

Molluscan fossils from the Ryukyu
Islands, Southwest Japan : Part 4, Gastropoda
and Pelecypoda from the Nakoshi Formation in
the Motobu Peninsula, Okinawa-jimam

著者	Noda Hiroshi
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Molluscan fossils from the Ryukyu Islands, Southwest Japan — Part 4, Gastropoda and Pelecypoda from the Nakoshi Formation in the Motobu Peninsula, Okinawa-jima —

Hiroshi Noda*

Abstract

A total 110 species of 68 bivalves and 42 gastropods are described from the Nakoshi Formation in the Motobu Peninsula, central part of Okinawa-jima Island. The Nakoshi molluscan fauna is of embaymental shallow marine (lower part of the Nakoshi Formation) to infaunal and open marine species (upper part of the Formation). The faunal association in total is quite different in composition from the fauna of the Chinen Sand or underlying the Shimajiri Group distributed in the southern part and central part of Okinawa-jima.

Key words: Okinawa-jima, Neogene, Gastropoda, Pelecypoda, Nakoshi Formation, Ryukyu

Introduction

Molluscan fossils from the Haneji Formation in the central part of Okinawa-jima (Fig. 1), were first studied by Nomura and Zinbo (1936), Yabe and Hatai (1941a, b) and then by MacNeil (1961). After the short note on *Anadara* and its associated molluscan fauna described from the Haneji Formation by Minoura (1978) and Noda (1971) except for some listed molluscan species, Nohara and Miyagi (1984) reported 51 species of 42 genera from the Nakoshi Sand (Table 1), which corresponds to the lower part of the Haneji Formation. During the study of the molluscan fauna from the Nakoshi Formation, the present writer recognized 62 pelecypods and 42 gastropods as described with photographs, herein. From the paleobiogeographical and systematic points of the present molluscan fauna in relation with the faunal province and systematic with those of Taiwan and Philippines and south-

west Japan seem to be important. Especially, the Nakoshi Formation was previously of the Pliocene in the geological age by molluscan studies (MacNeil, 1961; Noda, 1971), however, the micro-paleontological data as nannofossils pointed out the Nakoshi Formation is of Pleistocene (Nishida, 1973). Since the detail discussion on the geological data by molluscan fossils only is difficult but data of the molluscan fauna described herein from the Nakoshi Formation is significant for the discussion in future.

Before going into the discussion, the present writer would like to express his hearty thanks to Dr. Tamio Kotaka, Professor Emeritus of Tohoku University, Dr. Koichiro Masuda, Professor Emeritus of Miyagi University of Education, Prof. Tomohide Nohara of Ryukyu University, and Prof. Kenshiro Ogasawara of the University of Tsukuba, for their many helps and very kind suggestions during the present study. The photographic works are due to Mr. Yoshibumi Kikuchi of Institute of Geoscience, the University of Tsukuba. The present study was partly supported by a Grant in Aids for

* The University of Tsukuba (Professor Emeritus) and Department of Geology, National Science Museum (Visiting Researcher)

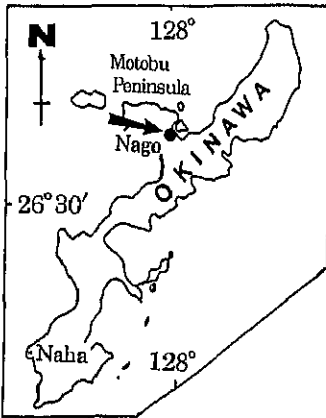
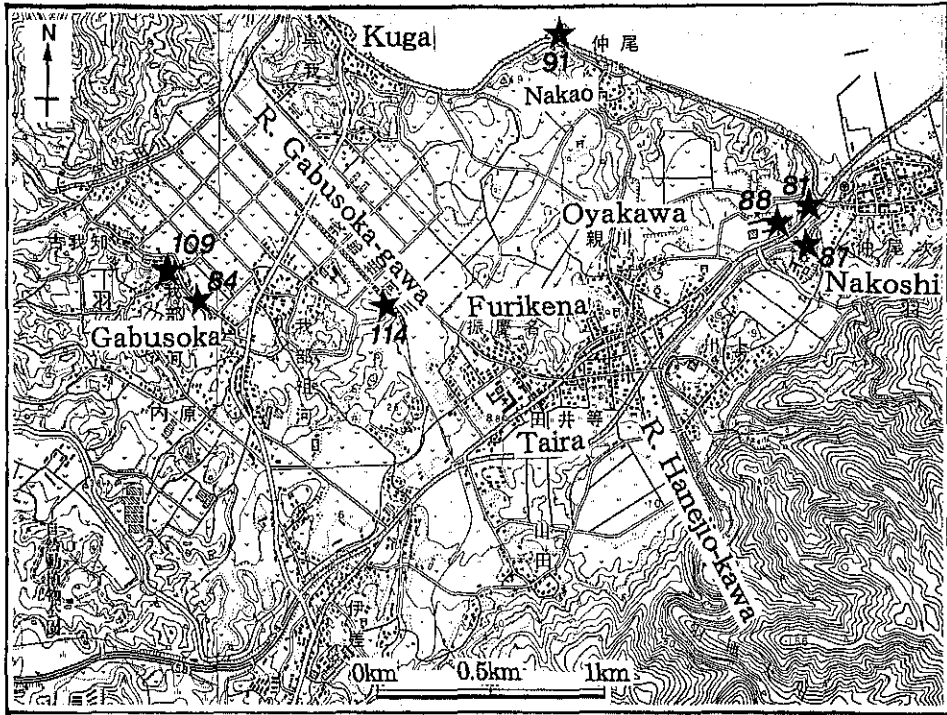


Fig. 1. Molluscan fossil localities in Haneji, Nago City.

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Occurrence of Molluscan Fauna in the Nago district

The stratigraphy in the area of Nakoshi, Motobu Peninsula, central part of Okinawa-jima

Island was summarized by Nohara and Miyagi (1984). The stratigraphic horizon of the present molluscan fauna described herein is of the Nakoshi Sand of MacNeil (1961) same with the Haneji Formation of Noda (1971) and the Nakoshi Sand of Nohara and Miyagi (1984). The marine molluscan fossils in the Nakoshi are restricted in the Nakoshi Sand. As the distribution of the Nakoshi Sand is restricted in the northern part of the Nago district as mentioned by Nohara and Miyagi (1984), the molluscan fossils are collected from the middle to northern part of Nago City (Fig. 1). The dominant fossil localities are pointed on Fig. 1. Among the localities, Loc. no. 84 (Figs. 5-7) is probably near to the locality of Nomura and Zinbo (1936). In the lower part of Nakoshi Formation is also distributed in the western part of the River Nasada-gawa on the Kuga Conglomerate (Figs. 2, 3, 4). The lower part of the formation is silty and becomes sandy toward above. The localities of nos. 81, 87, 88 at near Haneji Branch of Nago City Office are of *Operculina* dominant calcareous sandstone with pebbles or conglomerates.

Table 1. Number of molluscan fossils reported from the Nakoshi Formation.

Authors	Pelecypods	Gastropods	Scaphopods	Total	New. sp.
Yabe and Hanzawa (1925)	17 (17)	25 (25)	0	42 (42)	0
Nomura and Zinbo (1936)*	56 (44)	54 (37)	2 (2)	112 (83)	12
Yabe and Hatai (1941a)	6 (2)	8 (6)	0	14 (8)	1
MacNeil (1961)	0	28 (3)	0	28 (3)	2
Noda (1971)	13 (11)	7 (5)	0	20 (16)	2
Nohara and Miyagi (1984)	11 (3)	25 (15)	2 (2)	38 (20)	0
Present paper	68 (5)	42 (0)	0	110 (5)	1

Number in bracket shows the number of non-photographed species. * = Based on the data from Nomura and Zinbo (1934).

In total, the molluscan species from the Nakoshi Sand or Haneji Formation described herein are counted up to 68 species of bivalves, 42 of gastropods, and 110 species in total. As the illustration for the faunal discussion is important, 62 bivalves (91.1%) and 42 gastropods (100%) are illustrated herein and the comparison of the faunal association is mentioned below (Table 1). The total number of the species given by Nomura and Zinbo is almost same with the present data. However, Nomura and Zinbo (1936) illustrated only 12 pelecypod species (21.4%) and 17 gastropods (31.4%). The geological age of the Nakoshi Formation was previously considered to be Pliocene and correlated with the Takanabe, Tonohama and Kakegawa Formations distributed along the Pacific Ocean side of Japanese Island based on the extinct shallow marine molluscan species as like *Anadara suzukii*, *Amusiopecten praesignis*, *Venericardia panda* and others (Noda, 1971, Masuda, 1986, Ogasawara, 1981, 1986a, 1988, Ogasawara and Masuda, 1983 and others). However, as Fukuda *et al.* (1970) already mentioned that the Nakoshi Sandstone is almost same with the Ryukyu Limestone and also the Aka Formation in Kunijima Island in geological age.

The Nakoshi Sand yielded the extinct species *Amusiopecten praesignis* which was yielded from the overlying Naha Limestone as already been mentioned by Yabe and Hatai (1941b). The molluscan association of the Nakoshi Formation is different from the molluscan fauna of the Chinen Sandstone or the Chinen Formation in

the southern part of Okinawa-jima Island. The Chinen Sand was previously accepted to be Pleistocene by foraminifers by Ibaraki and Tsuchi (1975), and Ujiie (1985). However, the molluscan fauna of the Nakoshi is quite different from the Chinen in the composition of the fauna. Most of the species from the Nakoshi is of shallow or embaymental marine condition and composed of infaunal species, but those of the Chinen is of off shore marine condition and composed of epifaunal species. The Nakoshi molluscan fauna as listed (Table 1) is quite unique because there are no comparable fauna in the Ryukyus. Recently, the molluscan fauna which has similar composition with the Nakoshi as the extinct species of *Amusiopecten praesignis*, *Anadara suzukii*, and others from the Majya Formation was discussed as to be Late Miocene or Late Miocene to Pliocene in Kumejima Island (Ozawa, *et al.*, 1988; Kawagata *et al.*, MS).

According to the recent studies by Masuda and Huang (1990a, b, 1991, 1993A, b, 1994) on the molluscan fauna in Taiwan (Formosa), the molluscan fauna of those shallow or infaunal species as like the fauna called the Kakegawa Fauna in the Southwest Japan (worm water fauna) is originated or characterized from the late Miocene to Pliocene in the area of Formosa to Okinawa. Up to date, the most of molluscan species recorded from the Ryukyus are quite common with those of the fossil or Recent species of the Southwest Japan. Most of the molluscan species from the Shimajiri and

Table 2. Molluscan fossils from the Nakoshi Formation.

Bivalves	
<i>Acila (Acila) divaricata</i> (Hinds, 1843).....	Loc. 87 (rare)
<i>Barbatia (Acar) cf. reticulata</i> (Gmelin).....	Loc. 81 (rare)
<i>Spineara fausta</i> (Habe).....	Loc. 81 (rare)
<i>Barbatia (Abarbatia) decussata</i> (Sowerby).....	Loc. 81 (rare), 84 (rare)
<i>Verilarca interplicata</i> (Grabau and King).....	Loc. 81 (rare), 84 (rare), 109 (rare)
<i>Spinarca fausta</i> (Habe).....	Loc. 81 (rare)
<i>Trisidos</i> sp.	Loc. 87 (rare)
<i>Anadara (Scapharca) suzuki</i> (Yokoyama).....	Loc. 81 (rare), 84 (rare), 87 (rare), 88 (rare)
<i>Striarca (Galactella) symmetrica</i> (Reeve).....	Loc. 81 (rare), 88 (rare)
<i>Anadara (Scapharca) taiwanica</i> Noda.....	Loc. 81 (rare)
<i>Anadara (Scapharca) kotakai</i> Noda.....	Loc. 81 (rare)
<i>Anadara (Hataiarca) takaoensis</i> (Nomura).....	Loc. 81 (rare), 84 (common), 88 (common)
<i>Anadara (Hataiarca) kogachiensis</i> Noda.....	Loc. 81 (common), 83 (common), 84 (rare), 109 (few), 114 (few)
<i>Anadara (Tosarca) sedanensis</i> (Martin).....	Loc. 81 (rare), 84 (few), 88 (rare)
<i>Cucullaea</i> (s.s.) <i>granulosa</i> Jonas.....	Loc. 81 (rare), 84 (few), 87 (rare)
<i>Glycymeris (Glycymeris) formosana</i> (Yokoyama).....	Loc. 81 (rare), 87 (few), 88 (dominant)
<i>Tucetilla pilsbryi</i> (Yokoyama).....	Loc. 87 (rare)
<i>Musculites cf. japonica</i> (Dunker).....	Loc. 88 (rare)
<i>Modiolus</i> sp.	Loc. 109 (rare)
<i>Pteria cf. coturnix</i> (Dunker).....	Loc. 84 (rare)
<i>Atulina</i> sp.	Loc. 87 (rare)
<i>Chlamys (Azumapecten) subsquamatus</i> (Nomura).....	Loc. 84 (rare), 87 (rare)
<i>Chlamys (Mimachlamys) satoi</i> (Yokoyama).....	Loc. 84 (rare), 87 (few), 88 (rare)
<i>Chlamys (Mimachlamys) granulisquamatus</i> (Fischer).....	Loc. 84 (rare), 87 (rare), 88 (rare)
<i>Cryptopecten cf. nux nux</i> (Reeve).....	Loc. 81 (rare)
<i>Cryptopecten vesiculosus</i> (Dunker).....	Loc. 87 (rare)
<i>Decatopecten striatus</i> (Schumacher).....	Loc. 81 (rare), 84 (few), 87 (rare), 88 (rare)
<i>Decatopecten amiculum</i> (Philippi).....	Loc. 81 (rare), 84 (common), 87 (rare), 88 (rare)
<i>Amusiopecten praesignis</i> (Yokoyama).....	Loc. 81 (abundant), 84 (few), 87 (rare), 88 (abundant)
<i>Chlamys</i> sp.	Loc. 88 (rare)
<i>Plicatula simplex</i> Gould.....	Loc. 87 (rare)
<i>Anomia chinensis</i> Philippi.....	Loc. 81 (rare), 84 (rare), 87 (rare), 88 (rare)
<i>Pododesmus (Monia) noharai</i> Noda.....	Loc. 84 (rare), 109 (common), 114 (common)
<i>Ostrea denselamellosa</i> Lischke.....	Loc. 81 (rare), 84 (rare)
<i>Pretostrea imbricata</i> (Lamarck).....	Loc. 81 (rare), 84 (rare), 87 (rare), 109 (rare)
<i>Lucina kuninagaensis</i> Nomura and Zinbo.....	Loc. 81 (rare), 87 (rare)
<i>Epicodalia delicatula</i> Pilsbry.....	Loc. 87 (rare)
<i>Anodontia stearensiana</i> (Oyama, 1954).....	Loc. 109 (rare)
<i>Wallucina</i> sp.	Loc. 81 (rare)
<i>Chama</i> sp.	Loc. 81 (rare)
<i>Cardita leana</i> Dunker.....	Loc. 88 (rare)
<i>Glans granulatus</i> , n. sp.	Loc. 81 (rare)
<i>Nipponocrassatella nana</i> (A.Adams and Reeve).....	Loc. 81 (dominant), 84 (dominant)
<i>Vasticardium (Vasticardium) burchardi</i> (Dunker).....	Loc. 81 (rare), 84 (rare), 87 (few), 88 (few), 109 (rare)

<i>Lunulicardia subretusa</i> (Sowerby).....	Loc. 81 (rare), 88 (rare)
<i>Fragum alfiricum</i> (Fischer)	Loc. 81 (rare), 88 (rare)
<i>Laevicardium bivadiatum</i> (Bruguere).....	Loc. 81 (rare), 84 (rare)
<i>Fulvia</i> sp.	Loc. 81 (rare), 87 (rare), 114 (few)
<i>Lutraria</i> (<i>Psamophila</i>) <i>sieboldii</i> Deshayes	Loc. 81 (rare), 84 (rare), 87 (rare), 88 (rare)
<i>Tellinella verrucosa</i> (Hanley).....	Loc. 81 (rare), 87 (rare)
<i>Macoma</i> (<i>Macoma</i>) <i>praetexta</i> (Martens).....	Loc. 109 (rare)
<i>Grammatomya squamosa</i> (Lamarck)	Loc. 81 (rare), 88 (rare)
<i>Solecurtus divaricata</i> (Lischke).....	Loc. 81 (rare), 87 (rare), 88 (rare)
<i>Azorinus abbreviatus</i> (Gould).....	Loc. 88 (few)
<i>Solen</i> cf. <i>strictus</i> Gould	Loc. 88 (rare)
<i>Ventricolaria</i> (<i>Ventricoloidea</i>) <i>foveolata</i> (Gmelin)	Loc. 81 (rare), 87 (rare), 88 (rare)
<i>Periglypta</i> (<i>Tigammona</i>) <i>chemnitzii</i> (Hanley)	Loc. 84 (rare), 87 (rare)
<i>Glycydonta marica</i> (Linnaeus)	Loc. 87 (few)
<i>Placamen tiara</i> (Dilluwyn).....	Loc. 87 (rare)
<i>Circe</i> (<i>Circe</i>) <i>scriptta</i> (Linnaeus).....	Loc. 81 (rare), 88 (few)
<i>Pitar</i> (<i>Pitarina</i>) <i>japonicum</i> Kuroda and Kawamoto.....	Loc. 81 (rare), 84 (few), 86 (few), 88 (rare)
<i>Costellipitar</i> cf. <i>chordatum</i> (Roemer).....	Loc. 81 (rare), 88 (rare)
<i>Pardosinia amphidesmoises</i> (Reeve).....	Loc. 81 (rare), 87 (rare)
<i>Paphia</i> (<i>Paphia</i>) <i>euglypta</i> (Philippi).....	Loc. 81 (rare), 88 (rare)
<i>Callista</i> (<i>Callista</i>) <i>chinensis</i> (Holton).....	Loc. 87 (rare), 88 (few)
<i>Saxidomus purpuratus</i> (Sowerby)	Loc. 81 (rare)
<i>Clementia</i> (<i>Clementia</i>) <i>vatheloti</i> Mabilie.....	Loc. 81 (rare), 84 (rare), 87 (rare)
<i>Eufistulana grandis</i> (Deshaayes).....	Loc. 81 (few), 87 (rare), 88 (rare)
<i>Myadora fluctuosa</i> Gould	Loc. 87 (rare), 88 (rare)
<i>Laternula</i> (<i>Laternula</i>) <i>anatina</i> (Linnaeus).....	Loc. 87 (rare)

Gastropoda

<i>Fissuridea crucifera</i> (Pilsbry).....	Loc. 81 (rare)
<i>Turbo</i> (<i>Batillus</i>) <i>chinensis</i> Ozawa and Tomida	Loc. 87 (common)
<i>Clanculus bronni</i> (Dunker).....	Loc. 87 (rare)
<i>Tosatrochus attenuatus</i> (Jonas)	Loc. 87 (rare)
<i>Astraliium</i> (<i>Astraliium</i>) <i>haematragum</i> (Menke).....	Loc. 81 (rare), 87(few)
<i>Marmorostoma</i> (<i>Batillus</i>) <i>gemmata</i> (Reeve)	Loc. 81 (few), 84 (rare), 87 (rare), 88 (rare)
<i>Turritella</i> (<i>Kuroshioia</i>) <i>filiola</i> Yokoyama	Loc. 81 (few), 84 (few), 87 (dominant), 88 (few)
<i>Batillaria flectosiphonata</i> Ozawa	Loc. 109 (few)
<i>Rhinoclavis</i> (<i>Proclava</i>) <i>kochii</i> (Philippi)	Loc. 88 (rare)
<i>Cerithium</i> (<i>Proclava</i>) <i>turritum</i> Sowerby.....	Loc. 81 (rare)
<i>Amalthea conica</i> Schmacher.....	Loc. 88 (rare)
<i>Tugurium exutum</i> (Reeve)	Loc. 87 (few)
<i>Terebellum terebellum</i> (Linnaeus).....	Loc. 88 (rare)
<i>Strombus</i> (<i>Labistrombus</i>) <i>japonicus</i> (Reeve).....	Loc. 81 (common), 84 (few), 87 (few), 88 (common)
<i>Strombus</i> (<i>Euprotombus</i>) <i>aurisdianae</i> Linnaeus.....	Loc. 84 (rare)
<i>Polinices sagamiensis</i> Pilsbry.....	Loc. 81 (rare), 84 (rare)
<i>Eumaticina papilla</i> (Gmelin).....	Loc. 109 (rare)
<i>Erosaria</i> (<i>Erosaria</i>) cf. <i>erosa phragedanina</i> Melvill.....	Loc. 84 (rare)

<i>Ovula</i> sp.	Loc. 87 (rare)
<i>Semicassis</i> sp.	Loc. 81 (rare)
<i>Bursa</i> (<i>Bufovaria</i>) <i>rana</i> (Linnaeus).....	Loc. 81 (rare)
<i>Gyrineum pusillum</i> (Broderlip).....	Loc. 81 (rare), 84 (rare)
<i>Cymatium</i> (<i>Cymatitum</i>) <i>nicobaricum</i> (Roeding).....	Loc. 84 (rare)
<i>Volva</i> (<i>Pellissimnia</i>) <i>macneilli</i> Noda	Loc. 87 (rare)
<i>Volva</i> sp.	Loc. 84 (rare)
<i>Crenavolva</i> cf. <i>frumentum</i> (Sowerby).....	Loc. 84 (rare)
<i>Pollia martini</i> Shuto	Loc. 84 (rare)
<i>Hindsia</i> sp.	Loc. 81 (rare)
<i>Rostellaria</i> cf. <i>spinifera</i> Martens.....	Loc. 87 (rare)
<i>Nassarius</i> (<i>Zeuixis</i>) <i>caelatus</i> (Gould).....	Loc. 109 (few)
<i>Nassarius</i> (<i>Niotha</i>) <i>gemmulatus</i> (Lamarck)	Loc. 81 (rare)
<i>Uronitza obeliscus</i> (Reeve).....	Loc. 81 (rare)
<i>Pyrene flava</i> (Bruguiere)	Loc. 81 (rare), 88 (rare)
<i>Striotereburum</i> sp.	Loc. 88 (rare)
<i>Fusinus perplexus</i> (A.Adams).....	Loc. 88 (rare)
<i>Cancellaria</i> (<i>Trigonostoma</i>) <i>taiwanensis</i> Nomura.....	Loc. 109 (rare)
<i>Crassispira pseudoincipalis</i> (Yokoyama)	Loc. 81 (rare)
<i>Conus tessellatus</i> Born	Loc. 81 (rare), 88 (rare)
<i>Conus quercinus</i> Lightfoot	Loc. 84 (rare), 88 (rare)
<i>Myurella</i> (<i>Clathrotrebra</i>) <i>woodwardiana</i> (Martin).....	Loc. 81 (rare)
<i>Aliuculastrum</i> cf. <i>cylindricum</i> (Helbering)	Loc. 87 (rare)

(rare = 1-5, few = 6-10, common = 11-20, dominant = 20 more)

Shinzato Formations underlying in Okinawajima Island, are of all more deep-sea species and association is quite far from the fauna of the Nakoshi. Those shallow infaunal species should be originated in the Ryukyu area or migrated from more south to alive in the embaymental shallow marine environment of Okinawa at the end of Pliocene to Pleistocene before the development of environmental condition of the coral reef environment as the depositional age of the Ryukyu Limestone.

The faunal discussion of the Nakoshi molluscan fauna in relation with the systematic and distribution will be followed on the other chances elsewhere in near future.

Systematic description

Bivalvia

Family Nuculidae Gray, 1824

Genus *Acila* H. and A. Adams, 1858

Subgenus *Acila* H. and A. Adams, 1858

Acila (*Acila*) *divaricata* (Hinds, 1843)

Figs. 8-1a-1b.

Remarks; The present species was well discussed by Noda (1993) and Noda *et al.* (1995) who made synonymous list of the species. Thence after the following description and record of the species was published. The species is common in the northern part of Japan but the species was widely known down to the southern part of Japanese Islands as mentioned in the synonymous list. The specimens collected from the Nakoshi Formation are all small in size but the external sculptures, depressed posterior area and shell form are well identical with the named species. The following is additional to the Noda *et al.* (1995).

1986, *Acila* (*Acila*) *divaricata*, Masuda *et al.*, in Sato *et al.*, 8-9, pl. 1, figs. 1-2.

Table 3. Fossil localities of the Nakoshi Formation.

Loc. no. 81; Cliff behind of the Haneji Branch of Nago City Public Office, at Haneji, Nago City. Pebbly conglomerate bearing calcareous and foraminiferal (*Operculina*) sandstone. Nakoshi Formation.

Loc. no. 84; Small road side cliff at Kogachi, Nago City. Pebble bearing calcareous sandy siltstone. Nakoshi Formation. This locality is of quite near to the locality of Nomura and Zinbo (1934, 1936).

Loc. no. 87; North-side cliff of the Nakoshi River (Hanejiokawa), at Haneji, Nago City. Calcareous silty sandstone. Nakoshi Formation.

Loc. no. 88; School garden cliff of Haneji Middle High School, Nago City. Foraminiferal (*Operculina*) calcareous silty sandstone. Nakoshi Formation.

Loc. no. 91; Sea side cliff at Komisaki, Nakao, Nago City. Calcareous and fossiliferous sandstone. Nakoshi Formation.

Loc. no. 109 (Hill-side cliff at central part of Gabusoka, Nago City. Silty facies of the Nakoshi Formation. (Fossil locality no. 109 of Noda, 1971)

Loc. no. 114; Small river (Gabusoka-gawa River) side cliff at central part of Nakoshi, Nago City, Nakoshi Formation. (Fossil locality no. 114 of Noda, 1971)

- 1988, *Acila (Acila) submirabilis*, Yoon, pl. 1, figs. 15, 28.
- 1989, *Acila (Acila) divaricata*, Ito, 57, pl. 17, fig. 13.
- 1990, *Acila divaricata*, Baba, 228, pl. 22, figs. 7a-b.
- 1991, *Acila (Truncacilla) divaricata*, Noda, 9-10, fig. 6-2.
- 1992, *Acila divaricata*, Koizumi and Matsushima, 124, figs. 6-3-4.
- 1993, *Acila (Acila) divaricata*, Okumura and Takei, 156, pl. 33, figs. 5a-5b.
- 1993, *Acila (Acila) divaricata*, Katto and Masuda, 8-9, pl. 1, fig. 1.
- 1995, *Acila (Acila) divaricata submirabilis*, Noda *et al.*, 47-48, figs. 4-10-12, 16-8.
- 1998, *Acila (Acila) divaricata*, Okumura and Ueda, 69, pl. 8, fig. 14.

Locality; Loc. no. 87 (rare).

Family Arcidae Lamarck, 1809

Subfamily Arcinae Lamarck, 1809

Genus *Barbatia* Gray, 1842

Subgenus *Acar* Gray, 1842

Barbatia (Acar) cf. *reticulata* (Gmelin, 1792)

Fig. 8-7.

Compared with;

- 1792, *Arca reticulata* Gmelin, 3311. (*vide* Noda, 1966)
- 1966, *Arca (Acar)* cf. *reticulata*, Noda, 115, pl. 1, fig. 2.

Remarks; Only one imperfect specimen is at hand and has a reticulated structure on the external surface with posterior depressed area separated by posterior ridge running from near beak to posterior ventral margin.

Locality; Loc. no. 81 (rare).

Subgenus *Abarbatia* Dall, Bartsch and Rehder, 1938

Barbatia (Abarbatia) decussata (Sowerby, 1833)

Figs. 8-3a—3b.

- 1833, *Byssarca decussata* Sowerby, 22. (*non* Linnaeus, 1758)
- 1844, *Arca lima* Reeve, *Arca* sp. 101. (*vide* Noda, 1966)
- 1844, *Arca decussata*, Reeve, *Arca* sp. 81. (*non* Linnaeus, 1758; *vide* Noda, 1966)
- 1935, *Barbatia decussata*, Otuka, 884, pl. 55, fig. 118.
- 1941, *Barbatia decussata*, Hatai, 54-55, pl. 41, figs. 4-6, pl. 42, figs. 2-3.
- 1966, *Barbatia (Barbatia) decussata*, Noda, 59-60, pl. 1, figs. 1-3, 13-14, 17, pl. 6, figs. 17-18.
- 1967, *Barbatia (Abarbatia) decussata*, Habe and Kosuge, 123, pl. 45, fig. 18.
- 1971, *Barbatia (Abarbatia) lima*, Kuroda *et al.*, 329, 521, pl. 67, fig. 18.
- 1981, *Barbatia decussata*, Kira, 122, pl. 43, fig. 12.
- 1988b, *Barbatia (Barbatia) decussata*, Noda, 114, pl. 1, figs. 9a-12b.
- 1993, *Barbatia (Barbatia) decussata*, Okumura and Takei, pl. 33, figs. 9a-b.

Remarks; The present species is already discussed by Noda (1966) and the synonymous list was presented by Noda (1988b). The species is defined by small in size and fine radial ribs crossed with concentric growth lines making granular structure at their crossing. The posterior radial ribs are rather wide and dichotomous but these on middle to anterior part are narrower.

Localities; Loc. nos. 81 (rare), 84, (rare).

Subfamily Striarcinae Noetring, 1930

Genus *Spinearca* Iredale, 1939

Hiroshi Noda

Spinearca fausta (Habe, 1951)

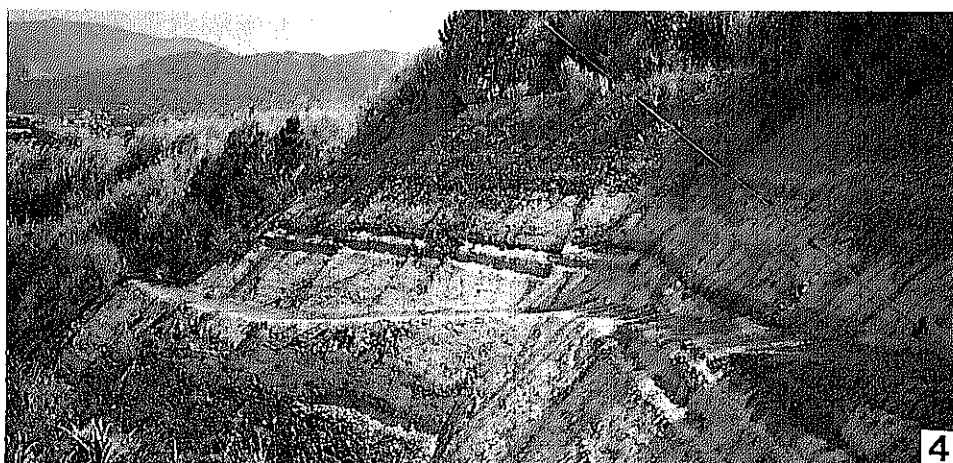
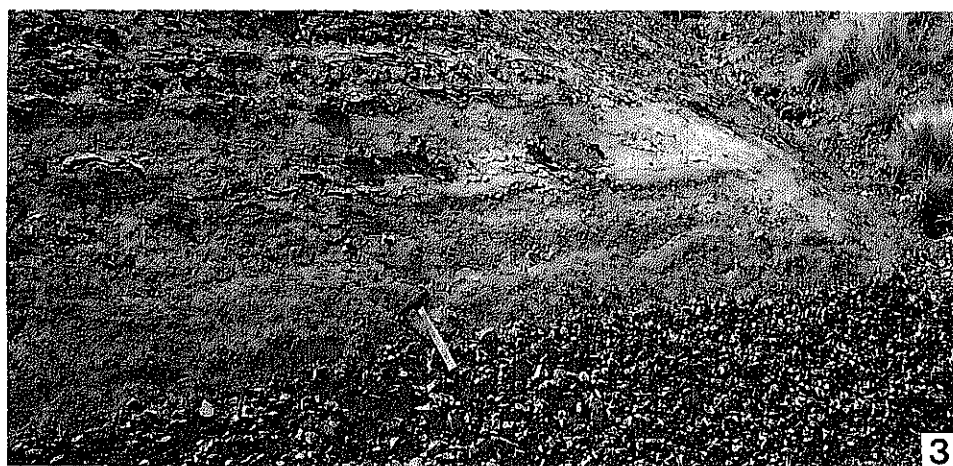
1951, *Striarca* (*Spinearca*) *fausta* Habe, 38, fig. 62.

1964, *Striarca* (*Spinearca*) *fausta*, Habe, 163, pl. 49, fig.

3.

1971, *Spinearca fausta*, Kuroda *et al.*, 333, 527, pl. 117, figs. 13-14.

1988b, *Spinearca fausta*, Noda, 123, pl. 2, figs. 2a-3c.



Remarks; The present species was formerly reported from the Haneji Formation by Noda (1988b).

Locality; Loc. no. 81 (rare).

Genus *Verilarca* Iredale, 1939

Verilarca interplicata (Grabau and King, 1928)
Fig. 8-6.

1928, *Arca (Barbatia) interplicata* Grabau and King, 161, pl. 1, fig. 9. (*vide* Habe, 1958)

1933, *Arca (Barbatia) yokoyamai* Nomura, 41, pl. 1, figs. 3a-d.

1935, *Barbatia (Trigonostoma) yokoyamai*, Kuroda, 15, fig. 33.

1935, *Barbatia yokoyamai*, Otuka, 883, pl. 55, fig. 112.

1954, *Striarca (Galactella) yokoyamai*, Taki and Oyama, 32, pl. 18, figs. 7a-8b.

1958, *Striarca (Spinearca) interplicata*, Habe, 255, pl. 12, fig. 15.

1963, *Striarca interplicata*, Yamada, figs. 3a-b.

1966, *Striarca interplicata*, Noda, 72, pl. 11, figs. 16-18.

1968, *Striarca (Verilarca) interplicata*, O'Hara, 54, pl. 1, fig. 23.

1971, *Verilarca interplicata*, Kuroda *et al.*, 332, 526, pl. 67, fig. 8.

1973, *Striarca (Galactella) interplicata*, Oyama, 79, pl. 26, figs. 3-4.

1977, *Arcopsis interplicata*, Habe, 41, pl. 7, figs. 3-4.

1981, *Striarca (Spinearca) interplicata*, Kira, 108, pl. 41, fig. 1.

1985, *Striarca (Galactella) interplicata*, Matsuura, pl. 32, fig. 16.

1988b, *Arcopsis interplicata*, Noda, 122, pl. 2, figs. 1a-c.

1990, *Verilarca interplicata*, Baba, 240, pl. 23, fig. 15.

Remarks; The present species is recorded from Pliocene to Recent. The species is distinguished *V. yokoyamai* in having high subquadrate form and ventral inner crenulations. The species is common in the warm water seas, however, there are some confusion for the classification in the genus level. The species has distinct and fine radial ribs, internal crenulations on the internal ventral margin, no ligamental grooves, and gape between anterior and poste-

rior teeth. The species is distinguished from *Striarca symmetrica*.

Localities; Loc. no. 81, no. 84, no. 109 (rare).

Genus *Trisidos* Roeding, 1798

Trisidos sp.

Fig. 8-12.

Remarks; Only one imperfect specimen was examined. The anterior part is narrow and slender but the posterior flat part wide and swollen. The uneven external surface is sculptured with fine radial ribs. The ligamental area is low and narrow. The present unnamed species resembles *Trisidos kiyonoi* Kuroda but it was remained unnamed because of ill preservation.

Locality; Loc. no. 87 (rare).

Subfamily Anadarinae Reinhart, 1935

Genus *Anadara* Gray, 1847

Subgenus *Scapharca* Gray, 1847

Anadara (Scapharca) suzukii (Yokoyama, 1926b)

Fig. 8-9.

1926b, *Arca suzukii* Yokoyama, 368, pl. 42, figs. 6-7.

1928b, *Arca (Scapharca) philippiana*, Yokoyama, 103-104, pl. 17, figs. 4-5.

1951, *Anadara (Dilvarca) suzukii*, Oyama, pl. 16, fig. 13.

1958, *Anadara tricenocosta*, Makiyama, pl. 54, figs. 6-7. (reproduction of Yokoyama's *Arca suzukii*, 1926)

1965, *Anadara (Scapharca) suzukii*, Noda, 100, pl. 10, figs. 3-7, 10-13, pl. 11, figs. 9-10.

1966, *Anadara (Scapharca) suzukii*, Noda, 111, pl. 8, fig. 2.

1981, *Anadara (Scapharca) suzukii*, Masuda and Ogasawara, pl. 2, fig. 1.

1986, *Anadara (Scapharca) suzukii*, Masuda *et al.* in Sato *et al.*, 12, pl. 1, fig. 13.

1988b, *Anadara (Scapharca) suzukii*, Noda, 118-119, pl. 4, figs. 11a-b.

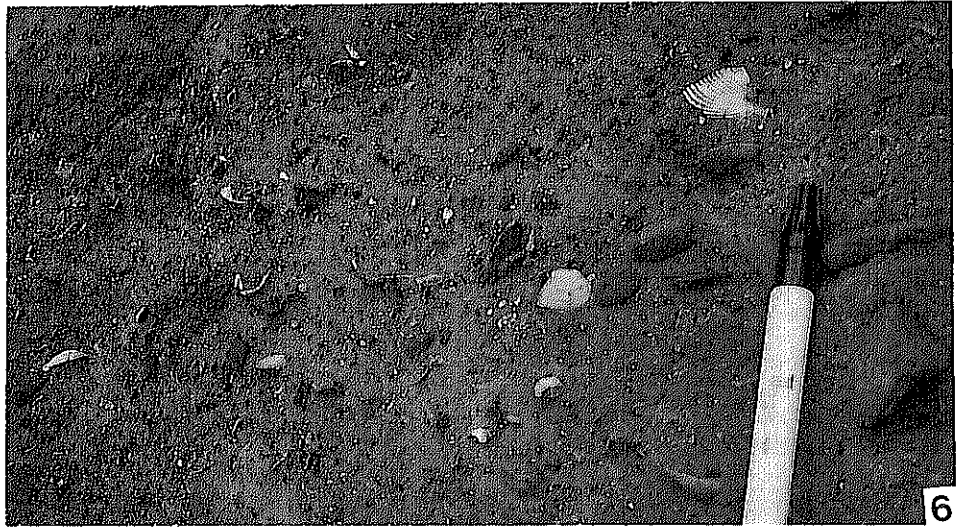
1993, *Anadara (Scapharca) suzukii*, Okumura and Takei, 158, pl. 33, fig. 7. (non fig. 15).

1993, *Anadara (Tosarca) tosaensis*, Okumura and Takei, pl. 33, fig. 14. (missed for pl. 33, fig. 14).

Fig. 2. Unconformity and reddish weathered zone of the basal part of Nakoshi Formation at the northern side cliff of Nasada River.

Fig. 3. Basal part of the Nakoshi Formation at north of Nasada River, from where *Anadara*, *Ostrea* and other embaymetal species were occurred.

Fig. 4. Siltstone facies at the lower part of the Nakoshi Formation at the same Locality of Fig. 3.



- 1993, *Anadara* sp., Okumura and Takei, pl. 34, figs. 5a-b.
1993, *Anadara suzukii*, Katto and Masuda, 9, pl. 1, figs. 4a-5b.
1998, *Anadara (Scapharca) suzukii* (Yokoyama), Ozawa *et al.*, 88-89, pl. 17, figs. 1a-b.

Remarks; After the original description from the Pliocene Ananai Formation in Kochi Prefecture by Yokoyama (1926), the species has been well known among the Pliocene-Pleistocene formations in the southwestern part of Japan. Though the present species resembles the Recent species *Anadara (Scapharca) tricenica* as mentioned by Makiyama (1958) and Noda (1963), *Anadara suzukii* has 24-25 non-dichotomous radial ribs and swollen shell. The species is an extinct species and is restricted to occur from the Pliocene to Pleistocene formations in the southwestern part of Japan. The most allied species, *Anadara ferruginea* is distinguished from the present species in having much more radial ribs. *Anadara suzukii* is also allied to *Anadara (S.) tricenica* as already mentioned by Noda (1963, 1966). Though Habe (1965) considered that *Anadara tricenica* is synonymous with *Anadara ferruginea* described four years prior to the former but is distinguished from the latter in having straight dorsal part. At the present, the species is known from the Takanabe, Ananai, Dainichi and Nakoshi Formations and its some correlated formations in southwest Japan. Schenck and Reinhart (1938) described *Anadara (Anadara) ferruginea waloensis* from the Pliocene to Pleistocene formation in Mindanao, the Philippines. At the time, they classified *Anadara ferruginea* into five subspecies as *A. f. ferruginea*, *A. f. dautzenbergi* (Lamy) from Caledonia, *A. f. timorensis* (Koperberg) from Timor, *A. f. waloensis*, n. subsp. from Philippines and *A. f. waylandi* (Cox) from Africa. The oldest comes from the Early Oligocene to Late Miocene in Africa. Number of radial ribs among these subspecies, the oldest subspecies has 21 and the youngest subspecies has 27 radial ribs. The num-

ber of radial ribs among these subspecies, increases from older to younger in age. This tendency is similar to these of *Anadara suzukii* to *Anadara tricenica* in southwest Japan (Noda, 1963).

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (rare), no. 88 (rare).

Anadara (Scapharca) taiwanica Noda, 1966
Figs. 8-11a-11b.

1966, *Anadara (Scapharca) taiwanica* Noda, 112-113, pl. 10, figs. 4-6.

Remarks; The present species was originally described from the Pliocene Miaoli Formation in Taiwan by Noda (1966). This is the first record from Japan, so the present occurrence from Okinawa expands the geographical distribution of the species. The Okinawan species is swollen inequivalve with 37-38 non-dichotomous radial ribs crossed with concentric growth line making small nodes structure on the sides of radial ribs. In comparison with both species from Okinawa and Formosa, the Okinawan specimen is smaller in size than the Formosan specimens.

Locality; Loc. no. 81 (rare).

Anadara (Scapharca) kotakai Noda, 1988
1988b, *Anadara (Scapharca) kotakai* Noda, 118.

Remarks; The present species was first described from the Haneji Formation by Noda (1988b). The present species is characterized by moderate swollen shell and 38-39 flat-topped radial ribs. The species is allied to *A. iwashibarensis* in shell form but has more larger number of radial ribs.

Locality; Loc. no. 81 (rare).

Subgenus *Hataiarca* Noda, 1966
Anadara (Hataiarca) takaoensis (Nomura, 1933)
Figs. 8-4a-4b

Fig. 5. Distant view of the fossil dominant locality (Loc. no. 84) at Kogachi.

Figs. 6-7. Fossiliferous calcareous sandstone with pebbles (Fig. 6) and massive siltstone but dominant in molluscan fossils (Fig. 7) of the Nakoshi Formation (Loc. no. 84).

- 1933, *Arca takaensis* Nomura, 39, pl. 3, figs. 2-5.
1941b, *Anadara (Scapharca) takaensis*, Yabe and Hatai, 73-74, pl. 7, figs. 2, 3, 6.
1965, *Anadara (Scapharca) takaensis*, Noda, 101, pl. 10, fig. 14, pl. 11, figs. 3-6.
1966, *Anadara (Scapharca) takaensis*, Noda, 112-113, pl. 10, fig. 1.
1984, *Anadara takaensis*, Nohara and Miyagi, pl. 1, fig. 4.
1988b, *Anadara (Hataiarca) takaensis*, Noda, 119, pl. 4, figs. 10a-b.
1990a, *Anadara (Scapharca) takaensis*, Masuda and Huang, 142, pl. 1, figs. 8-10.

Remarks; The present species is characterized by having 24-25 non-dichotomous distinct radial ribs with nodes, and posterior keel running from near beak to posterior ventral corner. As well discussed by Noda (1988b), the species is distinguished from *A. (H.) nodai* in having elongated shell with distinct 24-25 radial ribs with no nodes on radial ribs, *Anadara (H.) kogachiensis* is distinguished from the present species in having a small umbonal angle and elongated posterior margin.

Localities; Loc. no. 81 (rare), no. 84 (common), no. 88 (common).

Anadara (Hataiarca) kogachiensis Noda, 1971
Figs. 8-5a-5b, 10, 9-7-8b.

- 1971, *Anadara (Hataiarca) kogachiensis* Noda, 37-38, pl. 6, figs. 1-5, 8-17.
1978, *Anadara (Hataiarca) kogachiensis*, Minoura, 1-8.
1988b, *Anadara (Hataiarca) kogachiensis*, Noda, 119, pl. 4, figs. 5-6.

Remarks; The present species is common in the lower part of Nakoshi Formation and is characterized by having 25-26 low, flat-topped radial ribs, depressed area on posterior side separated by longitudinal ridge running from near beak to posterior ventral corner, and narrow umbonal angle. The present species was well discussed morphologically by Noda (1971) and Minoura (1978). The present species resembles the Recent species, *Anadara subcrenata* in having similar shell form and posterior depressed part, but the present species has small number of radial ribs and elongated posterior side, particularly in genomic forms.

Localities; Loc. no. 81 (common), no. 83 (common), no. 84 (rare), no. 109 (few), no. 114 (few).

Subgenus *Tosarca* Noda, 1965

Anadara (Tosarca) sedanensis (Martin, 1910)
Fig. 8-8.

- 1910, *Arca (Scapharca) sedanensis*, Martin, 381, pl. 54, figs. 125-127. (*vide* Noda, 1988b)
1933, *Arca (Arca) sedanensis*, Nomura, 38, pl. 4, fig. 16.
1941b, *Anadara (Scapharca) sedanensis*, Yabe and Hatai, 73, pl. 7, fig. 9.
1965, *Anadara (Tosarca) sedanensis*, Noda, pl. 11, figs. 1-2.
1966, *Anadara (Tosarca) sedanensis*, Noda, 123, tab. 26.
1986, *Anadara (Tosarca) sedanensis*, Masuda *et al.* in Sato *et al.*, 11, pl. 1, fig. 6.
1988b, *Anadara (Tosarca) sedanensis*, Noda, 120, pl. 3, figs. 6a-6b, 11.
1990a, *Anadara (Tosarca) sedanensis*, Masuda and Huang, 142, pl. 1, figs. 5-7.

Remarks; The present species is characterized by its large subquadrate shell with slightly elevated 45-50 radial ribs with flat-top and narrow ligamental area. The radial ribs of the ventral part are bi-furcated. The present species quite resembles *Anadara (Tosarca) tosaensis* described from the Plio-Pleistocene Ananai Formation in Kochi Prefecture but the latter has bifurcated ribs only on both sides of shell and small number (about 40) of radial ribs. *Anadara (Tosarca) vellicata* is another allied species but the species is distinguished from *A. (T.) sedanensis* in having narrow anterior part and small number of radial ribs. The subgenus *Tosarca* is a quite distinguishable among the genus *Anadara* as Habe (1977) treated it as a genus. *Tosarca* is known only from the Late Miocene to Pleistocene formations in Japan and Southeast Asia. Also, Woodring (1973) mentioned that the some species of the subgenus *Tosarca* are distributed in the Late Miocene to Pliocene in the Panama region. Biogeographically, the present genus or subgenus is probably distributed in more wide.

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 88 (rare).

Family Cucullaeidae Stewart, 1930

Genus *Cucullaea* Lamarck, 1802

Subgenus *Cucullaea* s.s.

Cucullaea (s.s.) *granulosa* Jonas, 1846

Fig. 8-14.

- 1846, *Cucullaea granulosa* Jonas, 36. (*vide* Habe, 1964)
1869, *Cucullaea granulosa*, Reeve, pl. 1, figs. 2a-b. (*vide* Noda, 1966)
1891, *Cucullaea granulosa*, Kobelt in Martin and Chemnitz, 6, pl. 1, fig. 5. (*vide* Noda, 1966)
1891, *Cucullaea concamerata*, Kobelt in Martini and Chemnitz, 5, pl. 1, figs. 3-4, pl. 5, figs. 1-2. (*vide* Noda, 1966)
1926a, *Cucullaea concamerata*, Yokoyama, 360, pl. 41, fig. 2.
1928a, *Cucullaea concamerata*, Yokoyama, 107, pl. 18, figs. 4-5.
1929, *Cucullaea concamerata*, Yokoyama, 17, pl. 8, fig. 2.
1930, *Cucullaea labiosa* var. *granulosa*, Kuroda, 34, fig. 40.
1933, *Cucullaea granulosa*, Nomura, 44, pl. 4, fig. 2.
1960, *Cucullaea granulosa*, Makiyama, pl. 104, figs. 4-5a.
1960, *Cucullaea granulosa*, Makiyama, pl. 115, fig. 2.
1964, *Cucullaea labiosa granulosa*, Habe, 261, figs. 1-2.
1971, *Cucullaea labiosa granulosa*, Kuroda *et al.*, 516, pl. 70, figs. 1-2.
1977, *Cucullaea labiosa granulosa*, Habe, 43, pl. 6, figs. 1-2.
1984, *Cucullaea labiosa granulosa*, Wang, pl. 5, figs. 1a-b.
1986, *Cucullaea granulosa*, Masuda *et al.*, in Sato *et al.*, 15, pl. 1, fig. 17.
1988b, *Cucullaea granulosa*, Noda, 124, pl. 2, figs. 13a-16.
1990a, *Cucullaea (Idonearca) granulosa*, Masuda and Huang, 143, pl. 2, figs. 3, 5, 7.
1993, *Cucullaea granulosa*, Okumura and Takei, 156, pl. 34, figs. 10a-c.
1993, *Cucullaea labiosa granulosa*, Katto and Masuda, 9, pl. 1, figs. 6a-b.
1993, *Bathyarca kyurokushimana*, Okumura and Takei, 156-157, pl. 34, fig. 10.
1994b, *Cucullaea granulosa*, Masuda and Huang, 391, pl. 1, figs. 10-11.
1995, *Cucullaea granulosa*, Nobuhara, fig. 7-6.
1998, *Cucullaea labiosa granulosa*, Ozawa *et al.*, 91-92, pl. 18, fig. 4.

Remarks; The present species is characterized by having large subquadrate shell with fine radial ribs crossed with concentric growth lines making a reticulated structure, fine crenulation

on internal ventral margin, horizontal teeth on both extremities, narrow trigonal ligamental area with grooves and thin plate along the posterior muscle scar. The present species is distributed mainly in sandy bottom in worm water seas.

Localities; Loc. no. 81 (rare), no. 84 (few), no. 87 (rare).

Family Glycymerididae Newton, 1922

Subfamily Glycymeridinae Newton, 1922

Genus *Glycymeris* Da Costa, 1778

Subgenus *Glycymeris* Da Costa, 1778

Glycymeris (Glycymeris) formosana (Yokoyama, 1928a)

Fig. 8-13.

- 1928a, *Pectunculus formosanus* Yokoyama, 106, pl. 18, figs. 1-3.
1941b, *Glycymeris formosanus*, Yabe and Hatai, 72-73, pl. 7, figs. 5, 7-8.
1990a, *Glycymeris* sp., Masuda and Huang, 144, pl. 3, fig. 5.
1993b, *Glycymeris formosanus*, Masuda and Huang, 262-263, pl. 2, figs. 1-2b.

Remarks; The present species is characterized by its sub-rounded shell with almost flat radial ribs separated by linear interspaces. The flat radial ribs are very finely striated. The species resembles *Glycymeris albolineata* in form but the latter has a dotted structure on the external surface.

Localities; Loc. no. 81 (rare), no. 87 (few), no. 88 (dominant).

Genus *Tucetilla* Iredale, 1939

Tucetilla pilsbryi (Yokoyama, 1920)

Figs. 8-2a-2b.

- 1920, *Pectunculus pilsbryi* Yokoyama, 170, pl. 18, figs. 8a-c.
1922b, *Pectunculus pilsbryi*, Yokoyama, 190, pl. 16, figs. 8-9.
1961, *Glycymeris (Tucetilla) pilsbryi*, Habe, 112, pl. 50, fig. 1.
1968, *Glycymeris (Tucetilla) pilsbryi*, O'Hara, pl. 2, figs. 4a-b.
1971, *Glycymeris (Tucetilla) pilsbryi*, Kuroda *et al.*, 336-337, 533, pl. 71, figs. 7-8.
1973, *Glycymeris (Tucetilla) pilsbryi*, Oyama, 77, pl. 22, figs. 8-9.

- 1977, *Tucetilla pilsbryi*, Habe, 47, pl. 8, fig. 8.
1980, *Glycymeris (Tucetilla) pilsbryi*, Noda, 79-80.
1986, *Glycymeris (Tucetilla) pilsbryi*, Matsukuma and Okamoto, figs. 2-H.
1986, *Tucetilla pilsbryi*, Takayasu *et al.*, pl. 55, figs. 6a-b, 9a-b.
1988a, *Glycymeris (Tucetilla) pilsbryi*, Noda, 65-66, pl. 16, fig. 21.
1989, *Tucetilla pilsbryi*, Ito, pl. 19, fig. 4.
1991, *Glycymeris (Tucetilla) pilsbryi*, Noda, 14, figs. 6-12, 14-17, 19a-20b.
1998, *Tucetilla pilsbryi*, Okumura and Ueda, 72, pl. 8, fig. 19.

Remarks; The present species is defined by its indistinct narrowly elevated radial ribs.

Locality; Loc. no. 87 (rare).

Family Mytilidae Rafinesque, 1815
Subfamily Musculinae Iredale, 1939
Genus *Musculista* Yamamoto and Habe, 1958
Musculista cf. japonica (Dunker, 1857)
Figs. 12-8-9.

Remarks; The present species is small and fragile but its fine radial riblets and obliquely elongated shell are well identical with the named species.

Locality; Loc. no. 88 (rare).

Subfamily Modiolinae Keen, 1958
Genus *Modiolus* Lamarck, 1799
Modiolus sp.
Figs. 12-11-12.

Remarks; Small specimens are collected and are defined by having thin obliquely elongated shell with very fine radial riblets. The present unnamed species is well identical with *Modiolus* sp. (Noda, 1971, p. 39, pl. 7, fig. 15) from the Nakoshi Formation.

Locality; Loc. no. 109 (rare).

Family Pteriidae Gray, 1847
Genus *Pteria* Scopoli, 1777
Pteria cf. coturnix (Dunker, 1882)

Compared with;

- 1882, *Avicula coturnix* Dunker, 288, pl. 10, figs. 1-2. (*vide* Noda, 1971)
1971, *Pteria cf. coturnix*, Noda, 38-39, pl. 7, fig. 16.

Remarks; The present species was recorded and illustrated from the Kogachi Member of the Nakoshi Formation by Noda (1971).

Locality; Loc. no. 84 (rare).

Family Pinnidae Leach, 1819
Genus *Atrina* Gray, 1847
Atrina sp.
Fig. 16-3.

Remarks; Only one incomplete joined shells was examined. The specimen is trigonally elongated with fine longitudinal ribs on anterior and concentric ribs on posterior side of shell, and narrow apical angle are referred to the genus *Atrina*. The present species resembles *Atrina pectinata* which was illustrated from the Pliocene to Pleistocene formations in southwest Japan (Okumura and Koyanagi, 1989, Okumura and Takei, 1993) in shell form but remained unnamed for more complete specimen.

Locality; Loc. no. 87 (rare).

Family Pectinidae Rafinesque, 1815
Subfamily Chlamydyinae Korobokov, 1960
Genus *Chlamys* Roeding, 1798
Subgenus *Azumapecten* Habe, 1977
Chlamys (Azumapecten) subsquamatus (Nomura, 1933)
Figs. 10-4-5, 7.

- 1933, *Pecten (Pecten) subsquamatus* Nomura, 53-54, pl. 1, figs. 11a-b.
1984, *Chlamys* sp. B., Nohara and Miyagi, pl. 1, fig. 6.

Remarks; The present species was originally described from the Pliocene Byoritsu Beds in Formosa by Nomura (1933). The present species is characterized by rather swollen left valve and flat right valve. The external surface of the left valve is sculptured by 4-5 elevated primary radial ribs with scales and secondarily 3-4 finer interstitial riblets.

The present species resembles the Recent species, *Ch. squamata* (Gmelin) in shell form and external sculptures, but it differs from the latter in having 1-3 smoothly rounded finer interstitial riblets. According to Masuda and

Huang (1993b), the present species is same with *Chlamys* (*C.*) *squamata* ranges from the Pliocene. However, the difference in the immature stage is quite clear as mentioned by Baba (1990, pl. 25, figs. 10a-b). *Chlamys nipponensis* (Kuroda, 1932) is another allied species but it is differentiated from the latter by having distinct primal ribs with scales. *Chlamys* (*Azumapecten*) *squamata* var. (Masuda, 1962, pl. 9, figs. 5-7) is quite similar to the present species but it has 5-6 scaly primal radial riblets on posterior and secondarily narrow elevated ribs with elongated anterior auricle.

Localities; Loc. no. 84 (rare), no. 87 (rare).

Subgenus *Mimachlamys* Iredale, 1929

Chlamys (*Mimachlamys*) *satoi* (Yokoyama, 1928)

Figs. 10—8-9c.

- 1928a, *Pecten* (*Chlamys*) *satoi* Yokoyama, 94, pl. 13, figs. 13-14, pl. 14, fig. 2.
 1932, *Pecten kakisakiensis*, Nomura and Niino, 177, pl. 12, figs. 3, 4.
 1960, *Gloripallium satowi*, (*sic*), Shuto, 119-120, pl. 12, fig. 5.
 1960, *Mimachlamys* cf. *minicea*, Shuto, 122, pl. 13, fig. 4.
 1960, *Chlamys satoi*, Makiyama, pl. 99, figs. 13-14, pl. 100, fig. 2.
 1962, *Chlamys* (*Mimachlamys*) *satoi*, Masuda, 189, pl. 19, figs. 18-19, pl. 22, fig. 14.
 1980, *Chlamys satoi*, Masuda, pl. 3, fig. 1.
 1981, *Chlamys satoi*, Masuda and Ogasawara, pl. 2, fig. 3.
 1984, *Chlamys* sp. A., Nohara and Miyagi, pl. 1, fig. 5.
 1986, *Chlamys* (*Mimachlamys*) *satoi*, Masuda et al. in Sato et al., 21-23, pl. 2, figs. 9, 10.
 1986a, *Chlamys satoi*, Masuda, pl. 10, fig. 3.
 1986, *Chlamys satoi*, Takahashi, pl. 13, fig. 1.
 ?1988, *Chlamys satoi*, O'Hara and Nemoto, 488-489, pl. 1, figs. 4, 5.
 1990a, *Chlamys* (*Mimachlamys*) cf. *satoi*, Masuda and Huang, 114, pl. 3, figs. 12-15.
 1991, *Chlamys satoi*, Noda, 17-19, figs. 7-5, 10, 13.
 1993b, *Chlamys* (*Mimachlamys*) *satoi*, Masuda and Huang, 263, pl. 2, figs. 4-9.
 1993, *Chlamys satowi*, (*sic.*), Okumura and Takei, 163, pl. 36, figs. 4-5.
 1993, *Chlamys satoi*, Katto and Masuda, 10, pl. 2, figs. 6-7.
 1993, *Chlamys satoi*, Nobuhara, fig. 7-7.
 1994b, *Chlamys* (*Mimachlamys*) *satoi*, Masuda and

- Huang, 509-510, pl. 2, figs. 1-7.
 1998, *Chlamys* (*Mimachlamys*) *satoi*, Ozawa et al., 96-97, pl. 23, fig. 7.

Remarks; The present species was originally described from the Upper Byoritsu Bed in Formosa by Yokoyama (1928a). Thenceafter the present species has been well known to occur from the Pliocene formations distributed along the southwestern Pacific Ocean side of Southwest Honshu, Japan (Masuda, 1962 and others). However, as Masuda and Huang (1994a, b) mentioned, the type locality of the species is unknown in stratigraphic horizon and also exact locality as mentioned by Yokoyama (1928a), they proposed the neotype collected from the Toukoushan Formation (Upper Byoritsu Beds) at Houlung, Miaoli Hsien. In addition, they concluded firstly that the species is come from Late Miocene Kueichulin Formation up to the Pleistocene. The species is defined by having 26-28 flat-topped radial ribs with scales on their top and both sides of them, and interstitial. According to the detail study on this species, Masuda (1962) mentioned that *Pecten kakizakiensis* and *Mimachlamys* cf. *minica* of Shuto (1960) are synonymous with the present species. The Nakoshi specimens attain more than 100 mm in size. *Chlamys gracilisquamosa* (Fischer, 1927) from the Seran Pliocene very resembles to the species in the scaly radial ribs and shell profile.

Localities; Loc. no. 84 (rare), no. 87 (few), no. 88 (rare).

Chlamys (*Mimachlamys*) *gracilisquamosus* (Fischer, 1927)

Figs. 10-1a—2b.

- 1927, *Pecten* (*Chlamys*) *gracilisquamosa* Fischer, 114, pl. 215, figs. 102a-c.
 1936, *Pecten* (*Pecten*) *gracilisquamosus*, Nomura and Zinbo, 235, pl. 11, fig. 1.
 1984, *Chlamys* sp. C, Nohara and Miyagi, pl. 1, fig. 7.

Remarks; The present species was originally described by Fischer (1927) from Pliocene in Seran. Thenceafter, the species was recorded from the Pliocene formation in Okinawa by

Nomura and Zinbo (1936). The left valve of the species is characteristic in having 29-30 radial ribs with fine scales, deep and wide byssal notch, trigonal anterior auricle ear, and distinct ctenolium. The species resembles *Ch. satoi* described in the earlier lines, but radial ribs are larger in number, and has finer scales. It is interesting to note that the Indonesian species, *Ch. gracilisquamosa* has 25 ribs (Fischer, 1927), Formosan species about 27-28 (Nomura and Zinbo, 1936), and Okinawan species has 28-30 though the ribs on both sides are quite fine.

Localities; Loc., no. 84 (rare), no. 87 (rare), no. 88 (rare).

Genus *Cryptopecten* Dall, Bartsch and Rehder, 1938

Cryptopecten cf. *nux nux* (Reeve, 1853)
Figs. 10-6a-6b.

Remarks; The present species was discussed in detailed by Hayami (1984) and complete synonymous list of the species was also made. The present species ranges from the Early Miocene in Tanzania (Eames and Cox, 1956) to Pliocene in Keniya (Cox, 1930).

The species is also described from the Pliocene Miaoli Formation in Formosa (Nomura, 1933) so that the distribution expands up to the southwest Japan via Okinawa.

Locality; Loc. no. 81 (rare).

Cryptopecten vesiculosus (Dunker, 1877)
Fig. 10-3

- 1988, *Cryptopecten vesiculosus*, Yoon, pl. 4, fig. 2.
1988, *Cryptopecten vesiculosus*, O'Hara and Nemoto, 489-490, pl. 2, figs. 1, 3.
1988, *Aequipecten vesiculosus*, Okumura, 41, pl. 13, figs. 6, 9-11.
1988, *Cryptopecten vesiculosus*, Mizuno and Amano, pl. 14, figs. 10, 15.
1990, *Cryptopecten vesiculosus*, Baba, 252, pl. 25, figs. 16a-b.
1991, *Cryptopecten vesiculosus*, Noda, 19, figs. 9-5, 8a-10b.
1993, *Cryptopecten vesiculosus*, Nobuhara, fig. 8-7.
1993, *Aequipecten vesiculosus*, Okumura and Takei, 164, pl. 36, figs. 2, 3, 6, 9.

Remarks; The synonymous list was already given by Hayami (1984). The present species was rare in the Nakoshi Formation.

Locality; Loc. no. 87 (rare).

Genus *Decatopecten* Sowerby, 1838
Decatopecten striatus (Schumacher, 1817)
Figs. 9-3a-3b, 6a-6b.

- 1817, *Pecten striatus* Schumacher, 120, pl. 4, fig. 4 (*vide* Oyama, 1973).
1922b, *Pecten subplicatus*, Yokoyama, 181, pl. 15, fig. 3.
1924, *Pecten plica*, Yokoyama, 56, pl. 4, fig. 11.
1951, *Decatopecten striatus*, Habe, 78, figs. 153-154.
1954, *Decatopecten striatus*, Taki and Oyama, pl. 35, fig. 3, pl. 41, fig. 11.
1961, *Decatopecten striatus*, Hayasaka, 30-31, pl. 3, figs. 11a-b.
1964, *Chlamys (Decatopecten) striatus*, Shikama, 51, pl. 31, figs. 1-5.
1968, *Decatopecten striatus*, O'Hara, 162, pl. 5, fig. 1.
1970, *Decatopecten striatus*, Habe and Kosuge, 135, pl. 50, fig. 16.
1971, *Decatopecten striatus*, Kuroda *et al.*, 365, 573, pl. 79, fig. 8.
1973, *Decatopecten striatus*, Oyama, 85, pl. 33, figs. 5-6.
1977, *Decatopecten striatus*, Habe, 85, pl. 16, figs. 1-2.
1990, *Decatopecten striatus*, Baba, 253, pl. 25, figs. 19a-b.

Remarks; The present species is rather common in the Nakoshi Formation. The species is defined by having subequilateral shell, well round ventral margin, flat umbonal area, 3-5 main radial ribs with concentric step and fine riblets on and internal ribs, 2-3 paired inner ribs on ventral border, fine crenulation on inner ventral margin, rather small muscle scar, trigonal ear, elongated cardinal crura and no byssal notch. The right valve is smoothly swollen but light valve has concentric gape at ventral margin and narrowly elevated ribs.

The present species resembles *Decatopecten amicus* in shell form and external sculptures, but the latter has much number of radial ribs (7-8). *Decatopecten plica* also resembles the present species but the former has small number of radial ribs.

Localities; Loc. no. 81 (rare), no. 84 (few), no. 87 (rare), no. 88 (rare).

Decatopecten amiculum (Philippi, 1851)

Figs. 9-1-2, 4-5.

- 1851, *Pecten* (*Decatopecten*) *amicularis* Philippi (*non vidi*).
1933, *Pecten* (*Decatopecten*) *amiculum*, Nomura and Zinbo, 235, pl. 11, figs. 2a-b.
1984, *Chlamys* sp. D., Nohara and Miyagi, pl. 1, fig. 8.
1984, *Decatopecten plica*, Nohara and Miyagi, pl. 1, fig. 10.
1988a, *Decatopecten amicularis*, Noda, 69, pl. 17, fig. 11.

Remarks; The present species was already illustrated by Nomura and Zinbo (1933) from the Nakoshi Sand in Okinawa as also same of Noda (1988a). The species is defined by subcircular shell, round-topped 7-9 radial ribs, fine radial riblets in right valve and interribs on the internal margin, very fine ventral crenulations and paired internal ribs at inner ventral margin and no byssal notch. The present species resembles *Decatopecten striatus* in their similar radial ribs and shell form but the number of radial ribs is larger.

Localities; Loc. no. 81 (rare), no. 84 (common), no. 87 (rare), no. 88 (rare).

Subfamily Pectininae Rafinesque, 1815

Genus *Amussiopecten* Sacco, 1897

Amussiopecten praesignis (Yokoyama, 1922a)

Figs. 11-1a-1c.

- 1922a, *Pecten praesignis* Yokoyama, 1-2, pl. 5, figs. 1-3.
1926a, *Pecten* (*Amustum*) *praesignis*, Yokoyama, 357-358, pl. 40, figs. 1-2, pl. 41, fig. 1. (same with Yokoyama, 1922a)
1928a, *Pecten* (*Amustum*) *praesignis*, Yokoyama, 96, pl. 15, fig. 1.
1931, *Amustum* (*Amussiopecten*) *praesignis*, Kuroda, 77, fig. 80.
1938, *Amussiopecten praesignis*, Otuka, 6, pl. 1, fig. 2.
1941a, *Pecten praesignis*, Yabe and Hatai, 465-466, pl. 11, fig. 1.
1955, *Amussiopecten praesignis*, Shuto, 103-104, pl. 17, figs. 1, 3.
1957, *Amussiopecten praesignis*, Akiyama, 33-34, pl. 7, figs. 5-6.
1958, *Amussiopecten praesignis*, Makiyama, pl. 52, figs. 1-2, pl. 53, fig. 1.
1960, *Pecten* sp., Aoki, 304, pl. 34, figs. 7-9.
1962, *Amussiopecten praesignis*, Masuda, 226, pl. 27, figs. 4-5.

- 1966, *Amussiopecten praesignis*, Aoki, 255, pl. 31, figs. 8a-b.
1973, *Amussiopecten praesignis*, Hayasaka, 101, pl. 6, fig. 2.
1973, *Amussiopecten praesignis*, Kanno and Chang, pl. 30, fig. 11.
1978, *Amussiopecten praesignis*, Okamoto and Honza, fig. 3.
1978, *Amussiopecten praesignis*, Okamoto, figs. X-1, 1a-b.
1980, *Amussiopecten* sp., Noda, 83, pl. 4, fig. 17.
1980, *Amussiopecten praesignis*, Masuda, pl. 3, fig. 2.
1980, *Amussiopecten praesignis*, O'Hara and Ito, 131-132, pl. 14, figs. 5-7, pl. 15, figs. 1-5.
1981, *Amussiopecten praesignis*, Masuda and Ogasawara, pl. 2, fig. 4.
1981, *Amussiopecten praesignis*, Tsuchi, pl. 4, fig. 2.
1984, *Amussiopecten praesignis*, Nohara and Miyagi, pl. 1, figs. 1a-2.
1984, *Amussiopecten* sp., Nohara and Miyagi, pl. 1, fig. 3.
1986, *Amussiopecten praesignis*, Masuda *et al.* in Sato *et al.*, 19-21, pl. 2, figs. 3a-b.
1986b, *Amussiopecten praesignis*, Masuda, pl. 10, fig. 1.
1988, *Amussiopecten praesignis*, Tsuchi *ed.*, pl. 4, fig. 2.
1988a, *Amussiopecten* sp., Noda, 69, pl. 17, fig. 12.
1990, *Amussiopecten praesignis*, Baba, 255, pl. 26, figs. 5a-b.
1991, *Amussiopecten praesignis*, Noda, 21-22, figs. 9-12-13.
1993, *Amussiopecten praesignis*, Okumura and Takei, 162-163, pl. 36, fig. 1.
1993, *Amussiopecten praesignis*, Katto and Masuda, 10, pl. 3, figs. 1-2b.
1993, *Amussiopecten praesignis*, Nobuhara, figs. 7-9.
1998, *Amussiopecten praesignis*, Ozawa *et al.*, 95-96, pl. 22, figs. 1a-b.

Remarks; The present species is a well-known Pliocene extinct pelecypod in Japan. There is some variation in number of radial ribs but its characteristic features as internal paired ribs, flat-topped radial ribs ranging from 15-18 in number and shallowly angled hinge line are distinctive. Recently, Ozawa *et al.* (1998) examined the geological age as Late Miocene for those assemblage of the Majya Formation in Kume-jima Island, Ryukyu. The Majya Formation was formerly assigned to Pliocene to occur the present species and other extinct peculiar species known among the Kakegawa Fauna. The specimen illustrated from Asuka, Dainichi Formation by Ozawa *et al.* (1998) has high shell and small number of radial ribs.

Localities; Loc. no. 81 (abundant), no. 84 (few), no. 87 (rare), no. 88 (abundant).

Chlamys sp.
Fig. 11-3.

The present species is characterized by fine radial ribs and elongated anterior auricle with wide and rather deep notch as like *Chlamys nipponensis* but it remained unnamed because of indistinct preservation.

Locality; Loc. no. 88. (rare).

Family Plicatulidae Watson, 1930
Genus *Plicatula* Lamarck, 1801
Plicatula simplex Gould, 1861
Fig. 11-4.

Remarks; Only one imperfect specimen, which identified to *P. simplex* in having elongated shell with 3-4 radial ribs. Noda made the synonymous list in 1991 and 1988.

Locality; Loc. no. 87 (rare).

Family Anomiidae Rafinesque, 1815
Subfamily Anomiinae Rafinesque, 1815
Genus *Anomia* Linnaeus, 1758
Anomia chinensis Philippi, 1849
Figs. 11-2a-2b.

1849, *Anomia chinensis* Philippi, 130. (*fide* Kuroda *et al.*, 1971)
1850, *Anomia cytaeum*, Reeve, pl. 2, figs. 10a-b. (*fide* Kuroda *et al.*, 1971)
1851, *Anomia chinensis*, Philippi, 131, pl. 1, fig. 1. (*fide* Kuroda *et al.*, 1971)
1868, *Anomia chinensis*, Philippi in Martin and Chemnitz, 58, pl. 6, figs. 1-2. (*non vidi*)
1907, *Anomia lischkei*, Dautzenberg and Fischer, 210, pl. 5, figs. 8-11. (*non vidi*)
1920, *Anomia cytaeum*, Yokoyama, 146, pl. 11, figs. 17a-b.
?1920, *Anomia nipponensis*, Yokoyama, 146, pl. 11, figs. 18a-b.
1928a, *Anomia lischkei*, Yokoyama, 91-92, pl. 14, figs. 4-5.
1951, *Anomia lischkei*, Habe, 90, fig. 185.
1960, *Anomia sinensis*, Habe, pl. 4, figs. 4, 7.
?1961, *Anomia chinensis*, Hayasaka, 33, pl. 3, fig. 7.
?1965, *Anomia sinensis*, Habe and Ito, 125, pl. 42, figs. 1-2.

?1967, *Anomia chinensis*, Habé and Kosuge, 137, pl. 51, figs. 5-7.
1969, *Anomia chinensis*, Hayasaka, 42, pl. 2, figs. 3a-b.
1969, *Anomia chinensis*, Matsushima, pl. 10, fig. 4.
1971, *Anomia chinensis*, Kuroda *et al.*, 378, 590-591, pl. 84, figs. 12-14.
1974, *Anomia chinensis*, Shibata in Itoigawa *et al.*, 71, pl. 15, figs. 5-7b.
1977, *Anomia chinensis*, Habe, 97, pl. 18, figs. 3-4.
1981, *Anomia chinensis*, Kira, 118, pl. 46, fig. 8.
1981, *Anomia chinensis*, Kira, 195, pl. 71, fig. 10.
1986, *Anomia chinensis*, Masuda *et al.* in Sato *et al.*, 26-28, pl. 3, figs. 3a-b.
1986, *Anomia chinensis*, Takayasu *et al.*, pl. 31, figs. 9a-b.
1988, *Anomia chinensis*, Okumura, 43, pl. 14, fig. 12.
1990, *Anomia chinensis*, Baba, 257, pl. 28, figs. 4a-b.
1993, *Anomia chinensis*, Noda *et al.*, 143-145, figs. 16-9a, b.
1993, *Anomia chinensis*, Okumura and Takei, 167, pl. 35, fig. 7.
1995, *Anomia chinensis*, Nakao, pl. 1, figs. 6-7.
1998, *Anomia chinensis*, Ozawa *et al.*, 98-99, pl. 23, figs. 1a-2b, 4a-5b.
1998, *Anomia chinensis*, Okumura and Ueda, 75, pl. 11, fig. 5.

Remarks; The present species is common in shallow sandy facies but there are some confusion in classification due to the preservation. The present species is defined by having one pedical impression and two small round muscle scars in middle part of shell. The present species is distinguished from *Pododesmus noharai* by having small shell with subrounded pedical scar and small round muscle scar in the middle part of the inner surface.

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (rare), no. 88 (rare).

Genus *Pododesmus* Philippi, 1837
Subgenus *Monia* Gray, 1849
Pododesmus (Monia) noharai Noda, 1971
Figs. 12-10a-10b.

1971, *Pododesmus (Monia) noharai* Noda, 39-40, pl. 7, fig. 17.

Remarks; The present species was originally described from the Haneji Formation by the present writer. The species is quite dominant in the Nakoshi Formation and is defined by large

subrounded shell with fine and irregular radial ribs and three muscle scars (one pedical and two muscle scars). The species of *Pododesmus* has a variable external surface and shell forms due to their adherent habitat. The present species distinguished from *P. (M.) macroschismus* in having finer radial striations on uneven surface and two moderate muscle scars. Noda (1971) also distinguishes the present species from *P. (M.) macroschismus ezoanus* as already mentioned.

Localities; Loc. no. 84 (rare), no. 109 (common), no. 114 (common).

Family Ostreidae Rafinesque, 1815

Genus *Ostrea* Linnaeus, 1758

Ostrea denselamellosa Lischke, 1869

Figs. 11-5a-5b.

- 1869, *Ostrea denselamellosa* Lischke, 177-179, pl. 13, figs. a-b, pl. 14, fig. 1.
1906, *Ostrea denselamellosa*, Tokunaga, 68, pl. 4, fig. 6.
1922, *Ostrea denselamellosa*, Yokoyama, 162, pl. 16, fig. 6.
1922a, *Ostrea denselamellosa*, Yokoyama, 375, pl. 43, fig. 11.
1928a, *Ostrea denselamellosa*, Yokoyama, 100, pl. 16, fig. 1.
1930, *Ostrea denselamellosa*, Hirase, 5-18, figs. 4-30.
1933, *Ostrea denselamellosa*, Nomura, 46-47, pl. 4, fig. 6.
1951, *Ostrea (Ostrea) denselamellosa*, Habe, figs. 187-188 on 92.
1954, *Ostrea denselamellosa*, Taki and Oyama, pl. 16, figs. 1-2.
1963, *Ostrea denselamellosa*, Yamada, figs. 5a-b.
1965, *Ostrea denselamellosa*, Habe and Ito, 126, pl. 42, fig. 10.
1967, *Ostrea denselamellosa*, Habe and Kosuge, 137, pl. 51, fig. 9.
1971, *Ostrea (Ostrea) denselamellosa*, Noda, 40-41, pl. 7, figs. 10, 18.
1971, *Ostrea denselamellosa*, Kuroda *et al.*, 381, 595, pl. 86, figs. 2, 3.
1973, *Ostrea denselamellosa*, Oyama, 89, pl. 30, figs. 1a-b.
1977, *Ostrea denselamellosa*, Habe, 110, pl. 20, fig. 5.
1986, *Ostrea denselamellosa*, Masuda *et al.* in Sato *et al.*, 28, pl. 3, figs. 5a-b.
1988, *Ostrea denselamellosa*, Matsukuma *et al.*, pl. 3, fig. 5.
1994, *Ostrea denselamellosa*, Masuda and Huang, pl. 1, fig. 13.

Remarks; The present species is easily distinguished from allied oyster species in having irregularly radiated ribs on left valve and flat shell with concentric growth lines on left flat shell surface and finely crenulation on both sides of small ligamental pit. The present species resembles *Ostrea promensis* Noetling described from Burma in external sculptures but the Japanese species is distinguished from Burma species in having more large and distinct radial ribs.

Localities; Loc. no. 81 (rare), no. 84 (rare).

Genus *Pretostrea* Iredale, 1939

Pretostrea imbricata (Lamarck, 1819)

Figs. 12-13a-13b.

- 1819, *Ostrea imbricata* Lamarck, 213. (*non vidi*)
1873, *Ostrea imbricata*, Reeve, pl. 17, figs. 36a-b. (*vide* Kuroda *et al.*, 1971)
1930, *Ostrea (Lopha) imbricata*, Kuroda, 53, 33-35, figs. 44-47.
1982, *Pretostrea imbricata*, Habe, 120, pl. 54, fig. 17.
1967, *Pretostrea imbricata*, Habe and Kosuge, 138, pl. 51, fig. 14.
1971, *Pretostrea imbricata*, Kuroda *et al.*, 380, 593, pl. 85, fig. 8.

Remarks; As *Ostrea hyotis* quite resembles *Ostrea imbricata* in the external sculptures, Nomura (1933) stated that both species may prove to be synonym in his description of *Ostrea hyotis* collected from Formosa. Hirase (1930) prior to Nomura three years, treated it to be a subspecies of *Ostrea hyotis* and Taki (1954, 1960) supported this. The present species resembles *Ostrea junghuhnii* Martin in having narrow ligamental area and blunt crenulations on both sides of ligamental pit but the latter has more irregularly elevated radial ribs and partially spinose.

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (rare), no. 109 (rare).

Family Lucinidae Fleming, 1828

Subfamily Lucininae Fleming, 1828

Genus *Lucina* Bruguière, 1797

Lucina kuninagaensis Nomura and Zinbo, 1936
Figs. 12-1a-1b.

1936, *Lucina kumiragaensis* Nomura and Zinbo, 241-242, pl. 11, figs. 10a-11b.

Remarks; The present species was originally described from the Nakoshi Sand by Nomura and Zinbo (1936) and is defined by concentric lamellae-like striation on external surface, blunt longitudinal ridge from near beak to postero-dorsal margin, small and smooth lunule, longitudinal narrow escutcheon, and elongated anterior muscle scar. *Lucina tenuicresta* Martin of Tesch (1920) from the Pliocene in Timor, resembles the present species but differs from the latter in having rougher concentric lamellated plicae.

Localities; Loc. no. 81 (rare), no. 87 (rare).

Genus *Epicodakia* Iredale, 1930

Epicodakia delicatula (Pilsbry, 1904)

Fig. 15-1.

1904, *Epicodakia delicatula* Pilsbry (*vide* Kuroda *et al.*, 1971)

1924, *Codakia bella* var. *delicatula*, Yokoyama, 50, pl. 3, fig. 8.

1954, *Ctena delicatula*, Taki and Oyama, 40, pl. 40, fig. 8.

1961, *Ctena delicatula*, Habe, 125, pl. 56 fig. 23.

1971, *Epicodakia delicatula*, Kuroda, *et al.*, 392, 610, pl. 118, fig. 13.

1973, *Epicodakia delicatula*, Oyama, 97, pl. 40, fig. 4.

1990, *Epicodakia delicatula*, Baba, 262, pl. 29, fig. 10.

Remarks; Only one small specimen was collected but it has characteristic radial ribs crossed with concentric growth lines. *Codakia okinawajimana* Nomura and Zinbo is allied to the present species but the external sculptures is differentiated from the latter species.

Locality; Loc. no. 81 (rare).

Subfamily Milthinae Chavan, 1969

Genus *Anodontia* Link, 1807

Anodontia stearensiana (Oyama, 1954)

Figs. 12-2a-2b.

1927, *Loripes philippiana*, Yokoyama, 434, pl. 50, figs. 1-2.

1935, *Anodontia bialata*, Otuka, 892, pl. 56, figs. 153-154.

1954, *Lucina* (*Lucina*) *stearensiana* Oyama, *in* Taki and Oyama, 40, pl. 47, figs. 1-2.

1961, *Anodontia stearensiana*, Hayasaka, 39, pl. 4, fig. 4.
1973, *Anodontia stearensiana*, Oyama, 95, pl. 40, figs. 1-2.

1977, *Anodontia stearensiana*, Omori, pl. 1, fig. 2.

1977, *Anodontia stearensiana*, Habe, 128-129, pl. 23, fig. 13.

1981, *Anodontia stearensiana*, Kira, 134, pl. 53, fig. 7.

1985, *Anodontia stearensiana*, Matsuura, pl. 32, fig. 25.

1990, *Anodontia stearensiana*, Baba, 267, pl. 31, fig. 1.

Remarks; Only one immature specimen was collected and is swollen shell with concentric growth lines, elongated anterior muscle scar and indistinct cardinal teeth.

Locality; Loc. no. 109 (rare).

Genus *Wallucina* Iredale, 1930

Wallucina sp.

Figs. 16-2a-2b.

Remarks; Only one small specimen was collected and is defined by small shell with concentric growth lines, small lunule, and fine crenulations on inner ventral margin.

Locality; Loc. no. 81 (rare).

Family Chamidae Lamarck, 1809

Genus *Chama* Linnaeus, 1758

Chama sp.

Fig. 16-10.

Remarks; Thick subrounded shell with irregular radial riblets crossed with concentric growth lines. Hinge structure is incomplete.

Locality; Loc. no. 81 (rare).

Family Carditidae Fleming, 1828

Subfamily Carditinae Fleming, 1828

Genus *Cardita* Bruguière, 1792

Cardita leana Dunker, 1860

Figs. 12-8-9.

1860, *Cardita leana* Dunker, 223. (*vide* Hayasaka, 1961)

1871, *Cardita leana*, Lischke, 140.

1954, *Cardita leana*, Taki and Oyama, 38, pl. 11, fig. 15, pl. 12, fig. 1.

1959, *Cardita leana*, Yamamoto and Habe, 85, pl. 12, fig. 20.

1961, *Cardita leana*, Hayasaka, 36-37, pl. 3, figs. 2a-b.

1993, *Cardita leana*, Okumura and Takei, pl. 36, fig. 8.

Remarks; The synonymous list was already made by Noda (1991) and is defined by small obliquely elongated shell with distinct radial ribs on posterior and finer riblets on anterior parts.

Locality; Loc. no. 88 (rare).

Subfamily Venericardiinae Chavan, 1969

Genus *Glans* Megerle von Mühlfeld, 1811

Glans granulatus Noda, n. sp.

Figs. 12-3a-4b.

Description; Shell medium in size, sub-rounded and inequilateral. Anterior part slightly narrower than posterior. External surface sculptured with 21-23 narrowly elevated radial ribs being squirt in cross section. Radial ribs on posterior become narrower than those of middle to anterior ones. Granular structure on radial ribs rather distinct. Interstitial of radial ribs narrow and sculptured with concentric growth lines. Beak situated anteriorly and pointed. Cardinal teeth distinct and lateral teeth narrowly elongated. Inner ventral margin crenulated according to external radial ribs. Lunule small and deeply depressed in heart shape.

Measurements (in mm);

Holotype IGUT no. 12354, Length 16.3, Height 16.8, Depth 6.8

Paratype IGUT no. 12353, Length 13.4, Height 14.3, Depth 5.4

Comparison and affinities; The present new species is characterized by its high shell and small number of narrowly elevated radial ribs (21-23) with distinct granules. The present new species resembles *Cyclocardia millegrana* Nomura and Zinbo (1934) described from the Ryukyu Limestone in Kikaijima (1936) in shell form and number of radial ribs but the new species is distinguished from the latter in having distinct granules on the radial ribs and more swollen shell. *G. sagamiensis* is more elongated.

Localities; Loc. no. 81 (rare).

Family Crassatelliidae Ferussac, 1822

Genus *Nipponocrassatella* Kuroda and Habe, 1971

Nipponocrassatella nana (Adams and Reeve, 1850)

Figs. 12-5a-7b.

1850, *Crassatella nana* Adams and Reeve, 15, pl. 23, fig. 2. (*vide* Noda, 1980)

1920, *Crassatella hetroglypta*, Yokoyama, 141, pl. 11, figs. 11-12.

1922b, *Crassatella hetroglypta*, Yokoyama, 164, pl. 13, fig. 8.

1927, *Crassatella hetroglypta*, Yokoyama, 134, pl. 49, fig. 11.

1935, *Crassatellites nanus*, Otuka, 889, pl. 56, figs. 146-147.

1936, *Crassatellites nanus*, Nomura and Zinbo, 339, pl. 11, figs. 6a-6b.

1954, *Crassatellites (Crassatellites) nanus*, Taki and Oyama, 38, pl. 12, figs. 10-11, pl. 33, fig. 8, pl. 46, fig. 11.

1961, *Crassatellites nanus*, Hayasaka, 36, pl. 3, fig. 3.

1967, *Crassatellites nanus*, Habe and Kosuge, 141, pl. 53, figs. 4-5.

1973, *Crassatellites (Nipponocrassatella) nana*, Oyama, 90, pl. 37, figs. 5, 8-10.

1980, *Crassatellites (Crassatellites) nanus*, Noda, 86-87.

1981, *Crassatellites nanus*, Kira, 130, pl. 52, fig. 13.

1984, *Crassatellites nanus*, Nohara and Miyagi, pl. 1, fig. 9.

1985, *Crassatellites (Nipponocrassatella) nana*, Matsuura, pl. 32, fig. 24.

1986, *Crassatellites nanus*, Takayasu *et al.*, pl. 62, fig. 12.

1988, *Nipponocrassatella nana*, Yoon, pl. 1, figs. 22-23.

1990, *Crassatella nana*, Baba, 276, pl. 32, fig. 12.

1991, *Eucrasatella nana*, Chen *et al* pl. 2, fig. 6a-6b.

1991, *Eucrasatella (Nipponocrassatella) nanus*, Noda, 25-26, figs. 11-1a-1b, 4a-b.

Remarks; The present species is distinguished from *Nipponocrassatella takanabensis* (Shuto, 1957) in having higher shell and distinct posterior depressed area. Noda (1991) already made the synonym list of the species. There are some allied species described from the Shinzato Formation as *N. kotakai* and *N. quadrata* but these are distinguished from the present species in having more swollen and wide posterior part. There are some variations in the shell form as high trigonal form (Figs. 14-7a-7b) with narrow apical angle to elongated trigonal form (Figs. 12-5a-7b, Figs. 14-5a-6b). Both types are associated in occurrence as like the Nobori Formation (Aoki and Baba, 1984a).

Locality; Loc. no. 81 (dominant), no. 84 (dominant).

Family Cardiidae Lamarck, 1809
 Subfamily Trachycardiinae Stewart, 1930
 Genus *Vasticardium* Iredale, 1928
 Subgenus *Vasticardium* Iredale, 1928
Vasticardium (*Vasticardium*) *burchardi* (Dunker, 1877)
 Figs. 13-8a—8c.

- 1877, *Cardium burchardi* Dunker, 67. (*vide* Kuroda *et al.*, 1971)
 1882, *Cardium burchardi*, Dunker, 210-211, pl. 18, figs. 4-6. (*vide* Kuroda *et al.*, 1971)
 1906, *Cardium tokyoensis*, Tokunaga, 51, pl. 3, fig. 12.
 1922b, *Cardium burchardi*, Yokoyama, 153, pl. 12, fig. 3.
 ?1926, *Cardium burchardi*, Yokoyama, 134, pl. 19, figs. 3-4.
 1928a, *Cardium burchardi*, Yokoyama, 84, pl. 9, fig. 7.
 1936, *Cardium* (*Trachycardium*) *burchardi*, Nomura and Zinbo, 243.
 1951, *Vasticardium* (*Vasticardium*) *burchardi*, Habe, 145, figs. 331-332.
 1954, *Acrosterigma* (*Vasticardium*) *burchardi*, Taki and Oyama, 42, pl. 32, fig. 3.
 1958, *Trachycardium burchardi*, Makiyama, pl. 37, figs. 3-4.
 1961, *Vasticardium* (*Vasticardium*) *burchardi*, Hayasaka, 41, pl. 42, figs. 13a-b.
 1968, *Vasticardium* (*Vasticardium*) *burchardi*, O'Hara, 72, pl. 9, fig. 9.
 1971, *Vasticardium burchardi*, Kuroda *et al.*, 399, 620, pl. 39, fig. 4.
 1971, *Laevicardium* sp., Noda, 41, pl. 7, fig. 11.
 1973, *Acrosterigma* (*Vasticardium*) *burchardi*, Oyama, 99, pl. 42, fig. 9.
 1977, *Trachycardium* (*Vasticardium*) *burchardi*, Habe, 165, pl. 32, figs. 1-2.
 1981, *Vasticardium burchardi*, Kira, 135, pl. 53, fig. 16.
 1990, *Vasticardium burchardi*, Baba, 277, pl. 32, fig. 5.
 1993, *Vasticardium burchardi*, Okumura and Takei, 174, pl. 37, figs. 1a-b.

Remarks; The present species has 40-43 distinct radial ribs. In particular, the posterior ten radial ribs carry distinct spines. *Vasticardium arenicola* (Reeve) and *V. enode* (Sowerby) are distinguished from the present species in having more characteristic spines on anterior part and wide, flat-topped radial ribs. Akutsu (1964) renamed the specimen described under the present species from the Miocene Kanomatazawa Formation in Tochigi Prefecture by Yokoyama (1926) as *Vasticardium arenicolooides*.

Accordingly, the present species is restricted

from only Pliocene to Recent.

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (few), no. 88 (few), 109 (rare).

Subfamily Fraginae Stewart, 1930
 Genus *Lunulicardia* Gray, 1853
Lunulicardia subretusa (Sowerby, 1840)
 Figs. 13-3a—5b.

- 1840, *Cardium subretusa* Sowerby (*non vidi*)
 1844, *Cardium hemicardium*, Reeve, pl. 7, fig. 38. (*non vidi*)
 1858, *Cardium guichardi*, Bernardi, 53, pl. 2, fig. 4. (*non vidi*)
 1927, *Cardium* (*Fragum*) *guichardi*, Bernardi, 122-123, pl. 241, figs. 112-113. (*non vidi*)
 1928a, *Hemicardium hemicardium*, Yokoyama, 84, pl. 9, fig. 10.
 1936, *Cardium* (*Fragum*) *hemicardium*, Nomura and Zinbo, 243.
 1941, *Cardium guichardi*, Hatai, pl. 61, figs. 4-6.
 1977, *Lunulicardia subretusa*, Habe, 168, pl. 32, figs. 3, 4.

Remarks; The present species has cordite quadrilateral shell, distinct ridge along the posterior part from umbo to ventral corner, 22-23 flat topped radial ribs separated by linear grooves with tubercles on anterior to middle part of shell and narrow radial ribs on posterior part. The cardinal tooth obliquely inclined and both lateral teeth are small. The ventral margin is crenulated. No lunule is developed. *Cardium tumoriferum* Lamarck is probably synonym with the present species. *Hemicardium fragum* is distinguished from the species in having subquadrate shell form. *Lunulicardia retusa* (Kira, 1981) resembles the present species but the latter has deep interspaces, subrounded posterior ridge and swollen umbonal part.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Genus *Fragum* Röding, 1798
Fragum alfuricum (Fischer, 1927)
 Figs. 13-1—2b.

- 1927, *Cardium* (*Fragum*) *alfuricum* Fischer, 123, pl. 216, fig. 11.
 1933, *Cardium* (*Fragum*) *alfuricum* (Fischer), Nomura, 80, pl. 3, fig. 22.

Remarks; Up to date, the present fossil species was recorded only from the Pliocene of Serra in Timor (Fischer, 1927) and Byoritsu Bed in Formosa (Nomura, 1933). The species is defined by inequilateral shell, distinct posterior ridge running from near beak to posterior ventral corner, 33-35 squarish radial ribs with scaly tubercles particularly on anterior, two small cardinal teeth under the beak, and crenulated ventral margin. The present species resembles *Fragum adamsi* (Adams and Reeve) but the latter has no distinct scaly tubercles on radial ribs.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Family Laevicardiinae Keen, 1936

Genus *Laevicardium* Swainson, 1840

Laevicardium biradiatum (Bruguière, 1798)

Figs. 13-9a-10b.

1789, *Cardium biradiatum* Bruguière (*vide* Nomura, 1936).

1844, *Cardium biradiatum*, Reeve, pl. 10, fig. 49.

1933, *Cardium (Laevicardium) biradiatum*, Nomura, 76, pl. 4, fig. 17.

1936, *Cardium (Laevicardium) biradiatum*, Nomura and Zinbo, 243, pl. 11, figs. 13a-b.

1941, *Cardium biradiatum*, Hatai, 71, pl. 35, figs. 6, 9.

1966, *Laevicardium biradiatum*, Habe and Kosuge, 154, pl. 59, fig. 11.

1971, *Laevicardium* sp., Noda, pl. 7, fig. 11.

?1984, *Laevicardium (Laevicardium) attenuatum*; Nohara and Miyagi, pl. 2, figs. 3a-3b.

Remarks; The present species is characterized by narrow umbonal area, small cardinal teeth, distinct lateral teeth, 40 flat-topped radial ribs with no scales. The present species is distinguished from *Laevicardium rubropictum* Habe and Kosuge in its longer shell form, rather swollen shell, and more distinct radial ribs. *Laevicardium* sp. reported from the Nakoshi Formation under the name of *Laevicardium* sp. (Noda, 1971) is referred to the present species.

Localities; Loc. no. 81 (rare), no. 84 (rare).

Genus *Fulvia* Gray, 1853

Fulvia sp.

Figs. 13-6-7.

Remarks; The present species resembles *Fulvia tenuicostata* (Lamarck) and *Fulvia mutica* (Reeve) but remained unnamed because of ill preservation. *Fulvia* sp. (Noda, 1971, 41-42, pl. 7, fig. 8, Loc. 109) recorded from the same formation is same with the present unnamed species.

Localities; Loc. no. 81 (rare), no. 87 (rare), no. 114 (few).

Family Mactridae Lamarck, 1809

Subfamily Lutraiinae H. and A. Adams, 1856

Genus *Lutraria* Lamarck, 1799

Subgenus *Psamophila* Brown, 1827

Lutraria (Psamophila) sieboldi Deshayes, 1854

Figs. 14-11a-11b.

1854, *Lutraria sieboldii* Reeve (sic), sp. 15. (*vide* Kuroda *et al.*, 1971)

1855, *Lutraria sieboldi*, Reeve, pl. 4, fig. 15. (*non vidi*)

1920, *Lutraria radiata*, Yokoyama, 110, pl. 7, figs. 11a-b.

1927a, *Lutraria sieboldi*, Yokoyama, 429, pl. 49, figs. 8-9.

1954, *Lutraria sieboldi*, Taki and Oyama, 46, pl. 8, figs. 11a-b, pl. 46, figs. 8a-b.

1961, *Lutraria sieboldi*, Hayasaka, 53-54, pl. 6, figs. 4a-b.

1967, *Lutraria sieboldi*, Habe and Kosuge, 158, pl. 59, fig. 12.

1971, *Lutraria (Psamophila) sieboldi*, Kuroda *et al.*, 672, 439, pl. 97, figs. 7-8.

1977, *Lutraria (Psamophila) sieboldi*, Habe, 183, pl. 35, fig. 3.

1981, *Lutraria sieboldi*, Kira, 150, pl. 58, fig. 5.

1990, *Lutraria sieboldi*, Baba, 281-282, pl. 33, fig. 9.

1994, *Lutraria sieboldi*, Masuda and Huang, pl. 1, fig. 30.

Remarks; The present species is rather common in the Nakoshi Formation and is characterized by its elongated shell with small spoon like chondrophore before the cardinal tooth. *Lutraria lucida* and *L. radiata* are included to the present species as synonymous one by Kuroda *et al.* (1971).

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (rare), no. 88 (few).

Family Tellinidae de Blainville, 1814

Subfamily Tellininae Blainville, 1814

Genus *Tellinella* Mörch, 1853

Tellinella verrucosa (Hanley, 1844)

Figs. 14-1a-1b.

- 1844, *Tellina verrucosa* Hanley. (*vide* Nomura, 1933)
1847, *Tellina verrucosa*, Sowerby, pl. 68, fig. 77. (*vide* Nomura, 1933)
1867, *Tellina verrucosa*, Sowerby, pl. 19, fig. 96. (*vide* Nomura, 1933)
1871, *Tellina verrucosa*, Roemer, 23, pl. 9, figs. 1-3. (*vide* Nomura, 1933)
1933, *Tellina verrucosa*, Nomura, 102, pl. 4, fig. 21.

Remarks; The present species is characterized by elliptically elongated form with narrowly rostrated posterior side, small dotted beads along the growth lines particularly in anterior and posterior sides, keel along the posterior margin from near beak to posterior ventral corner, and deeply sinuate pallial line. The present species is distinguished from *Tellinella pulcherrima* (Matsukuma, 1984) by its distinct posterior keel and rostrated posterior part. *Tellinella squamulosa* is another allied species but the species has more higher shell and widely rounded posterior border.

Measurement (in mm); Length 34.1, Height 16.9, Width 4.6.

Localities; Loc. no. 81 (rare), no. 87 (rare).

Subfamily Macominae Olsson, 1961

Genus *Macoma* Leach, 1819

Subgenus *Macoma* Leach, 1819

Macoma (Macoma) praetexta (Martens, 1865)

Fig. 14-10.

- 1971, *Macoma (Macoma) praetexta*, Noda, 42, pl. 7, fig. 2.
1977, *Macoma (Macoma) praetexta*, Habe, 209, pl. 42, figs. 5-6.
1998, *Macoma praetexta*, Okumura and Ueda, 81, pl. 14, fig. 7.

Remarks; Only one conjoined specimen was collected. The present species was once recorded from this formation by Noda (1971, p. 42, pl. 7, fig. 12).

Locality; Loc. no. 109 (rare).

Family Psammobiidae Fleming, 1828

Subfamily Psammobiinae Fleming, 1828

Genus *Grammatomya* Dall, 1898

Grammatomya squamosa (Lamarck, 1818)

Figs. 14-3-4.

- 1818, *Psammobia squamosa* Lamarck, 176. (*non vidi.*)
1848, *Psammobia rugulosa*, Adams and Reeve (*non vidi.*)
1857, *Psammobia squamosa*, Reeve, pl. 7, fig. 50. (*vide* Habe, 1977)
1974, *Gari (Grammatomya) squamosa*, Habe, 135, pl. 61, fig. 2.

Remarks; The present species is uncommon in fossil record. The species is characterized by its oblique striations crossed fine growth lines on middle to anterior part of external surface, and 11-13 radial ribs on posterior part, wide and deep pallial sinus, and crenulations on posterior internal margin. *Grammatomya pulcherrima* resembles the species but the former has more elongated shell, finer transverse striations, and roundly elevated radial ribs in immature stage.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Family Solecurtidae d'Orbigny, 1846

Genus *Solecurtus* Blainville, 1824

Solecurtus divaricatus (Lischke, 1869)

Fig. 14-12.

- 1869, *Macha divaricata* Lischke, 108-109.
1869, *Macha divaricata* Lischke, 142, pl. 10, figs. 1-2.
1882, *Macha divaricata*, Dunker, 175, pl. 7, fig. 26. (*non vidi*)
1888, *Solecurtus divaricatus*, Clessin in Martin and Chemnitz, 87, pl. 21, fig. 4. (*vide* Kuroda *et al.*, 1971)
1906, *Macha divaricata*, Tokunaga, 36, pl. 2, fig. 20.
1920, *Solecurtus divaricatus*, Yokoyama, 112, pl. 7, fig. 14.
1952, *Solecurtus divaricatus*, Habe, 206, figs. 494-495.
1961, *Solecurtus divaricatus*, Hayasaka, 56, pl. 7, figs. 3a-b.
1967, *Solecurtus divaricatus*, Habe and Kosuge, 160, pl. 60, fig. 20.
1968, *Solecurtus divaricatus*, O'Hara, 86, pl. 16, fig. 5.
1971, *Solecurtus divaricatus*, Kuroda *et al.*, 444-445, 680, pl. 99, fig. 7.
1973, *Solecurtus divaricatus*, Oyama, 111, pl. 54, fig. 7.
1977, *Solecurtus divaricatus*, Habe, 224, pl. 47, figs. 7-8.
1977, *Solecurtus divaricatus*, Matsuura, pl. 5, fig. 3.
1978, *Solecurtus divaricatus*, Kanno *et al.*, pl. 4, fig. 1.
1979, *Solecurtus divaricatus*, Mori and Nagata, pl. 13, fig. 10.
1981, *Solecurtus divaricatus*, Kira, 152, pl. 58, fig. 23.
1988, *Solecurtus divaricatus*, Mizuno and Amano, pl. 14,

- fig. 14.
 1990, *Solecortus divaricatus*, Baba, 290, pl. 35, figs. 13a-b.
 1993, *Solecortus divaricatus*, Noda *et al.*, 158, figs. 19-1-2.
 1994a, *Solecortus divaricatus*, Masuda and Huang, pl. 1, fig. 35.
 1995, *Solecortus divaricatus*, Nakao, pl. 1, figs. 1-2.
 1998, *Solecortus divaricata*, Ozawa *et al.*, 113, pl. 30, fig. 2.
 1998, *Solecortus divaricata*, Okumura and Ueda, 81, pl. 15, fig. 1.

Remarks; The present species is frequently recorded from the late Neogene to Pleistocene formations in the middle to southwestern parts of Japan. *Solecortus dunkeri* and *S. wilsoni* resemble the present species but are distinguished from the present species in having more dense oblique striations.

Localities; Loc. no. 81 (rare), no. 87 (rare), 88 (rare).

Genus *Azorinus* Recluz, 1869
Azorinus abbreviatus (Gould, 1861)
 Figs. 14-8a-9b.

- 1861, *Solecortus abbreviatus* Gould (*vide* Shuto, 1971)
 1920, *Solecortus abbreviatus*, Yokoyama, 11, pl. 7, figs. 12a-13b.
 1928a, *Solecortus abbreviatus*, Yokoyama, 124, pl. 9, fig. 12.
 1936, *Solecortus abbreviatus*, Suzuki and Ichimura, pl. 29, figs. 1-9.
 1954, *Azorinus abbreviatus*, Taki and Oyama, pl. 8, figs. 12a-13b.
 1967, *Azorinus abbreviatus*, Habe and Kosuge, 160, pl. 60, fig. 18.
 1968, *Azorinus abbreviatus*, O'Hara, 86, pl. 16, fig. 4.
 1970, *Azorinus abbreviatus*, Hayasaka and Hashimoto, 20, pl. 1, figs. 10-11
 1971, *Azorinus abbreviatus*, Kuroda *et al.*, 681, 446, pl. 98, fig. 6.
 1973, *Azorinus abbreviatus*, Oyama, 111, pl. 54, figs. 4-5.
 1977, *Azorinus abbreviatus*, Habe, 225, pl. 47, figs. 9, 10.
 1981, *Azorinus abbreviatus*, Kira, 152, pl. 58, fig. 21.
 1985, *Azorinus abbreviatus*, Matsuura, pl. 32, fig. 29.
 1986, *Azorinus abbreviatus*, Masuda *et al. in* Sato *et al.*, 34-35, pl. 4, figs. 10-12.
 1989, *Azorinus abbreviatus*, Ito, 64, pl. 26, fig. 1.
 1990, *Azorinus abbreviatus*, Baba, 290-291, pl. 35, fig. 14.
 1992, *Azorinus abbreviatus*, Okumura and Yamaguchi, 1021, figs. 3-7, 10.

- 1994a, *Azorinus abbreviatus*, Masuda and Huang, 393-394, pl. 1, fig. 30.

Remarks; The present species has thin fragile shell with a medial depression on near middle part of the shell, deeply sinuated pallial line and entruded cardinal teeth.

Locality; Loc. no. 88 (few).

Family Solenidae Lamarck, 1809
 Genus *Solen* Linnaeus, 1758
 Subgenus *Solen* s.s.
Solen (Solen) cf. *strictus* Gould, 1861
 Fig. 16-11.

Remarks; Imperfect specimens are examined but its slender shell, truncated posterior part and deep pallial sinuation are referred to the species.

Locality; Loc. no. 88 (rare).

Family Veneridae Rafinesque, 1815
 Subfamily Venerinae Rafinesque, 1815
 Genus *Ventricolaria* Keen, 1954
 Subgenus *Ventricoloidea* Sacco, 1900
Ventricolaria (Ventricoloidea) foveolata (Sowerby, 1853)
 Figs. 15-5a-5b, 7.

- 1966, *Ventricoloidea foveolata*, Aoki, pl. 31, fig. 9.
 1977, *Ventricolaria foveolata*, Habe 246, pl. 51, fig. 1.
 1986, *Ventricolaria (Ventricoloidea) foveolata*, Sato *et al.*, *in* Shuto *et al.*, 35-36, pl. 5, figs. 2-4.
 1988, *Ventricolaria (Ventricoloidea) foveolata*, Yoon, pl. 2, figs. 6-7.
 1989, *Venus (Ventricoloidea) foveolata*, Ito, 64, pl. 26, fig. 1.
 1990, *Ventricolaria (Ventricoloidea) foveolata*, Baba, 294, pl. 36, fig. 8.
 1991b, *Venus (Ventricoloidea) foveolata*, Noda, 30, fig. 11-11.
 1983, *Venus foveolata*, Aoki and Baba, 55, figs. 48a-b.
 1991, *Venus foveolata*, Chen *et al.*, pl. 2, figs. 9a-9b.
 1993, *Ventricolaria foveolata*, Nobuhara, fig. 8-8.
 1993, *Venus (Ventricoloidea) foveolata*, Katto and Masuda, 13, pl. 5, figs. 5a-b.
 1994, *Venus foveolata*, Masuda and Huang, pl. 2, fig. 8.
 1998, *Venus foveolata*, Okumura and Ueda, 79-80, pl. 13, fig. 7.

Description; The present species was discussed by Noda (1991b) and the synonymous

list was also mentioned up to 1991. After the description of Noda (1991b), the above cited papers recorded the present species. Shell medium in size, sub-rounded in form somewhat produced anteriorly. Anterior margin well rounded and posterior part somewhat angulated. Ventral margin well rounded. Beak small prominent, turned anteriorly and situated at near one-third anteriorly. Escutcheon narrow, lunule rather wide with concentric growth lines. External surface sculptured with concentric lamellae. Anterior cardinal tooth in three cardinal teeth on left valve bipartite, middle one obliquely and posterior one long. Cardinal socket rather deep. Both anterior and posterior muscle scars well impressed in subround. Pallial sinus rather wide and shallow. Internal margin crenulated finely.

Measurements (in mm);

IGUT no. 12383, Length 26.1 Height 23.3
Depth 7.8

IGUT no. 12382, Length 15.6 Height 14.9
Depth 4.5

Comparison; The present species is identical *Venus (Ventricoloidea) foveolata* Sowerby in having similar cardinal teeth, external sculptures and has regular concentric lamellae like structure. *V. (V.) treuma* differs from the present species in having more indistinct concentric lamellae.

Localities; Loc. no. 81 (rare), no. 87 (rare), no. 88 (rare).

Genus *Periglypta* Jukes-Brown, 1914

Subgenus *Tigammona* Iredale, 1930

Periglypta (Tigammona) chemnitzii (Hanley, 1844)

Fig. 15-12.

1977, *Periglypta (Tigammona) chemnitzii*, Habe, 247, pl. 51, figs. 8, 9.

Remarks; The external surface is reticulated by crossing of concentric fine lamellae like structure and fine radial ribs. The present species resembles *P. (P.) reticulata* Reeve but it differs from the latter in having elongated shell with lamellated growth line, and narrowly rounded pallial line.

Localities; Loc. no. 84 (rare), no. 87 (rare).

Subfamily Chioninae Frizzel, 1936

Genus *Glycydonta* Cotton, 1936

Glycydonta marica (Linnaeus, 1758)

Figs. 15-3a-4b.

1758, *Venus marica* Linnaeus, 685.

1863, *Venus marica*, Reeve, 104. (*vide* Kuroda *et al.*, 1971)

1951, *Leukoma marica*, Habe, figs. 393, 399.

1967, *Glycydonta marica*, Habe and Kosuge, 155, pl. 58, fig. 14.

1971, *Glycydonta marica japonica*, Kuroda *et al.*, 430, 662, pl. 93, fig. 4.

1977, *Glycydonta marica*, Habe, 250, pl. 53, figs. 1-2.

1981, *Glycydonta marica*, Kira, 147, pl. 57, fig. 18.

1993, *Glycydonta marica*, Noda *et al.*, 161, figs. 18-1a-2b, 20-3a-b.

Remarks; All specimens collected are immature form and resembles *G. marica japonica* Kira in having reticulated sculpture on external surface, but the latter has distinct scaly structure on posterior part.

Locality; Loc. no. 87 (few).

Genus *Placamen* Iredale, 1925

Placamen tiara (Dillwyn, 1816)

Figs. 15-2a-2b.

1817, *Chione tiara* Dillwyn, 162. (*vide* Kuroda *et al.*, 1971)

1846, *Venus foliacea*, Philippi, 107, pl. 5, fig. 1. (*vide* Kuroda *et al.*, 1971)

1855, *Venus tiara*, Sowerby, 722, pl. 158, figs. 125-130. (*non vidi*)

1863, *Venus tiara*, Reeve, sp. vol. 14, 109, pl. 23, figs. 109-110. (*non vidi*)

1869, *Venus isabellum*, Pfeifferi, 133, pl. 7, figs. 9-11. (*non vidi*)

1869, *Venus isabellum*, Martin and Chemnitz, 194, pl. 25, fig. 9. (*non vidi*)

1906, *Venus foliacea*, Tokunaga, 46 pl. 3, fig. 3.

1920, *Chione isabellina*, Yokoyama, 121, pl. 8, fig. 13.

1928a, *Chione foliacea*, Yokoyama, 80, pl. 7, fig. 7.

1941, *Venus tiara*, Hatai, pl. 48, figs. 2, 4, 5.

1951, *Placamen tiara*, Habe, 175, figs. 376-377.

1954, *Clausinella (Placamen) tiara*, Taki and Oyama, 44, pl. 9, fig. 13.

1958, *Placamen tiara*, Habe, 37, pl. 2, fig. 7.

1959, *Placamen tiara*, Tsuchi, pl. 8, fig. 28.

1960, *Placamen tiara*, Shuto, 142-143, pl. 14, fig. 14.

- 1961, *Placamen tiara*, Hayasaka, 47, pl. 4, figs. 11a-b.
 1967, *Placamen tiara*, Habe and Kosuge, 155, pl. 58, fig. 18.
 1968, *Placamen tiara*, O'Hara, 74, pl. 110, fig. 10.
 1971, *Placamen tiara*, Kuroda *et al.*, 660, 429, pl. 93, figs. 8-9.
 1973, *Claisinella (Placamen) tiara*, Taki and Oyama, 104, pl. 47, fig. 9.
 1974, *Claisinella (Placamen) tiara*, Omori, pl. 51, figs. 5, 9.
 1978, *Placamen tiara*, Kanno *et al.*, pl. 2, fig. 5.
 1981, *Placamen tiara*, Kira, 147, pl. 57, fig. 20.
 1986, *Placamen tiara*, Takayasu, *et al.*, pl. 61, fig. 1.
 1988, *Placamen tiara*, Matsukuma and Yoosukh, 574-575, pl. 2, figs. 1-4.
 1989, *Placamen tiara*, Ito, 65, pl. 26, fig. 7.
 1990, *Placamen tiara*, Masuda, 294-295, pl. 36, fig. 9.
 1990, *Placamen tiara*, Baba, 294-295, pl. 36, figs. 9a-b.
 1993, *Placamen tiara*, Noda *et al.*, 159-161, figs. 21-9a-b.
 1993, *Placamen tiara*, Majima and Honme, fig. 5-4.
 1993, *Placamen tiara*, Okumura and Takei, pl. 39, fig. 3.
 ?1993, *Placamen isabellina*, Katto and Masuda, 13, pl. 5, figs. 6a-b.

Remarks; The present species is common in the tropical to subtropical seas in the low latitudes. Only a small shell is collected, but is well identical with the named species by concentric and laminated plicae.

Locality; Loc. no. 87 (rare).

Subfamily Circinae Dall, 1898

Genus *Circe* Schumacher, 1817

Subgenus *Circe* Schumacher, 1817

Circe (Circe) scripta (Linnaeus, 1758)

Figs. 15-6a-6c, 8a-8b.

1758, *Venus scripta* Linnaeus, 689.

1851, *Circe scripta*, Sowerby, 1, pl. 139, figs. 38-43. (*non vidi*)

1928a, *Circe scripta*, Yokoyama, 81-82, pl. 8, figs. 7-8.

1928c, *Circe scripta*, Yokoyama, pl. 20, fig. 2.

1929, *Placamen tiara*, Yokoyama, 123, pl. 8, figs. 15-16.

1971, *Circe (Circe) scripta*, Kuroda *et al.*, 413, 640, pl. 90, fig. 6.

1977, *Circe (Circe) scripta*, Habe, 253, pl. 52, figs. 10-11.

1981 *Circe scripta*, Kira, 146, pl. 57, fig. 7.

1995, *Circe (Circe) scripta*, Nakao, pl. 1, figs. 9-10.

Remarks; The shell is subround in form, equivalve, and slightly inequilateral. The beak is small and umbonal area is flat. The external surface is sculptured with narrowly elevated con-

centric ribs and its interspaces are rather smooth but with fine growth lines. Both anterior and posterior margins are sculptured with fine radial ribs. Three cardinal teeth on right valve, and two in left valve. Lateral teeth is distinct. Lunule narrow, and escutcheon weakly defined. The present species is defined by its flat umbonal part, and fine radial ribs on the sides.

Measurements (in mm); IGUT no. 12384-1, Length 33.6, Height 20.3, Depth 6.8, IGUT no. 12384-2, Length 18.3, Height 16.3, Depth 2.9. Largest specimen (IGUT no. 12385) is Length 46.2, Height 36.0, Depth 9.6, in mm.

Localities; Loc. no. 81 (rare), no. 88 (few).

Subfamily Pitarinae Stewart, 1930

Genus *Pitar* Roemer, 1857

Subgenus *Pitarina* Jukes-Brown, 1913

Pitar (Pitarina) japonicum Kuroda and Kawamoto, 1956
 Figs. 15-13a-14.

1954, *Pitar (Agriopoma) japonica* (Kuroda), Hirase, pl. 35, fig. 1. (*nomen nudum*)

1956, *Pitar (Agriopoma) japonicum* Kuroda and Kawamoto, in Kawamoto and Tanabe, 89, figs. 1-4. (Frontispiece).

1960, *Pitar (Agriopoma) japonicum*, Taki in Okada *et al.*, 59, pl. 30, fig. 10.

1961, *Pitar (Agriopoma) japonica*, Hayasaka, 42-43, pl. 4, figs. 8a-b.

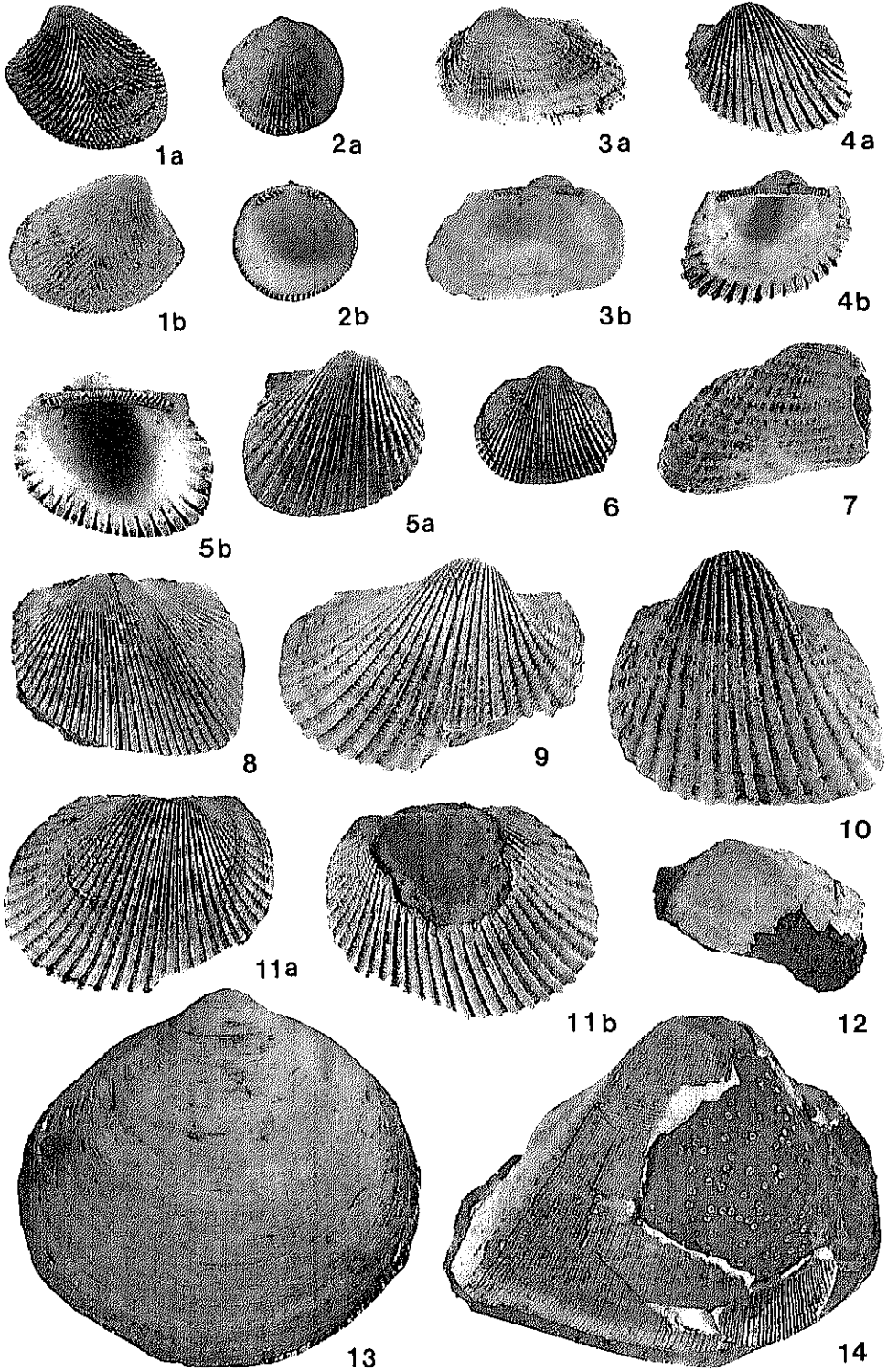
1967, *Pitar (Pitarina) japonicum*, Habe and Kosuge, 153, pl. 58, fig. 1.

1971, *Pitar (Pitarina) japonicum*, Kuroda *et al.*, 415, pl. 90, fig. 11.

1974, *Pitar (Agriopoma) japonica*, Habe, 130, pl. 58, fig. 19.

1986, *Pitar (Agriopoma) japonica*, Kuroda and Kawamoto, pl. 31, figs. 3-4.

Remarks; The present species was first illustrated by Hirase (1934) with no original description. Thenceafter, Kuroda and Kawamoto (*in* Kawamoto and Tanabe, 1956) described it in association with same figure of Hirase (1934). Hayasaka (1961) first translated their Japanese description to English. When he first recorded the fossil species from the Pleistocene Toshima Sand in Aichi Prefecture, the species is sub-trigonal shell with fine concentric growth lines



and distinct cardinal teeth. The present species is defined by its sub-trigonal shell with smooth growth lines, small beak, depressed lunule restricted by weak line, wide and moderate sinuation, elevated cardinal teeth, and linear lateral teeth. The species resembles *Pitar (Pitarina) striatus* but the present species has more slender umbonal part and sub-trigonal shell form.

Measurements (in mm);

IGUT no. 12390, Length 28.6, Height 24.1, Depth 9.4.

Localities; Loc. no. 81 (rare), no. 84 (few), 86 (few), no. 88 (rare).

Subgenus *Costellipitar* Habe, 1951

Pitar (Costellipitar) cf. chordatum (Roemer, 1876)

Figs. 15-10a—10b, 16-1a—1b.

1977, *Costellipitar chordatum*, Habe, 258, pl. 53, figs. 19-21.

Remarks; Only one small specimen which has concentric ribs, small lunule on anterior and three cardinal teeth on left valve, is referred to the species *Pitar chordatum* (Roemer).

Locality; Loc. no. 81 (rare), no. 88 (rare).

Subfamily Dosiniinae Deshayes, 1853

Genus *Pardosinia* Iredale, 1929

Pardosinia amphidesmoides (Reeve, 1850)

Figs. 15-9a—9b.

1850, *Artmis amphidesmoides* Reeve, 48, pl. 8, fig. 48. (*vide* Nomura, 1933)

1855, *Artmis amphidesmoides*, Sowerby, 659, pl. 141, fig. 19. (*vide* Nomura, 1933)

1933, *Dosinia amphidesmoides*, Nomura, 96, pl. 4, fig. 18.

1974, *Dosinia (Paradosinia) amphidesmoides*, Habe, 131, pl. 59, fig. 19.

1986, *Dosinia (Paradosinia) amphidesmoides*, Masuda *et al.* in Sato *et al.*, 39-40, pl. 5, figs. 9-10.

Remarks; The present species is characterized by its small subround shell with fine concentric growth lines, shortly rounded both dorsal margins, no escutcheon, narrow but distinct longitudinal depressed area along the posterior dorsal margin, and small lunule. The present species is quite characteristic in having a longitudinal depressed area along the posterior dorsal margin and no escutcheon, so it is easily distinguished from the other small subrounded shell among *Dosinia*.

Locality; Loc. no. 81 (rare), no. 87 (rare).

Subfamily Tapetinae H. and A. Adams, 1857

Genus *Paphia* Roeding, 1798

Subgenus *Paphia* Roeding, 1798

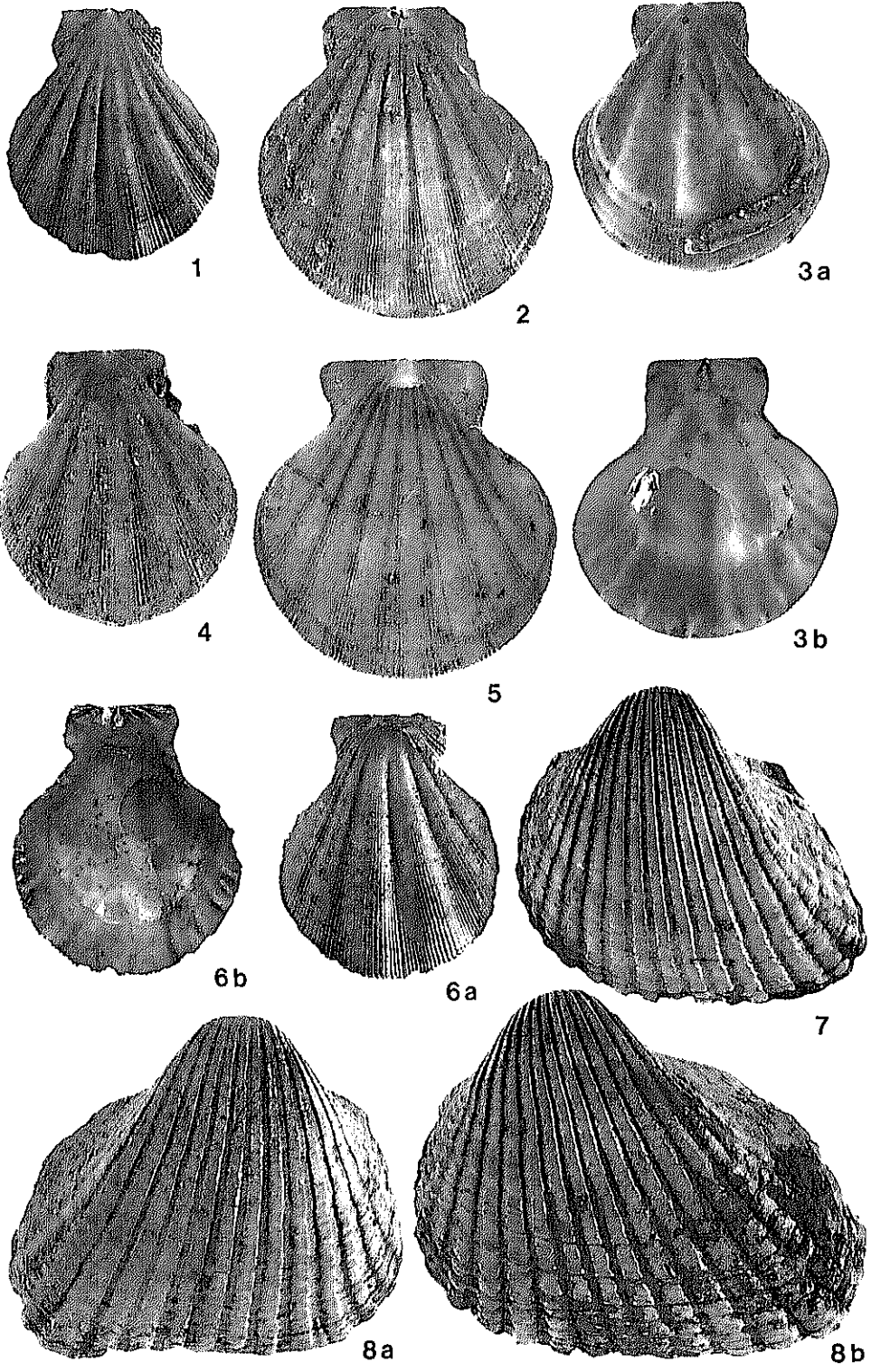
Paphia (Paphia) euglypta (Philippi, 1847)

Figs. 16-5—6.

←Fig. 8

1a-1b. <i>Acila (Acila) divaricata</i> (Hinds).....	p. 58
Loc. no. 87, x 2, IGUT coll. cat. no. 12321.	
2a-2b. <i>Tucetilla pilsbryi</i> (Yokoyama).....	p. 65
Loc. no. 87, x 1, IGUT coll. cat. no. 12322.	
3a-3b. <i>Barbatia (Abarbatia) decussata</i> (Sowerby).....	p. 59
Loc. no. 84, x 1, IGUT coll. cat. no. 12323.	
4a-4b. <i>Anadara (Hataiarca) takaensis</i> (Nomura).....	p. 63
Loc. no. 84, IGUT coll. cat. no. 12324.	
5a-5b, 10. <i>Anadara (Hataiarca) kogachiensis</i> Noda.....	p. 64
5a-5b, Loc. no. 109, x 2, IGUT coll. cat. no. 10727, 10,	
x 1, Loc. 109, IGUT coll. cat. no. 12327.	
6. <i>Veritarca interplicata</i> (Grabau and King)	
.....	p. 61

Loc. no. 109, x 1.5, IGUT coll. cat. no. 10345.	
7. <i>Barbatia (Acar) cf. reticulata</i> (Gmelin)	
Loc. no. 81, x 3, IGUT coll. cat. no. 10729.	
8. <i>Anadara (Tosarca) sedanensis</i> (Martin).....	p. 64
Loc. no. 88, x 1, IGUT coll. cat. no. 12325.	
9. <i>Anadara (Scapharca) suzuki</i> (Yokoyama).....	p. 61
Loc. no. 81, x 1, IGUT coll. cat. no. 12326.	
11a-11b. <i>Anadara (Scapharca) taiwanica</i> Noda.....	p. 63
Loc. no. 81, x 1, IGUT coll. cat. no. 12328.	
12. <i>Trisidos</i> sp.	p. 61
Loc. no. 87, x 1.5, IGUT coll. cat. no. 12329.	
13. <i>Glycymeris (Glycymeris) formosana</i> (Yokoyama)....	p. 65
Loc. no. 87, x 1, IGUT coll. cat. no. 12330.	
14. <i>Cucullaea (s.s.) granulosa</i> Jonas.....	p. 65
Loc. no. 81, x 0.7, IGUT coll. cat. no. 12331.	



- 1847, *Venus euglypta* Philippi, 89. (*vide* Kuroda *et al.*, 1971)
 1848, *Venus euglypta*, Philippi, 76, pl. 7, fig. 3. (*vide* Kuroda *et al.*, 1971)
 1864, *Tapes euglypta*, Roemer, 26-27, pl. 8, figs. 1-1b, 80, pl. 29, figs. 1-b. (*non vidi.*)
 1874, *Tapes euglypta*, Lischke, 80-82, pl. 6, figs. 8-11.
 1906, *Tapes euglypta*, Tokunaga, 50, pl. 3, fig. 8. *non*
 1920, *Paphia (Paphia) euglypta*, Yokoyama, 152, pl. 12, fig. 8.
 1935, *Paphia euglypta*, Otuka, 896, pl. 56, figs. 172-173.
 1965, *Paphia euglypta*, Habe and Ito, 135, pl. 45, fig. 7.
 1967, *Paphia euglypta*, Habe and Kosuge, 150, pl. 56, fig. 15.
 1968, *Paphia (Paphia) euglypta*, O'Hara, 76, pl. d, fig. 6.
 1971, *Paphia euglypta*, Kuroda *et al.*, 652, 423, pl. 92, fig. 2.
 1977, *Paphia (Paphia) euglypta*, Habe, 264, pl. 54 figs. 6-7.
 1980, *Paphia euglypta*, Aoki and Baba, fig. 8 (10).
 1981, *Paphia euglypta*, Kira, 144, pl. 56, fig. 25.
 1985, *Paphia (Paphia) euglypta*, Matsuura, pl. 32, fig. 22.
 1989, *Paphia (Paphia) euglypta*, Ito, 65, pl. 27, fig. 4.
 1990, *Paphia euglypta*, Baba, 300, pl. 37, fig. 12.
 1995, *Paphia (Paphia) euglypta*, Nakao, pl. 7, figs. 3-4.

Remarks; The present species resembles *Paphia naganumanum* Otuka described for the Yokoyama's (1920) *Tapes amabilis* which is distinguished from the present species in having different form of lunule and escutcheon. *Paphia schnelliana* also resembles the present species but the former distinguished from the present species in having much number of concentric ribs. The present species occurs from also the Ryukyu Limestone in Taiwan.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Subfamily Callistinae Nordsieck, 1969

Genus *Callista* Poli, 1791

Subgenus *Callista* Poli, 1791

Callista (Callista) chinensis (Holten, 1803)

Figs. 16-4a-4b.

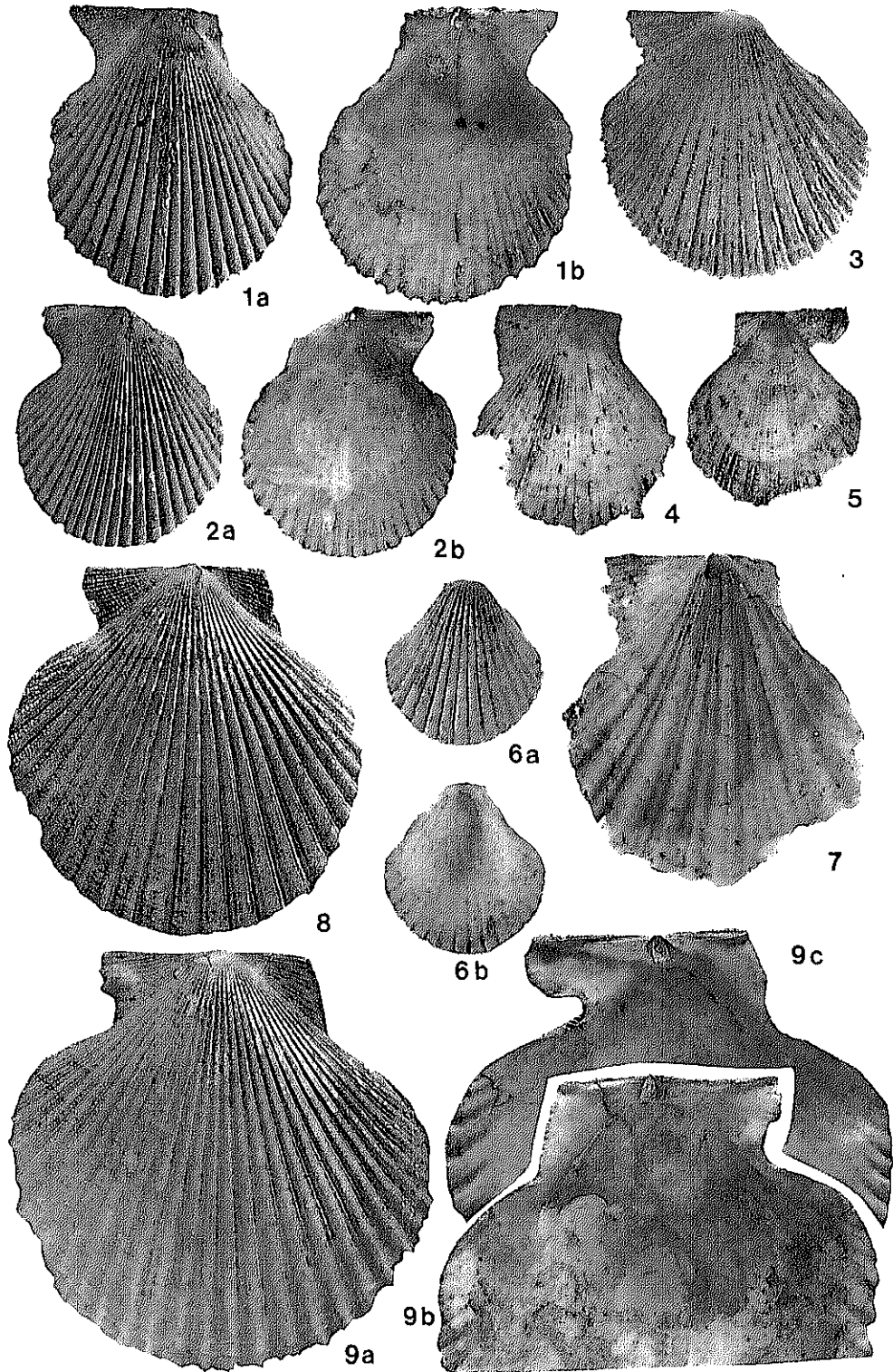
1803, *Venus chinensis* Holten, 20. (*vide* Kuroda *et al.*, 1971).

- 1855, *Cytherea sinensis* Sowerby, 624, pl. 131, figs. 80-81. (*vide* Kuroda *et al.*, 1971).
 1864, *Dione chinensis*, Reeve, *Dione*, pl. 1, fig. 4. (*vide* Kuroda *et al.*, 1971).
 1864, *Dione festiva*, Reeve, pl. 1, fig. 2. (*vide* Kuroda *et al.*, 1971).
 1869, *Cytherea chinensis*, Pfeiffer in Martin and Chemnitz, 31, pl. 11, fig. 2. (*non vidi.*)
 1869, *Cytherea (Callista) chinensis*, Roemer, 66, pl. 19, fig. 3. (*non vidi.*)
 1906, *Cytherea chinensis*, Tokunaga, 46, pl. 3, figs. 4a-b.
 1920, *Meretrix (Callista) chinensis*, Yokoyama, 120, pl. 8, figs. 9-10.
 1922b, *Meretrix (Callista) chinensis*, Yokoyama, 146, pl. 11, fig. 5.
 1928, *Meretrix (Macrocallista) ezoensis*, Yokoyama, 77, pl. 8, fig. 1. (*non Tapes ezoensis* Yokoyama, 1890).
 1935, *Callista pacifica*, Otuka, 895, pl. 56, fig. 181.
 1951, *Callista (Callista) chinensis*, Habe, 164, figs. 372-373.
 1954, *Callista (Callista) chinensis*, Taki and Oyama, 43, pl. 9, figs. 9-10.
 1960, *Callista (Callista) chinensis*, Shuto, 131-132, pl. 13, fig. 2.
 1961, *Callista (Callista) chinensis*, Hayasaka, 43-44, pl. 4, figs. 10a-b.
 1965, *Callista chinensis*, Kaseno and Matsuura, pl. 14, fig. 2.
 1967, *Callista chinensis*, Habe and Kosuge, 150, pl. 56, fig. 10.
 1968, *Callista chinensis*, O'Hara, 76, pl. 11, fig. 5.
 1971, *Callista chinensis*, Kuroda *et al.*, 644, 417, pl. 90, fig. 9.
 1973, *Callista chinensis*, Oyama, 101, pl. 45, figs. 1-2.
 1977, *Callista (Callista) chinensis*, Habe, 269, pl. 56, fig. 2.
 1977, *Callista chinensis*, Matsuura, pl. 9, fig. 9.
 1977, *Callista (Callista) chinensis*, Ogasawara, 116-117, pl. 12, fig. 5.
 1979, *Callista chinensis*, Mori and Nagata, pl. 12, fig. 5.
 1980, *Callista chinensis*, Aoki and Baba, fig. 18 (18).
 1980, *Callista chinensis*, Takayasu, 144, pl. 6, figs. 1a-b.
 1980, *Callista chinensis*, Aoki and Baba, fig. 18(18).
 1981, *Callista chinensis*, Ogasawara, pl. 1, fig. 3.
 1981, *Callista chinensis*, Kira, 141, pl. 56, fig. 3.
 1985, *Callista (Callista) chinensis*, Matsuura, pl. 32, fig. 28, pl. 39, fig. 10, pl. 42, fig. 9.
 1986, *Callista chinensis*, Takayasu *et al.*, pl. 23; fig. 20,

← Fig. 9

- 1-2, 4-5, *Decatopecten amiculum* (Philippi).....p. 69
 Loc. no. 84, IGUT coll. cat. no. 12332-12335.
 3a-3b, 6a-6b, *Decatopecten striatus* (Schumacher).....
p. 68

- 3a-3b, Loc. no. 87, x 1, IGUT coll. cat. no. 12336,
 fig 6a-6b, loc. 84, IGUT coll. cat. no. 12337.
 7-8b, *Anadara (Hataiarca) kogachiensis* Noda.....
p. 64
 Loc. no. 109, x 1, IGUT coll. cat. no. 12327.



- pl. 64, fig. 15, pl. 81, figs. 22, 24a-25b.
 1987, *Callista chinensis*, Amano *et al.*, pl. 1, fig. 13.
 1989, *Callista chinensis*, Ito, pl. 27, fig. 7.
 1990, *Callista chinensis*, Baba, 302, pl. 38, figs. 6a-b.
 1993, *Callista (Callista) chinensis*, Noda *et al.*, 163-164, figs. 21-11a-b.
 1993, *Callista chinensis*, Katto and Masuda, 13, pl. 5, figs. 1a-b.
 1993, *Callista (Callista) chinensis*, Okumura and Takei, pl. 39, fig. 9.
 1995, *Callista (Callista) chinensis*, Nakao, pl. 8, figs. 1-2.
 1998, *Callista chinensis*, Ozawa *et al.*, 104-105, pl. 26, figs. 10a-b.
 2001, *Callista (Callista) chinensis*, Nakao, pl. 4, figs. 3a-b.

Remarks; The present species is rather common in shallow sandy facies of the Pliocene and Pleistocene formations as cited in synonymous list. The species is elliptical in form with smooth external surface and distinct cardinal teeth.

Localities; Loc. no. 87 (rare), no. 88 (few).

Genus *Saxidomus* Conrad, 1837

Saxidomus purpuratus (Sowerby, 1852)

- 1852, *Tapes purpuratus* Sowerby, 692, pl. 150, figs. 124-125. (*sic* Noda, 1972)
 1869, *Saxidomus purpuratus*, Lischke, 127, pl. 4, figs. 4-5.
 1881, *Saxidomus purpuratus*, Brauns, 40, pl. 5, fig. 20.
 1920, *Saxidomus purpuratus*, Yokoyama, 127, pl. 9, figs. 8-9.
 1922b, *Saxidomus purpuratus*, Yokoyama, 153, pl. 12, fig. 9.
 1934, *Saxidomus purpuratus*, Kinoshita and Isahaya, 16, pl. 12, fig. 88.
 1954, *Saxidomus purpuratus*, Taki and Oyama, 43, pl. 10, figs. 8-9, pl. 32, fig. 9.
 1958, *Saxidomus purpuratus*, Ozaki, 128, pl. 23, fig. 1.
 1959, *Saxidomus purpuratus*, Yamamoto and Habe, 95, pl. 7, figs. 7-8.
 1960, *Saxidomus purpuratus*, Habe, 7, pl. 3, figs. 1-2.
 1962, *Saxidomus purpuratus*, Sawada, 84, pl. 17, fig. 6.

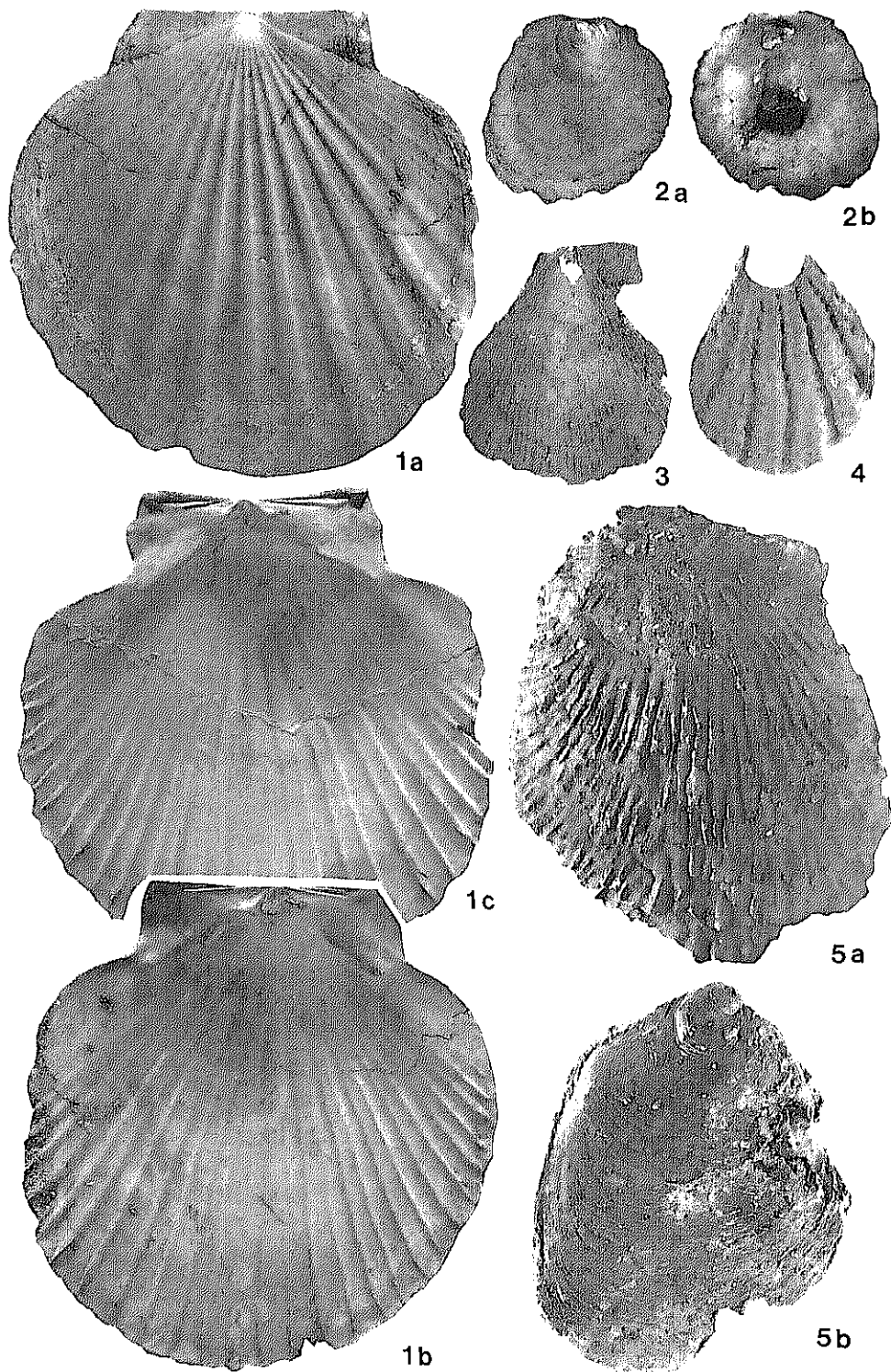
- 1965, *Saxidomus purpuratus*, Kaseno and Matsuura, pl. 19, fig. 14.
 1965, *Saxidomus purpuratus*, Habe and Ito, 138, pl. 46, fig. 5.
 1966, *Saxidomus purpuratus*, Sakagami *et al.*, pl. 8, fig. 2.
 1967, *Saxidomus purpuratus*, Habe and Kosuge, 152, pl. 57, fig. 8.
 1968, *Saxidomus purpuratus*, Noda and Masuda, 5, pl. 1, fig. 9.
 1968, *Saxidomus purpuratus*, O'Hara, 82, pl. 14, fig. 4.
 1969, *Saxidomus purpuratus*, Iwai and Siobara, pl. 2, fig. 7.
 1971, *Saxidomus purpuratus*, Kuroda *et al.*, 418, 645, pl. 93, figs. 5-7.
 1972, *Saxidomus purpuratus*, Noda, 685-687, pl. 4, figs. 1a-2b.
 1973, *Saxidomus purpuratus*, Oyama, 102, pl. 45, fig. 8, pl. 46, figs. 4-5.
 1977, *Saxidomus purpuratus*, Habe, 270, pl. 56, fig. 3.
 1977, *Saxidomus purpuratus*, Matsuura, pl. 4, fig. 7.
 1980, *Saxidomus purpuratus*, Takayasu, 144-145, pl. 4, figs. 2-5b, pl. 5, fig. 4.
 1981, *Saxidomus purpuratus*, Scarlato, 380, photo. 383.
 1981, *Saxidomus purpuratus*, Kira, 142, pl. 56, fig. 9.
 1983, *Saxidomus purpuratus*, Masuda *et al.*, 21, pl. 4, fig. 15.
 1986, *Saxidomus purpuratus*, Takayasu *et al.*, pl. 76, fig. 1.
 1988, *Saxidomus purpuratus*, Okamoto and Ibaraki, pl. 1, figs. 10-11, pl. 2, figs. 1-2.
 1990, *Saxidomus purpuratus*, Nemoto and Akinoto, pl. 13, fig. 3.
 1990, *Saxidomus purpuratus*, Baba, 302-303, pl. 38, fig. 8.
 1993, *Saxidomus purpuratus*, Noda *et al.*, 164, figs. 21-2a-3b.
 1995, *Saxidomus purpuratus*, Noda *et al.*, 68, figs. 9-10.

Remarks; The present species was already discussed for the rare occurrence in the southern part of Japan by Noda (1972) because of the species is dominantly distributed in the northern part of Japan. The species collected from the Nakoshi Formation is quite identical of the species, so that the distribution of the species is

←Fig. 10

- 1a-2b, *Chlamys (Mimachlamys) gracilisquamatus* (Fischer).....p. 67
 Loc. no. 84, x 1, IGUT coll. cat. no. 12338.
 3, *Cryptopecten vesiculosus* (Dunker).....p. 68
 Loc. no. 87, x 3, IGUT coll. cat. no. 12339.
 4,5,7, *Chlamys (Azumapekten) subsquamatus* (Nomura)p. 66

- 4, Loc. no. 84, x 1.5, IGUT no. 12340, 5, 7 x 1, IGUT coll. cat. no. 12341-42.
 6a-6b, *Cryptopecten cf. mix mix* (Dunker).....p. 68
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12343.
 8-9c, *Chlamys (Mimachlamys) satoi* (Yokoyama)
p. 67
 Loc. no. 84, x 0.7, IGUT coll. cat. no. 12344-12345.



rather broad in geographical distribution.

Locality; Loc. no. 81 (rare).

Subfamily Clementinae Frizzel, 1936

Genus *Clementia* Gray, 1842

Subgenus *Clementia* Gray, 1842

Clementia (Clementia) vatheleti Mabilie, 1901
Figs. 16-7a-7b.

- 1901, *Clementia vatheleti* Mabilie, 57. (*vide* Kuroda *et al.*, 1971)
1913, *Clementia vatheleti*, Jukes-Browne, 61-62, pl. 1, figs. 3-4. (*non vidi*)
1941b, *Clementia (Clementia) vatheleti*, Yabe and Hatai, 74-75, pl. 7, fig. 4.
1951, *Clementia (Clementia) vatheleti*, Habe, 185, fig. 423 on 183.
1957, *Clementia vatheleti*, Makiyama, pl. 10, figs. 14-15.
1958, *Clementia vatheleti*, Habe, 185, figs. 423.
1959, *Clementia vatheleti*, Yamamoto and Habe, 99, pl. 7, fig. 14.
1960, *Clementia vatheleti*, Shuto, 140-142, pl. 13, figs. 3-11, pl. 15, fig. 15.
1961, *Clementia (Clementia) vatheleti*, Hayasaka, 51, pl. 6, figs. 7a-b.
1965, *Clementia vatheleti*, Kaseno and Matsuura, pl. 16, figs. 5-6.
1971, *Clementia vatheleti*, Kuroda *et al.*, 663, 431, pl. 94, fig. 7.
1971, *Clementia (Clementia) vatheleti*, Noda, 42-43, pl. 7, fig. 13.
1977, *Clementia (Clementia) vatheleti*, Habe, 274, pl. 56, fig. 9.
1983, *Clementia vatheleti*, Aoki and Baba, 55, fig. 50.
1986, *Clementia vatheleti*, Masuda *et al.* in Sato *et al.*, 42-43.
1988, *Clementia (Clementia) vatheleti*, Okumura, 46, pl. 16, fig. 11.
1993, *Clementia (Clementia) vatheleti*, Okumura and Takei, 172, pl. 37, figs. 12, 14, 17-18.
1990, *Clementia (Clementia) vatheleti*, Ito, 127, pl. 33, fig. 4.
1993, *Clementia (Clementia) papyracea*, Ogasawara, 54-55, pl. 3, figs. 19-22.
1998, *Clementia (Clementia) papyracea*, Ozawa *et al.*, 108-109, pl. 28, fig. 2.

Remarks; Several conjoined valves are collected. The shell is well swollen with concentric ribs on immature stage and finer growth lines in later stage. Mabilie originally described the present species incompletely with no figure in 1902 but Jukes-Brown (1913) redescribed and illustrated the species. *Clementia papyracea* as Nakamura *et al.* (1999) mentioned resembles the present species but the former has more swollen and narrow posterior border.

Localities; Loc. no. 81 (rare), no. 84 (rare), no. 87 (rare).

Family Gastrochaenidae Gray, 1840

Genus *Eufistulana* Eames, 1951

Eufistulana grandis (Deshayes, 1854)
Figs. 16-12a-13.

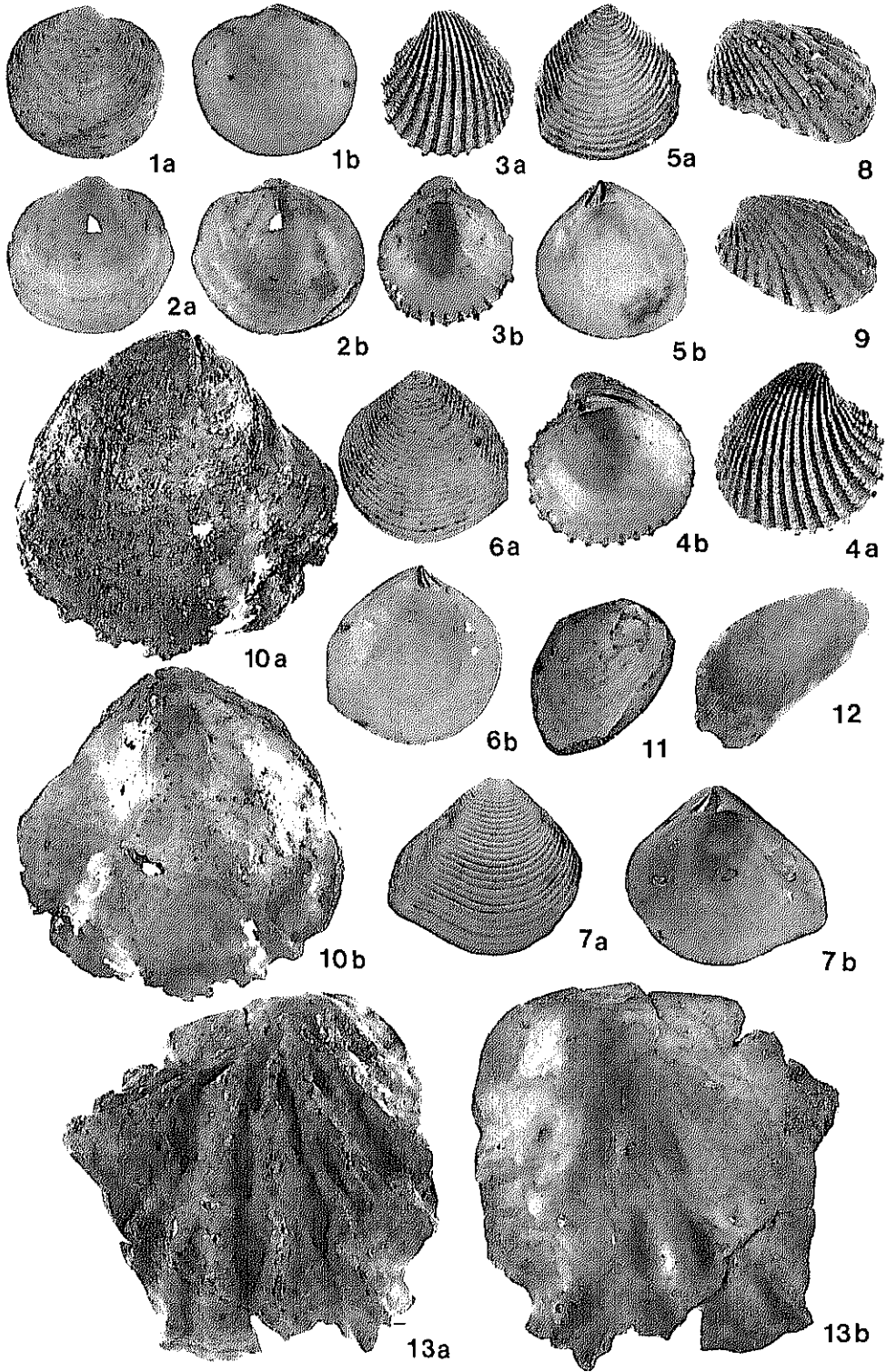
- 1854, *Chaena grandis* Deshayes, 330. (*non vidi*)
1862, *Gastrochaena grandis*, Tryon, 476. (*non vidi*)
1866, *Fistulana grandis*, Fischer, 321, pls. 12, 13. (*non vidi*)
1878, *Fistulana grandis*, Sowerby, pl. 1, fig. 3. (*non vidi*)
1884, *Fistulana grandis*, Sowerby, 132, pl. 471, fig. 16. (*non vidi*)
1895, *Fistulana grandis*, Clessin, 23, pl. 1, figs. 6-8. (*non vidi*)
1927a, *Vermetus ebaranus*, Yokoyama, 417, pl. 46, figs. 15-16. (not of fig. 17)
1952, *Gastrochaena grandis*, Habe, 240, figs. 647-649.
1955, *Gastrochaena grandis*, Taki and Habe in Kuroda, 5-6, pl. 1, figs. 1-4, pl. 2, figs. 12-18.
1961, *Gastrochaena grandis*, Habe, 140, pl. 63, fig. 14.
1977, *Eufistulana grandis*, Habe, 288, pl. 60, figs. 8-12.
1995, *Eufistulana grandis*, Nakao, pl. 8, fig. 5.

Remarks; The present species was discussed in detail by Taki (1943), and Taki and Habe in Kuroda (1955). According to them, the present species is mainly distributed in fine sandy bottom in shallow sea in the southern warm water regions. Taki and Habe (1955) included the fossil species *Vermetus ebaranus* Yokoyama (1927a), which was only one fossil species as a

←Fig. 11

- 1a-1c, *Amussiopecten praesignis* (Yokoyama).....p. 69
Loc. no. 88, x 0.7, IGUT coll. cat. no. 12346.
2a-2b, *Anomia chinensis* Philippi.....p. 70
Loc. no. 88, x 1, IGUT coll. cat. no. 12347.
3, *Chlamys* sp.p. 70

- Loc. no. 88, x 1.5, IGUT coll. cat. no. 12348.
4, *Plicatula simplex* (Smith).....p. 70
Loc. no. 87, x 2.5, IGUT coll. cat. no. 12349.
5a-5b, *Ostrea denselamellosa* Lischke.....p. 71
Loc. no. 84, x 0.7, IGUT coll. Cat. no. 12350.



synonymous species with the present species. However, Taki and Oyama (1954) remained Yokoyama's species as a valid species. The Nakoshi specimens are almost tubes but fragmental shell showing elongated shell with anteriorly beak and elongated shell was also collected. Both shell and tube are identical with *F. grandis*. *F. heyseana* Philippi (Koenen, 1894, 87-88, pl. 95, figs. 10a-c) resembles the present species but slightly different from Okinawan species in its shape of calcareous tube.

Localities; Loc. no. 81 (few), no. 87 (rare), no. 88 (rare).

Family Myochamidae Bronn, 1862

Genus *Myadora* Gray, 1840

Myadora fluctuosa Gould, 1861

Figs. 16-8a-9b.

1861, *Myadora fluctuosa* Gould (*non vidi*)

1861, *Myadora triangularis*, A. Adams (*non vidi*)

1882, *Myadora triangularis*, A. Adams, Dunker, 181-182, pl. 7, figs. 11-12. (*non vidi*)

1906, *Myadora fluctuosa*, Tokunaga, 39, pl. 2, fig. 24.

1920, *Myadora triangularis*, Yokoyama, 144, pl. 11, figs. 14-15.

1922b, *Myadora fluctuosa*, Yokoyama, 170, pl. 14, figs. 6-7.

1935, *Myadora fluctuosa*, Otuka, 901, pl. 57, fig. 209.

1950, *Myadora yokoyamai*, Habe, 28, figs. 7-9.

1950, *Myadora japonica*, Habe, 27, pl. 4, figs. 4-6.

1950, *Myadora proxima*, Habe, 27, pl. 4, figs. 1-3, 19-1.

1954, *Myadora japonica*, Taki and Oyama, 51, pl. 34, figs. 6-7.

1958, *Myadora japonica*, Ozaki, 121, pl. 22, fig. 7.

1964, *Myadora fluctuosa*, Johnson, 78, pl. 26, fig. 2.

1965, *Myadora japonica*, Kaseno and Matsuura, pl. 19, figs. 5-8.

1968, *Myadora japonica*, O'Hara, 89, figs. 10, 17.

1971, *Myadora japonica*, Kuroda *et al.*, 726, pl. 103, fig. 12, 429.

1973, *Myadora japonica*, O'Hara, 119, pl. 57, figs. 1, 4.

1977, *Myadora japonica*, Omori, pl. 1, fig. 10.

1977, *Myadora yokoyamai*, Habe, 307, pl. 65, figs. 1-2.

1985, *Myadora japonica*, Matsuura, pl. 39, fig. 17, pl. 41, fig. 17.

1986, *Myadora fluctuosa*, Takayasu *et al.*, pl. 34, fig. 2, pl. 39, fig. 11, pl. 55, fig. 5, pl. 64, figs. 12-13.

1988, *Myadora japonica*, Yoon, pl. 3, figs. 3, 11.

1990, *Myadora fluctuosa*, Baba, 310, pl. 40, fig. 8.

1993, *Myadora fluctuosa*, Okumura and Takei, pl. 40, fig. 1.

Remarks; The present species is flat, and trigonal in shape. The external surface is sculptured by concentric growth lines. The lateral teeth are distinct. Yokoyama (1920) described the present species in association with *Myadora triangularis* from the Naganuma Formation in Kanagawa Prefecture. Habe (1950) once proposed the new species *M. yokoyamai* but is included the present species as synonym.

Localities; Loc. no. 87 (rare), no. 88 (rare).

Family Laternulidae Hedley, 1918

Genus *Laternula* Roeding, 1798

Subgenus *Laternula* Roeding, 1798

Laternula (Laternula) anatina (Linnaeus, 1758)

Figs. 15-11a-11b.

1758, *Anatina anatina* Linnaeus, 88.

1863, *Anatina flexuosa*, Reeve, sp. 2. (*non vidi*)

1874, *Anatina japonica*, Lischke, 101, pl. 9, figs. 7-10.

1952, *Laternula flexuosa*, Habe, 267, fig. 707.

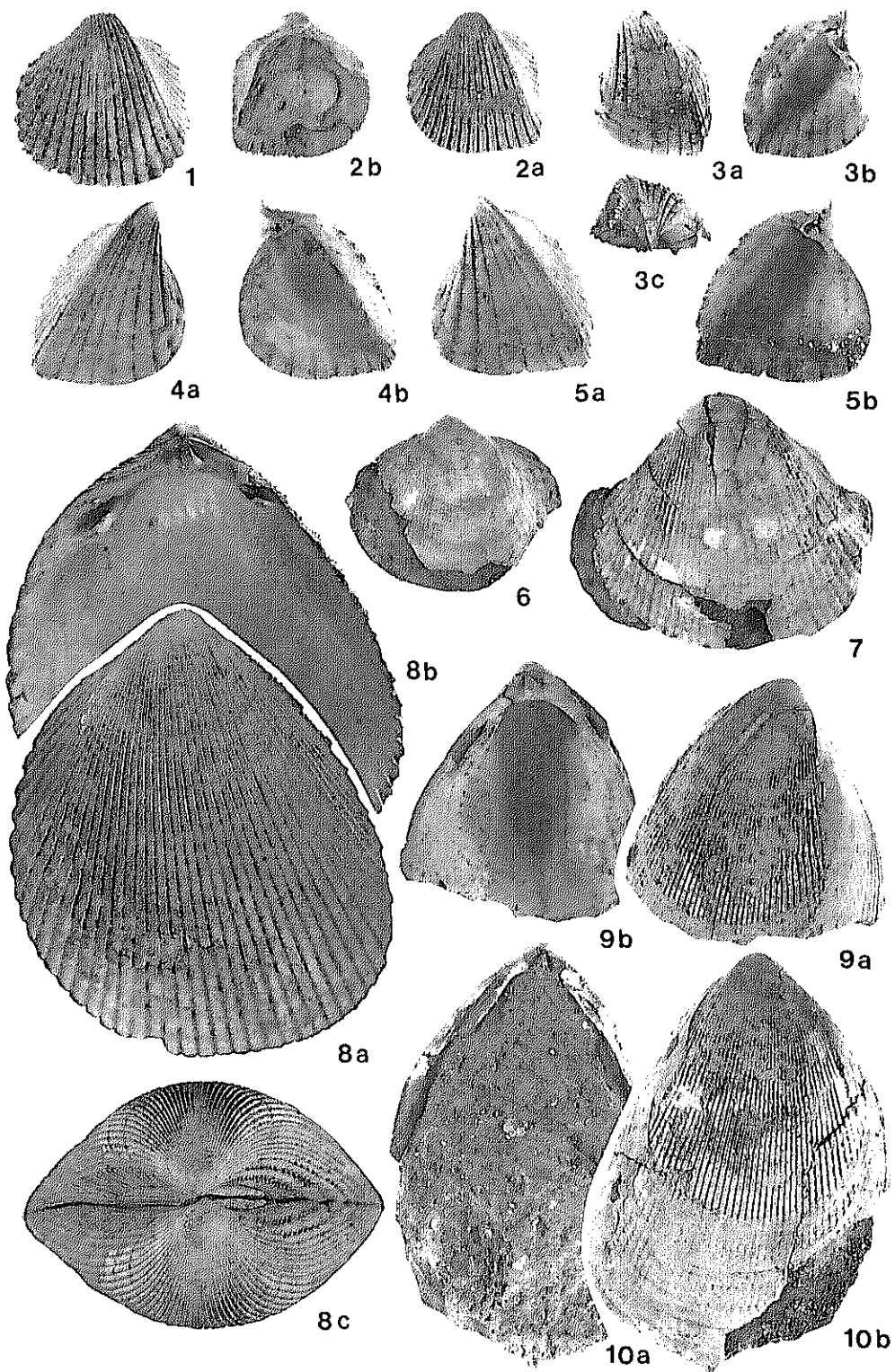
1967, *Laternula (Laternula) flexuosa*, Habe and Kosuge, 170, pl. 63, fig. 23.

1977, *Laternula (Laternula) anatina*, Habe, 311, pl. 65, figs. 13-14.

◀Fig. 12

1a-1b, <i>Lucina kuminagaensis</i> Nomura and Zinbo.....	Loc. no. 84, 5a-6b, x 1.5, 7a-7b, x 1, IGUT coll. cat. no. 12355.
.....p. 71	
Loc. no. 87, x 2, IGUT coll. cat. no. 12351.	
2a-2b, <i>Anodontia stearensiana</i> (Oyama).....p. 72	
Loc. no. 109, x 1.5, IGUT coll. cat. no. 12352.	
3a-4b, <i>Glans granulatus</i> n. sp.p. 73	
3a-3b, Paratype (IGUT coll. cat. no. 12353), 4a-4b,	
Holotype, Loc. no. 81, x 1.5, IGUT coll. cat. no. 12354.	
5a-7b, <i>Nipponocrassatellites nana</i> (Adams and Reeve)	
.....p. 73	

Loc. no. 84, 5a-6b, x 1.5, 7a-7b, x 1, IGUT coll. cat. no. 12355.
8-9, <i>Musculites cf. japonica</i> (Dunker).....p. 66
Loc. no. 88, x 3, IGUT coll. cat. no. 12356 (8), 12357 (9).
10a-10b, <i>Pododermus (Monia) noharai</i> Noda.....p. 70
Loc. no. 109, x 0.7, IGUT coll. cat. no. 12358.
11-12, <i>Modiolus</i> sp.p. 66
Loc. no. 88, x 3, IGUT coll. cat. no. 12359 (11), Loc. 88, no. 12360 (12).
13a-13b, <i>Pretostrea imbricata</i> (Lamarck).....p. 71
Loc. no. 87, x 0.7, IGUT coll. cat. no. 12361.



1981, *Laternula (Laternula) flexuosa*, Kira, 166, pl. 62, fig. 11.

Remarks; The present species is elongatedly swollen with rostrated posterior border, fine growth lines on external surface, and spoon-like chondrophore. Habe (1952) included *L. japonica* and *L. flexuosa* to the species as synonymous species with the present species. Accordingly the distribution of the species is expanded from southwestern Japan to more southern parts.

Locality; Loc. no. 87 (rare).

Gastropoda

Family Trochidae Rafinesque, 1815

Subfamily Trochinae Rafinesque, 1815

Genus *Clanculus* Montfort, 1810

Clanculus margaritarius (Philippi)

Figs. 17-7a-b.

1961, *Clanculus margaritarius*, MacNeil, 27, pl. 18, figs. 14-15.

Remarks; The present species resembles *Clanculus microdon ater* illustrated by MacNeil (1961, p. 27, pl. 16, figs. 4, 9) from the Pleistocene Ryukyu Limestone but the present species has more distinct nodous external surface. The shell is small in size with seven rows of dotted spiral ribs, four teeth on internal side of external aperture and narrow and deep umbilicus opening.

By having similar external sculptures of lines of dotted spiral cords, the present species seems to be swollen whorl in trigonal shell form. The apical angle of the present species is slightly large in comparison with those of *C. microdon* which has small nodous external structure. Up to the present, the species is only recorded from the Pleistocene to Recent.

Locality; Loc. no. 87, rare.

Genus *Tosatrochus* MacNeil, 1961

Tosatrochus attenuatus (Jonas, 1844)

Figs. 17-4a-4b.

1828, *Trochus elongatus* Wood (*non* Sowerby), 17, pl. 5, fig. 19. (*vide* MacNeil, 1961)

1844, *Trochus attenuatus* Jonas, 170. (*vide* MacNeil, 1961)

1879, *Trochus elongatus* Fischer, 281, pl. 92, fig. 1.

1889, *Cantharidus (Thalotia) elongatus*, Pilsbry, 143, pl. 45, fig. 56.

1961, *Tosatrochus attenuatus*, MacNeil, 26-27, pl. 10, figs. 16, 22-23.

1981, *Tosatrochus attenuata*, Kira, 14, pl. 7, fig. 10.

1984, *Tosatrochus attenuatus*, Nohara and Miyagi, pl. 2, figs. 12a-b.

Remarks; The present species was first recorded from the Nakoshi Sand in Okinawa as a fossil record by MacNeil (1961). The shell is moderate in size, and subtrigonal in shape. The external surface is sculptured with 5 rows of fine spiral lirae crossing with obliquely elevated longitudinal riblets. At the crossing with the spiral lirae, the longitudinal ribs are developed at the lower most of suture. The base is slightly swollen with 17 tuberculous riblets.

Loc. no. 87 (rare).

Family Fissurellidae Fleming, 1822

Subfamily Fissurellinae Fleming, 1822

Genus *Fissuridea* Swainson, 1840

Fissuridea crucifera (Pilsbry, 1890)

Fig. 17-12.

1890, *Glyphis crucifera* Pilsbry in Tryon, 275, pl. 32, figs. 27-30. (*vide* Nomura, 1935)

1935, *Fissuridea crucifera*, Nomura, 220, pl. 10, figs. 50a-b.

Remarks; The present species is characterized by small cone-shaped shell with reticulated external sculptures by crossing of fine concentric

◀Fig. 13

1-2b, *Fragum alfiricum* (Fischer).....p. 74

Loc. no. 88, x 2, IGUT coll. cat. no. 12362.

3a-5b, *Lumilicardia subretusa* (Sowerby).....p. 74

Loc. no. 81, x 2, IGUT coll. cat. no. 12363.

6-7, *Fulvia* sp.p. 75

6, Loc. no. 81, x1, IGUT coll. cat. no. 12364.

7, Loc. no. 114, x1, IGUT coll. cat. no. 12365.

8a-8c, *Vasticardium (Vasticardium) burchardi* (Dunker)

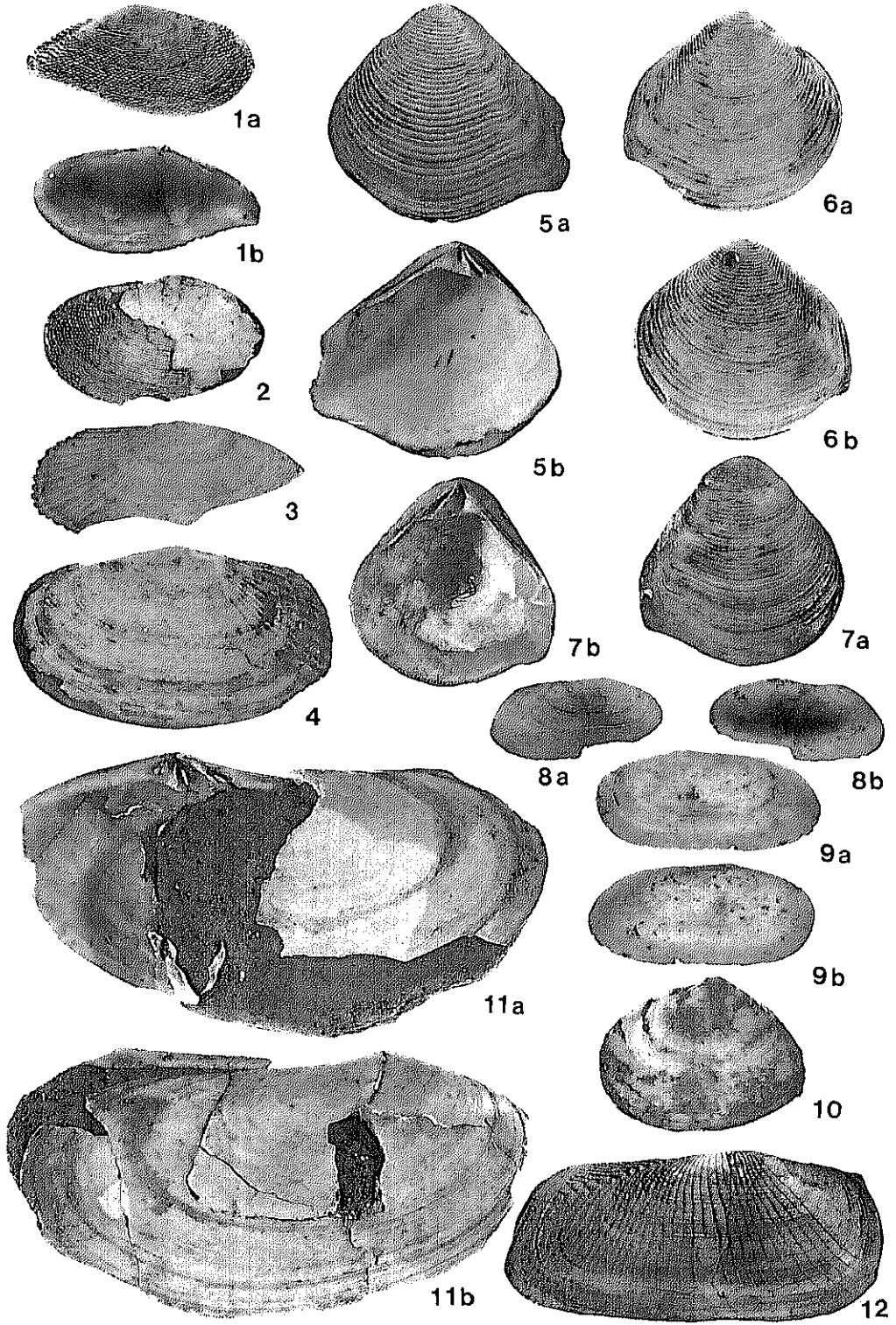
.....p. 74

Loc. no. 87, x1, IGUT coll. cat. no. 12366.

9a-10b, *Laevicardium biradiatum* (Bruignière).....

.....p. 75

Loc. no. 84, x 1, IGUT coll. cat. no. 12367.



lirae and distinct but fine 39-40 radial ribs. Nomura (1935) mentioned some confusion of the identification. *Diodora yokoyamai* Otuka (1937) has more finer and radial ribs.

Locality; Loc. no. 81 (rare).

Family Turbinidae Rafinesque, 1815

Subfamily Turbininae Rafinesque, 1815

Genus *Turbo* Linnaeus 1758

Subgenus *Batillus* Schumacher, 1817

Turbo (Batillus) chinensis Ozawa and Tomida, 1995

Figs. 17-1a—1b.

1995, *Turbo (Batillus) chinensis* Ozawa and Tomida, 269-275, pl. 1, figs. 1a-5.

Remarks; *Marmorostoma (Batillus) cf. cornata* described from the Nakoshi Sand by MacNeil (1961, Loc. no. 17440) is well identical with the present species. At the time, MacNeil described the species from the Nakoshi, he remained it under the name of *M. (B.) cf. cornata*. When he mentioned that the species from the Nakoshi is a new species, he remained it unnamed because it is an immature form. The specimens have small tubercles at the crossing of the primary and secondary spiral ribs and riblets. *Turbo chinensis* is differentiated from *Turbo yabei* in having no dotted sculptures on primary spiral ribs and has swollen base.

Locality; Loc. no. 87 (common).

Genus *Marmorostoma* Swainson, 1829

Subgenus *Batillus* Schumacher, 1817

Marmorostoma (Batillus) gemmata (Reeve, 1848)

Figs. 17-2a—3c.

1848, *Turbo gemmatus* Reeve, pl. 12, fig. 62. (*vide* MacNeil, 1961)

1888, *Turbo gemmatus*, Pilsbry, 216, pl. 44, figs. 68-69. (*vide* MacNeil, 1961)

1908, *Turbo (Senectus) gemmatus*, Schepman, 25, pl. 6, fig. 11. (*vide* MacNeil, 1961)

1922, *Turbo?* sp., Dickerson, pl. 5, fig. 17.

1936, *Turbo yabei* Nomura and Zinbo, 263-264, pl. 11, figs. 34a-b.

1938, *Turbo (Marmorostoma) gemmatus*, Alena, 288-289, fig. 12.

1948, *Turbo (Marmorostoma) gemmatus*, Cox, 17, pl. 1, figs. 2a-b.

1961, *Marmorostoma (Batillus) gemmata*, MacNeil, 31, pl. 11, fig. 4.

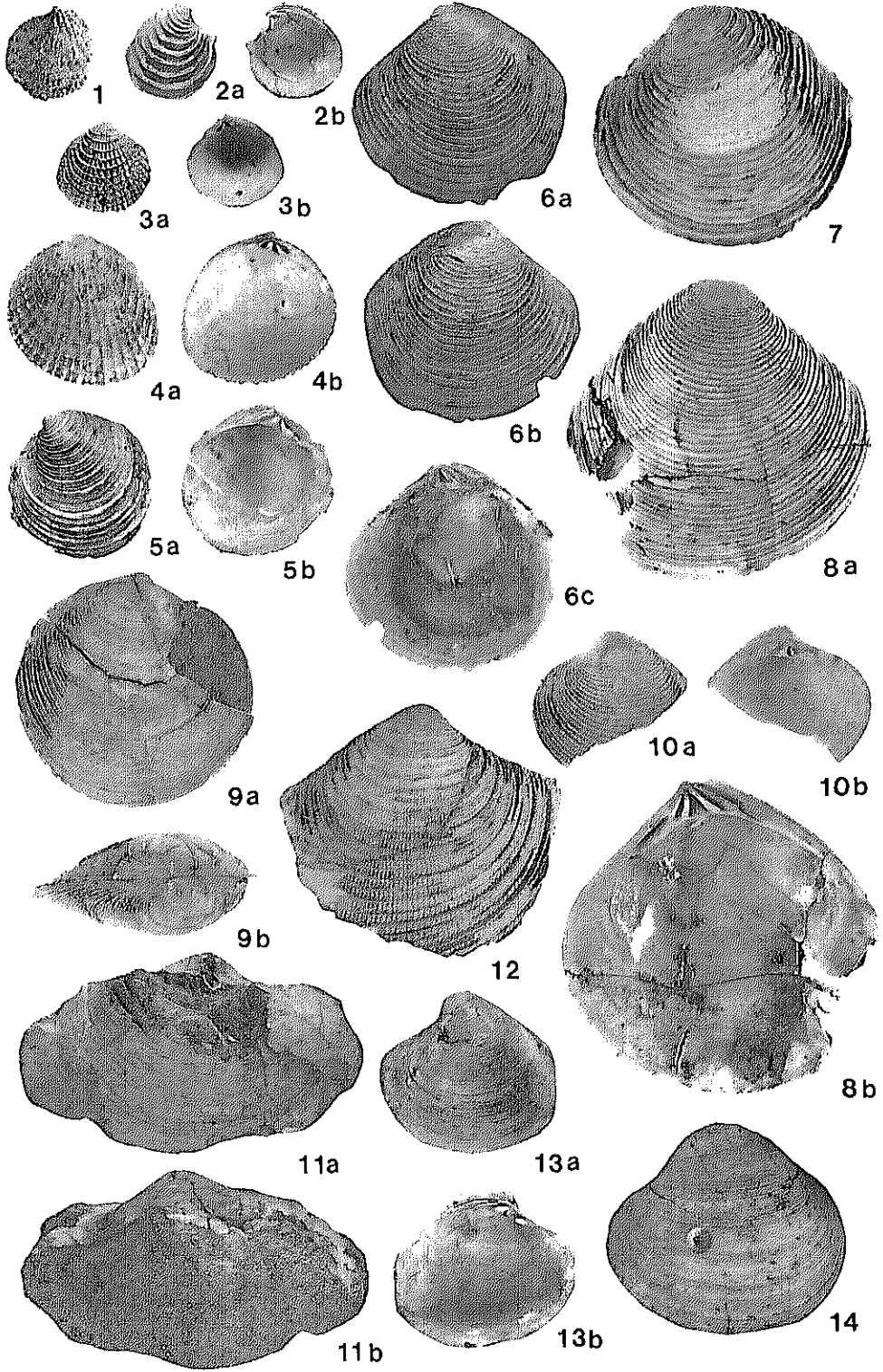
Remarks; The present species is characterized by moderate to small in size for the genus. The species is characterized by having moderate to small shell with 4 nodous spiral ribs crossing longitudinal striae. The secondary spiral ribs are developed from the penultimate whorl. On the body whorl, the main spiral ribs are associated with interstitial riblets. The body whorl is rather swollen and the base is also well rounded. The inner lip is smooth and thick. The longitudinal color pattern is still pressed in the specimen collected from Loc. no. 88. The species is distinguished from *T. chinensis* by its longitudinal and spiral sculptures.

The present species is recorded from the Pliocene to Recent. In Okinawa Island, the present species already known from the Nakoshi Formation by Nomura and Zinbo (1936) under the name of *Turbo yabei* which was identical with the present species as mentioned by MacNeil (1961). However, the geological ranges of the species is limited from the Pliocene to

←Fig. 14

1a-1b, <i>Tellinella verrucosa</i> (Hanley).....	p. 76
Loc. no. 81, x 1, IGUT coll. cat. no. 12368.	
2, <i>Tellinella pulcherima</i> (Sowerby)	
Loc. no. 84, x 1, IGUT coll. cat. no. 12369.	
3-4, <i>Grammatonya squamosa</i> (Lamarck).....	p. 76
Loc. no. 81, x 1, IGUT coll. cat. no. 12370, 71.	
5a-6b, 7a-7b, <i>Nipponocrassatella nana</i> (Adams and Reeve).....	p. 73
5a-6b, Loc. no. 84, x 1, IGUT coll. cat. no. 12372a,	
7a-7b, x 1, IGUT coll. cat. no. 12372b.	

8a-9b, <i>Azorinus abbreviatus</i> Gould.....	p. 77
8a-8b, Loc. no. 88, x 1.5, IGUT coll. cat. no. 12374,	
9a-9b, Loc. 88, IGUT coll. cat. no. 12375.	
10, <i>Macoma (Macoma) praetexta</i> (Martens).....	p. 76
Loc. no. 109, x 1, IGUT coll. cat. no. 12376.	
11a-11b, <i>Luttraria (Psamophila) sieboldi</i> Deshayes.....	p. 75
Loc. no. 81, x 1, IGUT coll. cat. no. 12377.	
12, <i>Solecrutus divaricatus</i> (Linnaeus).....	p. 76
Loc. no. 87, x 1, IGUT coll. cat. no. 12378.	



Recent in Okinawa to SE Asia. The earliest appearance of the present species is of Dickerson (1922) from the Miocene Vigo Formation in the Philippines. As already discussed by Aoki and Espiritu (1977), the Vigo Formation is of the Pliocene or mixed formation with the Miocene species. The geological age of the species is Pliocene to Pleistocene.

Localities: Loc. no. 81 (few), no. 84 (rare), no. 87 (rare), no. 88 (rare).

Subfamily Astreinae Davies, 1933

Genus *Astraliium* Link, 1807

Subgenus *Astraliium* Link, 1807

Astraliium (*Astraliium*) *haematragum* (Menke, 1829)

Figs. 17-8a-9b.

1971, *Astraliium haematragum*, Kuroda *et. al.*, 47, 72, pl. 15, fig. 3.

1981, *Astraliium haematragum*, Taki *in* Okada and Taki, 175, pl. 81, fig. 22.

1985, *Astraea* (*Astraliium*) *haematraga*, Dance, Compendium of sea shells, fig. on p. 55.

Remarks; The present species is defined by trochoidal shell with granular rows on suture, and 19-20 longitudinal spines at the lowest margin of the basal suture. The base is rather flat with 7 spiral rows of nodous ribs. The present species is said to be common at the rocky shores. Loc. no. 81 (rare), 87 (few).

Family Turritellidae Woodward, 1851

Genus *Turritella* Lamarck, 1790

Subgenus *Kurosoioia* Ida, 1952

Turritella (*Kurosoioia*) *filiola* Yokoyama, 1928a Figs. 19-4-5.

1928a, *Turritella filiola* Yokoyama, 57, pl. 4, fig. 7.

1938, *Turritella filiola*, Otuka, 39, fig. 13 on pl.

1952, *Turritella* (*Kurosoioia*) *filiola*, Ida, 44, pl. 1, figs. 5-6, pl. 7, fig. 7.

1959, *Turritella* (*Kurosoioia*) *filiola*, Kotaka, 85, pl. 3, figs. 6-8, pl. 11, figs. 1, 3.

1961, *Turritella* (*Haustator*) *filiola*, MacNeil, 36, pl. 1, fig. 20, pl. 11, figs. 22-26.

1969, *Turritella* (*Kurosoioia*) *filiola*, Shuto, 59, pl. 2, figs. 14-15, text-fig. 17.

1984, *Turritella filiola*, Nohara and Miyagi, pl. 2, fig. 13.

Remarks; MacNeil (1961) reported the present species from the Yonabaru Formation and Nakoshi Sand. As the direct examination of the specimens from the Miocene Yonabaru Clay which is the earliest occurrence of the species, it is hard to conclude the range of the species. The Yonabaru specimens (MacNeil, 1961, pl. 1, fig. 20) seem to have different external sculptures to those of *Turritella filiola* from the Nakoshi. This is a future problem to discuss together with the occurrence of *Turritella cingulifera* Sowerby as mentioned by Beets (1950a, p. 330). The species has beaded spiral ribs in association with 10-15 secondary dotted spiral ribs.

Localities: Loc. no. 81 (few), 84 (few), 87 (dominant), 88 (few).

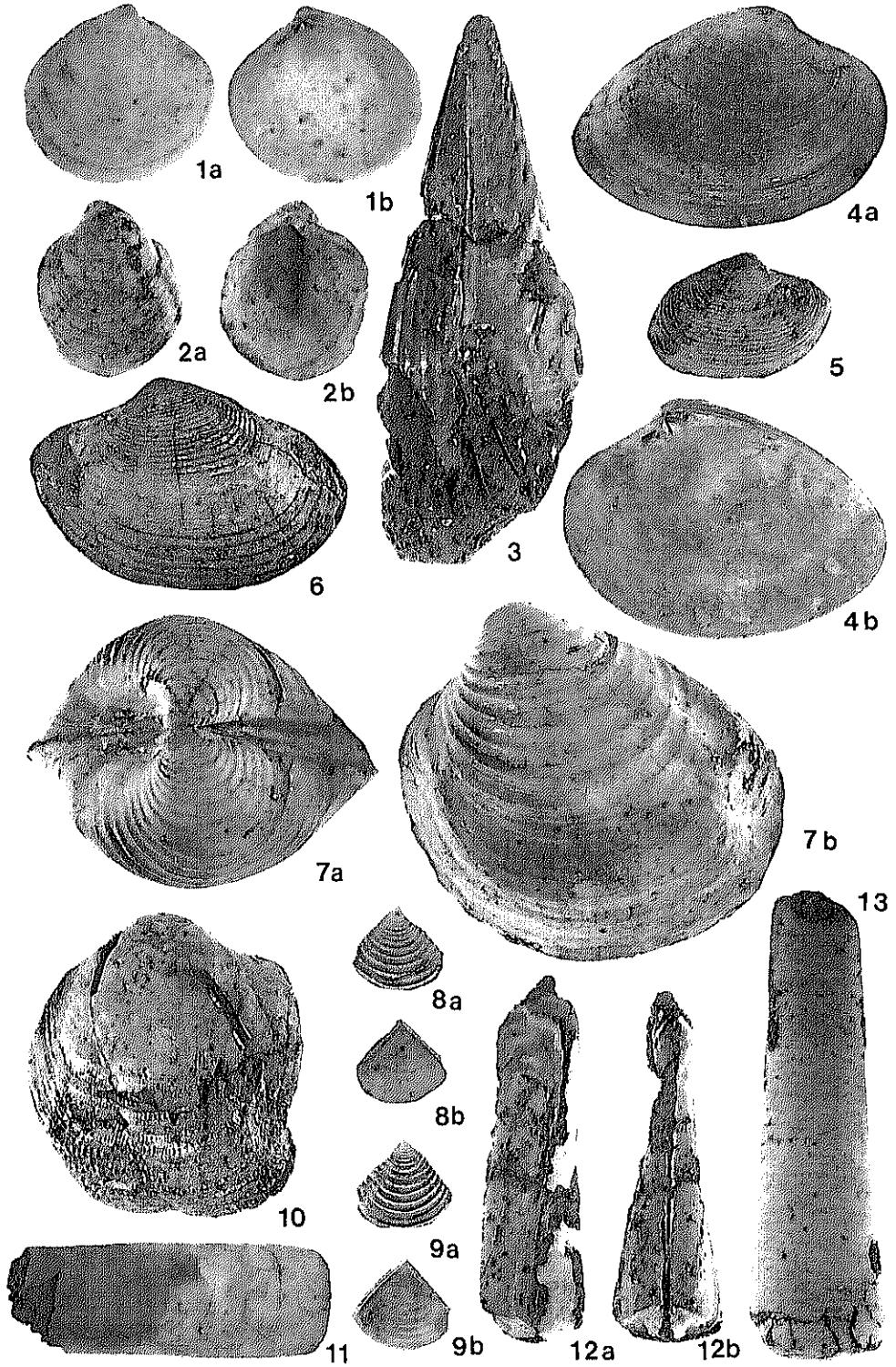
Family Potamididae H. & A. Adams, 1854

Genus *Batillaria* Benson, 1842

←Fig. 15

1, <i>Epicodakia delicatula</i> Pilsbry	p. 72
Loc. no. 87, x 1, IGUT coll. cat. no. 12379.	
2a-2b, <i>Placamen tiara</i> (Dilwyn)	p. 78
Loc. no. 87, x 1, IGUT coll. cat. no. 12380.	
3a-4b, <i>Glycydonta marica</i> (Linnaeus)	p. 78
Loc. no. 87, 3a-3b, x 1, 4a-4b, x 5, IGUT coll. cat. no. 12381.	
5a-5b, 7, <i>Ventricolaria</i> (<i>Ventricoloidea</i>) <i>foveolata</i> (Sowerby)	p. 77
5a-5b, Loc. no. 87, x 1, IGUT coll. cat. no. 12382, 7, Loc. no. 88, x 1, IGUT coll. cat. no. 12383.	
6a-6c, 8a-8b, <i>Circe</i> (<i>Circe</i>) <i>scripta</i> (Linnaeus)	p. 79
6a-6c, Loc. no. 81, x 1, IGUT coll. cat. no. 12384.	
8a-8b, IGUT. coll. cat. no. 12385.	

9a-9b, <i>Pardosinia amphidesmoides</i> (Reeve)	p. 81
Loc. no. 81, x 1.5, IGUT coll. cat. no. 12386.	
10a-10b, <i>Pitar</i> (<i>Costellipitar</i>) cf. <i>chordatum</i> (Roemer)	p. 81
Loc. no. 88, x 1, IGUT coll. cat. no. 12387.	
11a-11b, <i>Laternula</i> (<i>Laternula</i>) <i>anatina</i> (Linnaeus)	p. 89
Loc. no. 87, x 1, IGUT coll. cat. no. 12388.	
12, <i>Pelyglypta</i> (<i>Tigammona</i>) <i>chemnitzi</i> (Hanley) ...	p. 78
Loc. no. 84, x 1, IGUT coll. cat. no. 12389.	
13a-14, <i>Pitar</i> (<i>Pitarina</i>) <i>japonica</i> Kuroda and Kawamoto	p. 79
13a-13b, Loc. no. 88, x 1, IGUT coll. cat. no. 12390,	
14, Loc. no. 81, x 1, IGUT coll. cat. no. 12391.	



Batillaria flectosiphonata Ozawa, 1996
Figs. 20-18a-18b.

- ?1950, *Batillaria* aff. *zonalis* (Bruguière), MacNeil, 39, pl. 16, fig. 25, pl. 18, fig. 13.
1971, *Batillaria zonalis*, Noda, 45-46, pl. 7, figs. 2-3.
1995, *Batillaria multiformis*, Kubo and Kurozumi, 43, fig. 2.
1996, *Batillaria flectosiphonata* Ozawa, 190-194, pl. 1, figs. 1-12.
1995, *Batillaria multiformis*, Nakao, pl. 1, fig. 8.
2001, *Batillaria multiformis*, Nakao, pl. 1, fig. 4.

Remarks; The present species was originally described by the Recent specimens distributed in Iriomote-jima Island, the Ryukyus by Ozawa (1996). As some Pliocene to Pleistocene species were included the species at the original description, the species ranges from the Pleistocene to Recent in the Ryukyus. *Batillaria zonalis* is the most allied species and has 12-13 longitudinal folds crossed with spiral ribs. The folds on the body whorl become nodose at the shoulder.

Locality; Loc. no. 109 (few)

Family Cerithidae Fleming, 1822

Genus *Rhinoclavis* Swainson, 1840

Subgenus *Proclava* Thiele, 1929

Rhinoclavis (Proclava) kochi (Philippi, 1848)

Figs. 19-2a-b.

- 1848, *Rhinoclavis kochi* Philippi, 153 (*vide* Oyama, 1980)
1927, *Cerithiopsis kochi*, Yokoyama, 450, pl. 51, fig. 7.
1980, *Rhinoclavis kochi*, Oyama, 26, pl. 5, figs. 26-27.

Remarks; The external sculpture of the upper three spiral cords cutted by longitudinal lines and interspatial fine spiral cords. Two columner

folds are well recognized. The present species is distinguished from *Rhinoclavis articulata* (Adamns and Reeve) in having nearly straight columner folds and narrow aperture.

Locality; Loc. no. 88 (rare)

Genus *Cerithium* Bruguière, 1789

Cerithium (Proclava) turritum Sowerby, 1855

Figs. 20-7a-b.

- 1855, *Cerithium turritum* Sowerby, 860, sp. 47, pl. 158, fig. 101. (*vide* MacNeil, 1961)
1882, *Vertagus pfefferi* Dunker, 108, pl. 4, figs. 12-14.
1887, *Cerithium turritum*, Tryon, 147, pl. 28, figs. 55-56.
1936, *Cerithium turritum*, Nomura and Zinbo, 260, pl. 11, fig. 28.
1961, *Cerithium (Proclava) turritum*, MacNeil, 41, pl. 12, fig. 3.

Remarks; According to Kuroda and Habe (1952, p. 45), the both species *Cerithium turritum* and *C. pfefferi* are synonymous. The present species is characterized by having four spiral ribs and two internal lirae being crossed with longitudinal folds. Two columeller folds are recognized and the lower fold is weaker than the upper one.

Locality; Loc. no. 81 (rare)

Family Hipponicidae Troschel, 1861

Genus *Amalthea* Schumacher, 1817

Amalthea conica Schumacher, 1817

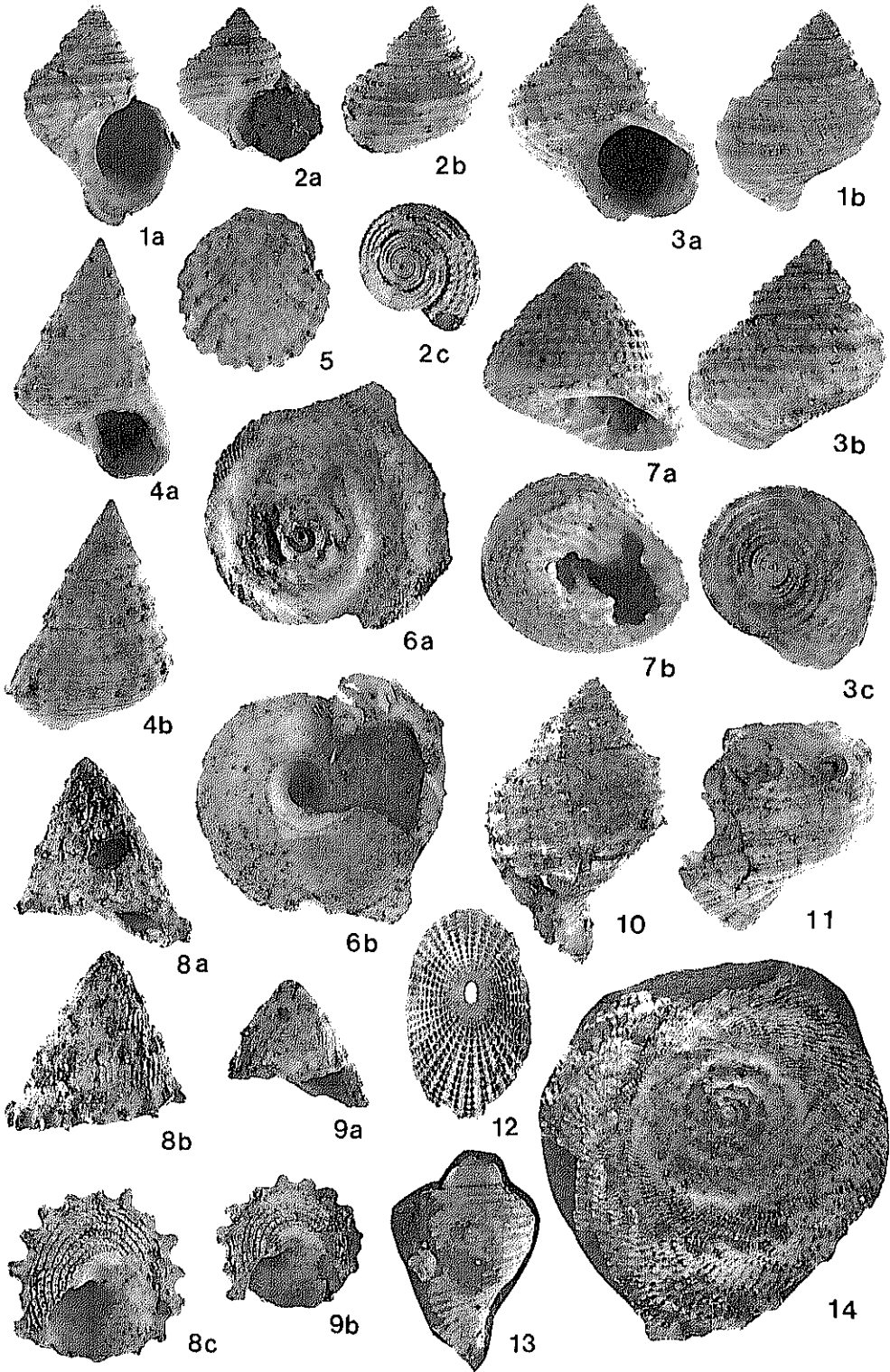
Fig. 17-5.

- 1817, *Amalthea conica* Schumacher, 181, pl. 21, fig. 4. (*vide* Kuroda et al., 1971)
1886, *Hipponix australis*, Tryon, 136, pl. 41, figs. 9-15. (*vide* Kuroda et al., 1971)

←Fig. 16

1a-1b, <i>Pitar (Costellipitar)</i> cf. <i>chordatum</i> (Roemer)	p. 81
Loc. no. 81, x 5, IGUT coll. cat. no. 12392.	
2a-2b, <i>Wallucina</i> sp.	p. 72
Loc. no. 81, x 3, IGUT coll. cat. no. 12393.	
3, <i>Atrina</i> sp.	p. 66
Loc. no. 87, x 1, IGUT coll. cat. no. 12394.	
4a-4b, <i>Callista</i> (s. s) <i>chinensis</i> (Hanley).....	p. 83
Loc. no. 88, x 1, IGUT coll. cat. no. 12395.	
5-6, <i>Paphia (Paphia) euglypta</i> (Philippi).....	p. 83
6. Loc. no. 81, x1, IGUT coll. cat. no. 12397. 5. Loc.	

no. 94 (IGUT coll. cat. no. 12396)	
7a-7b, <i>Clementia (Clementia) vatheleti</i> Mabillet.....	p. 87
Loc. no. 81, x 1, IGUT coll. cat. no. 12398.	
8a-9b, <i>Myadora fluctosa</i> Gould.....	p. 89
Loc. no. 87, x 1, IGUT coll. cat. no. 12399.	
10, <i>Chama</i> sp.	p. 72
Loc. no. 88, x 1, IGUT coll. cat. no. 12400.	
11, <i>Solen</i> sp.....	p. 77
Loc. no. 88, x 1, IGUT coll. cat. no. 12401.	
12a-13, <i>Eufistulano grandis</i> (Deshayes).....	p. 87
Loc. no. 87, x 1.5, IGUT coll. cat. no. 12402.	



- 1936, *Hipponix conicus*, Nomura and Zinbo, 262, pl. 6, figs. 31-32.
 1962, *Sabia conica*, Habe, 28, pl. 14, fig. 3.
 1967, *Sabia conica*, Habe and Kosuge, 40, pl. 15, fig. 15-16.
 1971, *Amalthea conica*, Kuroda *et al.*, 128, 84, pl. 23, figs. 18-19.
 1981, *Sabia conica*, Kira, 30, pl. 13, fig. 3.
 1993, *Amalthea conica*, Okumura and Takei, pl. 27, fig. 10.

Remarks; Only one specimen was collected at hand. The species is conical in form with irregularly elevated 22 radial ribs. The fossil records are quite scarce.

Locality; Loc.no. 88 (rare)

Family Xenophoridae Troscchel, 1852

Genus *Tugurium* Fischer, 1880

Tugurium exutum (Reeve, 1843)

Figs. 17-6a - b, 14.

- 1842, *Phorus exutus* Reeve, pl. 2, fig. 7. (*vide* MacNeil., 1961)
 1858, *Onustus exutus*, H. and A. Adams, 362, pl. 40, figs. 1a-b. (*vide* MacNeil, 1961)
 1879, *Onustus exutus*, Fischer, 430, pl. 22, figs. 1-2. (*vide* MacNeil, 1961)
 1886, *Xenophora (Tugurium) exuta*, Tryon, 161, pl. 46, figs. 90-91. (*vide* MacNeil, 1961)
 1927c, *Xenophora exuta*, Yokoyama, 176, pl. 47, fig. 10.
 1935, *Xenphora exuta*, Nomura, 198, pl. 10, figs. 35a-b.
 1953, *Onustus exutus*, Habe, 179, figs. 7-8.
 1959, *Tugurium exutum*, Makiyama, pl. 58, fig. 10.
 1961, *Tugurium exutum*, MacNeil, 47-48, pl. 12, fig. 10.
 1961, *Onustus exutus*, Hayasaka, 73, pl. 9, figs. 6a-b.
 1971, *Tugurium exutum*, Kuroda *et al.*, 92, 139, pl. 20, figs. 1-2.
 1993, *Tugurium exutum*, Okumura and Takei, 141, pl. 28,

figs. 1a - 2b. (non pl. 27, fig. 9.)

1989, *Tugurium exutum*, Ito, 46, pl. 5, fig. 2.

1993, *Onustus exutus*, Katto and Masuda, 16, pl. 7, fig. 9.

1993a, *Onustus exutus*, Masuda and Huang, 118-119, pl. 1, figs. 15-17.

1994a, *Onustus exutus*, Masuda and Huang, pl. 2, fig. 20.

1995, *Onustus exutus*, Nakao, pl.1, fig. 20.

Remarks; The present species is rather frequently described as mentioned by Masuda and Huang (1993) who made a synonymous list of the species. However, the fossil records are rather scarce. According to Ponder (1983), the present species is defined by having peripheral flange with scalloped edge and with no objects attached. In the earlier stage, the shell attains small pelecypods, flat formed *Operculina* (foraminifers), but middle to final stage, no shells materials attached. The radial fine folds are well presented.

Locality; Loc. no. 87 (few)

Family Strombidae Rafinesque, 1815

Genus *Terebellum* Roeding, 1798

Terebellum terebellum (Linnaeus, 1758)

Figs. 20-12a - b

1758, *Conus terebellum* Linnaeus, 718, no. 284.

1956, *Terebellum terebellum*, Kuroda and Kawamoto, 27, 87, pl 10, fig. 91.

1960, *Terebellum terebellum delicatum*, Abbott, 449, pls. 321, figs. 10-11.

1964, *Terebellum terebellum delicatum*, Habe, pl. 17, fig. 1.

1967, *Terebellum terebellum*, Jung and Abbott, 449-454, pls. 322-326.

1971, *Terebellum terebellum delicatum*, Kuroda *et al.*, 82,

←Fig. 17

- 1a-1b, *Turbo (Batillus) chinensis* Ozawa and Tomidap. 93
 1a-1b, Loc. no. 87, x 1.5, IGUT coll. cat. no. 12403.
 2a-3c, 11, *Marmorostoma (Batillus) gemmata* (Reeve)p. 93
 2a-2b, Loc. no. 81, x 1, IGUT coll. cat. no. 10404;
 3a-3c, Loc. no. 88, x 1, IGUT coll. cat. no. 10405.
 11, Loc. no. 87, x 1, IGUT coll. cat. no. 12413.
 4a-4b, *Tosatrochus attenuatus* (Jones)p. 91
 Loc. no. 87, x 1.5, IGUT coll. cat. no. 12406.
 5, *Amalthea conica* Schumacher.....p. 97
 Loc. no. 88, x 3, IGUT coll. cat. no. 12407.
 6a-6b, 14, *Tugurium exutus* Reeve.....p. 99

Loc. no. 87, x 1, IGUT coll. cat. no. 12408.

7a-7b, *Clanculus margaritarius* (Philippi).....p. 91
 Loc. no. 87, x 3, IGUT coll. cat. no. 12409.

8a-9b, *Astraliun (Astraliun) haematragum* (Menke)p. 95

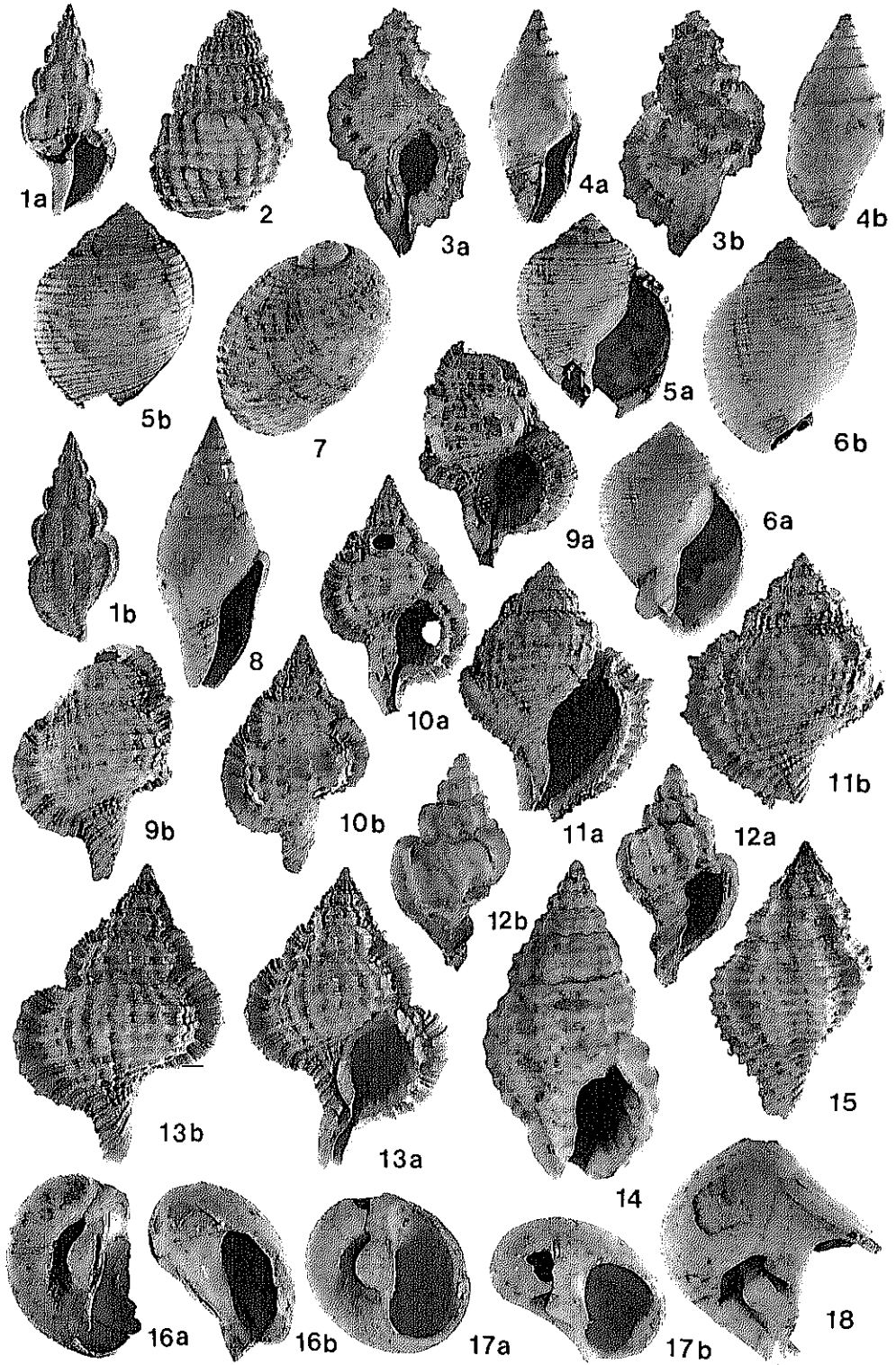
8a-8c, Loc. no. 81, x 1, IGUT coll. cat. no. 12410;

9a-9b, Loc. 87, x 1, IGUT coll. cat. no. 12411.

10, *Mario pamotanensis* Martens.....p. 106
 Loc. no. 109, x 1, IGUT coll. cat. no. 12412.

12, *Fissuridea crucifera* (Pilsbry).....p. 91
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12414.

13, *Semicassis* sp.p. 106
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12415.



- 125, pl. 22, figs. 6-7.
 1981, *Terebellum terebellum*, Taki in Okada and Taki, 159, pl. 76, fig. 11.
 1995, *Terebellum terebellum delicatum*, Nakao, pl. 1, fig. 21.

Remarks; According to Jung and Abbott (1967), *Terebellum terebellum* (Linnaeus, 1758) includes the following five forms, *T. terebellum terebellum*, *T. t. lineatum* Roding, 1758, *T. t. nebulosum* Roding, *T. t. punctulorum* Roding and *T. t. delicatum* Kuroda and Kawamoto. Those species are mainly distinguished by color pattern. Jung and Abbott (1967) showed some differences of the shell morphology according to the growth (size of shell). In the immature stage, the aperture of the species is narrowly open and short. A complete list of synonymous species was made by Jung and Abbott (1967). The species ranges from the Miocene to Recent.

Locality; Loc. no. 88 (rare).

Genus *Strombus* Linnaeus, 1758
 Subgenus *Labiostrombus* Oostingh, 1925
Strombus (Labiostrombus) japonicus (Reeve, 1851)
 Fig. 19-6a—8b.

- 1851, *Strombus japonicus* Reeve, pl. 17, fig. 42. (*vide* MacNeil, 1961)
 1922b, *Strombus japonicus*, Yokoyama, 70, pl. 3, fig. 12.
 1935, *Strombus taiwanicus* Nomura, 177-178, pl. 8, figs. 15a-b.
 1935, *Strombus (Labiostrombus) japonicus*, Otuka, 866,

- pl. 54, fig. 99.
 1936, *Strombus (Labiostrombus) japonicus*, Nomura and Zinbo, 259-260, pl. 11, figs. 27a-b.
 1954, *Canarium (Labiostrombus) japonicus*, Taki and Oyama, pl. 23, fig. 12.
 1961, *Canarium (Labiostrombus) japonicum*, Hayasaka, 74, pl. 9, figs. 14-15b.
 1961, *Strombus (Labiostrombus) cf. japonica*, MacNeil, 48, pl. 12, figs. 14-15, 22-23.
 1981, *Canarium (Doxander) japonicus*, Ogasawara, pl. 2, figs. 3a-3b, 12.
 1984, *Doxander japonica*, Nohara and Miyagi, pl. 2, figs. 9a-b.
 1994, *Strombus vittatus japonicus*, Nakao, pl. 1, fig. 23.

Remarks; *Strombus taiwanica* Nomura (1935, p. 125-126) is not distinguished from *S. japonicus* by similar external features. Among the specimens collected from the Nakoshi Sand, the small sized specimens are identical with *Strombus bivaricosus* Nomura (1935). Thencewhere, *Strombus taiwanica* and *S. bivaricosus* are identical with *S. japonicus*.

Locality; Loc. no. 81 (common), no. 84(rare), no. 87 (few), 88 (common).

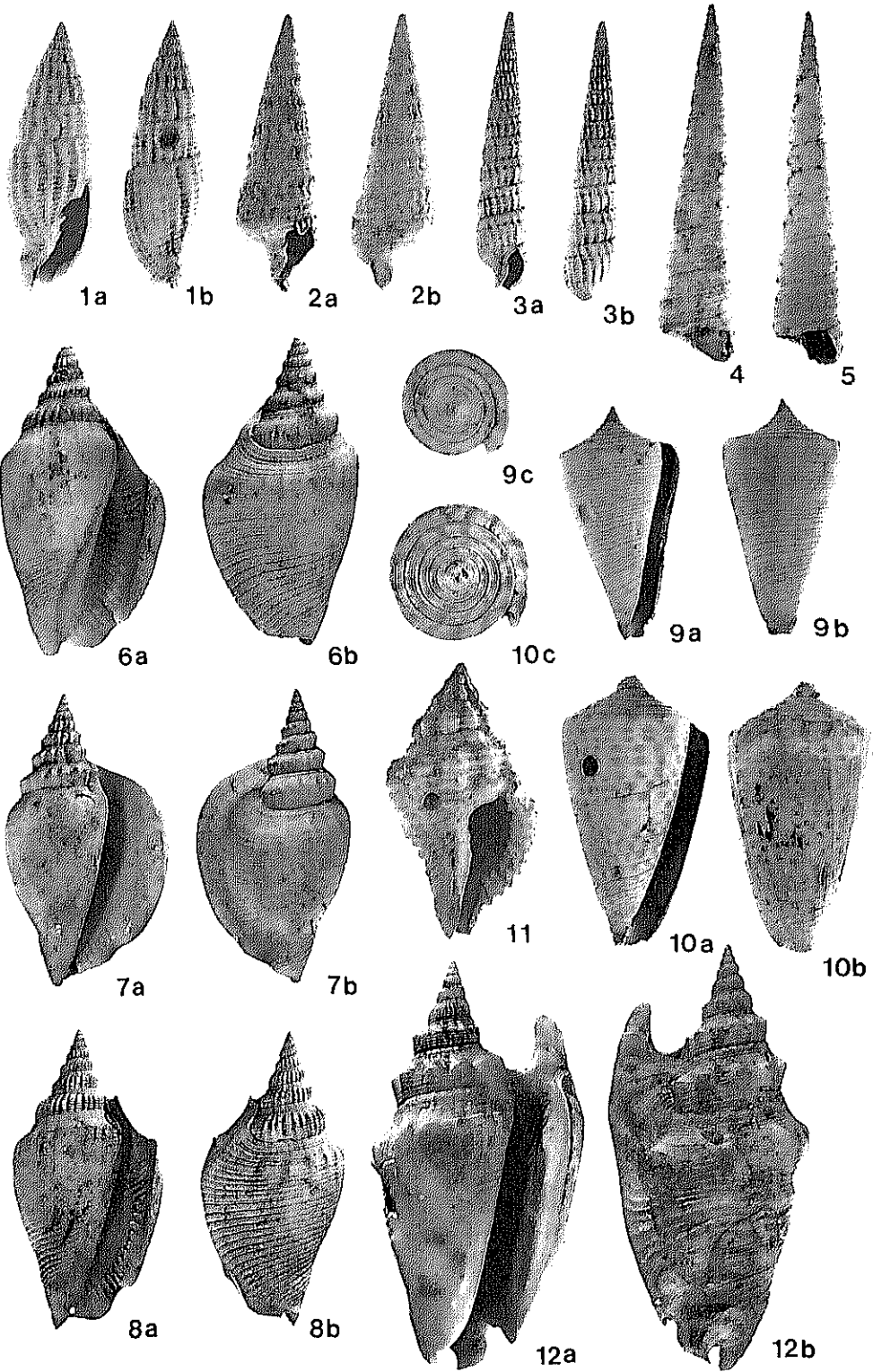
Subgenus *Euprotomus* Gill, 1869
Strombus (Euprotomus) aurisidiana Linnaeus, 1758
 Fig. 9-12a—b.

- 1936, *Strombus (Euprotomus) aurisidiana*, Nomura and Zinbo, 259, pl. 11, figs. 26a-b.
 1941, *Strombus aurisidiana*, Hatai, 102, pl. 20, figs. 2-3, pl. 31, figs. 6-8.

←Fig. 18

- 1a-1b, *Hindsia* sp.p. 107
 Loc.no. 81, x 3, IGUT coll. cat. no. 12416.
 2. *Nassarius (Niotha) gemmalatus* (Lischke).....p. 108
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12417.
 3a-3b. *Cymatium (Cymatriton) nicobaricum* (Broderlip).....p. 106
 Loc. no. 84, x 1.5, IGUT coll. cat. no. 12418.
 4a-4b, 8. *Pyrene flava* (Bruguière).....p. 108
 4a-4b, Loc. no. 81, x 2, IGUT coll. cat. no. 12419;
 5a-5b, Loc. no. 88, x 2, IGUT coll. cat. no. 12420.
 5a-6b. *Semicassis* sp.
 Loc. Miyagi-dam, x 2, IGUT coll. cat. no. 12453.
 (For comparison)
 7. *Eumaticina papilla* (Gmelin).....p. 103
 Loc. no. 109, x 2, IGUT coll. cat. no. 12421.
 9a-10b, 13a-13b. *Gyrineum pusillum* (Broderlip).....

-p. 106
 9a-10b, Loc. no. 84, x 1, IGUT coll. cat. no. 12422,
 13a-13b, Loc. no. 81, x 1.5, IGUT coll. cat. no. 12423.
 11a-11b. *Bursa (Bufenaria) rana* (Linnaeus).....p. 106
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12424.
 12a-12b. *Cancellaria (Trigonostoma) taiwanensis* Nomura.....p. 109
 Loc. no. 109, x 3, IGUT coll. cat. no. 12425.
 14. *Nassarius (Zeuxis) caelatus* (Gould)p. 108
 Loc. no. 109, x 5, IGUT coll. cat. no. 12426.
 15. *Pollia martini* Shuto.....p. 107
 Loc. no. 84, x 2, IGUT coll. cat. no. 12427.
 16a-18. *Polinices sagamiensis* Pilsbry.....p. 103
 16a-17b, Loc. no. 81, x 1, IGUT coll. cat. no. 12428;
 18, Loc. no. 84, x 1, IGUT coll. cat. no. 12429.



- 1984, *Euprotomus vomer*, Nohara and Miyagi, pl. 12, figs. 10a-b.
 1993, *Euprotomus* cf. *hirasei*, Katto and Masuda, 16, pl. 7, fig. 8.

Remarks; The present species is well identical with the Recent species, *Euprotomus vomer* Roeding in having fine crenulated sculpture at the immature whorls, a row of tubercles on near shoulder from middle to body whorls, pointed up outer lip, double siphonal canals on the anterior end with thick outer and inner lips. Nohara and Miyagi (1984) first illustrated the present species from the Nakoshi Formation. *Euprotomus aurisidiana* is allied to the present species in having similar external sculptures and the size of outer lip but the present species has more slender shell and more distinct row of tubercles. *E. bulla* Roeding has more swollen shell.

Locality; Loc. no. 84 (rare)

Family Naticidae Forbes, 1838
 Subfamily Polinicinae Grag, 1847
 Genus *Polinices* Montfort, 1810
Polinices sagamiensis Pilsbry, 1904
 Figs. 18-16a-18.

- 1904, *Polinices sagamiensis* Pilsbry, 23-24, pl. 4, figs. 37-37a. (*vide* Majima, 1989)
 1922b, *Polinices powislanus* Yokoyama, 83-84, pl. 4, fig. 12.
 1927a, *Polinices sagamiensis*, Makiyama, 74-75, pl. 3, figs. 1-2.
 1928a, *Polinices sagamiensis*, Yokoyama, 63, pl. 6, fig. 2.
 1935, *Polynices sagamiensis*, Otuka, 866, pl. 53, fig. 36.
 1956, *Polinices sagamiensis*, Kawamoto, p. 27, pl. 10, fig. 95.
 1961, *Polinices sagamiensis*, Azuma, pl. 21, fig. 2.
 1961, *Polinices sagamiensis*, Shikama, text-fig. 191-6.
 1969, *Polinices sagamiensis*, Oyama, text-fig. 4.

- 1970, *Polinices sagamiensis*, Habe and Kosuge, 48, pl. 18, fig. 29.
 1971, *Polinices sagamiensis*, Kuroda *et al.*, 182-183, 120, pl. 18, figs. 7-8.
 1973, *Polinices sagamiensis*, Oyama, 31-32, pl. 7, figs. 7a-b.
 1981, *Polinices sagamiensis*, Kira, 41, pl. 17, fig. 15.
 1985, *Polinices sagamiensis*, Majima, pl. 17, Na-b.
 1961, *Polinices* cf. *albumen*, MacNeil., 45-46, pl. 4, figs. 23-27.
 1981, *Polinices powislanum*, Kira, 41, pl. 17, fig. 16.
 1989, *Polinices sagamiensis*, Majima, 45-46, pl. 4, figs. 23-27, text-figs. 4.2, 15.13, 15.14, 17.3.
 1993, *Polinices sagamiensis*, Okumura and Takei, pl. 28, figs. 7a-c.

Remarks; The complete synonymous list was made by Majima (1989, p. 45-46). The species is characterized by ovately round to globosely elongated shell with thick and large umbilical callus, and deep groove. Up to date the species was recorded from the Pliocene to Pleistocene formations in the southwest Japan.

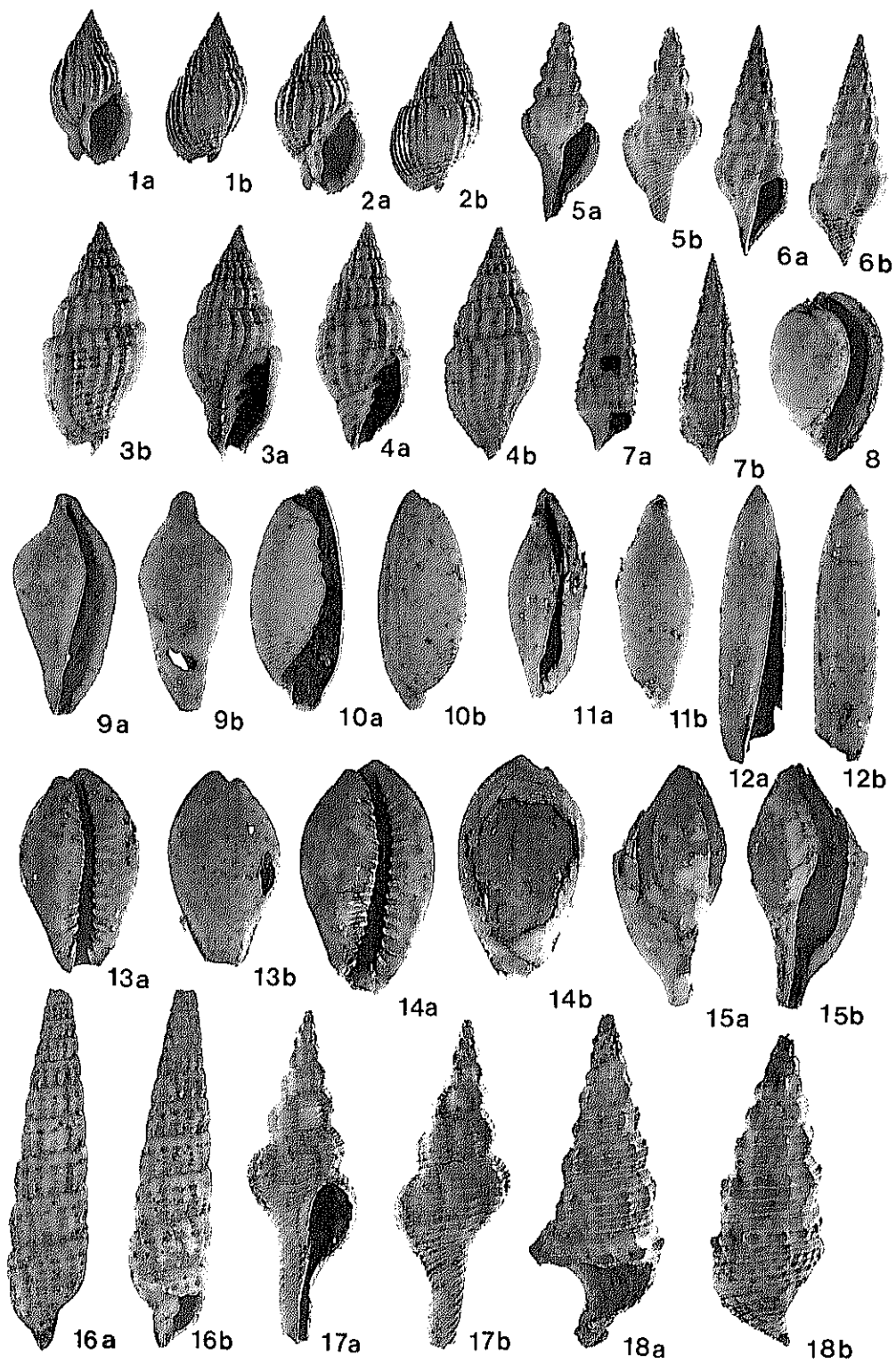
Locality; Loc. no. 81 (rare), no. 84 (rare).

Genus *Eunaticina* Fischer, 1885
Eunaticina papilla (Gmelin, 1791)
 Fig. 18-7.

- 1791, *Nerita papilla* Gmelin, 3675. (*vide* Kuroda *et al.*, 1971)
 1864, *Sigaretus papilla*, pl. 4, figs. 19a-b. (*vide* Kuroda *et al.* 1971)
 1886, *Sigaretus (Eunaticina) papilla*, Tryon, 58, pl. 28, figs. 78-79, 87-88. (*vide* Majima, 1989)
 1905, *Sigaretus papilla*, Martin, 269, pl. 40, figs. 647-648. (*vide* Majima, 1989)
 1906, *Sigaretus papilla*, Tokunaga, 19, pl. 1, fig. 34.
 1920, *Sigaretus papilla*, Tesch, 68, pl. 132, figs. 204a-b.
 1922, *Sigaretus papilla*, Yokoyama, 84, pl. 5, fig. 8.
 1954, *Eunaticina papilla*, Taki and Oyama, 17, pl. 25, fig. 8.

← Fig. 19

1a-1b, <i>Uromitra obeliscus</i> (Reeve).....	p. 108
Loc. no. 81, x 2, IGUT coll. cat. no. 12430.	
2a-2b, <i>Rhinoclavis (Proclava) kochi</i> Philippi.....	p. 97
Loc. no. 88 (rare), x 1.5, IGUT coll. cat. no. 12431.	
3a-3b, <i>Mylurella (Clathrotrebra) woodwardi</i> (Marten)	
.....	p. 110
Loc. no. 81, x 1.5, IGUT coll. cat. no. 12432.	
4-5, <i>Turritella (Kurosoiia) filiola</i> (Reeve).....	p. 95
Loc. no. 81, x 2, IGUT coll. cat. no. 12433.	
6a-8b, <i>Strombus (Labiostrombus) japonica</i> (Reeve).....	
.....	p. 101
Loc. no. 88, x 1, IGUT coll. cat. no. 12434.	
9a-9c, <i>Comus quercinus</i> Lightfoot.....	p. 110
Loc. no. 84, x 1, IGUT coll. cat. no. 12435.	
10a-10c, <i>Comus tessellatus</i> Born.....	p. 110
Loc. no. 88, x 1, IGUT coll. cat. no. 12436.	
11, <i>Pollia martini</i> Shuto.....	p. 107
Loc. no. 84, x 2, IGUT coll. cat. no. 12427.	
12a-12b, <i>Strombus (Euprotombus) aurisidiana</i> Linnaeus	
.....	p. 101
Loc. no. 84, x 1, IGUT coll. cat. no. 12437.	



- 1961, *Eumaticina papilla*, Azuma, 199, pl. 13, fig. 7.
 1961, *Eumaticina papilla*, Habe, 40, pl. 8, fig. 14.
 1961, *Eumaticina papilla*, Hayasaka, 77-78, pl. 9, figs. 21a-b.
 1964, *Eumaticina papilla*, Habe, 61, pl. 18, fig. 14.
 1969, *Eumaticina papilla*, Oyama, 80, text-fig. 6.
 1970, *Eumaticina papilla*, Habe and Kosuge, 45, pl. 18, fig. 3.
 1971, *Eumaticina papilla*, Kuroda *et al.*, 188-189, 123, pl. 108, fig. 10.
 1982, *Eumaticina papilla*, Kanno *et al.*, 104, pl. 17, figs. 11a-b.
 1989, *Eumaticina papilla*, Majima, 68, pl. 9, fig. 16, text-figs. 15, 36, 23a-d, tab. 28.
 1995, *Eumaticina papilla*, Nakao, pl.1, fig. 3.
 1998, *Eumaticina papilla*, Ozawa *et al.*, 34-35, pl.4, figs. 3a-b.

Remarks; Majima (1989) made a complete synonymous list and he mentioned the type locality of the species is Tranquebar, India (*fide* Weinkauff, 1883). The species is recorded from the Pliocene to early Pleistocene (Dainichi Formation, Semata Formation, Shimoda Formation, Toshima Sand), but not from the formations before the Pleistocene. *Simun neritoideum* was once recorded from the Nakoshi Sand by Nomura and Zinbo (1936, pl. 11, figs. 33a-b) and is quite similar to the present species.

Locality; Loc. no. 109 (rare).

Family Cypraeidae Rafinesque, 1815

Subfamily Nariinae Schilder, 1927

Genus *Erosaria* Troschel, 1863

Subgenus *Erosaria* s.s.

Erosaria (Erosaria) erosa cf. *phragedaina* Melville, 1888
 Figs. 20-13a-14b.

Compared with;

- 1935, *Cypraea miliaris* Gmelin, Nomura, 172, pl. 9, figs. 4a-b.
 1961, *Erosaria (E.) erosa* cf. *phragedaina*, MacNeil, 51, pl. 19, figs. 9, 12.
 1993, *Cypraea* sp., Okumura and Takei, 141, pl. 27, figs. 11a-c.

Remarks; The present species resembles *Cypraea carneola* Linnaeus described by Yokoyama (1928c) from the Upper Byoritsu Bed in Taiwan in shell form and apertural features (16 to 18 in number) but the latter has much more number of apertural crenulation.

Locality; Loc. no. 84 (rare)

Family Ovulidae Bruguière, 1792

Genus *Ovula* Bruguière, 1792

Ovula sp.

Fig. 20-8.

Remarks; The present unnamed species has smooth external surface in ovately elongated shell and narrow aperture as long as shell height with depressed apex. The siphonal canal is short but apparent. As the only one imperfect specimen especially the outer lip was missing, is at hand, the more collection is necessary to discuss

◀Fig. 20

- 1a-4b. *Nassarius (Zeuxis) caelatus* (A.Adams)...p. 108
 Loc. no. 81, 1a-2b, x 1, 3a-4b, x 3, IGUT coll. cat. no. 12438-12439.
 5a-5b. *Rostellaria* cf. *spinifera* Marten.p. 107
 Loc. no. 87, x 1.5, IGUT coll. cat. no. 12440.
 6a-6b. *Crassispira pseudoprincipalis* (Yokoyama)
p. 109
 Loc. no. 81, x 1.5, IGUT coll. cat. no. 12441.
 7a-7b. *Cerithium (Proclava) turritum* Sowerby
p. 97
 Loc. no. 81, x 2, IGUT coll. cat. no. 12442.
 8. *Ovula* sp.p. 105
 Loc. no. 87, x 2, IGUT coll. cat. no. 12443
 9a-9b. *Certhiopsis* cf. *frumentum* Sowerby.p. 107
 Loc. no. 84, x 3, IGUT coll. cat. no. 12444.
 10a-10b. *Aliculsteum* cf. *cylindricum* Sowerby.

-p. 110
 Loc. no. 87, x 5, IGUT coll. cat. no. 12445.
 11a-11b. *Phenacovolva macneilli* Noda.p. 107
 Loc. no. 87, x 3, IGUT coll. cat. no. 12446.
 12a-12b. *Terebellum terebellum* (Linnaeus).....p. 99
 Loc. no. 88, x 1.5, IGUT coll. cat. no. 12447.
 13a-14b. *Erosaria* (s.s.) *erosa* cf. *phragedaina* Melville
p. 105
 Loc. no. 84, x 1, IGUT coll. cat. no. 12448.
 15a-15b. *Volva* sp.p. 107
 Loc. no. 84, x 1, IGUT coll. cat. no. 12449.
 16a-16b. *Strioterebrum* sp.p. 108
 Loc. no. 88, x 5, IGUT coll. cat. no. 12450.
 17a-17b. *Fusinus perplexus* (A.Adams)p. 109
 Loc. no. 88, x 1, IGUT coll. cat. no. 12451.
 18a-18b. *Batillaria flectosiphonata* Ozawap. 97
 Loc. no. 109, x 1.5, IGUT coll. cat. no. 12452.

the species since it is referred to the genus *Ovula*.

Locality; Loc. no. 87 (rare).

Family Bursidae Thiele, 1925

Genus *Bursa* Roeding, 1798

Subgenus *Bufoñaria* Schumacher, 1817

Bursa (*Bufoñaria*) *rana* (Linnaeus, 1758)

Figs. 18-11a--b.

1758, *Murex rana* Linnaeus, 748.

1844, *Ranella albivaricosa* Reeve, pl. 1, fig. 2. (*non vidi*)

1881, *Ranella albivaricosa*, Tryon, pl. 18, fig. 6. (*non vidi*)

1915, *Ranella* (*Bursa*) *subgranosa*, Tesch, 70, pl. 82, fig. 152.

1920, *Ranella* (*Bursa*) *nobilis*, Tesch, 41, pl. 129, fig. 153.

1922, *Ranella* (*Bursa*) *subgranosa*, Dickerson, pl. 4, fig. 13b.

1928a, *Gyrineum scelestum* Yokoyama, 44-45, pl. 3, figs. 5-6.

1961, *Bursa* (*Bufoñaria*) *rana*, MacNeil, 60, pl. 13, fig. 5.

Remarks; The present species is defined by having smooth mammilated protoconchs (3 1/2 turns), primally and secondarily spiral cords crossed longitudinal ribs. Two longitudinal valixes are crossed with spiral ribs. At their crossings, the tubercles and nodes are developed. The longitudinal folds are on the both sides of aperture. About 11-12 inside teeth are developed on the outer lip. The inner side of outer lip.

Locality; Loc. no. 81 (rare)

Genus *Gyrineum* Link, 1807

Gyrineum pusillum (Broderlip, 1832)

Figs. 18-9a--10b, 13a--b.

1984, *Apollon cuspidatus*, Nohara and Miyagi, pl. 2, figs. 6a-b, 7.

Remarks; The present species is different from *Gyrineum cuspidatus* (Reeve) which recorded from the same formation by Nohara and Miyagi (1984) in having more finer reticulated sculptures due to the fine longitudinal ribs in comparison with the latter species.

Locality; Loc. no. 81 (rare), no. 84 (rare).

Genus *Cymathium* Roeding, 1798

Subgenus *Cymatriton* s.s.

Cymathium (*Cymatriton*) *nicobaricum* (Roeding, 1798)

Figs. 18-3a--b.

Remarks; The present species at hand is an immature form of the species. The external sculptures as the longitudinal folds, longitudinal ribs crossed with the spiral ribs, thick outer lip, teeth on inner side of aperture, slightly anteriorly curved siphonal canal are referred to the species named.

Locality; Loc. no. 84 (rare).

Family Cassididae Latereille, 1825

Genus *Mario* Montfort, 1810

Mario pamotanensis Martin, 1899

Fig. 17-10.

1899, *Mario pamotanensis* Martin, 157, pl. 24, figs. 365-365a.

Remarks; The present species is characterized by narrowly elevated spiral ribs and subsutural flat part at near suture line as shoulder. The shell is moderate in size (shell length 42.1 mm, width 27.9 mm). The protoconch was missing but 5 whorls are remained. The body whorl is moderately swollen and sculptured with spiral ribs and its intermediates. The subsutural flat area is also sculptured with two main rows of spiral ribs and its intermediates. The siphonal canal is narrow and slightly inclined forward. The present species is incomplete in preservation but the species is comparable to *Mario pamotanensis*. But the Javan species has two to three spiral ribs and more smooth spiral ribs. As the present species is distinguished from the Javan species, the Okinawan species should be more examined in future.

Locality; Loc. no. 109 (rare).

Genus *Semicassis* Moersch, 1852

Semicassis sp. indet.

Fig. 17-13.

Remarks; Only one immature specimen is at

hand. The external surface is sculptured with roundly elevated spiral ribs. The body whorl is almost 80% of shell height.

Locality; Loc. no. 81 (rare).

Family Ovulidae Bruguière, 1792
Genus *Phenacovolva* Iredale, 1930
Phenacovolva macneili Noda, 1980
Figs. 20-11a-11b.

1961, *Volva* (? *Pellasinmia*) sp., MacNeil, 53, pl. 13, fig. 8.

1980, *Phenacovolva macneili* Noda, 15, pl. 7, figs. 12a-b.

Remarks; The present species is probably same with *Volva* (? *Pellasinmia*) sp. of MacNeil (1961, p. 53, pl. 13, fig. 8) described from the Chinen Formation. The external surface is sculptured by fine spiral grooves being distinct on the both sides but not on middle part of the shell.

Locality; Loc. no. 87 rare.

Genus *Volva* Bruguière, 1792
Volva sp.
Figs. 20-15a-15b.

Remarks; The imperfect specimen is at hand. The shell is moderate in size since the apical part was missing. The outer inner lip is stoutly thick with faint teeth like sculpture. As the aperture and main part of the shell was missing, the present species is remained unnamed. However, this unnamed species resembles with *Volva volva* (Linnaeus) and *V. v. habeii* Oyama.

Locality; Loc. no. 84 (rare).

Genus *Crenovolva* Sowerby, 1823
Crenovolva cf. *frumentum* (Sowerby, 1823)
Figs. 20-9a-9b.

Remarks; The shell is ovately elongated with very fine spiral grooves on the both upper and lower sides of shell, since the main part of body whorl is rather smooth. The upper most part of aperture is erected to the upper margin of shell and higher as shell height. The elongated apex beyonds the shell height. The inside of the outer

lip tightly toothed. The present species is comparable with *Diminovula sinem* (Sowerby) but the present species has somewhat swollen at shoulder. The present species is referred to *Crenovolva frumentum* (Sowerby) as illustrated by Habe (1974, pl. 19, fig. 5).

Locality; Loc. no. 84 (rare).

Family Buccinidae Rafinesque, 1815
Genus *Pollia* Sowerby, 1834
Pollia martini Shuto, 1969
Figs. 18-15, 19-11.

1969, *Pollia martini* Shuto, 11, pl. 12, fig. 33.

Remarks; The present species is characterized by thick and solid shell with 9 longitudinal folds crossed by spiral ribs, 9 horizontal teeth at inner margin of the aperture, and slightly inclined siphonal canal. The present species is identical with *Pollia martini* described from the late Miocene Dingle Formation by Shuto (1969). The species is distinguished from *Coralliophila hataii* described from the Pleistocene in Aichi Prefecture (Hayasaka, 1961).

Locality; Loc. no. 84 (rare).

Genus *Hindsia* H. and A. Adams, 1850
Hindsia sp.
Figs. 18-1a-1b.

Remarks; Only one small specimen is at hand. The species has small and pointed 1.5 coiled protoconch with smooth surface, and 12 longitudinal folds crossed with narrowly elevated 5 radial ribs.

Locality; Loc. no. 81 (rare).

Genus *Rostellaria* Lamarck, 1799
Rostellaria cf. *spinifera* Martens, 1899
Figs. 20-5a-5b.

Remarks; Only small specimen is at hand. The specimen has 14 longitudinal folds crossed with concentric fine spiral ribs.

Locality; Loc. no. 87 (rare).

Family Nassariidae Iredale, 1916

Subfamily Nassariinae Iredale, 1916

Genus *Nassarius* Dumeril, 1806

Subgenus *Zeuxis* H. and A. Adams, 1853

Nassarius (Zeuxis) caelatus (Gould, 1850)

Figs. 20-1a—4b.

1928a, *Nassa (Hinia) verbeeki*, Yokoyama, 40, pl. 2, figs. 9, 13.

1935, *Nassarius (Zeuxis) caelatus*, Otuka, 871, pl. 53, fig. 44.

1936, *Nassarius (Alechtrion) caelatus*, Nomura and Zinbo, 256, pl. 11, fig. 24.

1961, *Nassarius (Niotha) caelatus*, MacNeil, 79, pl. 13, fig. 30.

1971, *Nassarius (Zeuxis) caelatus*, Noda, 46-47, pl. 7, figs. 1a-b.

1982, *Nassarius caelatus verbeeki*, Kanno *et al.*, 113, pl. 19, figs. 9a-b.

1993, *Nassarius (Hinia) caelatus dainichiensis*, Okumura and Takei, 146, pl. 30, fig. 1.

Remarks; Complete synonymous list of the present species was mentioned by Cernohorsky (1984). The species mentioned above were considered to be synonymous with *Nassarius caelatus* Gould. The species is widely distributed in the sea of the Red Sea, Persian Gulf, South Africa, Philippines, China, Fiji and Java at the subtidal at a depth of 150 m (Cernohorsky, 1984). The species ranges from Miocene to Recent. The Okinawan species is well identical with the species whose holotype specimen was illustrated by Cernohorsky (1984, pl. 24, fig. 7, USNM no. 5724).

Locality; Loc. no. 81 (few).

Subgenus *Niotha* H. and A. Adams, 1853

Nassarius (Niotha) gemmulatus (Lamarck, 1822)

Fig. 18-2.

According to Cernohorsky (1984, p. 78-79), the following species are included as the synonymous species of the species.

1844, *Buccinum gemmulatum*, Deshayes, 169 (*file* MacNeil, 1961)

1928a, *Nassa (Niotha) gemmulata*, Yokoyama, 40, pl. 2, fig. 8.

1936, *Nassarius gemmulatus*, Nomura and Zinbo, pl. 106, fig. 9.

1961, *Nassarius (Niotha) gemmulatus*, MacNeil, 79, pl. 13, fig. 29.

1969, *Nassarius (Niotha) gemmulatus*, Shuto, 144, pl. 12, figs. 14, 15, 17.

Remarks; Only one imperfect specimen was collected from sandstone of the Nakoshi Formation. The external fine but distinct reticulated sculpture made by 5 rows of spiral and 22 longitudinal ribs are identical with the present species. The present species is distinguished from *Nassarius (Niotha) fulleri* MacNeil (1961) in having no distinct outer lip and reticulated external sculptures.

Locality; Loc. no. 81 (rare).

Family Mitridae Swainson, 1831

Genus *Uromitra* Bellardi, 1887

Uromitra obeliscus (Reeve, 1844)

Figs. 19-1a—1b.

1844, *Mitra obeliscus* Reeve, 107.

1961, *Uromitra* aff. *obeliscus*, MacNeil, 90, pl. 4, fig. 17, pl. 14, figs. 5, 7-8.

Remarks; The present species is referred to *Uromitra obeliscus* which was collected from the Yonabaru Formation by MacNeil (1961, p. 90, pl. 4, fig. 17). The species is characterized by reticulated sculpture made of crossing of 19 longitudinal ribs and 6-7 fine spiral riblets. The upper two of columnar folds are stout and the lowest one is weak but clear.

Locality; Loc. no. 81 (rare).

Family Terebridae Moerch, 1852

Genus *Strioterebrum* Sacco, 1891

Strioterebrum sp.

Figs. 20-16a—16b.

Small turreted shell with longitudinal ribs crossed spiral ribs. The specimen at hand is small and apical part is missing. It is hard to identify the species.

Locality; Loc. no. 88 (rare).

Family Columbelloidea Swainson, 1840

Genus *Pyrene* Roeding, 1798

Pyrene flava (Bruguière)

Figs. 18-4a—4b, 8.

1961, *Pyrene* aff. *flava*, MacNeil, 66, pl. 13, figs. 12, 18.

Remarks; As mentioned by MacNeil (1961, p. 66), the present species is difficult to identify in the species level. The specimens collected from the Nakoshi Formation (Loc. nos. 81 and 88) are defined by swollen body whorl with smooth external surface and spiral grooves at the siphonal part. *Pyrene* aff. *ligula* recorded from the Naha Limestone by MacNeil (1961) is distinguished from the present species in having more slender shell and narrow aperture. The species has inner teeth at inner surface of aperture, well swollen body whorl and step-like suture lines and small protoconch volution.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Family Fasciolaridae Montfort, 1810

Genus *Fusinus* Rafinesque, 1815

Fusinus perplexus (A.Adams, 1864)

Figs. 20-17a—17b.

1864, *Fusus perplexus* A.Adams, 106 (*non vidi*).

1869, *Fusus inconstans*, Lischke, 34, pl. 2, figs. 1-2.

1871, *Fusus inconstans*, Lischke, 26, pl. 3, figs. 1-5.

1903, *Fusus perplexus*, Cossman, 125, pl. 4, figs. 17-18. (*vide* Baba, 1990)

1936, *Fusinus perplexus*, Nomura and Hatai, 39.

1961, *Fusinus perplexus*, MacNeil, 84, pl. 13, fig. 22.

1971, *Fusinus perplexus*, Kuroda *et al.*, 280-281, 183, pl. 49, fig. 3

1984, *Fusinus perplexus*, Nohara and Miyagi, pl. 2, figs. 11a-b.

1989, *Fusinus perplexus*, Ito, 49, pl. 8, fig. 11.

1990, *Fusinus perplexus*, Baba pl. 33, fig. 33.

1993, *Fusinus perplexus*, Okumura and Takei, 146-147, pl. 30, fig. 5.

Remarks; The specimen at hand is moderate in size as the species. Eight longitudinal folds on body whorl are crossed with spiral ribs. These ribs disappeared to upper and lower sides of each suture lines. The apical part was missing but long siphonal canal. The inner surface of aperture is crenulated horizontally.

Locality; Loc. no. 88 (rare).

Family Cancellariidae Gray, 1853

Genus *Cancellaria* Lamarck, 1799

Subgenus *Trigonostoma* Blainville, 1826

Cancellaria (*Trigonostoma*) *taiwanensis* Nomura, 1935

Figs. 18-12a—12b.

1935, *Cancellaria* (*Trigonostoma*) *taiwanensis* Nomura, 212-213, pl. 13, fig. 14.

Remarks; The present species is defined by 9 distinct longitudinal folds on the body whorl and obsolete spiral threads between the folds, and two oblique columellar folds. The protoconch volution is round and swollen with smooth surface. The present species is of immature form (shell height 10.8 mm, shell diameter 6.5 mm) but is identical with *Cancellaria taiwanensis* by the same sculptures on the external surface. *Cancellaria chinensis* MacNeil (1961, p. 99, pl. 14, fig. 12) is distinguished from the present species in having distinct columellar folds and more than ten longitudinal folds on the external surface.

Cancellaria scalariformis Lamarck (Tesch, 1915, p. 35, pl. 79, figs. 81a-b) is another allied species.

Locality; Loc. no. 109 (rare).

Family Turridae Swainson, 1815

Subfamily Crassispirinae Morrison, 1966

Genus *Crassispira* Swainson, 1840

Crassispira pseudoprincipalis (Yokoyama, 1920)

Figs. 20-6a—6b.

1920, *Pleurotoma* (*Drillia*) *pseudoprincipalis* Yokoyama, 37-38, pl. 1, fig. 21.

1928a, *Drillia pseudoprincipalis*, Yokoyama, 32, pl. 32, fig. 15.

1960, *Clathrodrillia* (*Pseudoinquisitor*) *pseudoprincipalis*, Makiyama, pl. 87, fig. 15.

1965, *Pleurotoma* sp., Shuto, 168, pl. 30, figs. 4, 6, 12.

1973, *Crassispira pseudoprincipalis*, Oyama, 151, pl. 15, fig. 12.

1984, *Crassispira pseudoprincipalis*, sic. Nohara and Miyagi, pl. 2, fig. 8.

1990, *Crassispira pseudoprincipalis*, Baba, 193, pl. 16, fig. 11.

Remarks; The present species was originally described from the Pleistocene Formation in

Naganuma, Kanagawa Prefecture by Yokoyama (1920) with some allied species. The species illustrated from the Nakoshi Formation by Nohara and Miyagi (1984) is referred to the present species. The species has 12 longitudinal folds crossed with fine spiral ribs and 6-7 subsutural threads.

Locality; Loc. no. 81 (rare).

Family Conidae Rafinesque, 1815

Genus *Comus* Linnaeus, 1758

Comus tesselatus Born, 1778

Figs. 19-10a-10c.

1843, *Comus tesselatus*, Reeve, pl. 28, figs. 163. (*non vidi*)

1936, *Comus tesselatus*, Nomura and Zinbo, 250, pl. 11, fig. 18.

1970, *Lithocomus tesselatus*, Habe and Kosuge, 91, pl. 36, fig. 6.

Remarks; The present species is moderate in size with brown to orange colored dotted pattern and spiral fine 8-10 grooves on the lower part of the body whorl, and bluntly elevated apical fold. The shoulder is rather distinctly sharp. The apical part is sculptured with 10-11 spirals, and distinct and concentric grooves. The apical part is narrowly erected.

Localities; Loc. no. 81 (rare), no. 88 (rare).

Comus quercinus Lightfoot, 1786

Figs. 19-9a-9c.

Remarks; The present species is characterized by obconical shell with concentric shell with brown color band with fine concentric ribs on the basal part. The protoconch is high and 5 volutions and 10 spiral whorls are sculptured with small dotted shoulder. The base is sculptured with fine concentric grooves.

Locality; Loc. no. 84 (few), no. 88 (rare).

Family Terebridae Moerch, 1852

Genus *Myurella* Hinds, 1844

Subgenus *Clathroterebra* Oyama, 1961

Myurella (Clathroterebra) woodwardiana (Martin, 1887)

Figs. 19-3a-3b.

1883-1887, *Terebra woodwardiana* Martin, 73, pl. 5, fig. 76.

1915, *Terebra woodwardiana*, Tesch, 38, pl. 79, figs. 79a-b.

1927, *Terebra (Myurella) woodwardiana*, Fischer, 90, pl. 214, fig. 68.

1938, *Terebra (Myurella) bomasensis*, Ostingh, 54, pl. 4, fig. 83.

1969, *Myurella (Clathroterebra) woodwardiana*, Shuto, 230-231, pl. 23, figs. 8-9, 11-12, 14, 16-17, 23, text-figs. 41, 43.

Remarks; The present species is defined by having 4 high protoconch volutions with one distinct subsutural groove, about 20 longitudinal ribs, and 5 spiral ribs. The aperture is narrowly elongated. The inner lip smooth with two folds. The siphonal canal is slightly wide and short.

Locality; Loc. no. 81 (rare).

Family Haminoidea Pilsbry, 1815

Genus *Aliculastrum* Pilsbry, 1896

Aliculastrum cf. cylindricum (Helbling, 1779)

Fig. 20-10

Compared with;

1961 *Aliculastrum cylindricum*, Hayasaka, 95, pl. 10, fig. 8.

Remarks; Only one immature shell was collected and is characterized by cylindrical thin shell with spiral grooves on the upper and lower external surface of the shell and long aperture. *Aliculastrum cylindricum* from the Yontan Limestone (MacNeil, 1961, pl. 19, fig. 24) has more cylindrical shell than that of the present species.

Locality; Loc. no. 87 (rare).

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