea granulosa* Jonas, NT90-85, m. × 1.2, p.156
Figs. 11–13. *Oblimopa japonica* (A. Adams), 11: NT90-101-1, m. × 1.5, 12: NT90-101-2, c. × 3, 13: NT90-101-3, c. × 3
Fig. 14. *Oblimopa* cf. *O. japonica* (A. Adams), NT90-102, c. × 1.0, p.161
Fig. 15. *Glycymeris* (*Glycymeris*) *rotunda* (Dunker), NT90-100, c. × 1.1, p.160
Fig. 16. *Glycymeris* (*Glycymeris*) *vestita* (Dunker), NT90-99, c. × 1.1, p.160

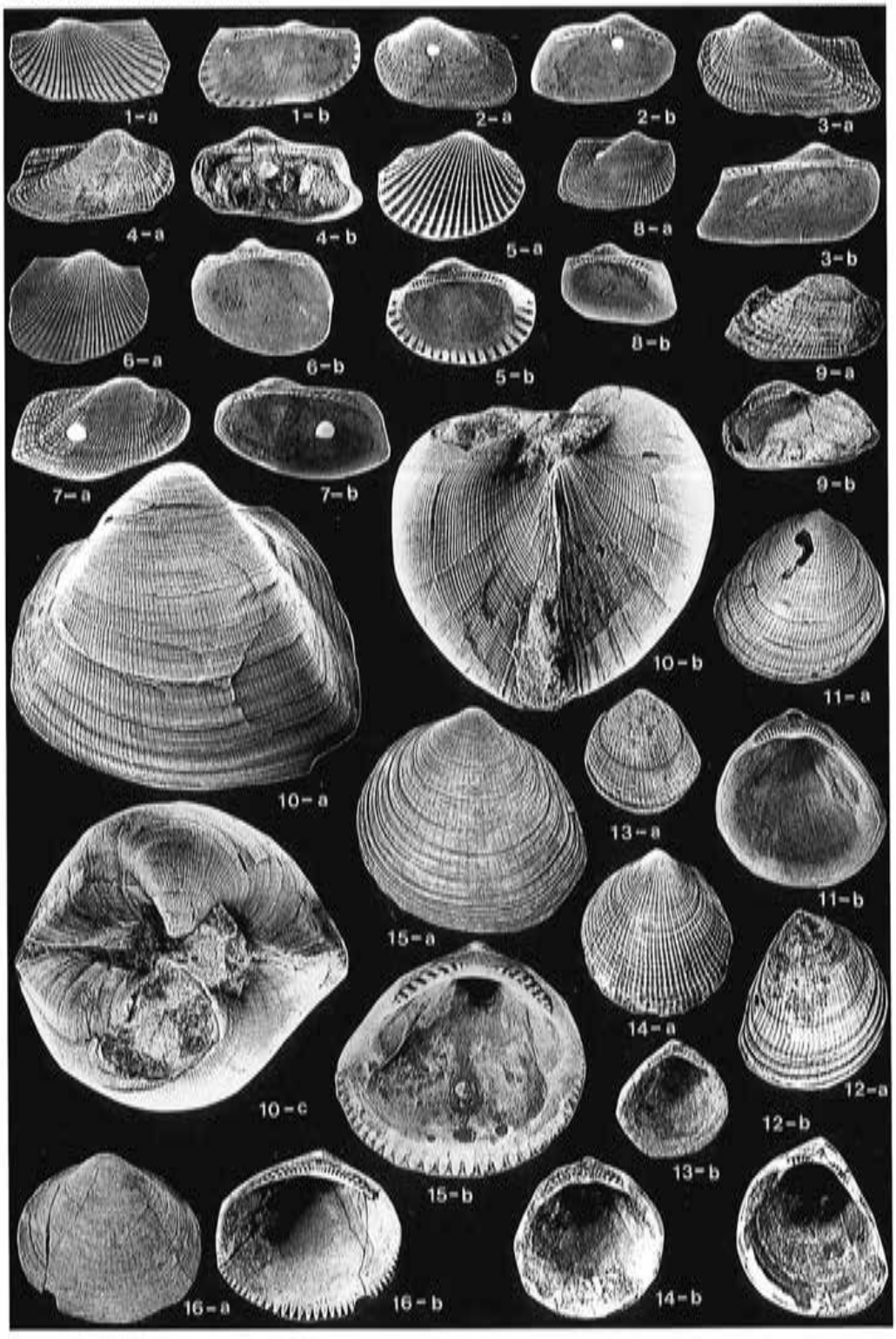

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Plate 35

Fig. 1. *Septifer* sp., NT90-105, c. × 1.8, p.162
Fig. 2. *Atrina* (*Servatrina*) *pectinata japonica* (Reeve), NT90-106, m. × 1.0, p.161
Fig. 3. *Spondylus barbatus* Reeve, NT90-113, c. × 1.8, p.165
Fig. 4. *Modiolus* (*Modiolus*) *modiolus difficilis* (Kuroda and Habe), NT90-103, m. × 1.0
Fig. 5. *Modiolus* (*Modiolusia*) *elongatus* (Swainson), NT90-104, m. × 1.1
Figs. 6,10,11. *Ostrea denselamellosa* Lischke, 6: NT90-121-1, c. × 1.8, 10: NT90-121-2, c. × 1.0, 11: NT90-121-3, c. × 0.9
Fig. 7. *Anomia chinensis* Philippi, NT90-120, c. × 3, p.167
Fig. 8. *Bathytormus foveolatus* (Sowerby), NT90-122, m. × 1.0, p.167
Fig. 9. *Basterotia gouldi* (A. Adams), NT90-124, c. × 3
Fig. 12. *Cycladicama cumingii* (Hanley), NT90-142, m. × 0.9, p.172
Fig. 13. *Crassatellites tosana* Nomura, NT90-123, c. × 3, p.168
Fig. 14. *Alvenius ojianus* (Yokoyama), NT90-143, c. × 4

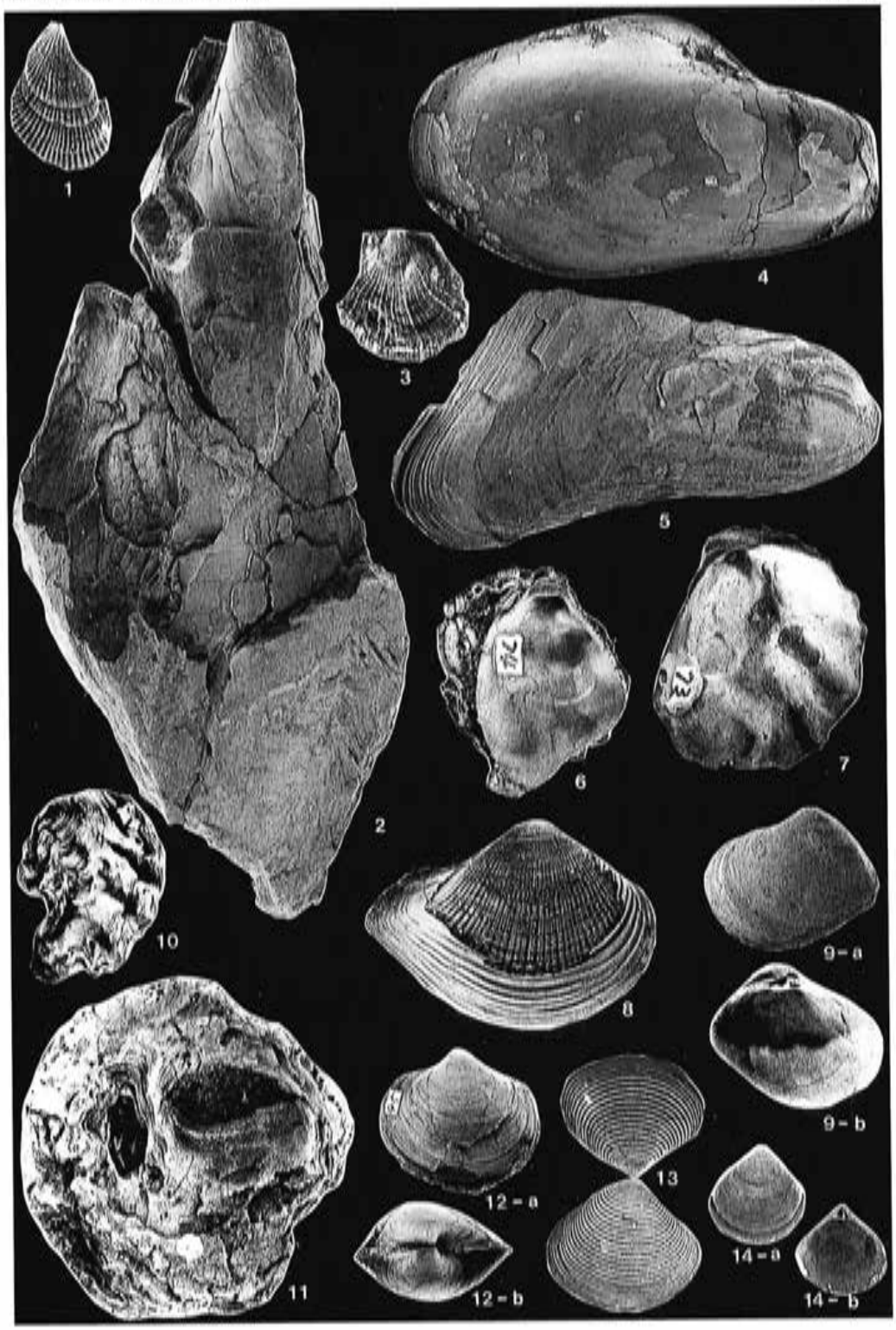

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Plate 36

Fig. 1. *Amussiopecten praesignis* Yokoyama, NT90-108, c. × 0.9, p.162

Figs. 2, 3, 6, 9. *Aequipecten vesiculosus* (Dunker), 2: NT90-111-1, m. × 1.1, 3: NT90-111-2, c. × 2.5, 6: NT90-111-3, c. × 2, 9: NT90-111-4, m. × 1.8, p.164

Fig. 4, 5. *Chlamys* (*Chlyamys*) *satowi* Yokoyama, 4: NT90-110-1, c. × 1.3, 5: NT90-110-2, m. × 0.8, p.163

Fig. 7. *Polynemamussium intuscostatum* Yokoyama, NT90-107, m. × 2, p.162

Fig. 8. *Cardita leana* Dunker, NT90-125, c. × 3

Fig. 10. *Patinopecten* (*Mizuhopecten*) *tokyoensis* Tokunaga, NT90-112, m. × 3, p.164

Fig. 11. *Pecten* (*Notovola*) *albicans* Schröter, NT90-109, c. × 2, p.163

Fig. 12. *Pleuromeris pygmaea* Kuroda and Habe, NT90-126, c. × 5, p.168

Fig. 13. *Venericardia* (*Megacardita*) sp. NT90-127, m. × 5, p.169

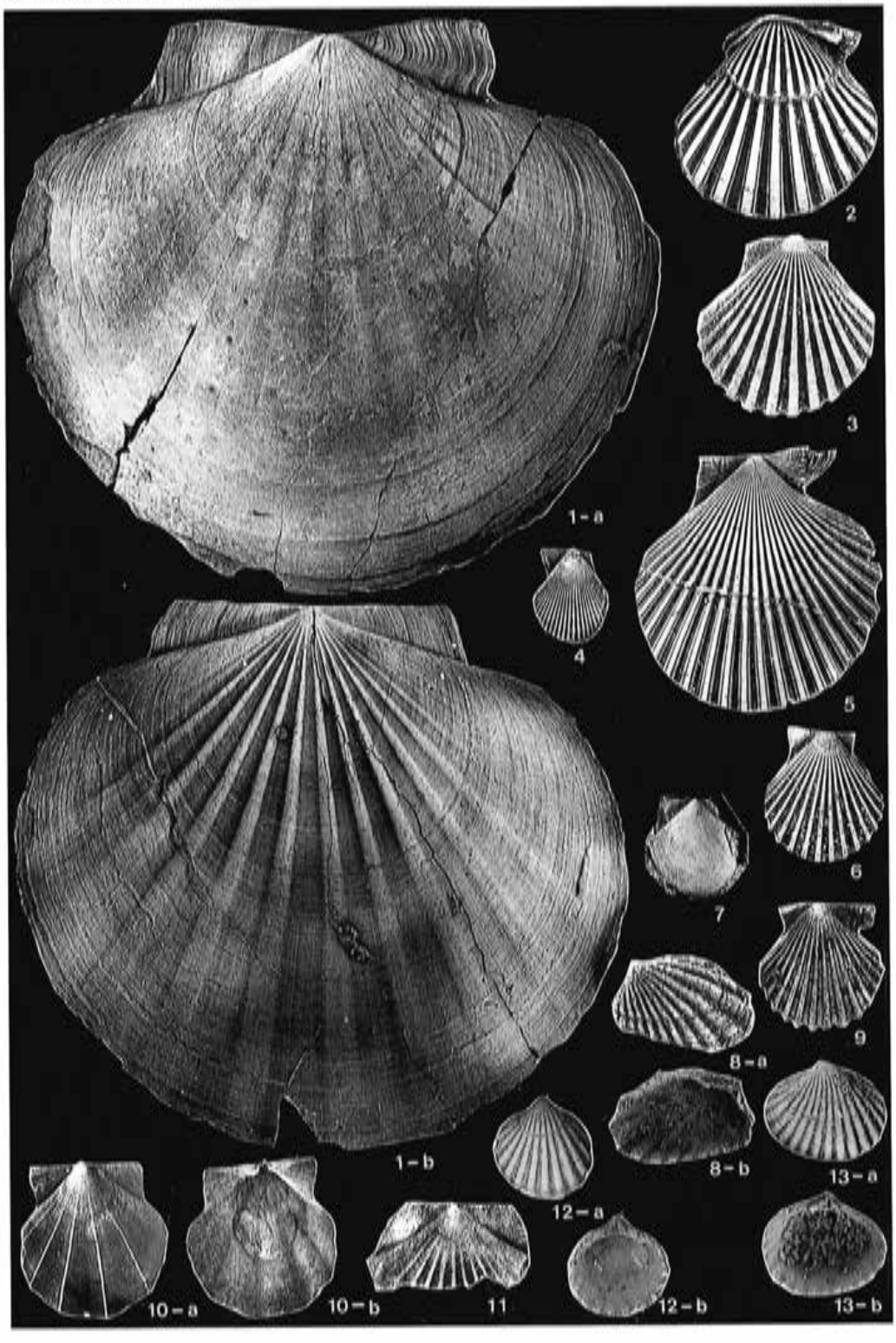

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Plate 37

Fig. 1. *Ctenoides lischkei* (Lamy), NT90-116, m. × 2, p.165
Fig. 2. *Limatula* (*Stabilima*) *strengei* (Swerby), NT90-115, m. × 4, p.165
Fig. 3. *Lima* (*Lima*) *zushiensis* Yokoyama, NT90-118, m. × 1.3, p.166
Fig. 4. *Lima* cf. *L. quantoensis* Yokoyama, NT90-119, m. × 1.6, p.166
Fig. 5. *Limatula* (*Limatula*) *vladiostokensis* (Scalato), NT90-114, m. × 1.8
Fig. 6. *Ctenoides* cf. *C. lischlkei* (Lamy), NT90-117, m. × 3, p.166
Fig. 7. *Pillucina* (*Pillucina*) *pisidium* (Dunker), NT90-145, c. × 1.7
Fig. 8. *Divaricella* aff. *D. soyoae* Habe, NT90-148, c. × 3, p.173
Fig. 9. *Bellucina civica* (Yokoyama) NT90-144, c. × 3
Fig. 10. *Lucinoma* sp., NT90-147, c. × 4, p.173
Fig. 11. *Veremolpa mindanensis* Smith, NT90-141, m. × 3
Figs. 12, 14, 17, 18. *Clementia* (*Clementia*) *papyracea* (Gray), 12: NT90-139-1, m. × 6, 14: NT90-139-2, m. × 1.7, 17: NT90-139-3, m. × 0.8, 18: NT90-139-4, × 0.8, p.172
Fig. 13. *Venericardia panda* Yokoyama, NT90-128, m. × 0.9, p.168
Fig. 15. *Thracia* sp., NT90-163, c. × 4, p.178
Fig. 16, 19. *Fulvia mutica* (Reeve), 16: NT90-151-1, m. × 1.3, 19: NT90-151-2, m. × 1.7, p.175
Fig. 20. *Vasticardium burchardi* (Dunker), NT90-149, c. × 0.9, p.174

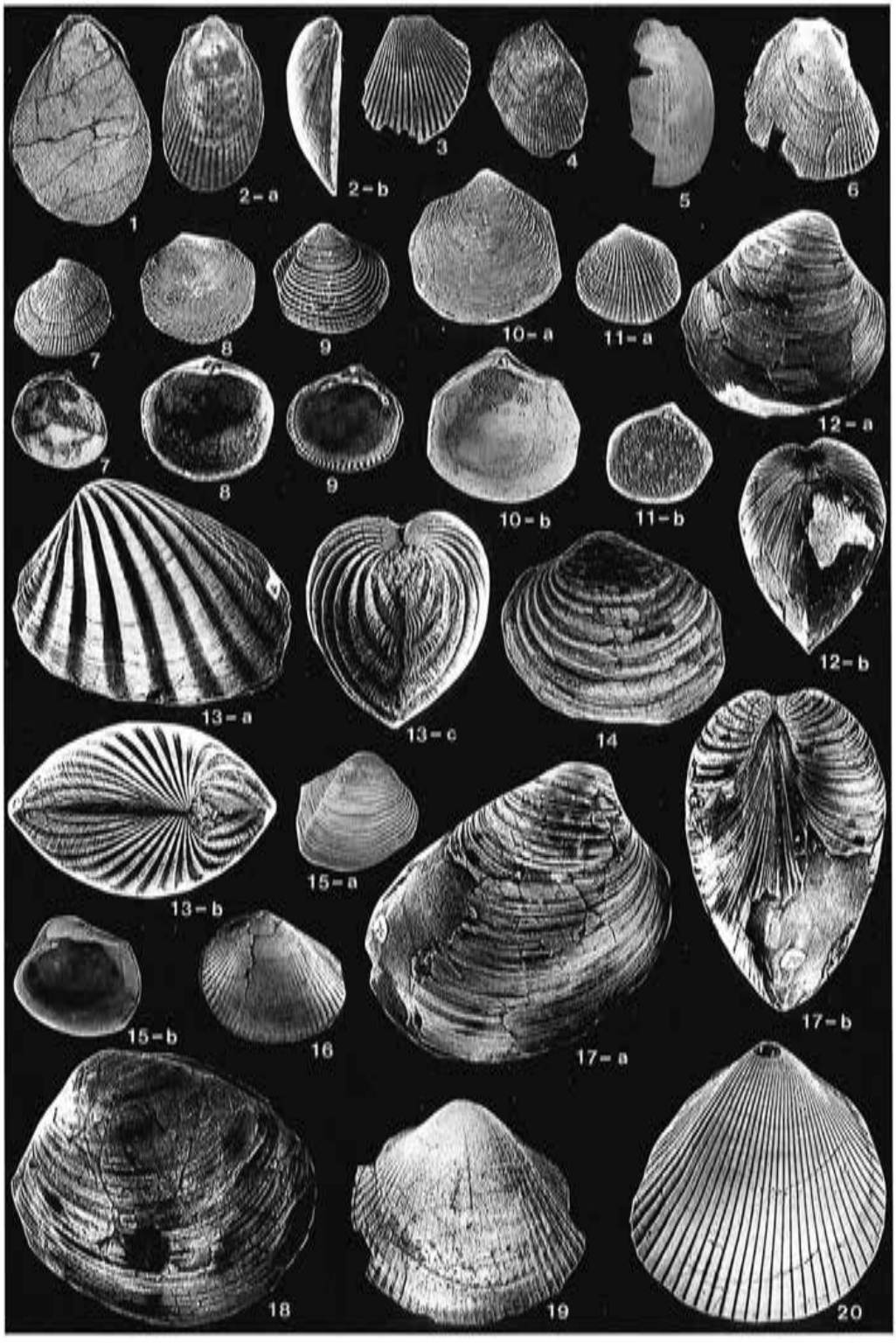

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Plate 38

Figs. 1, 2. *Paphia* (*Paphia*) *tonohamaensis* n. sp., 1, 2: NT90-138 (Conjoined), m. 1: × 1, 2: × 0.8, p.170

Figs. 3, 4, 6, 11, 12. *Paphia* (*Paphia*) *schnelliana* (Dunker), 3: NT90-137-1, m. × 1.1, 4: NT90-137-2, m. × 0.9, 6: NT90-137-3, m. × 1, 11: NT90-137-4, m. × 1.0, 12: NT90-137-5, m. × 0.9, p.170

Figs. 5, 8, 9. *Paphia* (*Paphia*) aff. *P.* (*P.*) *exilis* Shuto, 5: NT90-135-1, m. × 0.9, 8: NT90-135-2, m. × 0.9, 9: NT90-135-3, m. × 1.0, p.171

Figs. 7, 10. *Paphia* (*Paphia*) sp., 7, 10: NT90-136 (Conjoined), m. 7: × 0.9, 10: × 0.9, p.171

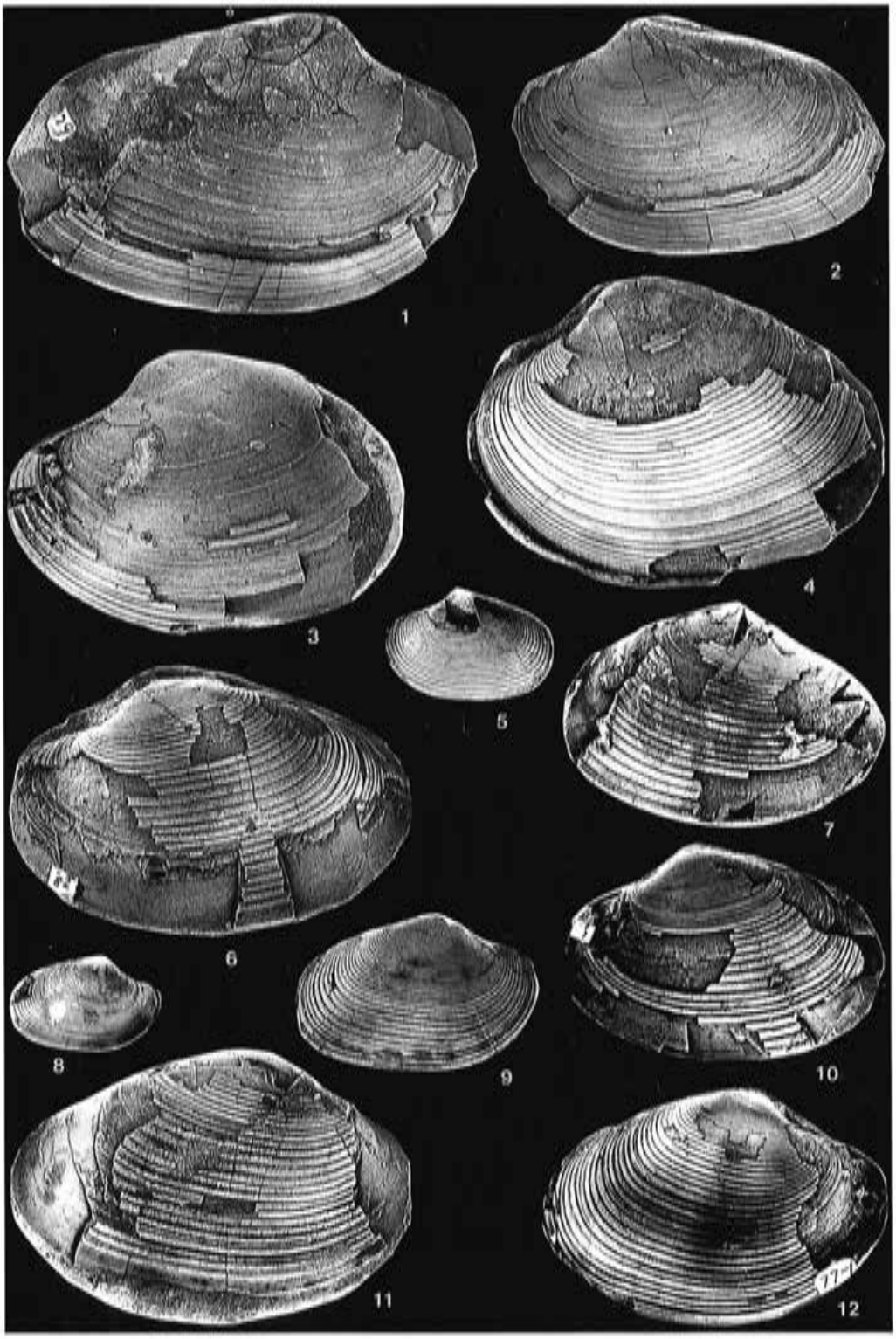

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Plate 39

Fig. 1. *Fulvia mutica* (Reeve), NT90-151-3, m. × 1.2
Fig. 2. *Keenaea samarangae* (Makiyama), NT90-150, m. × 1.5, p.174
Fig. 3. *Placamen tiara* (Dillwyn), NT90-140, m. × 1.3
Figs. 4, 8. *Ventricolaria foveolata* (Sowerby), 4: NT90-132-1, c. × 4, 8: NT90-132-2, c. × 1.0, p.170
Fig. 5. *Lucinoma annulata* (Reeve), NT90-146, m. × 1.9
Fig. 6. *Dosinorbis* (*Phacosoma*) *japonicus* (Reeve), NT90-131, m. × 1.5
Fig. 7. *Pitar* (*Pitarina*) sp., NT90-130, m. × 1.3, p.169
Fig. 9. *Callista* (*Callista*) *chinensis*, NT90-133, m. × 1.0
Figs. 10, 13. *Moerella*(?) sp. 10: NT90-156-1, m. × 4, 13: NT90-156-2, m. × 4, p.176
Fig. 11. *Corbula tosana* Yokoyama, NT90-129, c. × 1.2, p.169
Fig. 12. *Thraciopsis transmontana* (Yokoyama), NT90-164, m. × 4
Figs. 14–16, 20. *Angulus* cf. *A. vestalioides* (Yokoyama), 14: NT90-157-1, m. × 1.5, 15: NT90-157-2, m. × 1.5, 16: NT90-157-3, m. × 1.6, 20: NT90-157-4, m. × 1.8, p.176
Fig. 17. *Merisca* (*Pistris*) *subtruncata* (Hanley), NT90-155, m. × 2, p.176
Fig. 18. *Gomphina veneriformis* (Lamarck), NT90-134, m. × 1.9
Fig. 19. *Gari anomala* (Deshays), NT90-154, m. × 1.7, p.175

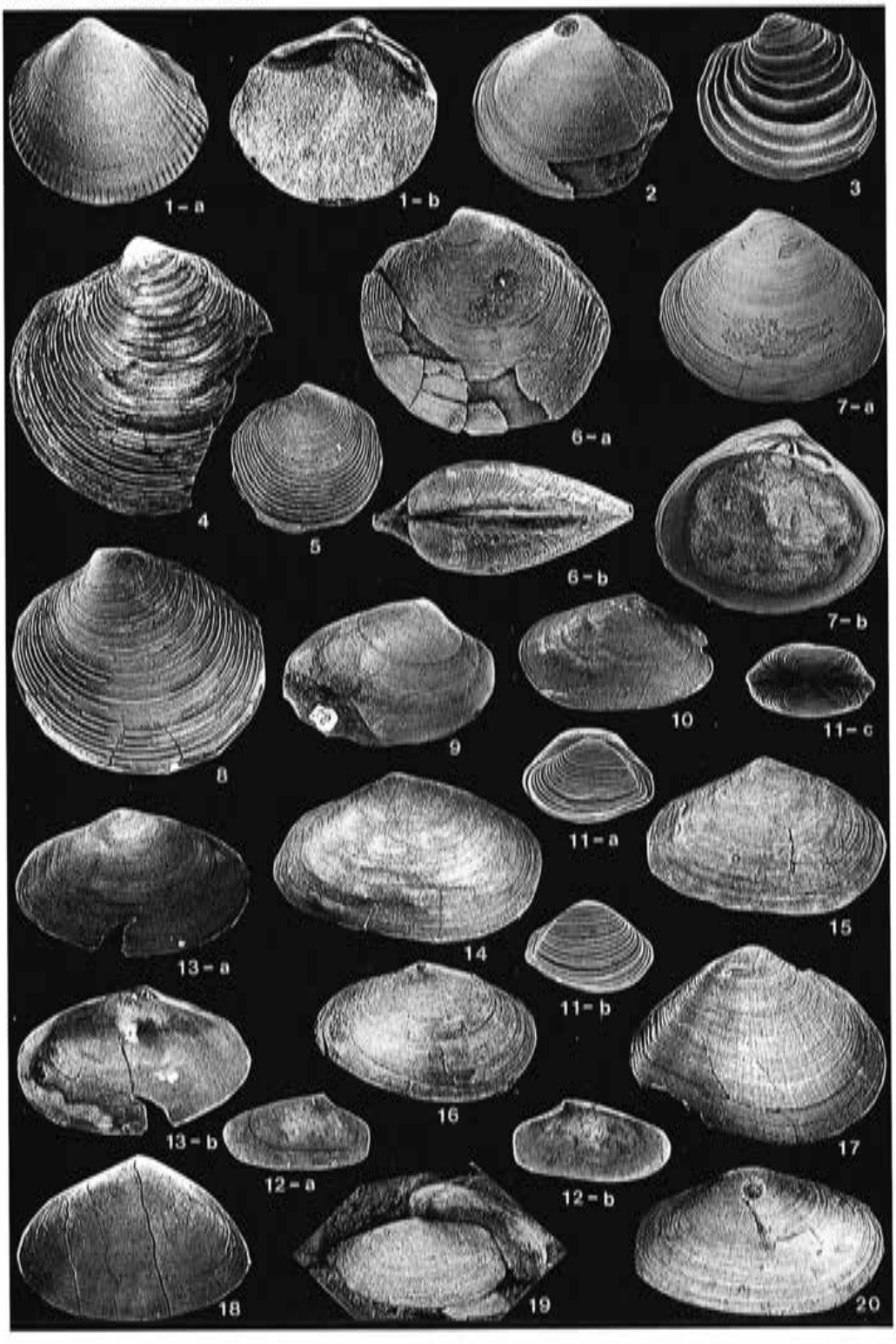
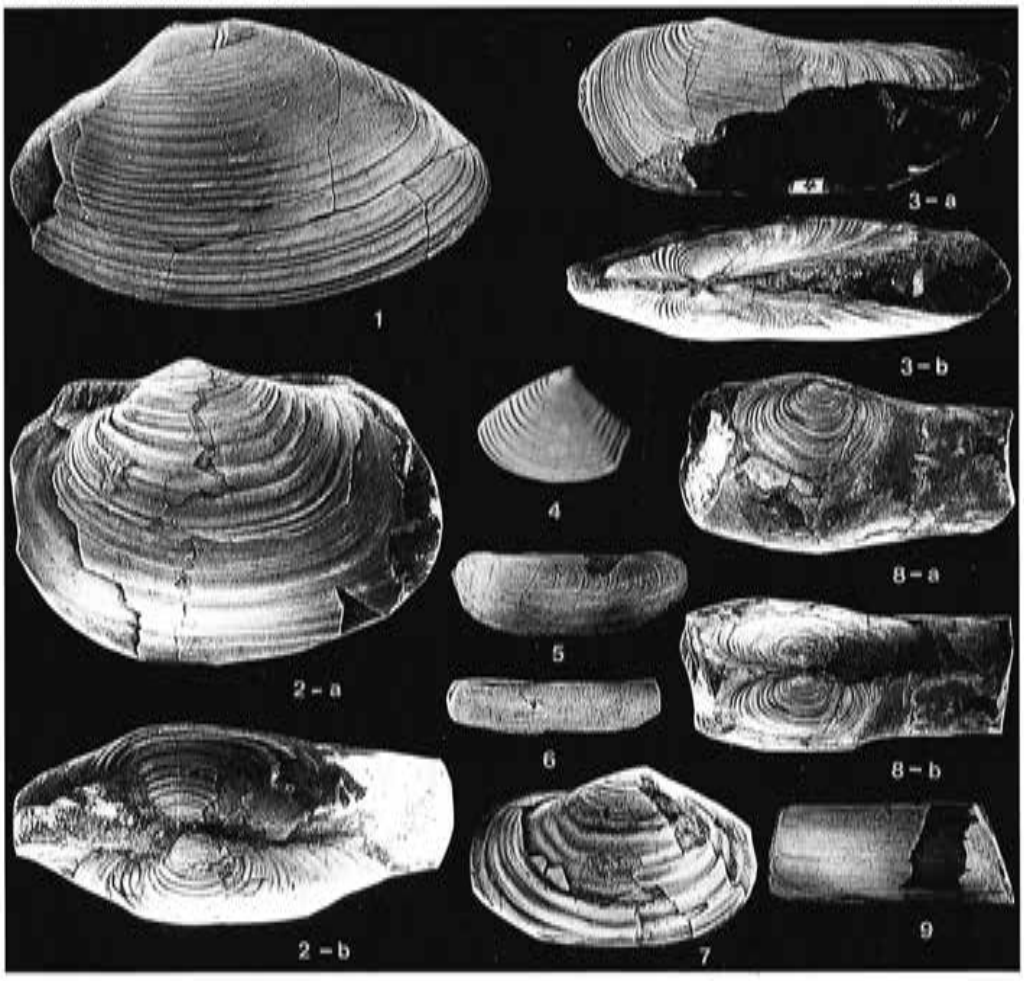

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Plate 40

Fig. 1. *Oxyperas* (*Oxyperas*) *bernardi* (Pilsbry), NT90-153, c. × 1.0, p.175
Figs. 2, 7. *Panopea japonica* (A. Adams), 2: NT90-161-1, m. × 0.9, 7: NT90-161-2, m. × 0.8, p.178
Fig. 3. *Lutraria* (*Psammophila*) *arcuata* (Reeve), NT90-152, m. × 0.9
Fig. 4. *Myadora fluctuosa* Gould, NT90-162, m. × 3
Fig. 5. *Ensiculus cultellus* Linné, NT90-158, m. × 0.9, p.177
Fig. 6. *Solen* (*Ensisolen*) *roseomaculatus* Pilsbry, NT90-160, m. × 1.3
Fig. 8. *Nipponoclava gigantea* (Sowerby), NT90-165, m. × 0.9, p.178
Fig. 9. *Solen* (*Solen*) *strictus* Gould, NT90-159, m. × 3, p.177


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