Neogene Bivalves from Panay Island, the Philippines : Contributions to the Geology and Palaeontology of Southeast Asia, CVII

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Neogene Bivalves from Panay Island, the Philippines

Contributions to the Geology and Palaeontology of Southeast Asia, CVII

By

Tsugio SHUTO

Abstract

This is the second part of the palaeontological study of the younger Caenozoic molluscs of Panay Island, the Philippines. The material was obtained at four localities of the eastern section of the Iloilo basin in 1964. Biological consideration and correlation of the fossil assemblages were given in the first part of the report (SHUTO, 1969) and systematic descriptions of fourty-nine species of bivalves are treated in this part. Seven of fourty-nine are new to science.

Contents

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Introduction

The geologic sequence of the Iloilo basin in Panay Island, Central Philippines, have been regarded as a type section for the Neogene biostratigraphy in that country. Reexamination of the type sections of that basin was undertaken as a part of the project, the palaeontological reconnaissance of the Southeast Asia supervised by Professor R. TORIYAMA of Kyushu University and Professor Emeritus T. KOBAYASHI of the University of Tokyo. The field work was carried out in November of 1964 by Drs. T. KANAYA of Tohoku University and T. SHUTO of Kyushu University with the colaboration of Messrs. S. A. GONZALES and P. J. SANTOS of the Petroleum Division of the Bureau of Mines, Republic of the Philippines under the conduct of Professor K. ASANO of Tohoku University. The molluscan material obtained on that occasion was studied by SHUTO and the general consideration on the fossil assemblages and the systematic descriptions of the gastropods were given in the preceding report, "Neogene gastropods from Panay Island, the Philippines," as the contributions to the "Geology and Palaeontology of Southeast Asia" No. 68 (SHUTO, 1969). The present report is the second part of the study and contains the systematic descriptions of 49 species of bivalves, of which seven are new to science.

Acknowledgements

On printing the present work the writer wishes to express his sincere thanks to several persons, who gave valuable assistance, advice and co-operation in the course of the study.

Professor Ryuzo TORIYAMA of Kyushu University and Professor Emeritus Teiichi KOBAYASHI of the University of Tokyo promoted the project. The Bureau of Mines of the Republic of the Phillippines directed by Mr. Fernando S. BUSUEGO gave the effective support to the Japanese party. The Petroleum Division con-

ducted by Mr. Felipe U. FRANCISCO enabled the field work of the Japanese party with their full co-operation. Particularly the writer is indebted to Messrs. Benjamin A. GOZALES and Perfecto J. SANTOS.

The great number of books and molluscan specimens were needed for the taxonomic work. The writer is indebted in access to the necessary material and literature to Dr. Tadashige HABE of the National Science Museum of Tokyo, Dr. Katura OYAMA of the Geological Survey of Japan, Dr. Masuoki HORIKOSHI of the University of Tokyo, Professor H. J. MACGILLAVRY of the University of Amster-

Table 1.

	species	fossil locality in Panay SKGS-	known geologic and geographic range
1	*Yoldia* (*Orthoyoldia*) *franciscoi* sp. nov.	71	
2	*Saccella panayensis* sp. nov.	71	
3	*Trisidos* sp. cfr. *T. semitorta* (LAMARCK)	74	Plio. (Timor), Low. Pleist. (Taiwan), Rec. (Southeast Asian waters)
4	*Anadara* (*Scapharca*) *pilula* (REEVE)	71 and 73	Plio.-Pleist. (Indonesia and Taiwan), Rec. (Philippines)
5	*A.* (*S.*) *gendinganensis* (MARTIN)	73	Plio. (Java)
6	*A.* (*Anadara*) *tambacana* (MARTIN)	71 and 72	Up. Mio.-Plio. (Java), Plio. (South India)
7	*A.* (*A.*) *dichotoma* (DESHAYES)	74	Plio. (Timor and Seram), Rec. (Southeast Asia to North Australia)
8	*A.* (*A.*) *ferruginea* (REEVE)	71, 72, and 73	Plio. (Java and Timor), Rec. (Southeast Asian waters)
9	*A.* (*A.*) *luzonica pterimorpha* subsp. nov.	74	another subspecies, *pangkaensis* (MARTIN) and *terhaari* (OOSTINGH) from Plio. (Java).
10	*A.* (*A.*) *burnesi* (D'ARCHIAC et HAIME)	71	Up. Mio.-Plio. (Indonesia and Burma)
11	*A.* sp.	74	
12	*Arcopsis bataviana* (MARTIN)	72	Up. Mio.-Plio. (Java and Timor)
13	*Striarca lamyi* (KOPERBERG)	74	Up. Plio. (Timor)
14	*Melaxinaea pectiniformis* (LAMARCK)	74	Plio. (Java), Rec. (Southeast Asian waters)
15	*Chlamys* (*Mimachlamys*) sp. cfr. *C.* (*M.*) *singaporinus* (SOWERBY)	71	Rec. (South China Sea, Indian Ocean, Red Sea)
16	*Ostrea* (*Ostrea*) *glomerata* GOULD	72	Up. Mio.-Pleist. (Indonesia), Rec. (Southeast Asia to New Zealand)
17	*Linga* (*Bellucina*) *gonzalesi* sp. nov.	71	
18	*Marikellia panayensis* sp. nov.	71	
19	*Cardiocardita javana* (MARTIN)	74	Up. Mio. (Java)
20	*Fragum* (*Lunulicardia*) *subretusa* (SOWERBY)	73	Low. Pleist. (Taiwan), Rec. (Southeast Asian waters)
21	*Laevicardium* (*Fulvia*) sp.	71	

Table 1. (Continued)

	species	fossil locality in Panay SKGS-	known geologic and geographic range
22	*Vepricardium* ? sp.	71	
23	*Protocardia* sp.	73	
24	*Tellina (Laciolina) incarnata busuegoi* subsp. nov.	71	
25	*T. (Punipagia) rotunda* MARTIN	72	Mio. (Java)
26	*T. (P.) pudica* HANLEY	71	Rec. (Southeast Asia to Japan)
27	*T. (Arcopaginula) inflata* GMELIN	71 and 73	Up. Mio.-Plio. (Indonesia), Rec. (Southeast Asian waters)
28	*T. (A.)* sp.	72	
29	*T. (Semelangulus)* sp.	73	
30	*T. (Moerella) nannodes* MARTIN	71	Plio. (Java), Low. Pleist. (Taiwan)
31	*T. (Exotica)* sp.	71	
32	*T. (Merisca) diaphana* (DESHAYES)	73	Rec. (Southeast Asia to South Japan)
33	*Macoma (Austromacoma) telahabensis* (MARTIN)	71	Low. Mio. (Java)
34	*Gari (Gari) pulchella* (LAMARCK)	71 and 73	Rec. (Philippine waters)
35	*G. (Gobraeus)* sp. cfr. *G. (G.) crassula* (DESHAYES)	73	Rec. (Philippine waters)
36	*Azorinus (Azorinus) abbreviatus* (GOULD)	71	Low. Pleist. (Taiwan), Upp. Pleist. (South Japan), Rec. (Southeast Asia to Japan)
37	*Circe rivularis* (BORN)	73	Rec. (Southeast Asian waters)
38	*Meretrix meretrix* (LINNÉ)	73	Low. Pleist. (Taiwan), Rec. (Southeast Asian waters)
39	*Lioconcha (Sulcilioconcha) philippinaria* (HANLEY)	73	Plio. (Timor), Rec. (Southeast Asian waters)
40	*Dosinia (Phacosoma) exasperata* (PHILIPPI)	71	Rec. (Southeast Asian waters)
41	*Clementia (Clementia) papyracea* (GRAY)	73	Low. Mio.-Pleist. (South and Southeast Asia), Rec. (Indo-Southwest Pacific region)
42	*Paphia (Paratapes) undulata neglecta* (MARTIN)	71 and 73	Mio.-Plio. (Java and Borneo)
43	*P. (Eumarcia) cheribonensis* OOSTINGH	71 and 73	Plio. (Java)
44	*Placamen calophylla* (PHILIPPI)	71 and 73	Mio.-Plio. (Philippines, Indonesia, North Borneo), Low. Pleist. (Taiwan), Rec. (Southeast Asian waters)
45	*Veremolpa bataviana* (MARTIN)	71	Up. Mio.-Plio. (Java)
46	*V. trigonalis* (MARTIN)	74	Up. Mio.-Plio.(Indonesia)
47	*V. gonzalesi* sp. nov.	72	Plio. (Timor)
48	*Corbula (Corbula) scaphoides* HINDS	74	Up. Mio.-Pleist. (South and Southeast Asia), Rec. (Southeast Asian waters)
49	*C. (Anisocorbula) socialis* MARTIN	74	Low. Mio.-Plio. (Indo-Southwest Pacific region)

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Systematic Descriptions

Measurement of the bivalve shells

The bivalve shells are measured at several dimensions such as length (L), height (H), depth (D), length of the anterior part before the umbo (La), length of the lunule (Ll), umbonal angle (∠U), and number of the radial and concentric sculpture. Taxodont bivalves are also measured at the length of the hinge line (Lh) and the number of the hinge teeth on the anterior and posterior rows, if the hinge is differentiated into two rows. Some of the quadrate shells such as *Tellina* are measured at the height between the subparallel ventral and postero-dorsal margins (Hd).

L is defined here as the maximum length between the anterior and posterior margins (1 and 6 in text-fig. 1). H is the measure of the distance between the umbo and the tangent of the ventral margin parallel to the measured line L (1 and 6). La is represented by the length of the anterior part on the line L before the crossing of the measured lines L and H (1 and 6). Definition of ∠U is somewhat complicated. It is represented by the angle formed by two tangential lines of the postero- and antero-dorsal margins. If either of the dorsal margins is convexedly arcuate, the tangent at the mid-point of the arc is chosen (left hand part=posterior part of 1 and right hand part=anterior part of 4). While it is

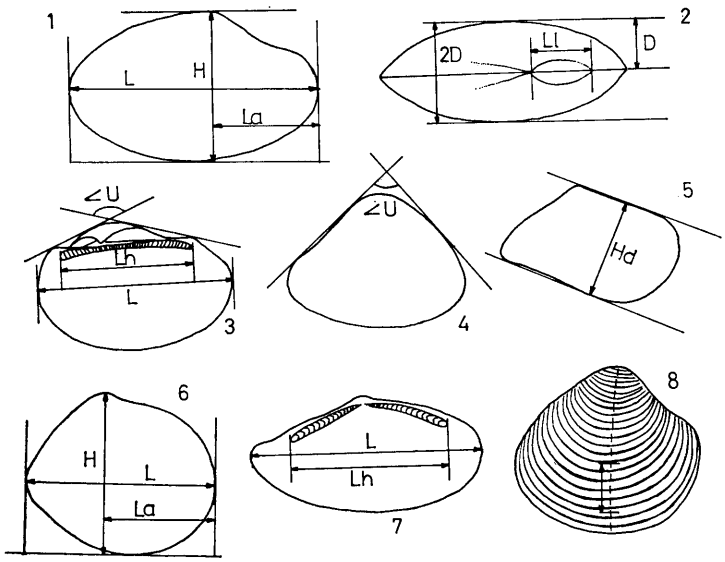

Fig. 1. Measurements of the bivalve shells.

concave, the line should be tangent both to the umbonal area and the convex remote part of the dorsal margin (right hand part=anterior part of 1 and left hand part=posterior part of 4). The radial sculpture may be counted separately on the anterior, main and posterior surface, if the surface is divided into the parts. The concentrics are counted at an unit distance on the line connecting the umbo to the middle part of the ventral margin and expressed in the formula of, for example, 10/3 (1-4), which means that the concentrics are 10 per 3 mm between 1 and 4 mm from the ventral margin on the measured line (8 in text-fig. 1).

Class Bivalvia
Subclass Palaeotaxodonta
Order Nuculoida
Superfamily Nuculoidea
Family Nuculidae
Genus *Yoldia* MÖLLER, 1842
(type-species: *Yoldia hyperborea* TORELL [pro *Yoldia arctica* MÖLLER, non *Nucula arctica* GRAY] by subsequent designation, GARDNER, 1916, ICZN 1966 Opinion 769)
synonym: *Microyoldia* VERRILL et BUSH, 1897 (type-species: *Y. regularis* VERRILL, by O. D.)
Tepidoleda IREDALE, 1939 (type-species: *T. lata orion* IREDALE by O. D.)
Subgenus *Orthoyoldia* VERRILL et BUSH, 1897
(type-species: *Yoldia scapania* DALL by original designation)

Yoldia (*Orthoyoldia*) *franciscoi* sp. nov.
Pl. 1, Figs. 1, 2 and 3 and Text-fig. 2

Material.—Holotype: GK-L 7057 (left valve) and paratypes: GK-L 7058 (right valve), 7059 (right valve), 7060 (right valve) and 6575 (right valve) from one and the same locality. Preservation is excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	Lu (mm)	Lu/L (%)	∠U (degrees)
7057	9.5	5.9	2.25	62.0	23.7	3.8	40.0	137.9
7058	8.1	5.15	2.0	63.5	24.7	3.3	40.7	140.9
7060	8.7	5.4	2.05	62.0	23.6	3.5	40.2	140.3

specimen GK-L	teeth ant.	teeth post.	valve
7057	19	21	left
7058	18	19	right
7060	10	20	right

Diagnosis.—The shell is moderately small, moderately thin, subelliptical and polished. The umbo is hardly elevated above the dorsal margin and situated at the anterior two-fifths of the shell-length. The anterodorsal margin is almost straight, converges with the longer posterodorsal margin at the angle of about 140 degrees and continues to the anterior margin with narrow curvature. While

the posterodorsal margin forms a blunt angle with the posterior margin, which is not rostrate at all. The ventral margin is broadly arcuate. A very obsolete fold running from the umbo to the postero-ventral corner separates the compressed posterior part from the main surface. The surface is provided with fine and close concentric striations. In addition a few coarser and slightly oblique striations are discernible at the anterior and middle part of the ventral border on the adult specimens. The lunule is weakly defined by a ridge, while the concave escutcheon is bordered by a sharp ridge.

The hinge line is divided into two series, which are separated from each other by the distinct and triangular resilium pit. The anterior series has a slightly small number of the teeth than the posterior one. The teeth are thin, erected and tall. The anterior adductor scar is rhomboidal and larger than the elongate posterior one. The pallial sinus is moderately wide and not very deep

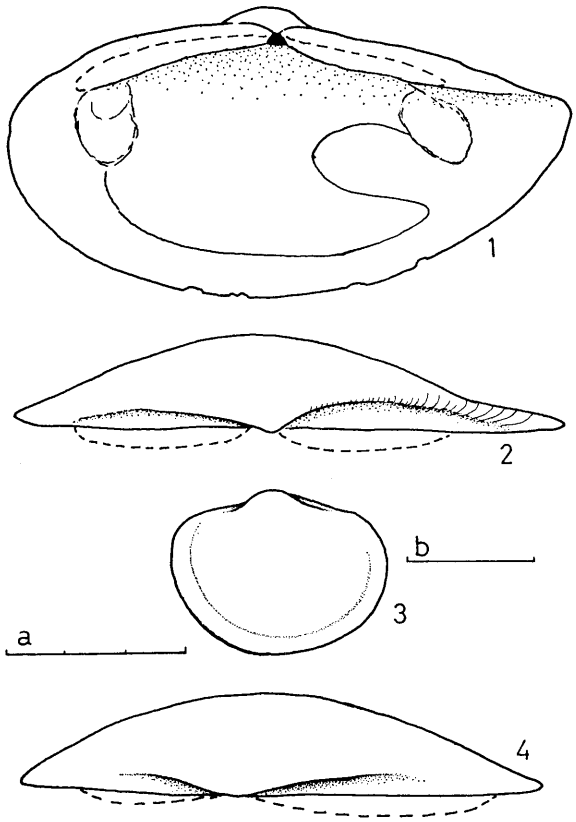

Fig. 2. 1 and 2 *Saccella panayensis* sp. nov., GK-L 6636, right valve.
1: interior view showing adductor muscle scars and pallial line.
2: umbonal view.
3 and 4 *Yoldia* (*Orthoyoldia*) *franciscoi* sp. nov., GK-L 7058, right valve.
3: prodissoconch. 4: umbonal view.
Broken lines indicate outline of the hinge teeth. Unit bar a represents 3 mm for 1, 2 and 4 and bar b does 1 mm for 3.

on the juvenile specimen but somewhat narrow and remarkably deep with the bluntly round apex near the beak on the adult specimen. The pedal scar is moderately large and deeply impressed immediately below the beak. Another linear scar is visible below the umbo toward the antero-ventral part.

The prodissoconch is distinct. It is ovoid, almost equilateral but with the slightly longer anterior side than the posterior one.

Comparison.—The present specimens are superficially similar to *Yoldiella* VERRILL and BUSH, 1897, but the former is readily distinguished from the latter being provided with the deep pallial sinus. The specimens are better included in *Orthoyoldia* VERRILL and BUSH, 1897, on the basis of the important characteristics of the hinge teeth, pallial sinus and adductor muscle scars, although the former is definitely less elliptical with smaller umbonal angle than the latter. The species of *Orthoyoldia* has not been known from the Indo-west Pacific region.

The present specimens are characterized by their compressed glossy shell with rather small umbonal angle and faint oblique ventral sculpture besides the important interior features mentioned above. They resemble *Leda alfurica* FISCHER (1927, p. 116, pl. 216, fs. 104a, b and c) from the Pliocene of Timor, but are easily distinguished from the latter in having a more compressed and wider posterior area and weaker sculpture. *Yoldia* (*Orthoyoldia*) *ovalis* GABB (1873, p. 255; PILSBRY, 1922, p. 402, text-fig. 34; WOODRING, 1928, p. 22, pl. 1, fs. 20 and 21) is a laterally elongate species, from which the present specimens differ in having higher shell with smaller umbonal angle. The present specimens should represent a distinct species.

Yoldia lepidula A. ADAMS (1856, p. 50; REEVE, 1871, pl. 2, f. 7), an ally to the present species, also shows larger umbonal angle and less arcuate ventral margin with straight part at the middle than the latter.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Genus *Saccella* WOODRING, 1925

(type-species: *Arca fragilis* CHEMNITZ=*Leda commutata* PHILIPPI by original designation)

Saccella panayensis sp. nov.

Pl. 1, Figs. 4–7 and Text-fig. 2

Material.—Holotype: GK-L 6635 (left valve) and paratype: GK-L 6636 (right valve) from one and the same locality. Preservation is excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)
6635	13.65	7.25	2.9	6.5	53.2	21.3	47.6	143.7
6636	9.05	4.7	1.8	4.5	51.9	19.9	49.7	155.2

specimen GK-L	teeth numb.	lirae numb./mm	valve
6635	22	10/3(1–4)	L
6636	16	10/2(0.2–3.2)	R

Diagnosis.—The shell is small, pear-shaped and glossy. The umbo is situated almost at the middle. The antero-dorsal margin is slightly convex, while the postero-dorsal one is slightly concave just behind the umbo. The ventral margin is broadly arcuate continuing to the narrowly rounded anterior end. The posterior part is tapered to the weak rostration. The surface is regularly curved except for a slight depression along the postero-dorsal margin. The lunule and and escutcheon are very clearly defined by the sharp ridges. The sculpture consists of regular concentric lirae, which are much wider than the interstices. They are finer and more raised with a round top at the early stage and become flat separated only by striae at the later stage. Number of the lirae is about 3.5 per 1 mm and about 5 per 1 mm respectively at the ventromedian part of the adult and juvenile specimens. The hinge teeth is divided by the resilium pit into the anterior and posterior rows, of which the former has somewhat more numerous teeth than the latter. The adductor muscle scars are indistinct. The pallial sinus is moderately shallow.

Comparison.—The present specimens resemble *Saccella sematensis* (SUZUKI et ISIZUKA) (1943, p. 48, pl. 1, f. 3) from the lower Pleistocene of central Japan, but the former is laterally longer with a more pointed rostrum. Furthermore the sculpture of *S. sematensis* is coarser.

Comparing with *Nuculana bantamensis* OOSTINGH (1933, p. 196, f. 10), the present specimens have coarser sculpture and a more broadly arcuate ventral margin.

The present specimens are similar to *Leda novaeguineensis* SMITH (1885, p. 237, pl. 19, f. 10), which is included in *Saccella* with typical features, but the latter has a higher shell with a small umbo leaning anteriorly.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Subclass Pterimorphia
Order Arcoida
Superfamily Arcoidea
Family Arcidae
Subfamily Arcinae

Genus *Trisidos* RÖDING, 1798
(type-species: *Arca tortuosa* LINNÉ, by original designation)
synonym: *Trisis* OKEN, 1815 (obj.)
Parallelopipedium MÖRCH, 1850 (obj.)
Epitrisis IREDALE, 1939 (type-sp.: *Arca semitorta* LAMARCK, by O. D.)

Trisidos sp. cfr. *T. semitorta* (LAMARCK)
Pl. 4, Fig. 17

1835. *Arca semitorta* LAMARCK, Anim. sans vert. (DESHAYES, edit.) Vol. 6, p. 460.

1844. *Arca semitorta,* REEVE, Conch. Icon. Vol. 2, *Arca,* pl. 13, f. 89.
1891. *Arca* (*Parallelopipedium*) *semitorta,* MARTINI et CHEMNITZ, Conch. Cab. Bd. 8, Abth. 2, p. 134, Taf. 35, fs. 1–2.
1928. *Arca* (*Parallelopipedium*) *tortuosa,* YOKOYAMA, Imp. Geol. Surv. Japan Rep. No. 101, p. 105, pl. 16, f. 2.

Material.—GK-L 6675 and 6676. Both the specimens are fragmental.

Measurements.—Length of the preserved part: 43.1 mm; height of the preserved part: 22.2 mm on GK-L 6675.

Descriptive remarks.—The shell is moderately large and elongato-quadrate. It is distorted around the hinge axis, judging from the curvature of the ventral margin and the posterior shell surface. The decussate sculpture consists of alternating radial threads and regularly spaced concentric lines. The cardinal area is broken off.

Comparison.—The specimens should be included in *Trisidos* RÖDING, 1798, on the basis of the distorted, laterally elongate shell with irregular sculpture, although the hinge can not be examined. Moderate distortion of the shell and

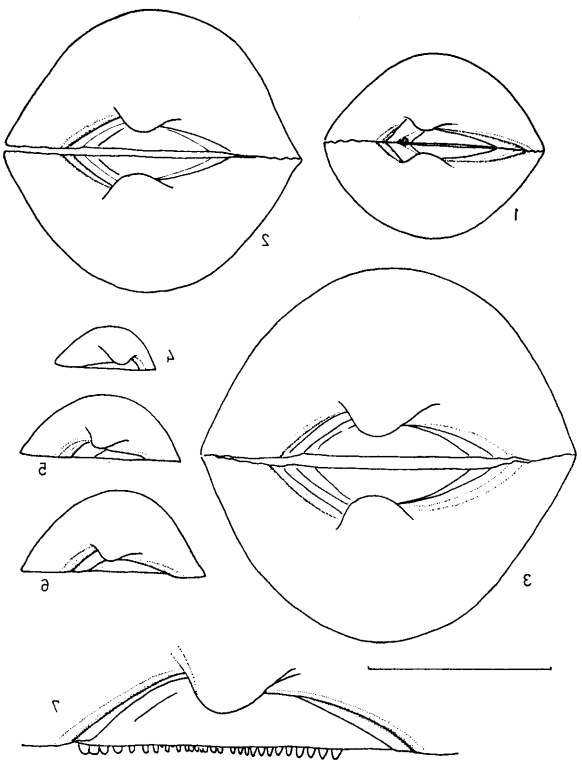

Fig. 3 Umbonal view of *Anadara* (*Scapharca*) *pilura* (REEVE) showing the ontogenetic change of the ligamental area and relative depth of the valve (D/L) by the growth series.
1: GK-L 6622, 2: GK-L 6621, 3: GK-L 7480–7481, 4: GK-L 6633, 5: GK-L 6632, 6: GK-L 6630, 7: GK-L 7479. All the figured specimens came from loc. SKGS-71.
Unit bar represents 10 mm for all the specimens.

rather strong sculpture suggest that the specimens may belong to *T. semitorta* LAMARCK.

Locality.—SKGS-74.

Horizons.—Pliocene of Timor and Lower Pleistocene of Taiwan. Upper part of the Dingle Formation.

Subfamily Anadarinae

Genus *Anadara* GRAY, 1847

(type-species: *Arca antiquata* LINNÉ by original designation)

Subgenus *Scapharca* GRAY, 1847

(type-species: *Arca inaequivalvis* BRUGUIÈRE by original designation)

Anadara (Scapharca) pilula (REEVE)

Pl. 2, Figs. 1–6 and Text-fig. 3

1844. *Arca pilula* REEVE, Proc. Zool. Soc. London, p. 39.
1844. *Arca pilula* REEVE, Conch. Icon., Vol. 2, *Arca*, pl. 2, f. 8.
1891. *Arca (Anomalocardia) pilula*, KOBELT in MARTINI and CHEMNITZ, Conch. Cab. Bd. 8, Abt. 2, p. 108, Taf. 28, fs. 7–8.
1910. *Arca (Anadara) rhombea*, MARTIN (partim), Samml. Geol. Reichs-Mus. N. S. Bd. 3, Abt. 2, p. 368, Taf. 52, fs. 89–92.
1933. *Arca (Arca) rhombea*, NOMURA, Sci. Rep. Tohoku Imp. Univ. 2nd Ser., Vol. 16, p. 37, pl. 4, f. 13.
1966. *Potiarca pilula*, HABE and KOSUGE, Shells of the World in colour, Vol. 2, p. 125, pl. 46, f. 5.

Material.—GK-L 6285, 6286 (conjoined), 6287–6313 from loc. SKGS-73, GK-L 6621, 6622 (conjoined), 6623–6633 and 7479–7482 from SKGS-71.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6285	18.0	18.2	15.45	6.3	10.55	101.1	91.3	35.0
6287	19.4	19.6	9.45	8.5	11.8	101.1	48.7	43.8
6288	19.2	20.45	9.6	7.8	12.1	104.4	47.9	40.6
6289	18.8	18.55	8.35	8.1	11.15	98.6	44.4	43.1
6292	16.75	16.45	7.5	6.6	9.8	98.2	44.8	39.4
6306	29.8	29.35	12.9	10.6	17.5	98.4	43.3	35.6
6307	28.65	27.95	13.2	10.6	17.15	97.3	46.0	37.0
6308	26.4	26.5	12.5	10.6	14.8	100.4	47.3	40.2
6309	25.8	25.35	11.2	11.7	13.7	97.9	43.3	45.3
6310	23.7	23.9	10.9	9.9	14.7	100.8	45.9	41.8
6621	15.4	16.05	7.6	5.8	8.4	100.3	49.3	37.7
6621	15.2	15.25	7.3	—	—	100.3	48.0	—
6622	11.6	11.45	9.5	3.9	7.25	98.6	81.8	33.7
6623	18.45	19.50	10.0	6.7	10.85	105.5	54.2	36.3
6624	19.4	19.6	9.1	7.7	11.5	101.0	46.8	39.7
6626	16.7	16.1	7.75	6.4	9.4	96.3	46.4	38.3
6627	15.45	15.6	7.15	6.3	9.5	100.9	46.3	40.8

specimen GK-L	Lh/L (%)	teeth ant.	teeth post.	ribs numb.	Valve
6285	56.6	—	—	26	L (conj.)
6287	60.8	13	18	25	R
6288	63.0	12	17	24	R
6289	59.3	13	16	25	R
6292	58.5	12	14	27	R
6306	58.7	—	—	27	L
6307	59.9	—	—	27	L
6308	56.1	11	16	26	L
6309	53.1	14	17	27	R
6310	62.0	13	18	24	R
6621	54.6	12	17	26	L (conj.)
6621	—	—	—	25	R (conj.)
6622	62.4	—	—	24	L (conj.)
6623	58.8	13	19	26	L
6624	59.3	17	19	25	L
6626	56.3	13	16	26	L
6627	61.5	11	16	26	R

Descriptive remarks.—The shell is medium in size, rather solid, inequivalve with larger left valve than the right one and slightly inequilateral. It is rhomboid orbicular and extremely inflated so as to illustrate almost equal height, length and depth of the conjoined valves. The umbo is almost central, large and remarkably elevated above the dorsal margin. The antero- and postero-dorsal margins are together short and form the blunt shoulder angle respectively with the anterior and the posterior margins. The posterior flexure is distinct near the umbo and obscure near the distal margin. The sculpture consists of the regular radial ribs and raised concentric lines. The ribs, ranging 24–27, are squarish with an almost flat top and vertical sides and crossed by the growth lines forming crenulation. On the left valve the ribs are wider, while they are slightly narrower than the interspaces and only weakly crenulated on the right valve except for the anterior part. The left valve holds the right one at the ventral margin. The inner margin is heavily crenulated. The hinge teeth are not continuous, but separated at the middle into two series, shorter anterior series and longer posterior one. The cardinal area is slightly inequilateral with shorter and wider anterior part, which has the ligament-free area at the anterior extremity. This part, bordered posteriorly by a sharp oblique groove, is wider at the early stage and becomes narrow later. The posterior aductor scar is close to the posterior end of the hinge teeth, while the anterior one is apart from the anterior end of the hinge teeth.

Comparison.—The present specimens are quite identical to *Arca pilula* REEVE (1843, pl. 2, f. 8) from the Philippines and also closely resemble some of the Indonesian Neogene and Quaternary specimens of "*Arca rhombea* BORN" of MARTIN. *Arca pilula* is inequivalve with the larger left valve than the right one and whole ribs on the left valve are crenulate while only the anterior ones are so on the right valve according to the original author. He also mentioned that *A. rhombea* BORN (1778, p. 90; KOBELT, 1891, p. 57, Taf. 16, fs. 5–6) is equivalve with the extremely high and large umbo and the prominent posterior flexure and

its right valve is provided with the distinct crenulation as on the left one. This indicates that *A. pilula* and *A. rhombea* belong respectively to the different subgenera and some of the Indonesian fossil specimens of "*A. rhombea*" may really belong to *A. pilula*.

The present material consists of a fairly good number of the specimens from two localities, illustrating a growth series. The sample from loc. SKGS-71 does not show any basic difference from the sample from loc. SKGS-73. The growth series exhibits clear allometric development about some characters. The relative depth of the valve to the length becomes larger in the course of the growth. The cardinal area also shows allometry concerning the relative length of the anterior and posterior halves and the relative width of the ligament-free area to the whole area. At the early stage the anterior part is extremely short occupying only one fourth of the whole length and increased its relative length gradually to attain two-fifths of the whole length. The cardinal area is smooth and not quite on one plane but curved up posteriorly to the rim at first. At the juvenile stage a distinct oblique groove below the beak appears to separate the ligamental area from the ligament-free area of the anterior part. The ligament-free area is relatively wide at first and then gradually becomes narrows as mentioned before.

Arca (*Anadara*) *sabinae* MORLET (1889, p. 189, pl. 8, f. 6) from Indo-China shows so closely resembling features with the present species that the specific distinction seems to be baseless.

Localities.—SKGS-71 and 73.

Horizons.—Pliocene to Recent in Southeast Asian waters. The Cabatuan and the Ulian Formation in Panay.

Anadara (*Scapharca*) *gendinganensis* (MARTIN)

Pl. 3, Figs. 5, 12 and 13 and Text-fig. 4

1910. *Arca* (*Scapharca*) *gendinganensis* MARTIN, Samml. Geol. Reichs-Mus. Leiden N. F. Bd. 1, Abt. 2, p. 381, Taf. 54, fs. 121–124.

Material.—GK-L 6363. A single left valve.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6363	23.2	18.65	8.45	8.0	16.1	80.4	36.4	34.5

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	valve
6363	69.4	43	29	left

Descriptive remarks.—The shell is moderately small, inflated and rhomboid with depressedly expanded postero-dorsal part, obliquely truncated posterior end, steeply tapering anterior end and broadly arcuate ventral margin. The umbo is broad, low and distinctly prosogyrate. The posterior flexure is distinct. The surface sculpture consists of 29 ribs which are quadrate in profile with the flat top and separated by rather deep, narrower and flat interspaces. The growth

lines are fine and close but occasionally distinct. They cross over the ribs to form the fine crenulations, which are distinct on both anterior and posterior parts. The ligamental area is very narrow, very inequilateral and provided with a few chevron-like grooves at the central part below the beak and with fine horizontal striae at the rest. The hinge teeth consist of shorter anterior row and longer posterior one, which merge with each other at some distance behind the pointed beak. The hinge line is slightly arcuate. The inner margin is heavily crenulated.

Comparison.—The original author pointed out that *Arca gendinganensis* is remarkably variable in the shell form. Some have an elevated umbo and the others have a low one. The present specimen closely resembles the latter form except for the ratio of the length of the hinge teeth to the dorsal line, which is smaller on the present specimen than on the Javan fossils.

Arca loricata REEVE (1844, pl. 9, f. 58), which is included in *Scapharca* on the basis of larger left valve than the right, is a close ally to *A. gendinganensis* in having the similar outline, inflation and sculpture. They may be treated as conspecific, if the minor difference of the umbo and sculpture is not evaluated.

K. MARTIN compared his specimens of *A. gendinganensis* with living *A. antiquata* (LINNÉ) (1758, p. 694; REEVE, 1844, pl. 9, f. 60), but the shell of the latter is much larger, equivalve and provided with more numerous ribs than the former.

Locality.—SKGS-73.

Horizons.—Pliocene of Java. Upper part of the Ulian Formation of Panay.

Subgenus *Anadara* (s. s.)

Anadara (*Anadara*) *tambacana* (MARTIN)

Pl. 2, Figs. 9, 11 and 12; Pl. 3, Figs. 14 and 17 and Text-fig. 4

1885. *Arca tambacana* MARTIN, Samml. Geol. Reichs-Mus. Leiden Ser. 1, Bd. 3, p. 244, Tab. 12, f. 249.
1910. *Arca* (*Anadara*) *tambacana,* MARTIN, ibid. N. F. Bd. 1, Abt. 2, p. 367, Taf. 52, fs. 88, 88a, b, and c.
1924. *Anadara tambacana,* COSSMANN, Jour. d. Conchyl. Tom. 68, p. 94, pl. 4, fs. 11 and 12.

Material.—GK-L 6592 (right), 6593 (conjoined) and 5494 (left) from loc. SKGS-71 and GK-L 7056 (conjoined) from loc. SKGS-72.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6592	23.45	16.9	7.7	8.2	16.2	72.1	32.8	35.0
6593	14.2	10.35	4.35	5.45	10.65	72.9	30.6	38.4
7056	21.25	14.45	6.65	7.15	14.95	68.0	31.3	33.6

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	valve
6592	69.1	47	24	R
6593	75.0	39	23	L (conj.)
7056	70.4	47	24	R (conj.)

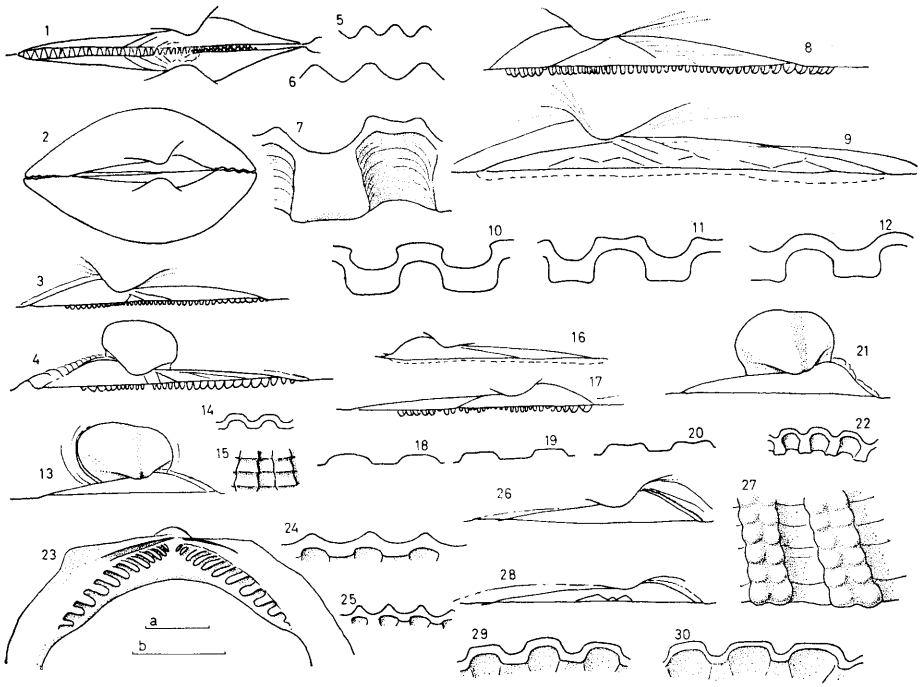

Fig. 4 On some morphologic features of taxodont species from Panay.

1–7 *Anadara* (*Anadara*) *tambacana* (MARTIN)
1: ligamental area of conjoined valves, GK-L 6593. 2: top view of the same specimen as the preceding. 3: ligamental area of right valve, GK-L 6592. 4: ligamental area and post larval shell of sessile stage, right valve, GK-L 7495. 5–7: serial change of the profile of the radial ribs of central part through growth stages, GK-L 7492.

8–12 *Anadara* (*Anadara*) *ferruginea* (REEVE)
8: ligamental area of right valve, GK-L 7055. 9: ligamental area of right valve, GK-L 7453. 10–12: rib-form at the distal margin on anterior (10), mid-ventral (11) and posterior part (12), GK-L 7055.

13–15 *Anadara* sp. GK-L 6672.
13: ligamental area and post-larvel shell. 14: profile of ribs at mid-ventral margin. 15: details of the rib morphology.

16–20: *Anadara* (*Anadara*) *luzonica pterimorpha* subsp. nov.
16: ligamental area of right valve, GK-L 6713. 17: ligamental area of left valve, GK-L 6712. 18–20: profile of ribs at posterior (18), main (19) and anterior part (20).

21–22 *Anadara* (*Anadara*) *burnesi* (D'ARCHIAC et HAIME)
21: ligamental area and post larvel shell of left valve, GK-L 6634.
22: profile of ribs of the same specimen as the preceding.

23–25 *Melaxinaea pectiniformis* (LAMARCK)
23: cardinal area of GK-L 6680. 24: profile of ribs of GK-L 6680.
25: profile of the ribs of GK-L 6677.

26–27 *Anadara* (*Anadara*) *dichotoma* (DESHAYES)
26: ligamental area of left valve, GK-L 7710. 27: detailed morphology of ribs of the same specimen as the preceding.

28–30 *Anadara* (*Scapharca*) *gendinganensis* (MARTIN)
28: ligamental area of left valve, GK-L 6363. 29–30: profile of ribs at posterior (29) and anterior part (30).

Unit bar a represents 1 mm for 5–7 and 27, bar b does 3 mm for 1, 4, 10–26, 29 and 30 and 6 mm for 2, 3, 8, 9 and 28.

Descriptive remarks.—The shell is rhomboid-orbicular, medium in size, equivalve, inequilateral and inflated. The umbo is large, moderately elevated, prosogyrate and incurved and leans to the anterior. The beaks are remote from each other. The anterior and posterior ends are obliquely truncated forming blunt angles with the dorsal margin respectively. The antero-ventral and postero-ventral margins are regularly rounded to continue to the weakly arcuate ventral margin. The posterior flexure is weak. The sculpture consists of about 24 ribs and the distinct growth lines. The ribs are roof-shaped separated by similarly reverted roof-shaped interspaces at first, then the ribs become flat at the top, while the interspaces keep the original form. Finally the ribs are bipartite at the top with a shallow furrow between and the interspaces become round at the bottom. The distinct crenulations are formed at the crossings of the concentric lines and the top of the ribs with the exception of the weak ones at the anterior and posterior ends until the adolescent stage. The deterioration of the crenulation seems to be an adult feature of the species. The cardinal area is moderately wide and inequilateral. The shorter and broader anterior half is free from the ligament and the posterior half, occupying about 60 percent of the hinge length, is separated from the anterior half by an oblique groove immediately below the beak and has a few grooves. The hinge line is almost straight and discontinuous interrupted by the apparent discordance just behind the beak. The anterior row is much shorter than the posterior one and situated slightly apart from the very margin. While the teeth of the posterior half are in line with the very margin and visible from outside when the ligament is removed (Pl. 2, Fig. 11).

Comparison.—The present specimens are easily identified to *Arca tambacana* MARTIN by the typical characters of the ribs, shell-form and cardinal area.

Localities.—SKGS-71 and 72.

Horizons.—Upper Miocene and Pliocene of Indonesia. Upper part of the Ulian Formation and the Cabatuan Formation of Panay.

Anadara (*Anadara*) *dichotoma* (DESHAYES)

Pl. 3, Figs. 1, 2, 3, 7, 9 and 15 and Text-fig. 4

1863. *Arca dichotoma* DESHAYES, Conchyl. de l'ile de la Réunion (Bourbon) p. 22, pl. 3, fs. 18 and 19.
1885. *Arca singularis* MARTIN, Samml. Geol. Reichs-Mus. Leiden Ser. 1, Bd. 3, p. 247, pl. 13, f. 252.
1891. *Arca* (*Barbatia ?*) *dichotoma*, KOBELT in MARTINI and CHEMNITZ, Conch. Cab. Bd. 8, Abt. 2, p. 29, pl. 8, fs. 7 and 8.
1907. *Arca dautzenbergi* LAMY, Jour. de Conchyl. Tom. 55, p. 232, pl. 3, fs. 9–11.
1909. *Arca* (*Scapharca*) *dichotoma gratiosa* LYNGE, Mem. Acad. Roy. Sci. et Lettr. Danemark. Ser. 7, Sec. Sci., Tom. 5, No. 3, p. 125 (29), pl. 2, fs. 3 and 4.
1920. *Arca* (*Anadara*) *singularis*, TESCH, Paläont. v. Timor, Lief. 8, p. 93, pl. 137, fs. 250a and 250b.
1935. *Mabellarca dautzenbergi*, IREDALE, Great Barrier Reef Exp. Sci. Rep. Vol. 5, No. 6, Mollusca P't. 1, p. 265, pl. 2, fs. 13 and 13a.

Material.—GK-L 6673, 6674, 6710 and 6711 from one and the same locality.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6673	13.5	9.4	4.3	3.75	—	69.6	31.9	27.8
6710	11.1	7.6	3.25	2.75	7.7	68.5	29.3	24.8
6711	10.0	7.0	3.0	2.75	6.7	70.0	30.0	27.5

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	valve
6673	—	—	26	L
6710	69.4	40	19	L
6711	67.0	37	21	R

Descriptive remarks.—The shell is small, moderately inflated, remarkably inequilateral with an anteriorly leaning umbo and elliptical with smoothly rounded margin except for rather straight dorsal side. The posterior part is compressed and devoid of the distinct flexure. The umbo is broad and moderately elevated above the dorsal line. The antero-dorsal angle is sharp. The ribs are variable in number counted by 20–26, as wide as the deep interspaces and beautifully granulated at the crossings of the concentric lines. The most characteristic feature of the ribs is the pattern of the development of their granules. The granules are in a single row on the juvenile part of the ribs. While each rib is gradually bipartited by the median shallow groove and consequently the granules are drawn up in two rows. The inner surface is distinctly costate correspondingly to the sculpture on the outer surface. The cardinal area is moderately wide, extremely inequilateral, somewhat curved up to the posterior rim and almost smooth except for weak horizontal striae. The hinge teeth are discontinuous separated by a narrow tooth-free area. The anterior row is about a half as long as the posterior one.

Comparison.—The present specimens are featured by the elliptical shell with dichotomous ribs. *Arca dichotoma* DESHAYES (1863, p. 22, pl. 3, fs. 18 and 19), *A. singularis* MARTIN (1885, p. 247, pl. 13, f. 252) and *A. dautzenbergi* LAMY (1907, p. 232, pl. 3, fs. 9–11) are close allies to the present specimens. *Arca dichotoma* is, according to the original author, provided with sharp posterior flexure, where about four ribs are not bifurcated. While LYNGE described that the mentioned characteristic is not constant but variable among the specimens. If this is true, one can hardly find out the basic difference to separate three named taxa. Hence it should be reasonable to treat them as conspecific. *Arca singularis* MARTIN seems to be rather variable in morphology especially in shell-form. *Arca dichotoma* (especially forma *dautzenbergi*) very closely resembles *A. singularis*, especially to the specimens from the Pliocene of Timor reported by TESCH (1920, p. 93, pl. 137, fs. 250a and 250b). The difference is only in that the former, in general, has longitudinally longer granules than the latter. The present fossil specimens examplify a remarkable variation concerning the last mentioned point indicating that the character is invalid as a criterion for specific separation.

Locality.—SKGS-74.

Horizons.—Pliocene of Timor and Seram and Recent in Southeast Asian waters to North Australia. Upper part of the Dingle Formation in Panay.

Anadara (Anadara) ferruginea (REEVE)

Pl. 2, Figs. 10, 13, 15 and 16 and Text-fig. 4

1844. *Arca ferruginea* REEVE, Proc. Zool. Soc. London p. 43.
1844. *Arca ferruginea*, REEVE, Conch. Icon. Vol. 2, *Arca*, pl. 6, f. 39.
1910. *Arca (Anadara) ferruginea*, MARTIN, Samml. Geol. Reichs-Mus. Leiden N. F. Bd. 1, Abt. 2, p. 366, Taf. 52, f. 85.
1920. *Arca (Anadara) ferruginea*, TESCH, Paläont. v. Timor, Lief. 8, p. 93, Taf. 138, f. 251.

Material.—GK-L 6364 (left, immature) from loc. SKGS-73, GK-L 7055 (right) from loc. SKGS-72 and GK-L 7453 (conjoined, slightly broken at the postero-ventral part) from loc. SKGS-71.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6364	23.05	16.9	7.75	6.6	15.6	73.3	33.6	28.6
7055	29.6	20.5	10.25	9.3	22.3	69.3	34.6	31.4
7453	37.6	27.8	12.5	13.4	28.8	73.9	33.2	35.6

specimen GK-L	Lh/L (%)	∠U (degrees)	teeth numb.	ribs numb.	valve
6364	67.7	140.4	46	26	L
7055	75.3	136.1	45	26	R
7453	76.6	149.2	—	26	R

Descriptive remarks.—The shell is equivalve, medium in size, rather solid, very inflated, ovoid and inequilateral with longer posterior part than the anterior. The umbo is large and elevated above the dorsal line. The posterior truncation is oblique with a marked sinus immediately below the postero-dorsal corner. The posterior flexure is distinct. The surface is sculptured by regularly spaced ribs and distinct growth lines. The ribs are triangular with granular crenulation on the top at the early growth stage. Thereafter the ribs are widened gradually to show quadrate profile and finally they have a slight depression on the top. In keeping pace with the widening of the ribs the crenulation becomes weak to illustrate very fine crenules at the both sides of the top of each rib. On the median depression of the ribs the growth lines are not so strong. The ribs are as wide as or wider than the interspaces on the main and posterior surfaces, while they are narrower on the anterior. The inner margin is coarsely crenulate.

The cardinal area is wide and inequilateral with shorter and wider anterior part and longer and narrower posterior part. The ligamental area is triangular with ligament-free area on the anterior vicinity. The ligament-free area is rather wide occupying more than 30 percent of the cardial area until the adolescent stage, but it becomes abruptly small occupying only 20 percent of the area at the adult stage. The chevron-like grooves are developed on whole ligamental

area at the adult stage, although they are visible only just below the beak until the juvenile stage. The hinge line is almost straight except for both ends. The adductor muscle scars are subequal in size, but the anterior one is ovate and the posterior one is quadrate.

Comparison.—The present specimens perfectly conform with *Arca ferruginea* REEVE (1844, pl. 6, f. 39), especially with the Pliocene fossil specimens from Timor (TESCH, 1920, p. 93, pl. 138, f. 251) on the basis of the shell-form and bifurcated ribs.

Anadara (*Anadara*) *ferruginea* (REEVE) shows close resemblance to *A.* (*A.*) *tambacana* (MARTIN) in the character of the radial ribs until the juvenile stage. While they diverge into different trends: that is to say, the median furrows of the ribs are developed more distinctly on *A. tambacana.* Furthermore the dorsal and the ventral margins of *A. tambacana* are subparallel, while those on *A. ferruginea* are remarkably oblique.

Localities.—SKGS-71, 72 and 73.

Horizons.—Pliocene of Indonesia. The Cabatuan and the upper part of the Ulian Formation of Panay.

Anadara (*Anadara*) *luzonica pterimorpha* subsp. nov.
Pl. 3, Figs. 6, 10, 11 and 18 and Text-fig. 4

Material.—Holotype: GK-L 6712 (left valve) and paratypes: GK-L 6713 to 6715.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6712	12.4	9.3	4.25	3.5	9.7	74.9	34.2	28.2
6713	10.85	7.8	3.3	3.2	8.0	71.8	30.4	29.5
6715	8.5	6.3	2.3	2.25	6.0	74.1	27.1	26.5

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	valve
6712	78.2	41	25	L
6713	73.7	49	24	R
6715	70.6	44	24	R

Diagnosis.—The shell is small, solid and inflated but the posterior part behind the posterior flexure is rather compressed. The outline of the shell is oval with the narrow anterior and the extremely expanded postrior part. The posterior expansion is so great that the dorsal and the ventral margin are distinctly oblique from each other. The remarkably prosocline umbo leans to the anterior end. The ribs are about 25, not very high and almost flat at the top except for the intersection with the growth lines, where the ribs are granulated. In details the ribs of the central area is flat at the top, while those of the anterior and posterior parts of the main surface show respectively the tendency for concave top and round top. The ratio of the breadth of the ribs (R) to the interspaces (I) is rather variable, but it is clear that the ratio is relatively smaller

on the central part than on the anterior and posterior parts.

specimen GK-L	ant.	ratio main	post.
6712	R>I	R≒I	R>I
6713	R=4/5 I	R=2/3 I	R≒I
6715	R≒I	R=4/5 I	R≒I

The inner margin is heavily crenulate. The hinge line is long almost occupying whole length of the dorsal side and laterally asymmetrical with shorter anterior and longer posterior rows. The ligamental area is narrow and asymmetrical. The anterior part is short and wide and the posterior one is long and narrow. A distinct oblique groove is discernible from immediately below the beak to posterior one-third of the ligamental plate on both valves.

Comparison.—The present specimens seem to be a close ally to *Arca luzonica luzonica* REEVE (1844, pl. 7, f. 44) with a typically widened posterior part and flat-topped ribs. The former, however, is distinctive from the latter in having still more accuminate anterior part and more expanded posterior part than the latter.

Arca (Scapharca) terhaari OOSTINGH (1935, p. 139, pl. 12, fs. 114–121) from the Pliocene of Boemiajoe, Java, is variable in shell-form according to the original author. The majority of the specimens show an oblong quadrate outline with subparallel dorsal and ventral margins and vertically truncated posterior end, while some of the specimens show a triangular form with anteriorly converging dorsal and ventral margins and obliquely truncated posterior end. Furthermore a few specimens exemplify the intermediate feature between the two forms mentioned above. The present specimens resemble the triangular form of *A. terhaari,* but the former is more inflated at the main part and still more widened at the postero-dorsal part. Furthermore the present specimens have only one oblique groove in the cardinal area. *A. pangkaensis* MARTIN (1910, p. 372, pl. 53, f. 117) also shows a similar morphology to the foregoing ones. Considering the variability of the shell-form of these taxa, the writer is inclined to treat them as conspecific and the difference should concern only with subspecific distinction.

Locality.—SKGS-74.

Horizon.—Upper part of the Dingle Formation.

Anadara (Anadara) burnesi (D'ARCHIAC et HAIME)

Pl. 2, Figs. 7, 8 and 14 and Text-fig. 4

1853. *Arca burnesi* D'ARCHIAC et HAIME, Descript. des anim. foss. du groupe numm. de l'Inde. p. 264, pl. 22, fs. 5a–5b.
1885. *Arca burnesi* MARTIN, Samml. Geol. Reichs-Mus. Leiden Ser. 1, Bd. 3, p. 245, Tab. 12, f. 250.
1901. *Arca burnesi,* NOETLING, Palaeont. Indica N. S. Vol. 1, p. 131, pl. 5, fs. 6–10.
1920. *Arca (Scapharca) burnesi,* TESCH, Paläont. v. Timor Lief. 8, p. 138, Taf. 2, fs. 258a and 258b.

Material.—GK-L 6634. A single left valve from loc. SKGS-71.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6634	11.0	8.2	3.8	3.2	7.25	74.4	34.5	29.1

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	concentric numb.
6634	65.9	36	24	13/4 mm

Descriptive remarks.—The shell is small, thick, solid, inflated and inequilateral. The umbo is prosocline, swollen and elevated above the dorsal line. The anterior part is narrow and the posterior part is wide as on other *Anadara* species, while the postero-dorsal area is extremely narrow as to show the posterior truncation parallel and close to the postero-umbonal flexure. The post-larval shell is provided with the distinct median depression until the shell attains about 3 mm long. The depression disappears abruptly thereafter. The ribs are subquadrate in cross-section, but the top is somewhat rounded. The ribs are much wider than the interspaces on the central area, while the former is almost equal to the latter on the anterior and the posterior area, although the breadth of the ribs themselves is not changed remarkably throughout the whole surface. The inner margin is heavily crenulated. The ligamental area is wide, almost smooth except for the fine striae parallel to the hinge line, and inequilateral with short and broad anterior and long and narrow posterior parts. The hinge line is slightly arched.

Comparison.—The present specimen is qualified by its small postero-dorsal part behind the posterior flexure and resembles *Arca burnesi* D'ARCHIAC et HAIME (1853, p. 264, pl. 22, fs. 5a–5d). The latter, however, shows remarkable variation concerning the shell form according to the original and subsequent descriptions. Some specimen has so developed postero-dorsal part that it may be regarded as a different species. The present specimen is still distinctive by its broadly expanded ventral part, which is more convex than any of the known examples of the species.

The present specimen looks like *Anadara tjaringiensis* (MARTIN) (1910, p. 372, pl. 52, fs. 98–100), which has longer and more attenuated anterior part, smaller relative height of less inflated shell and chevron-like grooves on the cardinal area.

Locality.—SKGS-71.

Horizons.—Upper Miocene to Pliocene of Indonesia and Burma. Cabatuan Formation in Panay.

Anadara sp.

Pl. 3, Figs. 4, 8 and 16 and Text-fig. 4

Material.—GK-L 6672. A single left valve. Preservation is moderate.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Lh (mm)	H/L (%)	D/L (%)	La/L (%)
6672	10.5	7.2	3.1	2.95	6.8	68.5	29.5	28.1

specimen GK-L	Lh/L (%)	teeth numb.	ribs numb.	concentric lirae	valve
6672	64.8	34	25	11/4 mm	L

Descriptive remarks.—The shell is small, moderately inflated, orbicular and distinctly inequilateral with narrower and shorter anterior half. The post-larval shell has a median depression until the shell attains about 3 mm long. Thereafter the median depression abruptly disappears. The elevated umbo is remarkably prosocline and leans toward anterior. The postero-ventral side is much more expanded than the antero-ventral side. The radial ribs are slightly rounded at top and crossed by the regularly spaced concentric lines. The crossings are distinctly crenulated. The ribs are about 1.2 to 1.3 times wider than the interspaces at the central area, while the former is narrower than the latter at the anterior and the posterior area. The ligamental area is moderately narrow, asymmetrical and almost smooth.

Comparison.—The present specimen is characterized by its orbicular outline, regularly crenulated radial ribs and smooth cardinal area. There are a few similar species among the living and fossil examples, but the observed similarity between the species is not conclusive. Furthermore the specimen appears to be immature without the gerontic feature of the growth lines at the ventral part. Hence the identification is suspended.

Locality.—SKGS-74.

Horizon.—Upper part of the Dingle Formation.

Family Noetiidae

Subfamily Striarcinae

Genus *Arcopsis* KOENEN, 1885

(type-species: *Arca limopsis* KOENEN by subsequent designation, REINHART, 1935)

synonym: *Fossularca* COSSMANN, 1887 (type-sp.: *Arca quadrilatera* LAMARCK, by O. D.)

Cabinarca IREDALE, 1939 (type-sp.: *C. pellita* IREDALE, by O. D.)

Mulinarca IREDALE, 1939 (type-sp.: *Barbatia aceraea* MELVILL et STANDEN, by O. D.)

Scapularca COSSMANN et PEYROT, 1912 (type-sp.: *Arca scapulina* LAMARCK, by O. D.)

Spinearca IREDALE, 1939 (type-sp.: *S. deliciosa* IREDALE, by O. D.)

Verilarca IREDALE, 1939 (type-sp.: *V. bivia* IREDALE, by O. D.)

Arcopsis bataviana (MARTIN)

Pl. 1, Figs. 10, 12, 18–21 and Text-fig. 5

1885. *Arca bataviana* MARTIN, Samml. Geol. Reichs. Mus. Leiden, Ser. 1, Bd. 3, p.253, Tab. 13, fs. 256 and 257.
1910. *Arca* (*Barbatia*) *bataviana*, MARTIN, ibid. N. F. Bd. 1, Abt. 2, p. 364, Taf. 51, fs. 82 and 82a.
1920. *Arca* (*Barbatia*) *bataviana*, TESCH, Paläont. v. Timor, Lief. 8, p. 98, Taf. 138, fs. 260 and 260a.

Material.—GK-L 7035, 7036 and 7037. Preservation is excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	Lh (mm)	H/L (%)	D/L (%)	Lh/L (%)	post-angle
7035	11.85	8.3	2.55	6.4	70.0	21.5	54.0	129.0
7036	11.0	7.8	2.6	6.6	70.9	23.6	60.0	141.2
7037	11.0	7.4	2.25	6.1	67.3	20.5	55.5	138.5

specimen GK-L	teeth numb.	ribs main	ribs post.	valve
7035	30	47	12	R
7036	28	50	14	L
7037	27	50	13	R

Descriptive remarks.—The shell is moderately small, obliquely quadrate and moderately compressed. The umbo is situated at the middle of the dorsal margin and moderately elevated above it. The anterior half of the shell is shorter than the posterior half. The ventral margin is not parallel to the dorsal one but slightly oblique to the latter. The anterior margin is regularly rounded, while the posterior margin is obliquely and markedly truncated. The posterior flexure is distinct on both valves. The surface is sculptured with numerous fine radial

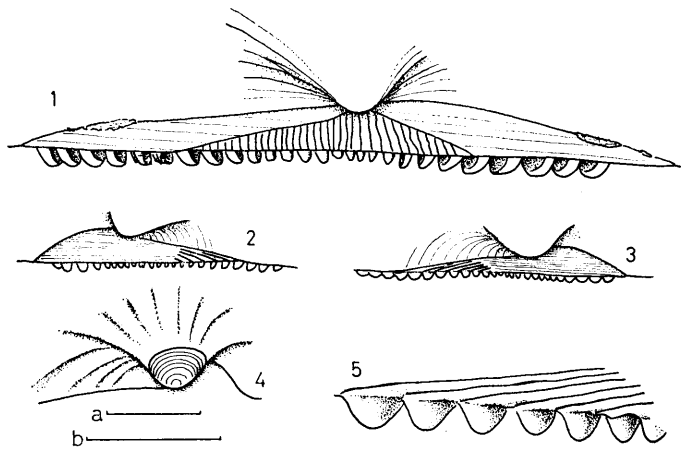

Fig. 5 1 ligamental area of *Arcopsis bataviana* (MARTIN).
2–5 *Striarca lamyi* (KOPERBERG)
2: ligamental area of right valve, GK-L 6716. 3: ligamental area of right valve, GK-L 6717. 4: prodissoconch. 5: correlation of the ligamental plates and teeth.
Unit bar a represents 1 mm for 1 and 0.5 mm for 4 and 5 and bar b does 3 mm for 2 and 3.

riblets and weak growth lines. The inner margin is smooth. The hinge line is slightly arcuate. The ligamental plate is restricted to the central one-third of the area and provided with somewhat irregular, close and vertical grooves. The adductor muscle scars are subequal in dimension and provided with raised myophoric flange.

Comparison.—The present specimens are quite identical with *Arca bataviana* MARTIN (1885, p. 253, pl. 13, fs. 256 and 256a) by their shell-form, sculpture and cardinal characteristics. The ligamental area of the present species occupies only a narrow triangular part below the beak on the cardinal area. This indicates the species belongs to *Arcopsis* KOENEN, 1885.

Locality.—SKGS-72.

Horizons.—Upper Miocene and Pliocene of Java and Timor and the upper part of the Ulian Formation in Panay.

Genus *Striarca* CONRAD, 1862

(type-species: *Arca centenaria* SAY, 1824, by original designation)

synonym: *Breviarca* CONRAD, 1872 (type-sp.: *Arca saffordi* GABB, by S. D., STEWART, 1930)

Estellacar IREDALE, 1939 (type-sp.: *E. saga* IREDALE, by O. D.)

Galactella COSSMANN et PEYROT, 1912 (type-sp.: *Arca lactea* LINNÉ, by O. D.)

Striarca lamyi (KOPERBERG)

Pl. 4, Figs. 4–7 and 10 and Text-fig. 5

1931. *Limopsis lamyi* KOPERBERG, 2e Nederlandsche Timor-Exp. 1916, p. 19, pl. 1, fs. 3a and b.

Material.—GK-L 6716 (right), 6717 (left) and 6718 (right) from one and the same locality. GK-L 6718 is a self-repaired shell.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	Lh (mm)	H/L (%)	D/L (%)	Lh/L (%)	teeth numb.
6716	9.4	7.75	2.85	6.55	82.4	30.3	69.7	26
6717	9.1	7.3	2.95	6.00	80.2	32.4	65.9	28

specimen GK-L	ribs main	ribs post.	concentrics 2–4 mm	valve
6716	54	29	13/2 mm	R
6717	49	23	11/2 mm	L

Descriptive remarks.—The shell is small, compressed and quadrate. The umbo is prosogyrate, inrolled, moderately elevated above the dorsal line and leans somewhat anteriorly. The dorsal margin is relatively long forming the distinct shoulder angles at both ends. The antero-ventral and especially postero-ventral corner are narrowly rounded. The posterior flexure is weak especially near the distal area. The prodissoconch is oval with the maximum diameter of

0.5 mm and sculptured with the minute, close and concentric striae. The prodissoconch I and II can not be distinguished. The sculpture of the post larval shell consists of fine and numerous radial riblets and minute concentric lines. The radial sculpture starts slightly apart from the margin of the prodissoconch where the radials are about 10 cord-like very fine riblets separated by wider interspaces and crossed by the concentric lines forming distinct granules at the intersections. This pattern of the sculpture is maintained throughout the growth stages, although the riblets are increased in number by intercalation of new ones by and by and the granules become more distinct later on. The granules are rather spinous on the anterior and posterior parts after adolescent stage. The inner margin is finely crenulated.

The ligamental area is distinctly asymmetrical with shorter and broader anterior part and longer and narrower posterior one. There are about five distinct oblique grooves on the posterior one-third of the area and the remain of the area has obsolete horizontal grooves. One tooth exists at the terminal of each plate bounded at both sides by the oblique grooves as indicated in text-fig. 5. The hinge line is arcuate and almost continuous. The adductor muscle scars are obsolete and devoid of the myophoric flange.

Comparison.—KOPERBERG referred *lamyi* to *Limopsis* SASSI, 1827, but his specimens are devoid of the resilium pit between the anterior and posterior rows of the hinge teeth according to the original description. They should belong to *Striarca* CONRAD, 1862, on the basis of the diagnostic features similar to those mentioned above about the present material. The present material quite conforms with the original specimens except for the slight difference that the former is slightly higher than the latter in shell-form.

Arca (*Barbatia*) *axinaea* BOETTGAR (1883, Jaarb. Mijnw. p. 133, pl. 5, fs. 4a–4c) closely resembles the present species superficially, but the ligamental area lies at the central part of the cardinal area. They differ from each other at generic level.

Arca minuta REEVE (1844, Conch. Icon. pl. 17, f. 112) from the Philippine waters also shows the superficial similarity to the present species, but has the ligamental area at the middle of the cardinal area.

Locality.—SKGS-74.

Horizons.—Upper Pliocene of Timor. Upper part of the Dingle Formation in Panay.

Family Glycymerididae
Subfamily Gycymeridinae
Genus *Melaxinaea* IREDALE, 1930
(type-species: *Melaxinaea labyrintha* IREDALE by original designation)

Melaxinaea pectiniformis (LAMARCK)
Pl. 4, Figs. 1–3, 8 and 9 and Text-fig. 4

1759. *Arca pectunculus* LINNÉ (part), Syst. Nat. ed. 10, p. 695.

1819. *Arca pectiniformis* LAMARCK, Hist. nat. anim. sans. vert. Tom. 6, part 1, p. 53, No. 16.
1835. *Pectunculus pectiniformis*, d'ORBIGNY, ibid. ed. 2, Tom. 6, p. 494, No. 16.
1843. *Pectunculus pectiniformis*, REEVE, Conch. Icon. Vol. 1, *Pectunculus*, sp. 11, pl. 3, fs. 11a and b.
1885. *Pectunculus pectiniformis* var., MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 3, p. 237, Tab. 12, f. 241.
1888. *Arca pectunculus*, MARTINI and CHEMNITZ, Conch. Cab. Bd. 7, p. 235, pl. 58, fs. 568–569.

Material.—GK-L 6677 to 6688 from one and the same locality. All the specimens are more or less coroded.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	Lh (mm)	H/L (%)	D/L (%)	Lh/L (%)
6677	17.5	16.6	3.95	7.15	94.7	22.6	40.9
6678	14.5	14.15	3.7	6.0	97.5	25.5	41.4
6679	13.8	13.3	3.4	6.05	96.3	24.6	43.8
6680	11.35	10.95	2.85	—	96.5	25.1	—
6681	11.3	10.85	3.0	—	95.8	26.5	—

specimen GK-L	teeth ant.	teeth post.	ribs numb.	valve
6677	13	15	21	L
6678	14	16	23	L
6679	13	14	21	R
6680	11	13	22	L
6681	12	12	22	L

Descriptive remarks.—The shell is moderately small, solid, circular, compressed and equilateral with scarcely elevated orthogyrate umbo. The dorsal margin is almost horizontal forming weak ear-like projection below. The length of the dorsal margin becomes relatively short in the course of the ontogenetic growth and the ear-like form becomes obscure in adult stage. The surface is sculptured with very fine concentric lines and regularly spaced roof-shaped radial ribs, which are almost the same in relief after the juvenile stage, although the interspaces grow wider. In consequence the ribs are separated by wider interspaces near the distal margin on the adult specimens. The inner ventral margin is markedly crenulated. The ligamental area is very narrow with chevron-like regular grooves. The hinge teeth is divided into anterior and posterior rows, which are on lines of chevron and converge below the beak. The adductor muscle scars are similar to each other both in shape and size.

Comparison.—The present specimens show the typical features of *Melaxinaea* IREDALE, 1930. They are very unique with their roof-shaped thin radial ribs separated by wider interspaces and almost straight rows of hinge teeth among the known species of *Melaxinaea*, because the majority of the species of the genus have wide round ribs separated by much narrower grooves and curved rows of hinge teeth. According to E. SMITH (1891, p. 432–33), *Arca pectunculus* LINNÉ contains two forms. The one has the roof-shaped ribs separated by much wider interspaces and the other has wider and round ribs with narrower inter-

spaces. The former is *A. pectiniformis* s. s. and the latter was named later *amboinensis* by GMELIN (Syst. Nat. ed. 13, p. 3255, No. 43). The present fossil example is identical to *A. pectiniformis* LINNÉ in this sense, which naturally belongs to *Melaxinaea.*

The present specimens are readily distinguished from *A. angsanana* MARTIN (1921, p. 484, pl. 61, f. 104) from the Miocene of Java in having much less numerous ribs and smaller conversion angle of the hinge line than the latter, although the two groups are similar in the general characters.

The present specimens are quite identical with MARTIN's figured specimen of *"Pectunculus pectiniformis* var." (1885, p. 237, pl. 12, f. 241). MARTIN's specimen should be included in *Melaxinaea pectiniformis* LINNÉ of the sense just mentioned above.

Glycymeris capricornea HEDLEY (1906, p. 468, pl. 36, fs. 5 and 6) being included in *Tucetilla* IREDALE, 1930, by IREDALE, has much wider cardinal area and curved rows of the teeth, although the shell-form and sculpture resemble those of the present specimens.

Locality.—SKGS-74.

Horizons.—Pliocene of Java. Upper part of the Dingle Formation of Panay.

Order Pterioida
Suborder Pteriina
Superfamily Pectinoidea
Family Pectinidae
Genus *Chlamys* RÖDING, 1798, (non KOCH, 1801)
(type-species: *Pecten islandicus* MÜLLER, 1776, by subsequent designation, HERRMANNSEN, 1847)
Subgenus *Mimachlamys* IREDALE, 1929
(type-species: *Pecten asperrimus* LAMARCK by original designation)

Chlamys (*Mimachlamys*) sp. cfr. *C.* (*M.*) *singaporinus* (SOWERBY)
Pl. 7, Fig. 6

1853. *Pecten singaporinus* SOWERBY, Thes. Conch. Vol. 1, p. 74, pl. 13, f. 55 and pl. 14, f. 71.
1853. *Pecten singaporinus,* REEVE, Conch. Icon. Vol. 8, *Pecten,* pl. 20, sp. 74, f. 74.
1888. *Pecten singaporinus,* KOBELT in MARTINI and CHEMNITZ, Conch. Cab. Bd. 7, Abt. 2, p. 94, Taf. 25, fs. 2–4.

Material.—GK-L 7454. A single broken left valve. Judging from finely preserved surface texture the specimen was broken at the procedure of sampling.

Measurements.—Height of the shell: 40.7 mm, length: ca 37 mm, depth: 9.6 mm.

Descriptive remarks.—The shell is moderate in size attaining about 40 mm in height and very compressed. It is almost equilateral with orthogyrate umbo and slightly higher than long. The sculpture consists of regularly rounded radial ribs and furrows. The ribs are almost equal to and symmetrical with the fur-

rows. The incremental lines are distinct and regularly spaced except near the ventral margin, where they become close set. The ribs on the preserved part are counted 18 suggesting total 21. The posterior ear is 10.9 mm in length, slightly sinuous posteriorly and provided with five weak riblets, which disappear near the posterior margin. The interior margin has crenulation corresponding with the surface furrows.

Comparison.—The present specimen is well characterized by the suborbicular outline being higher than wide, medium size, compressed profile and regularly spaced and simply rounded ribs as many as twenty one. Especially characteristic are the ribs, which are perfectly semicircular in profile separated by equidimensional valleys with round bottom and devoid of any superimposing or side riblets. The specimen closely resembles *Chlamys* (*Mimachlamys*) *singaporinus* (SOWERBY) (1853, Vol. 1, p. 74, pl. 13, f. 55; pl. 14, f. 71), but the concrete identification is suspended because of imperfect preservation of the specimen.

E. SMITH (1844, p. 115) claimed that *Pecten singaporinus* SOWERBY was conspecific with *P. pica* REEVE from New Zealand and *P. cumingii* REEVE from East Australia. He also pointed out the affinity of *singaporinus* to Japanese *P. awajiensis* PILSBRY.

Locality.—SKGS-71.

Horizons.—Living in South China Sea, Indian Ocean and Red Sea. Cabatuan Formation in Panay.

Suborder Ostreina
Superfamily Ostreoidea
Family Ostreidae
Subfamily Ostreinae
Genus *Ostrea* LINNÉ, 1758
(type-species: *Ostrea edulis* LINNÉ by tautonymy)
synonym: *Eostrea* IHERING, 1907 (type-sp.: *Ostrea puelchana* D'ORBIGNY)
Anodontostrea SUTER, 1917 (type-sp.: *Ostrea angasi* SOWERBY)
Monoeciostrea ORTON, 1928 (type-sp.: *Ostrea edulis* LINNÉ)
Subgenus *Ostrea* (s. s.)

Ostrea (*Ostrea*) *glomerata* GOULD
Pl. 7, Figs. 7 and 8

1850. *Ostrea glomerata* GOULD, Proc. Boston Soc. Nat. Hist. Vol. 7, p. 346.
1852. *Ostrea glomerata,* GOULD, United States Expl. Exped. Vol. 12, p. 461, pl. 43, fs. 577, 577a, and 577b.
1871. *Ostrea lacerans,* REEVE, Conch. Icon. Vol. 18, *Ostrea,* pl. 22, f. 51.
1871. *Ostrea glomerata,* REEVE, ibid. Vol. 18, *Ostrea,* pl. 22, fs. 52a, b, c and d.
1885. *Ostrea lacerans,* MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 3, p. 276, Tab. 14, fs. 277 and 277a.
1910. *Ostrea glomerata,* MARTIN, ibid. N. F. Bd. 1, Abt. 3, p. 337, Taf. 47, fs. 11–14.
1913. *Ostrea glomerata,* SUTER, Manual of the New Zealand Mollusca, p. 891, pl. 57, f. 6.

Material.—GK-L 7524. A single left valve.

Measurements.—Maximum diameter: 52 mm, minimum diameter: ca 41 mm.

Descriptive remarks.—The shell is nearly orbicular but with irregular indentation. The surface is provided with the irregularly spaced radial ribs and foliated growth lamellae. The cardinal area is wide and sub-trigonal with distinct ligamental furrow at the middle. The inner margin adjacent to the cardinal area is finely crenulated.

Comparison.—The cardinal area of the present specimen is large, high trigonal with a median ligamental furrow, and the inner margin near the cardinal area is finely crenulated. On the basis of this character the specimen is included in *Ostrea* (s. s.). Among *Ostrea* species it is allied to *Ostrea glomerata* GOULD living in southern Pacific with resembling morpho-character that the ribs are irregularly spaced and abruptly denuded with rather spinose ends and that the growth lamellae are occasionally prominent. *Ostrea lacerans* HANLEY is another ally to the present specimen. Considering the wide range of variation of shell morphology, distinction at species level of *O. glomerata* and *O. lacerans* seems impractical. The present author prefers to treat them as conspecific.

Locality.—SKGS-72.

Horizons.—Upper Miocene and Pleistocene in Indonesia and Recent in Southeast Asian waters to New Zealand. Middle part of the Ulian Formation in Panay.

Subclass Heterodonta
Order Veneroida
Superfamily Lucinoidea
Family Lucinidae
Genus *Linga* De GREGORIO, 1884
(type-species: *Lucina columbella* LAMARCK by subsequent designation, SACCO, 1889)
synonym: *Quasilucina* STEWART, 1930 (type-sp.: *Lucina carinifera* CONRAD by O. D.)
Subgenus *Bellucina* DALL, 1901
(type-species: *Parvilucina eucosmia* DALL, 1901, by original designation
=*Lucina pisum* REEVE, 1850, non SOWERBY, 1836, nec D'ORBIGNY, 1841, nec PHILIPPI, 1850
=*Lucina semperina* ISSEL, 1869)
synonym: *Cardiolucina* SACCO, 1901 (type-sp.: *Cardium agassizi* MICHELOTTI by O. D.)

Linga (*Bellucina*) *gonzalesi* sp. nov.
Pl. 1, Figs. 8, 11, 13–17 and Text-fig. 6

Material.—Holotype: GK-L 6656 (conjoined) and paratypes: GK-L 6653–6655 and 6657–6658 from one and the same locality. Preservation is excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	radials ant.	main	post.
6652	7.6	7.2	3.3	97.3	43.4	109.2	2	9	1
6653	6.45	5.95	2.5	92.2	38.8	110.9	2	8	1
6656	7.35	6.4	3.0	87.1	40.8	115.2	3	7	1
do	7.35	—	3.0	—	40.8	—	3	7	1

specimen GK-L	concentrics (per mm)	valve
6652	9/5(1–6)	R
6653	8/5(0–5)	R
6656	6.5/5(1–6)	R
do	—	L

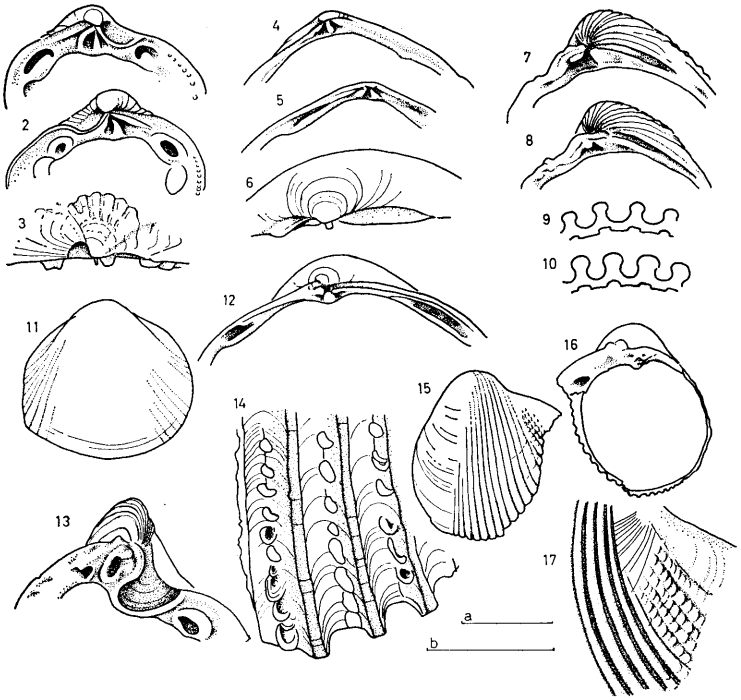

Fig. 6 1–3 *Linga (Bellucina) gonzalesi* sp. nov.
1: cardinal area of left valve, GK-L 6656. 2: cardinal area of right valve, GK-L 6657. 3: larval and post larval shell of GK-L 6657.
4–6 *Marikellia panayensis* sp. nov.
4: cardinal area of right valve, GK-L 6641. 5: cardinal area of left valve, GK-L 6643. 6: umbonal view of GK-L 6641.
7–10 *Carditocardia javana* (MARTIN)
7: cardinal area of right valve, GK-L 6733. 8: cardinal area of somewhat coroded right valve, GK-L 6734. 9: profile of ribs at mid-ventral margin, GK-L 6733. 10: ditto, GK-L 6734.
11–12 *Laevicardium (Fulvia)* sp. GK-L 6640.
11: outer view showing general morphology. 12: cardinal area.
13 cardinal area of *Fragum (Lunulicardia) subretusa* (SOWERBY), left valve, GK-L 6319.
14 details of rib-morphology of *Vepricardium*? sp., GK-L 6670.
15–17 *Protocardia* sp., GK-L 6451.
15: outer view. 16: inner view. 17: sculpture of posterior part.
Unit bar a represents 1 mm for 12 and 17 and bar b does 3 mm for 1–11, 13, 15 and 16 and 6 mm for 14.

Diagnosis.—The shell is rhomboid, very solid and inflated. The umbo is prosocline, somewhat inrolled and slightly posterior to the middle of the shell length. The posterior margin is slightly concave corresponding to a depression on the posterior surface. The anterior and posterior parts are separated from the main surface, where the strong radial ribs are erected, wider than the interspaces and form coarse reticulation with the concentric lirae. The intersections of the radials and the concentrics are strongly granualted. While the ribs are weak on the anterior and especially on the posterior part, which is even partly free from the ribs. The lunule is cordate and extremely deep with sharp boundary-edge. The escutcheon is indistinct. The inner margin of the valve is crenulate; the crenulation is very coarse along the ventral and anterior margins and very fine along the posterior, postero-dorsal and antero-dorsal margins. The hinge plate is wide and stout with two cardinals and the anterior and posterior laterals on each valve. 3a is somewhat weak, 3b is strong and curved trigonal, 2 is trigonal and just below the beak and 4b is long and curved. The laterals are prominent and equidistant from the cardinals. They are orbicular with socket at the center on the right valve and protruded on the left valve. The adductor muscle scars are subequal, but the anterior one is short-oval and the posterior one is elongate.

Comparison.—The lunule of the type species of *Bellucina, B. pisum* (REEVE) (1850, pl. 11, f. 66a and b), is not immersed. If the stress is put on this feature, the present specimens are excluded from *Bellucina*. The author, however, prefers to include it in that subgenus supposing the feature of the lunule is rather variable. The other characteristics of the present specimens quite agree with those of *Bellucina*. The present specimens are distinguished from *B. pisum* by much heavier sculpture. The present specimens are similar to *B. semperiana* (ISSEL) in the general features especially in the coarse texture, but the former is about a half as large as *B. semperiana* (ISSEL) and provided with deeper lunule, fewer and stronger ribs and longer outline.

ICKE (and MARTIN) reported a lucinid, *Lucina polli* ICKE, from the Pliocene of Nias Island (1912, p. 252, pl. 18, fs. 40 and 40a), which is considered to be included in *Bellucina* on the basis of the general characteristics. The present specimens show apparent difference from ICKES's species in having a more oblique shell with much less numerous and coarser radial ribs and concentric lirae.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Superfamily Leptonoidea

Family Kelliidae

Genus *Marikellia* IREDALE, 1936

(type-species: *Kellia solida* ANGAS by original designation)

Marikellia panayensis sp. nov.

Pl. 6, Figs. 2, 3, 13 and 14 and Text-fig. 6

Material.—Holotype: GK-L 6641 (right), paratypes: 6642 (left) and 6643 (left). Preservation is fairly good.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degree)	concentrics (numb. per mm)	valve
6641	8.35	6.75	2.30	80.7	27.6	108.1	16/3 mm	R
6642	6.25	4.65	1.35	74.4	21.6	127.3	13/2 mm	L

Diagnosis.—The shell is small, moderately inflated and trigonally ovate with almost straight antero- and postero-dorsal margins. The umbo is moderately elevated and situated at about anterior one-third. The anterior and posterior margins are narrowly rounded and smoothly continuous to the broadly rounded ventral margin. The lunule is elongate, sharply defined by bordering ridge and asymmetrical with broader right half than the left one. The escutcheon is lanceolate, less sharp than the lunule and smooth. The surface is sculptured with close concentric threads, which are thin and erected on the anterior part but broad and low on the posterior. The inner margin is smooth. Both valves have three cardinals and strong laterals respectively. On the right valve the middle cardinal (1) is stout and trigonal, the anterior one (3a) is weak, thin and very oblique continuing to the anterior lateral and the posterior one (3b) is also weak and continuing to the posterior lateral. The left middle cardinal (2a) is tusk-like and strong, the anterior one (2b) is strong and the posterior one (4b) is rudimentary. The posterior laterals are more distant from the cardinals than the anterior ones. The anterior adductor muscle scar is quadrate and the posterior one is larger and elliptical. The pallial line is entire.

Comparison.—The present specimens should be included in *Marikellia* IREDALE, 1936, on the basis of diagnosis mentioned above. They are readily distinguished from *M. solida* (ANGAS) (1877, as *Kellia*, p. 176, pl. 26, f. 25) by the fact that the former has more trigonal outline with less expanded postero-dorsal part and stronger concentric threads than the latter.

They are also different from *M. rotunda* (DESHAYES) (1855, as *Erycina*, p. 181) in having longer posterior part and less expanded postero-dorsal side. There is no known species of *Marikellia* of nucloid form as the present species.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Superfamily Carditoidea
Family Carditidae
Subfamily Carditamerinae
Genus *Cardiocardita* ANTON, 1839
(type-species: *Chama ajar* ADANSON (invalid, pre Linnean, =*Cardita ajar* BRUGUIÈRE by subsequent designation, HERRMANNSEN, 1846)

Cardiocardita javana (MARTIN)
Pl. 4, Figs. 11, 12, 13, 16 and 18, Pl. 7, Figs. 11 and 12 and Text-fig. 6

1880. *Cardita javana* MARTIN, Tertiärschichten auf Java, p. 111, Tab. 17, f. 11.

Material.—GK-L 6733 (right) and 6734 (right, broken at the postero-ventral part). The specimens are more or less corroded on whole surface.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	L1 (mm)	H/L (%)	D/L (%)	L1/L (%)	∠U (degrees)
6733	8.15	8.10	3.35	1.30	99.4	41.1	16.0	92.1
6734	7.65	7.85	3.25	1.20	102.6	42.4	15.7	89.3

specimen GK-L	radials numb.	concentrics (numb. per mm)	valve
6733	18	6/3 mm	R
6734	16	5/3 mm	R

Descriptive remarks.—The shell is subquadrate, moderately small and solid. The umbo is prosocline. The lunule is cordate, sharply defined and smooth. The central part of the lunule is somewhat elevated forming the central mound. The ribs are stout, erected and almost equal to or narrower than the interspaces, which are quite round at the bottom and sides. The concentric lines cross over the ribs to turn out distinct crenulation. The hinge plate is solid with two cardinals and anterior lateral soket on the right valve. 3a is short and weak and 3b is heavy, oblique and very long. The anterior and posterior adductor muscle scars are subquadrate and pear-shaped respectively. The pallial line is entire.

Comparison.—The present specimens clearly show the carditid texture of the shell-form and cardinal. The lateral teeth of the present specimens are very weak suggesting the closer phylogenetic position to Venericardiinae, but the lunule is not deeply immersed as on Venericardiinae but has the central mound. Accordingly the present specimens are collectively included in *Cardiocardita* ANTON, 1839, of Carditamerinae.

Comparing with Javan fossils, the present specimens are provided with somewhat finer radial ribs. The radials, however, appear to be very variable in size and number. Hence the slight difference of this character between samples does not serve for the criterion of taxonomic separation. The present specimens are reasonably treated as conspecific to the Javan ones.

Locality.—SKGS-74.

Horizons.—Upper Miocene of Java. Upper part of the Dingle Formation of Panay.

Superfamily Cardioidea
Family Cardiidae
Subfamily Fraginae
Genus *Fragum* RÖDING, 1798
(type-species: *Cardium fragum* LINNÉ by tautonymy)
synonym: *Hemicardia* SPENGLER, 1799, auct.
Subgenus *Lunulicardia* GRAY, 1853

(type-species: *Cardium retusum* LINNÉ by monotypy)
synonym: *Opisocardium* BAYLE, 1879 (obj.)

Fragum (Lunulicardia) subretusum (SOWERBY)
Text-figs. 6 and 7

1840. *Cardium subretusum* SOWERBY, Proc. Zool. Soc. London, Conch. Illust. f. 24.
1845. *Cardium subretusum,* REEVE, Conch. Icon. Vol. 2, *Cardium,* pl. 19, f. 100.
1928. *Hemicardium hemicardium,* YOKOYAMA, Imp. Geol. Surv. Japan, No. 101, p. 84, pl. 9, f. 10.
1954. *Lunulicardia subretusa,* KIRA, Colored Illust. Shells Japan, Vol. 1, p. 108, pl. 54, f. 15.
1966. *Lunulicardia subretusa,* HABE and KOSUGE, Shells of the World in Colour, Vol. 2, p. 152, pl. 58, f. 9.

Material.—GK-L 6319. Excellently preserved left valve.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	ribs ant.	ribs post.	valve
6319	10.2	10.7	5.2	104.9	51.0	102.4	10*	12	left

* including a prominent rib on the posterior angle.

Descriptive remarks.—The shell is trigonal with prominent and extremely prosocline umbo. The anterior margin is rounded and the posterior one is obliquely truncated. The ventral margin is somewhat concave before the postero-ventral corner. The surface is divided into the anterior and posterior parts by a sharp posterior flexure. The lunule is deeply immersed. The ribs are flat and separated by shallow and narrow grooves with serial pits at the bottom on almost whole surface except near the anterior margin, where they are somewhat erected with round top. The cardinals consist of a couple of tusk-like teeth. The laterals are prominent; the posterior one is close to the cardinals, while the anterior one is situated immediately anterior to the lunule. The anterior and posterior adductor muscle scars are respectively trigonal and ovate. The pallilal line is entire and apart from the ventral margin.

Comparison.—The present specimen is readily distinguished from *Fragum (Lunulicardia) retusum* (LINNÉ), (1758, p. 1121, N. 75) on the basis of the sharper posterior angulation and the pitted grooves of the sculpture.

Hemicardium hemicardium of YOKOYAMA (1928, p. 84, pl. 9, f. 10) is considered to be included in the present species judging from the general outline and the pitted radial grooves.

Cardium guichardi of FISCHER (1927, p. 122, pl. 216, fs. 112a and b and 113) from the Pliocene of Timor shows closely similar features to the present species, but the former has weaker cardinals and less immersed lunule than the latter.

Locality.—SKGS-73.

Horizons.—Pleistocene and Recent in Southeast Asian waters. Upper part of the Ulian Formation of Panay.

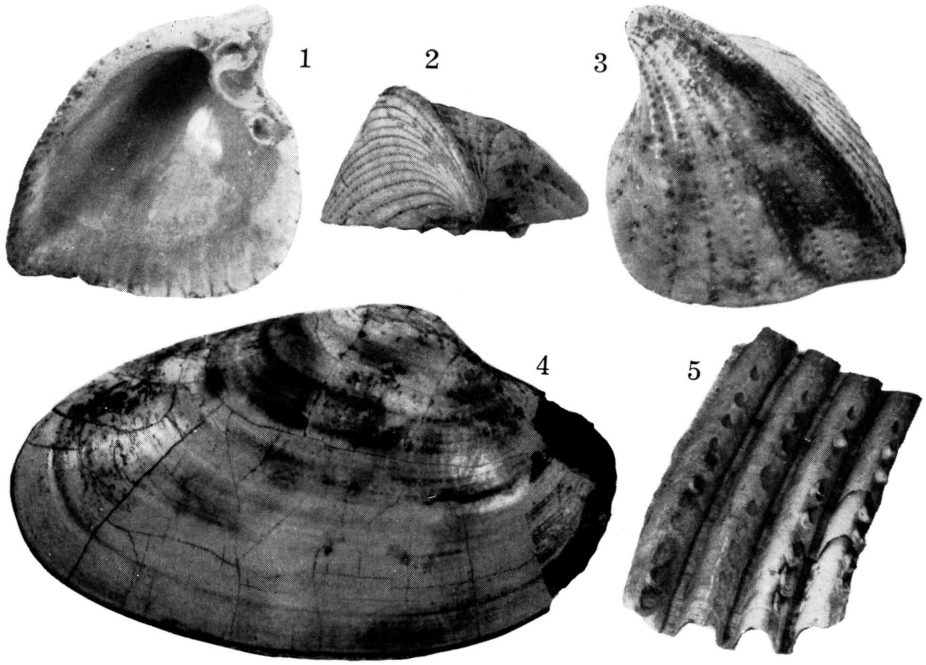

Fig. 7 1–3 *Fragum* (*Lunulicardia*) *subretusa* (SOWERBY), GK-L 6319, (×3.7), loc. SKGS-73.
4 *Paphia* (*Eumarcia*) *cheribonensis* OOSTINGH, GK-L 6317, (×1.4), loc. SKGS-73.
5 *Vepricardium* ? sp., GK-L 6670, (×2.1), loc. SKGS-71.

Subfamily Laevicardiinae
Genus *Laevicardium* SWAINSON, 1840
(type-species: *Cardium oblongum* GMELIN by subsequent designation, STOLICZKA, 1871)
Subgenus *Fulvia* GRAY, 1853
(type-species: *Cardium apertum* BRUGUIÈRE by monotypy)

Laevicardium (*Fulvia*) sp.
Pl. 6, Figs. 5, 6 and 10 and Text-fig. 6

Material.—GK-L 6639 and 6640. Preservation is not very excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	ribs ant.	ribs post.	valve
6640	5.40	5.05	1.95	93.5	36.1	113.5	15	10	R

Descriptive remarks.—The shell is very small, thin and rhomboid-oval with the moderately erected umbo at the middle of the shell-length. Length is somewhat larger than height. The surface is almost smooth except for fine concentric striae at first, but weak radial ribs appear when the shell attains about 3 mm long. They are obsolete on the main (central) part and moderately distinct at

the anterior and posterior parts. They are wider than the interspaces and overriden by the concentric threads later. The inner margin of the shell is not crenulated. The hinge is thin and of typical cardiid. That is to say, the cardinals are subequal and face each other and the laterals are remote.

Comparison.—The present specimens are included in *Laevicardium* SWAINSON, 1840, on the basis of the thin and ventricose shell with weak radial sculpture. The curvature of the ventro-posterior margin in posterior view suggests the slight posterior gaping. This indicates the specimens belong to subgenus *Fulvia* GRAY, 1853. The present specimens are featured by extremely small size, equilateral outline and moderately distinct radial ribs on both ends. There is no comparative species, but the establishment of a new taxon is suspended because of the insufficient state of preservation.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Subfamily Cardiinae

Genus *Vepricardium* IREDALE, 1929

(type-species: *Vepricardium pulchricostatum* IREDALE by original designation)

Vepricardium ? sp.

Text-figs. 6 and 7

Material.—GK-L 6670. A single fragment (20×14 mm) with four ribs.

Descriptive remarks.—The shell is moderate in thickness. The radial ribs are regularly spaced, round at the top and separated by narrower and incised interspaces. The bottom of the interspaces is roundly concave and its sides are overhanging. Craw-like spines stand in a row along the flank of the roof of the ribs. Each spine is oriented at a certain angle with the trend of the rib itself. The incremental lines are very fine but occasionally distinct and cross over the ribs. The grooves are protruded to form marginal crenulation. The inner surface is provided with the distinct relief corresponding to the surficial sculpture.

Comparison.—The present specimen, although it is only a fragment, is characterized by the large and regular ribs with a row of spines, which suggest its similarity to *Vepricardium* and *Trachycardium*. The author, however, prefers to include the present specimen in *Vepricardium* on the basis of the detailed feature of the spines.

The specific identification is not practical.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Subfamily Protocardiinae

Genus *Protocardia* von BEYRICH, 1845

(type-species: *Cardium hillanum* SOWERBY by subsequent designation, HERRMANNSEN, 1847)

Protocardia sp.
Pl. 7, Figs. 2 and 3 and Text-fig. 6

Material.—A fragmental specimen with cardinal area. Preservation is not sufficient. GK-L 6451.

Descriptive remarks.—The shell is very small. The shell-surface is divided into three parts, the anterior, central (main) and posterior ones. The anterior fourty percent of the surface is provided with fine concentric lines and close and minute radial striae. The central fourty percent is sculptured with the erected and sharply edged fourteen ribs, which are separated by wider interspaces. These ribs are generally flat and smooth at the top, but a few posterior ones are moderately crenulate. The remain of the surface (posterior surface) has only sharp concentric lines at the early stage of growth, and five weak ribs are introduced at the juvenile stage and become stronger later. Consequently that area has distinct reticulation with granules at the crossings. The details of the hinge teeth are not observable, because of unsuitable preservation, but the specimen apparently shows a cardiid hinge.

Comparison.—The present specimen is considered to be a member of Protocardiinae on the basis of the cardiid hinge teeth and protocardian sculpture. In details, however, it does not perfectly agree with any genera and subgenera of the subfamily. Anterior 40 percent of the surface is provided with fine concentric lines and minute radial striae and its boundary with the main surface is not sharply defined. On the posterior part the concentric lines are conspicuous at first and then the radial ribs are set off, which are remarkably granulated. There is no known representatives with the characteristic features mentioned above. It probably represents a new subgenus, but the estabilshment is suspended because of unsuitable preservation of the specimen.

Locality.—SKGS-73.

Horizon.—Upper part of the Ulian Formation.

Superfamily Tellinoidea
Family Tellinidae
Subfamily Tellininae
Genus *Tellina* LINNÉ, 1758
(type-species: *Tellina radiata* LINNÉ by subsequent designation, CHILDREN, 1823)
Subgenus *Laciolina* IREDALE, 1937
(type-species: *Tellina quoyi* SOWERBY by original designation)

Tellina (*Laciolina*) *incarnata busuegoi* subsp. nov.
Pl. 5, Figs. 6 and 12 and Pl. 6, Figs. 7–9 and Text-fig. 8

Material.—Holotype: GK-L 6648 (conjoined) and paratypes: GK-L 6645–6647, 6649–6651 and 7494 from one and the same locality. Preservation is excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6645	14.85	9.30	2.75	7.95	62.5	18.5	53.5	132.2	L
6648	11.50	7.40	2.05	6.45	64.4	17.8	56.1	135.1	L
do	11.65	7.50	2.10	6.60	64.4	18.0	56.7	134.2	R (conj.)
6649	14.05	8.70	2.45	7.60	61.9	17.4	54.1	136.3	R
7494	14.25	9.30	2.45	7.20	65.3	17.2	50.5	133.7	L

Diagnosis.—The shell is moderately small, thin and inequivalve. The outline is elliptical with slightly arcuate antero-dorsal margin and straight postero-dorsal one. The anterior part is longer than the posterior one. The posterior flexure is weak. The ventral margin is weakly sinuated in front of the posterior corner. The posterior part is bent slightly to the left and its end is somewhat gaping. The escutcheon is lanceolate and sharply defined. The ligamental plate is visible from outside in the escutcheon immediately behind the umbo (Text-fig. 8). The lunule is obscure. The sculpture consists of fine incremental lines. The hinge plate is small with radiating cardinals. On the right valve the anterior cardinal tooth is larger than the posterior bifid one and the posterior lateral tooth is remote and weak. The left valve has one bifid and vertical cardinal tooth and the posterior lateral. The anterior adductor muscle scar is oval and smaller than the posterior one of similar shape. The pallial sinus is confluent and extremely deep with the apex immediately below the anterior adductor scar. The area of the sinus occupies more than half of the inpallial area.

Comparison.—The general outline and character of the hinge indicate the present specimens are included in *Laciolina* IREDALE, 1937.

They show close resemblance to *T.* (*L.*) *incarnata* (LINNÉ) living in France (1758, p. 675) in the general features and the distinction is very difficult. It seems there is no reason to separate morphologically the present specimens from *T.* (*L.*) *incarnata,* but the present author hesitates to regard them consubspecific because of their remote geographic distribution and prefers to treat the present specimens as a subspecies of *T. incarnata.* The visible morphological difference between them is that the present specimens have somewhat smaller umbonal angle, less accuminate posterior part and slightly weaker hinge than *T.* (*L.*) *incarnata.*

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Subgenus *Punipagia* IREDALE, 1930

(type-species: *Tellina subelliptica* SOWERBY (in REEVE)=*T. hypelliptica* SALISBURY by original designation)

synonym: *Punigapia* THIELE, 1934, spelling error

Tellina (*Punipagia*) *rotunda* MARTIN

Pl. 5, Figs. 3, 5, 8 and 9 and Text-fig. 8

1885. *Tellina rotunda* MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 3, p. 203, Tab. 10, f. 205.

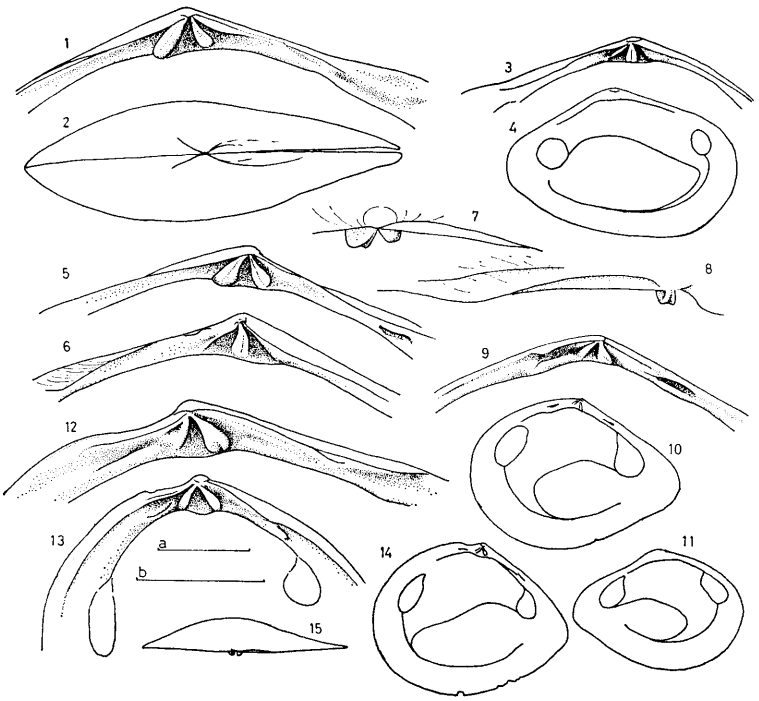

Fig. 8 1–8 *Tellina (Laciolina) incarnata busuegoi* subsp. nov.
1: cardinal area of right valve, GK-L 6648a. 2: umbonal view of conjoined valves, GK-L 6648ab. 3: cardinal area of left valve, GK-L 7494. 4: inner view showing adductor muscle scars and pallial line, left valve, GK-L 6645, 5: cardinal area of right valve, GK-L 6646. 6: cardinal area of left valve, GK-L 6648. 7: umbonal view showing beak and cardinals, right valve, GK-L 6648a. 8: umbonal view, left valve, GK-L 6648b.
9–11 *Tellina (Punipagia) pudica* HANLEY
9: cardinal area of right valve, GK-L 6659. 10: inner view showing adductor muscle scars and pallial line, right valve, GK-L 6664. 11: inner view, left valve, GK-L 6666.
12–15 *Tellina (Punipagia) rotunda* MARTIN
12: cardinal area of right valve, GK-L 7041. 13: ditto, right valve, GK-L 7044. 14: inner view showing adductor muscle scars and pallial line, GK-L 7044. 15: umbonal view of the same specimen as the preceding.
Unit bar a represents 3 mm for 2, 3, 10, 11, 14 and 15 and 6 mm for 4 and bar b does 1 mm for 1, 5–9, 12 and 13.

Material.—GK-L 7041 to 7047 from one and the same locality. Preservation is excellent.

Measurements.—

speciman GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degree)	valve
7041	12.5	9.75	2.3	6.50	78.0	18.4	52.0	143.3	R
7042	9.7	8.00	1.9	5.75	82.4	19.6	59.3	143.1	R
7044	5.1	4.80	0.9	3.10	94.1	17.6	60.7	132.4	R
7045	11.9	9.30	2.1	6.70	78.0	17.6	56.3	140.4	R
7046	9.2	8.00	1.6	5.30	87.0	17.4	57.6	140.9	R
7047	5.2	4.90	0.9	3.00	94.2	17.3	57.7	128.7	R

Descriptive remarks.—The shell is small, compressed and elliptical with hemicircular anterior half and trigonal posterior half. A distinct concavity is in front of the small and low umbo. The posterior end is weakly truncated. The posterior flexure is weak, but has a clear ridge to separate the posterior area from the main one. The anterior part is remarkably longer than the posterior one at the early stage of growth and their difference becomes smaller as shell grows because of the more rapid growth of the posterior part than the anterior. The surface is glossy and provided with close concentric striae and less numerous radiating ones. The areas are indistinct. The hinge on the right valve is provided with radiating two cardinals and anterior and posterior laterals. The anterior lateral tooth is close to the cardinal, while the posterior one is remote. The elliptical anterior adductor scar is larger than the rhomboid posterior one. The pallial sinus is deep, confluent and occupies about one half of the inpallial area.

Comparison.—The present specimens are featured by the elliptical, compressed and glossy shell, the hinge consisting of two radiating cardinals, approximate anterior and remote posterior laterals and deep triangular pallial sinus and included in *Punipagia* IREDALE, 1930. They are quite identical to *Tellina rotunda* MARTIN (1885, p. 203, pl. 10, f. 205) from the Miocene of Java. They are distinguished from *Tellina subelliptica* SOWERBY in REEVE (1868, pl. 39, f. 220), the type-species of *Punipagia,* in being provided with more sharply accuminate posterior half and more compressed anterior half than the latter.

Locality.—SKGS-72.

Horizons.—Miocene of Java. Upper part of the Ulian Formation of Panay.

Tellina (*Punipagia*) *pudica* HANLEY
Pl. 5, Figs. 7, 10, 11 and 13 and Text-fig. 8

1844. *Tellina pudica* HANLEY, Proc. Zool. Soc. London, Vol. 12, p. 62.
1846. *Tellina pudica,* SOWERBY, Thes. Conch. Vol. 1, p. 246, No. 46, pl. 56, f. 7.
1866. *Tellina pudica,* REEVE, Conch. Icon. Vol. 17, *Tellina,* pl. 31, f. 176.
1871. *Tellina* (*Arcopagia*) *pudica,* RÖMER, in MARTINI and CHEMNITZ, Conch. Cab. Bd. 10, Abt. 4, p. 95.
1909. *Tellina* (*Arcopagia*) *pudica,* LYNGE, Mem. Acad. Roy. Sci. Lettr. Danemark, Ser. 7, Sect. Sci., Tom. 5, No. 3, p. 98, pl. 3, fs. 35–37.

Material.—GK-L 6659–6666 from one and the same locality. Preservation is generally excellent.

Measurements.—

secimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6659	7.1	4.90	1.35	3.50	68.9	19.0	49.3	131.4	R
6660	7.1	5.05	1.40	3.65	71.0	19.7	51.4	130.1	R
6663	6.9	5.00	1.45	3.40	72.4	20.9	49.3	126.5	L
6664	7.0	4.90	1.30	3.35	69.8	18.5	47.9	125.6	R

Descriptive remarks.—The shell is very small and rhomboidally oval with tapering posterior part. The umbo is small, low and central. The postero-dorsal

margin is straight and equal to or slightly longer than the very slightly arcuate antero-dorsal margin. The anterior end is round, while the posterior one is truncated and gaping. The posterior flexure is obsolete especially on the right valve. The surface is sculptured with minute incremental lines. The right valve has two radiating cardinals and two laterals. The anterior lateral tooth is close to the cardinals and the posterior one is moderately remote (almost middle between the cardinals and the posterior scar). The left valve also has two cardinals and two laterals. The adductor muscle scars are large; anterior one is elliptical and the posterior one is pear-shaped. The pallial sinus is moderately deep and confluent on the half way, and the sinus area is less than half of the inpallial area.

Comparison.—The present specimens are quite similar to *Tellina pudica* HANLEY (1844, p. 62 and 1846 in SOWERBY, p. 246, pl. 56, f. 7) from the Philippine waters in the shell form and dentition. They are, however, different in coloration. The present specimens illustrate dark brown color instead of milky white of the living species. The writer prefers to treat them as conspecific, because the coloration may depend on the ecological condition.

Tellina culter HANLEY (1844, p. 69 and 1846 in SOWERBY, p. 279, pl. 57, f. 51) from the Philippine waters is also an ally to the present specimen, but the former is distinctly larger them the latter.

There are a few known species with similar shell form such as *T. australis* DESHAYES (1854, p. 362 and REEVE, 1867, pl. 50, f. 297) and *T. cygnus* HANLEY (1844, p. 144, HANLEY in SOWERBY, 1846, p. 310, pl. 59, f. 122 and REEVE, 1866, pl. 29, f. 157), but they are readily distinguished from the present specimens in having different dentition.

Locality.—SKGS-71.

Horizons.—Living in the Philippines. Cabatuan Formation in Panay.

Subgenus *Arcopaginula* LAMY, 1918
(type-species: *Tellian inflata* GMELIN by monotypy)

Tellina (*Arcopaginula*) *inflata* GMELIN
Pl. 6, Figs. 1 and 4 and Pl. 10, Figs. 13 and 14 and Text-fig. 9

1791. *Tellina inflata* GMELIN, Systema Naturae, ed. 13, p. 3230.
1818. *Tellina striatula* LAMARCK, Anim. s. vert. Tom. 5, p. 529.
1843. *Tellina hippopoidea* JONAS, JONAS in PHILIPPI, Abbild. u. Beschr. Bd. 1, p. 72, *Tellina,* Taf. 1, f. 3.
1846. *Tellina striatula,* HANLEY in SOWERBY, Thes. Conch. Vol. 1, p. 255, pl. 61, f. 175.
1866. *Tellina striatula,* SOWERBY in REEVE, Conch. Icon. Vol. 17, *Tellina,* pl. 8, f. 34.
1870. *Tellina* (*Peronaeoderma*) *simplex,* H. ADAMS, Proc. Zool. Soc. London, p. 789, pl. 48, f. 5.
1871. *Tellina inflata,* RÖMER in MARTINI and CHEMNITZ, Conch. Cab. Bd. 10, Abt. 4, p. 91, Taf. 9, f. 76.
1879. *Tellina hippopoidea,* MARTIN, Tertiärschichten a. Java, p. 96, Tab. 16, f. 1.
1920. *Tellina hippopoidea,* TESCH, Paläont. v. Timor, Lief. 8, p. 105, Taf. 140, fs. 279a, b and c.

1961. *Arcopaginula inflata*, HABE, Coloured Illustr. Shells Japan, Vol. 2, p. 137, pl. 62, f. 7.
1966. *Arcopaginula inflata*, HABE and KOSUGE, Shells of the World in Colour, Vol. 2, p. 171, pl. 66, f. 17.

Material.—GK-L 6313 (conjoined) from loc. SKGS-73 and GK-L 6570, 6571, 6582 and 6667 from SKGS-71.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6313	46.1	38.4	8.2	26.6	83.3	17.8	57.7	119.3	R (conj.)

Descriptive remarks.—The shell is moderately large, thin, compressed and elliptical. The anterior part is slightly longer than the posterior half. The posterior part is not rostrate but truncate. The escutcheon is long lanceolate and sharply defined. The surface is glossy and sculptured with fine concentric

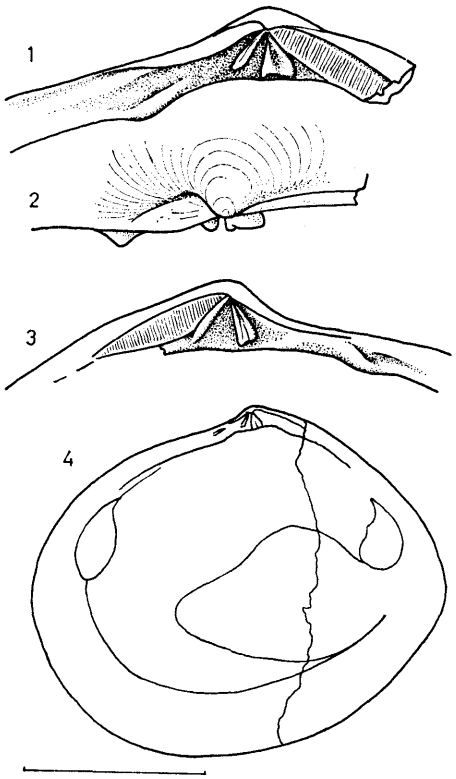

Fig. 9 *Tellina* (*Arcopapaginula*) *inflata* (GMELIN)
1: cardinal area of right valve, GK-L 6570. 2: umbonal view of the same specimen as the preceding. 3: cardinal area of left valve, GK-L 6571. 4: inner view showing adductor muscle scars and pallial line, GK-L 6570.
Unit bar represents 4 mm for 1–3 and 12 mm for 4.

lines and minute and close radial striae. Both valves have two cardinals and two laterals. The right anterior cardinal tooth is thinner than the bifid and trigonal right posterior one, while the bifid left anterior cardinal is thicker than the simple left posterior one. The anterior lateral tooth is heavy and slightly apart from the cardinals on both valves. The posterior lateral is weak and remote. The ligament is opisthodetic with heavy nymph. The subequal adductor muscle scars are rather small. The pallial sinus is deep, but only partly confluent. The sinus area is about one-third of the inpallial area.

Comparison.—The specimens in hand including the imperfect ones are quite identical to the well known *Tellina inflata* GMELIN, the type-species of *Arcopaginula* LAMY, 1918.

Localities.—SKGS-71 and 73.

Horizons.—Upper Miocene and Pliocene of Indonesia and also living in Southeast Asian waters. The Cabatuan and the upper part of the Ulian Formation in Panay.

Tellina (*Arcopaginula*) sp.
Pl. 5, Figs. 1, 2 and 4 and Text-fig. 10

Material.—GK-L 7050. A single right valve. Preservation is almost perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Hd (mm)	H/L (%)	D/L (%)	La/L (%)
7050	16.9	12.4	3.3	9.9	11.7	73.4	19.5	58.6

specimen GK-L	Hd/L (%)	∠U (degrees)	valve
7050	69.2	120.7	R

Descriptive remarks.—The shell is moderately small, compressed and ovato-rhomboid with straight postero-dorsal margin and subparallel antero-dorsal and postero-ventral margins. The anterior part is longer than the posterior one, which is slightly bent to the right. The anterior end is regularly rounded, while the posterior margin is narrowly truncated. The posterior flexure is weak. The escutcheon is long and clear. The surface is glossy and has regular concentric lines. The cardinals consist of the short and trigonal anterior tooth and longer and bifid posterior one. The laterals are strong; the anterior lateral is near the cardinal, while the posterior one is remote. The pallial sinus is deep and confluent at 85 percent. The sinus area occupies almost one half of the inpallial area.

Comparison.—Ovato-rhomboid outline without posterior rostration and the pattern of the hinge dentition suggest that the specimen belongs to *Arcopaginula,* although the former is less ovoid than the latter. There are a few species showing similar shell-form, for example *Tellina corbunoides* HANLEY (1844, p. 70 and HANLEY in SOWERBY, 1846, p. 280, pl. 57, f. 50 and 57), but the present specimen is distinctive by its dentition.

Locality.—SKGS-72.

Horizon.—Upper part of the Ulian Formation.

Subgenus *Semelangulus* IREDALE, 1924
(type-species: *Tellina tenuilirata* SOWERBY in REEVE
by original designation)

Tellina (*Semelangulus*) sp.
Pl. 5, Figs. 14 and 17 and Text-fig. 10

Material.—GK-L 6360. A single left valve.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6360	9.95	6.00	1.55	5.60	60.4	15.6	56.3	135.3	L

Descriptive remarks.—The shell is small and elliptical. The umbo is small and situated at some distance behind the middle of the dorsal margin. The antero- and postero-dorsal margins are straight and the former is subparallel to the postero-ventral margin. The main surface is compressed near the umbo and slightly concave along the weak posterior flexure. The concentric lines are distinct and regularly spaced. The hinge plate is weak; the anterior cardinal tooth is strong, vertical, trigonal and bifid and the posterior one is very thin and oblique. No laterals. The anterior adductor muscle scar is elongate pear-shaped and the posterior one is quadrate. The pallial sinus is extremely deep with the apex just below the anterior scar and confluent except for a small portion near the anteiror scar. It reflects below the umbo. The sinus area is about two-thirds of the inpallial area.

Comparison.—The present specimen looks like *Moerella* FISCHER, 1887, but they are readily distinguished from each other, because the former has no laterals. In this point the present specimen is clearly distinguished from *Tellina irridescens* BENSON (REEVE, 1867, pl. 34, fs. 189a and b) inspite of superficial similarity.

The present specimen is allied to *Tellina lucerna* HANLEY (HANLEY in SOWERBY, 1846, p. 300, pl. 58, f. 98) but not perfectly identical. The difference lies in that the present specimen has smaller shell with sharper postero-ventral angle.

Locality.—SKGS-73.

Horizon.—Upper part of the Ulian Formation.

Subgenus *Moerella* FISCHER, 1887
(type-species: *Tellina donacina* LINNÉ by monotypy)
synonym: *Donacilla* GRAY, 1851, non, PHILIPPI, 1836, obj.
by S. D. SALISBURY, 1934
Moera H. et A. ADAMS, 1856, non HUEBNER, 1819,
obj. S. D. STOLICZKA, 1871
Bathytellina KURODA et HABE, 1958 (type-sp.:
B. citrocarnea KURODA et HABE by O. D.)

Tellina (*Moerella*) *nannodes* MARTIN
Pl. 5, Figs. 15 and 16 and Text-fig. 10

1885. *Tellina* (*Peronaeoderma*) *nannodes* MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 3, p. 201, Tab. 10, f. 202.
1933. *Tellina prototenuilirata* NOMURA, Sci. Rep. Tohoku Imp. Univ. 2nd Ser., Vol. 16, p. 100, pl. 4, fs. 7a, b, and 9a, b.

Material.—GK-L 6644. A single left valve. Preservation is perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	Hd (mm)	H/L (%)	D/L (%)	La/L (%)
6644	7.3	4.7	1.2	5.75	4.3	64.3	16.4	78.8

specimen GK-L	Hd/L (%)	∠U (degrees)	concent. per mm	valve
6644	58.9	119.9	11/1 mm	L

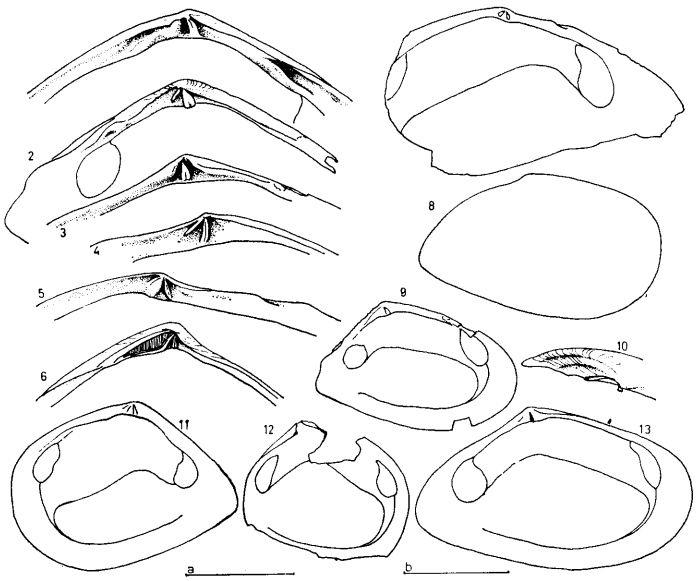

Fig. 10 1 and 11 *Tellina* (*Arcopaginula*) sp., right valve, GK-L 7050.
1: cardinal area. 11: inner view showing adductor muscle scars and pallial line.
2, 9 and 10 *Tellina* (*Moerella*) *nannodes* MARTIN, left valve, GK-L 6644.
2: cardinal area. 9: inner view showing adductor muscle scars and pallial line. 10: escutcheon and posterior part of the shell.
3 and 13 *Tellina* (*Semelangulus*) sp., left valve, GK-L 6360.
3: cardinal area. 13: inner view showing adductor muscle scars and pallial line.
4, 5, 7 and 8 *Tellina* (*Exotica*) sp.
4: cardinal area of left valve, GK-L 6638. 5: ditto, right valve, GK-L 6637. 7: inner view showing adductor muscle scars and pallial line, the same specimen as the preceding. 8: outline indicated by growth line, the same specimen.
6 and 12 *Macoma* (*Austromacoma*) *telahabensis* (MARTIN)
6: cardinal area of left valve, GK-L 7452. 12: inner view of left valve, GK-L 6583.
Unit bar a represents 0.5 mm for 2, 3 and 5 and 25 mm for 6 and bar b does 4 mm for 1, 4, 9, 10 and 13, 8 mm for 7, 8 and 11 and 27 mm for 12.

Descriptive remarks.—The shell is very small and oblong elliptical. The anterior part is longer than the posterior one. The almost straight antero-dorsal margin is parallel to the postero-ventral margins. The posterior flexure is distinct. Two radial folds are developed on the posterior area. The surface sculpture consists of the distinct and regular growth lines, which are especially erected on the posterior part. The hinge plate is small with strong and bifid anterior cardinal, thin and oblique posterior one and distinct posterior lateral tooth near the posterior adductor scar. The elliptical anterior scar is larger than the oval posterior one. The pallial sinus is deep and almost confluent. The sinus area is more than one half of the inpallial area.

Comparsion.—The anterior lateral tooth is not visible on the present specimen because that part of the antero-dorsal margin is slightly broken. The present specimen is referable to *Moerella* FISCHER, 1887. It is identical to *Tellina nannodes* MARTIN (1885, p. 201, pl. 10, f. 202) from the Pliocene of Java with the characteristic features just mentioned. NOMURA described a small tellinid species, *Tellina prototenuilirata,* from the Lower Pleistocene of west Taiwan. Comparison of the original descriptions and figures of these two taxa does not lead to find out any reasonable basis for specific separation of them.

Tellina hilaria HANLEY (1844, p. 140 and HANLAY in SOWERBY, 1846, p. 281, pl. 57, f. 54, REEVE, 1867, pl. 46, f. 274) is a close ally to the present species and the separation is very difficult.

Locality.—SKGS-71.

Horizons.—Pliocene of Java and Lower Pleistocene of Taiwan. Cabatuan Formation of Panay.

Subgenus *Exotica* LAMY, 1918
(type-species: *Exotica exotica* LAMY=? *Tellina triradiata* A. ADAMS by tautonymy)

Tellina (*Exotica*) sp.
Pl. 6, Figs. 11 and 12 and Text-fig. 10

Material.—GK-L 6637, 6638 and two other fragments with cardinal area.

Measurements.—GK-L 6637, Length: 24.5 mm, height: ca 18 mm, depth: ca 11.2 mm, umbonal angle: 148.1 degrees.

Descriptive remarks.—The shell is thin and moderate in size. The growth lines indicate the elliptical outline of the shell with remarkably curved postero-dorsal margin so as to form the pointed posterior end. The anterior part is somewhat longer than the posterior one. The posterior flexure is obsolete. The surface is glossy and provided with fine concentric striae. The hinge has two cardinals and no laterals on both valves. The simple right anterior cardinal is larger than the bifid posterior one, while the bifid left anterior is vertical and larger than the thin and oblique posterior one. The pallial sinus is very deep with the apex below the anterior adductor muscle scar, which is rhomboid and slightly smaller than the pear-shaped posterior one. The pallial line shows sharp bending between the lower end of the posterior scar and the cardinals. The

sinus area is more than half of the inpallial area.

Comparison.—On account of imperfect preservation the concrete comparison is impossible. The present specimens, however, show similarity to *Tellina micans* HANLEY (1844, p. 72 and HANLEY in SOWERBY, 1847, Thes. Conch. Vol. 1, p. 309. pl. 59, f. 106) and *T. opalina* SOWERBY (1868, REEVE, pl. 44, f. 258a and 258b). The former is readily distinguished from *T. micans*, which has weak oblique lines near the ventral margin of the adult form. It is also distinguished from *T. opalina* in being devoid of the sinuation in front of the postero-ventral corner.

Locality.—SKGS-71.

Horizon.—Cabatuan Formation.

Subgenus *Merisca* DALL, 1900
(type-species: *Tellina crystallina* WOOD, 1815=*Tellina cristallina* SPENGLER, 1798, by original designation)

Tellina (Merisca) diaphana (DESHYES)
Pl. 10, Fig. 11

1854. *Tellina diaphana* DESYAYES, Proc. Zool. Soc. London, p. 364, No. 216.
1868. *Tellina diaphana*, REEVE, Conch. Icon. Vol. 17, *Tellina*, pl. 51, f. 302.
1871. *Tellina diaphana*, RÖMER, in MARTINI and CHEMNITZ, Conch. Cab. Bd. 10, Abt. 4, p. 47, Taf. 13, fs. 7–9.
1952. *Arcopagia (Merisca) diaphana*, HABE, Genera of Japanese Shells, p. 215, fs. 534 and 535.

Material.—GK-L 6314. A conjoined but imperfect specimen.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	valve
6314	ca 31.7	ca 24.3	4.1	ca 77	ca 13	115.7	R

Descriptive remarks.—The shell is trigonal with almost straight dorsal margins. The umbo is pointed and situated behind the middle of the dorsal margin. The posterior part is slightly bent rightward and its end is truncated. The posterior flexure is distinct and erected along the border of the smooth escutcheon on both valves. There is a broad and shallow depression in front of the flexure on the right valves, while on the left a narrow and shallow furrow is there. The concentric sculpture is distinct and erected especially on the posterior part. The ligament is opisthodetic and semi-internal. The hinge is not observed.

Comparison.—The present specimen is apparently included in *Merisca* DALL, 1900, on the basis of the characteristic exterior features, although the hinge and the sinus are not examined.

Its short outline with expanded ventral side indicates conspecific relation to *T. diaphana* DESHAYES (1854, p. 364).

Locality.—SKGS-73.

Horizons.—Living in Southeast Asian waters. Upper part of the Ulian Formation in Panay.

Subfamily Macominae

Genus *Macoma* LEACH, 1819

(type-species: *Macoma tenera* LEACH=*Tellina calcarea* GMELIN, by monotypy)

synonym: *Macroma, Macrotoma,* spelling error

Limecola BROWN, 1844 (ex LEACH MS) (in synonymy of *Tellina solidula* PULTENEY=*T. balthica rubra* DACOSTA)

Macomopsis SACCO, 1901 (type-sp.: *Tellina elliptica* BROCCHI by O. D.)

Subgenus *Austromacoma* OLSSON, 1961

(type-species: *Solen constrictus* BRUGUIÈRE by original designation)

Macoma (Austromacoma) talahabensis (MARTIN)

Pl. 7, Figs. 9, 10 and 13 and Text-fig. 10

1921. *Tellina talahabensis* MARTIN, Samml. Geol. Reichs-Mus. Leiden, N. F. Bd. 1, Abt. 2, p. 490, Taf. 61, f. 124.

Material.—GK-L 7451 (conjoined), 7452 (conjoined) and 6583 (broken left valve) from one and the same locality.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
7451	ca 57	48.5	13.7	ca 28.5	85	24	50	113.2	R (conj.)
7452	ca 61.6	50.4	12.1	31.9	82	20	52	115.1	L (conj.)

Descriptive remarks.—The shell is large, oval and not chalky. The umbo is almost central. The antero- and postero-dorsal margins are almost straight. The posterior part is curved rightward. The posterior flexure is distinct with a few additional folds on the right valve. While it is indistinct on the left valve, the posterior area is indicated by the bordering depression. The surface sculpture consists of the distinct concentric lines and weak radial striae, which do not cross over the concentric lines. The hinge teeth are slender consisting of the vertical and bifid anterior cardinal tooth and the very thin and oblique posterior one on the left valve. No laterals. The nymph is large and prominent. The opisthodetic ligamental groove is long and deep. The adductor muscle scars are equidimensional. The pallial sinus is very deep and confluent. The pallial line is abruptly bent below the umbo. The sinus area is more than 60 percent of the inpallial area.

Comparison.—The present specimens belong to *Austromacoma* OLSSON, 1961, on the basis of its non-chalky macomoid shell and quite identical to *Tellina talahabensis* MARTIN (1921, p. 490, Taf. 61, f. 124) from the lower Miocene of Java. The present species closely resembles *Tellina edentula* SPENGLER (1798, p. 97 and REEVE, 1866, pl. 28, f. 153) and the distinction is based only on the slight difference that the latter has centrally situated umbo and distinct rib-like fold on the posterior flexure. They may be probably conspecific.

Locality.—SKGS-71.

Horizons.—Lower Miocene of Java. Cabatuan Formation of Panay.

Family Psammobiidae

Genus *Cari* SCHUMACHER, 1817

(type-species: *Gari vulgaris* SCHUMACHER=*Solen amethystus* WOOD, pending)

synonym: *Psammotaea* LAMARCK, 1818 (type-sp.: *Psammotaea donacina* LAMARCK by S. D., CHILDREN, 1823)

Capsella DESHAYES, 1855 (non GRAY, 1851)

Milligaretta IREDALE, 1936 (type-sp.: *M. venta* IREDALE by O. D.)

Subgenus *Gari* (s. s.)

Gari (*Gari*) *pulchella* (LAMARCK)

Pl. 6, Figs. 15 and 16, Pl. 24, Fig. 12 and Text-fig. 11

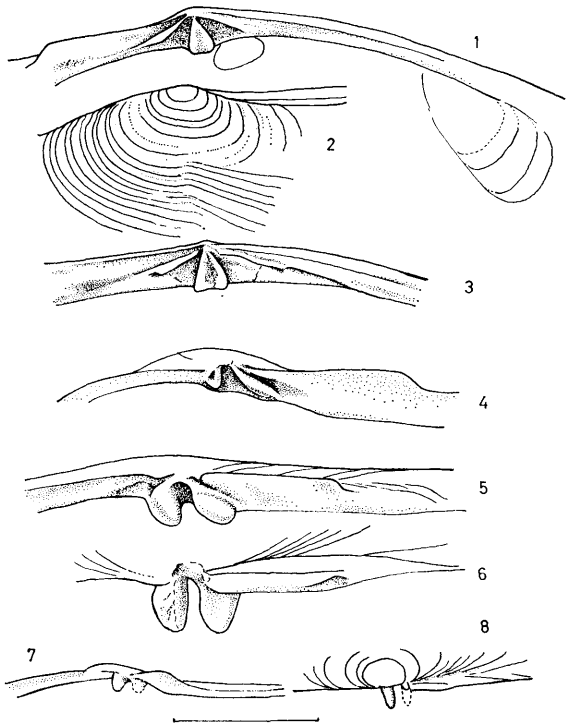

Fig. 11 1–3 *Gari* (*Gari*) *pulchella* (LAMARCK)
1: cardinal area of left valve, GK-L 6669. 2: sculpture of the same specimen as the preceding. 3: cardinal area of left valve, GK-L 6359.
4 *Gari* (*Gobraeus*) cfr. *crassula* (DESHAYES), cardinal area of right valve, GK-L 6316.
5–8 *Azorinus* (*Azorinus*) *abbreviatus* (GOULD)
5: cardinal area of right valve, GK-L 6572. 6: umbonal view of the same part of the preceding. 7: cardinal area of immature right valve, GK-L 7574, ligamental plate being relatively shorter than on the adult specimen. 8: umbonal view of the same specimen.
Unit bar represents 4 mm for all the figures.

1835. *Psammobia pulchella* LAMARCK, Anim. sans vert. Tom. 6, p. 177.
1857. *Psammobia pulchella*, REEVE, Conch. Icon. Vol. 10, *Psammobia*, pl. 4, f. 23.

Material.—GK-L 6359 from loc. SKGS-73 and GK-1 6669 from SKGS-71. Both the specimens are imperfect left valves.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6359	42.7	21.3	5.25	20.8	49.8	12.3	48.7	154.6	L

Descriptive remarks.—The shell is thin, fragile and ovatotrapezoid with a very large umbonal angle. A weak flexure is discernible from the umbo to the posterior corner. The posterior end is obliquely truncated. The surface sculpture consists of concentric and oblique lines. The latter covers the posterior half except for the area behind the posterior flexure. Both valves have two cardinals respectively. The left anterior cardinal is trigonal and large, showing a tendency for bifurcation and the left posterior one is very thin fringing the ligamental plate. A small pedal scar is visible immediately below the cardinals.

Comparison.—The present specimens are featured by the elliptical outline with broad ventral side, narrowly accuminate anterior part, obliquely truncated posterior part and the raised oblique lines disappearing at the posterior flexure. On the basis of these characteristics they are quite identical to *Gari pulchella* (LAMARCK) living in the Philippines waters.

They also resemble *G. anomala* (DESHAYES) (1854, p. 320, and REEVE, 1857, pl. 1, f. 5) in many features, but are distinguished from the latter in having oblique posterior truncation instead of vertical one of *G. anomala* and also different pattern of the sculpture. The difference between them is, however, so slight that separation of them at species level seems unreasonable.

Localities.—SKGS-71 and 73.

Horizons.—Living in the Philippine waters. Cabatuan and the upper part of the Ulian Formation in Panay.

Subgenus *Gobraeus* BROWN, 1844, ex LEACH, MS
(type-species: *Solen vespertinus* GMELIN=*Tellina depressa* PENNANT by monotypy)
synonym: *Psammocola* De BLAINVILLE, 1825, auct., non De BLAINVILLE, 1824, obj.

Gari (*Gobraeus*) sp. cfr. *G.* (*G.*) *crassula* (DESHAYES)
Pl. 10, Figs. 2 and 15 and Text-fig. 11

1854. *Capsa* (*Capsella*) *crassula* DESHAYES, Proc. Zool. Soc. London, p. 349.
1857. *Capsella crassula*, REEVE, Conch. Icon. Vol. 10, *Capsella*, pl. 2, fs. 8a and b.

Material.—GK-L 6316. A single imperfect and distinctly coroded right valve.
Measurements.—Length: ca 29.3 mm, height: 16.6 mm, depth: 3.9 mm.
Descriptive remarks.—The shell is elliptical, almost equilateral with a small

and almost central umbo and very large umbonal angle. There is no posterior flexure. The surface is sculptured with only concentric lines. The hinge plate is small with two cardinal teeth. The right anterior is just below the umbo, vertical and rather thin, and the right posterior is strong, long and oblique separated from the ligamental plate by a shallow groove. The pallial sinus is deep reaching to the middle of the shell and partly confluent.

Comparison.—The cardinal teeth of the present specimen resemble those of *Asaphis* MODEER, 1793, rather than *Gobraeus* BROWN, 1844, but the present specimen is not provided with radial sculpture like *Asaphis*. Almost equilateral shell-outline also differs from the posteriorly expanded form of *Asaphis*.

The present specimen is comparable with *G. crassula* (DESHAYES) (1854, as *Capsella*, p. 349 and REEVE, 1857, pl. 2, fs. 8a and b) in the elliptical outline, hinge teeth and pallial sinus. Strictly speaking, slight difference is observable about the nymph, which is somewhat heavier on *G. crassula* than on the present specimen. Under the circumstances, it is highly probable that the present specimen belongs to *G. crassula*, but the concrete identification is suspended on account of imperfect preservation.

Locality.—SKGS-73.

Horizons.—Living in the Philippine waters. Upper part of the Ulian Formation of Panay.

Family Solecurtidae

Genus *Azorinus* RÉCLUZ, 1869

(type-species: *Solen coarctatus* GMELIN=*Solen chamasolen* DA COSTA by monotypy)

synonym: *Azor* BROWN, 1844, (ex LEACH MS) non SOWERBY, 1824, obj.

Azoa WINKWORTH, 1930 (obj. by O. D.)

Subgenus *Azorinus* (s. s.)

Azorinus (*Azorinus*) *abbreviatus* (GOULD)

Pl. 6, Figs. 17 and 18 and Text-fig. 11

1861. *Solecurtus abbreviatus* GOULD, Proc. Boston Soc. Nat. Hist. Vol. 8, p. 26.
1874. *Solecurtus abbreviatus*, REEVE, Conch. Icon. Vol. 19, *Solecurtus*, pl. 2, fs. 6a and b.
1888. *Solecurtus abbreviatus*, CLESSIN in MARTINI and CHEMNITZ, Conch. Cab. Bd. 11, Abt. 3, p. 93, Taf. 22, f. 3.
1928. *Solecurtus abbreviatus*, YOKOYAMA, Imp. Geol. Surv. Japan, Rep. No. 101, p. 124, pl. 19, f. 12.
1954. *Azorinus abbreviatus*, KIRA, Coloured Illustr. Shells Japan, Vol. 1, p. 116, pl. 58, f. 21.

Material.—GK-L 6572 (conjoined), 6573 and 6574. Preservation is perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	H/L (%)	D/L (%)	La/L (%)	∠U (degrees)	valve
6572	ca 43.3	20.6	4.6	19.0	48	11	44	163	R (conj.)

Descriptive remarks.—The shell is elongately quadrate with subparallel ventral and dorsal margins. The umbo is scarcely elevated and situated slightly anteriorly to the middle of the shell. The umbonal angle is very large but the dorsal margin is not on the straight line. The anterior and posterior margins are respectively regularly rounded and obliquely truncated. The both ends are gaping. The shallow furrow stretches from the umbo to the mid-ventral margin and it is bordered on both sides by week ridges. The concentric lines comprise the surface sculpture. The hinge plate is extremely small and provided with tusk-like two cardinals on both valves. The nymph is distinct. It is relatively short and expanded outward at the immature stage, and it becomes relatively long and less expanded at later stages. The very fine radial lines are discernible on the inner surface. The anterior adductor muscle scar is elliptical and the posterior one is rhomboid-oval. The pallial sinus is moderately deep with the blunt apex reaching below the cardinal teeth. It is partly confluent. The pallial line joins with the posterior scar at the inner upper part of the scar.

Comparison.—The present specimens are quite identical to the living *Azoritus abbreviatus* (GOULD) in the details of the morphological features.

Locality.—SKGS-71.

Horizons.—Upper Pliocene of West Taiwan and Upper Pleistocene of Southwest Japan and also living in Southeast Asian waters. Cabatuan Formation of Panay.

Superfamily Veneroidea
Family Veneridae
Subfamily Circinae
Genus *Circe* SCHUMACHER, 1817
(type-species: *Circe violacea* SCHUMACHER=*Venus scripta* LINNÉ by monotypy)

Circe rivularis (BORN)
Pl. 8, Figs. 5 and 6 and Text-fig. 13

1780. *Venus rivularis* BORN, Test. Mus. Vindobon. p. 72, Tab. 5, f. 7.
1855. *Circe rivularis*, SOWERBY, Thes. Conch. Vol. 2, p. 652, pl. 139, fs. 46–48.
1864. *Circe rivularis*, REEVE, Conch. Icon. Vol. 14, *Circe*, pl. 1, fs. 3a and b.

Material.—GK-L 6318. A broken left valve with cardinal area.

Remarks.—The shell is extremely compressed especially at the umbonal area. The umbo is pointed. The sculpture consists of the very fine concentric lines, which are occasionally coarse except on the umbonal area, and oblique folds near the postero- and antero-dorsal margins. The folds are rather granular at the dorsal margin. The lunule is long lanceolate and the escutcheon is longer. They are separated from the main surface by a sharp angulation. The cardinals are three and radiating. 2a and 4b are thin and 2b is large and bifid. The anterior lateral is strong and moderately apart from the cardinals. Judging from the sockets, the right valve is provided with three equally distinct cardinals and a shallow depression behind 3b. There is a continuous ridge along the postero-

dorsal margin. The posterior adductor muscle scar is pear-shaped.

Circe scripta (LINNÉ) and *C. rivularis* (BORN) very closely resemble each other and the degree of compression of the shell, especially of the umbonal region is regarded as the effective criterion to separate two species. The umbonal region of the present specimen is extremely compressed and agrees with that of *C. rivularis*. Furthermore the oblique folds near the dorsal margins of the present specimen show the fine granulation at the very margin. This feature is also diagnostic on the specimens of *C. rivularis*, although the morphology of the oblique folds is in general very variable. It is reliable that the present specimen is included in *"C. rivularis"*. Whether *C. rivularis* and *C. scripta* are conspecific or not is, however, another thing. Evaluating the morphological similarity and difference between the two, the author is inclined to treat them as conspecific.

Locality.—SKGS-73.

Horizons.—Living in the South Asian waters. Upper part of the Ulian Formation in Panay.

Subfamily Meretricinae

Genus *Meretrix* LAMARCK, 1799

(type-species: *Venus meretrix* LINNÉ by tautonymy)

Meretrix meretrix (LINNÉ)

Pl. 8, Figs. 3 and 7 and Text-fig. 12

1758. *Venus meretrix* LINNÉ, Syst. Nat. ed. 10, p. 686, No. 102.
1818. *Cytherea petechialis* LAMARCK, Anim. sans. vert. Tom. 5, p. 561, No. 2.
1818. *Venus zonaria* LAMARCK, ibid. Tom. 5, p. 562, No. 5.
1818. *Venus impudica* LAMARCK, ibid. Tom. 5, p. 561, No. 3.
1855. *Meroe meretrix*, SOWERBY, Thes. Conch. Vol. 2, p. 619, pl. 129, fs. 48–50.
1861. *Meretrix petechialis*, RÖMER, Monogr. d. Molluskengatt. *Venus*, Bd. 1, p. 29, Taf. 9, f. 1.
1861. *Meretrix lusoria*, RÖMER, ibid., p. 30, Taf. 12, f. 1 and Taf. 11, fs. 1–2.
1864. *Cytherea impudica*, REEVE, Conch. Icon. Vol. 14, *Cytherea*, pl. 3, f. 10.
1869. *Cytherea meretrix*, PHEIFFER in MARTINI and CHEMNITZ, Conch. Cab. Bd. 11, Abt. 1, p. 15, Taf. 3, fs. 4–6, 8 and 9.
1924. *Meretrix meretrix*, YOKOYAMA, Imp. Geol. Surv. Japan, Rep. No. 101, p. 75, pl. 7, f. 9.
1966. *Meretrix meretrix*, HABE and KOSUGE, Shells of the World in Colour, Vol. 2, p. 163, pl. 64, f. 3.

Material.—GK-L 6358. A left valve. Surface is slightly worn.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	valve
6358	42.4	36.1	12.1	82.7	28.6	99.1	L

Remarks.—The shell is trigonal with almost straight dorsal side and broadly rounded ventral side. The umbo is not erected and situated at anterior two-fifths of the shell-length. A faint angulation is discernible from the umbo to the postero-ventral corner. The surface is almost smooth except for weak concentric striae. The short escutcheon is bordered by a shallow groove and the lunule is

indistinct. The inner margin is smooth. The hinge is moderately strong. The cardinals are radiating and consist of trigonal 2a and 2b and very oblique and long 4b, which is attached to the strong nymph. The anterior lateral is heavy and apart from the cardinals. No posterior lateral. The anterior adductor muscle scar is elliptical and smaller than the circular posterior one. The sinus is very shallow.

The present specimen is readily included in *Meretrix* on the basis of the hinge dentition and the general form. Separation of the weakly striated species of *Meretrix* is very difficult, because the colour pattern and trifling difference in the shell form are regarded as the criteria for specific separation. Colour pattern is, of course, not preserved on the present fossil specimen and the shell-form, in general, seems rather variable. The inflated tall shell with short anterior side and remarkably accuminated posterior end is evaluated in this case to identify the present specimen to *Meretrix meretrix* (LINNÉ). Synonymy is chiefly after DAUTZENBERG and FISCHER (1905).

Locality.—SKGS-73.

Horizons.—Lower Pleistocene of Taiwan and living in Southeast Asian seas. Upper part of the Ulian Formation of Panay.

Subfamily Pitarinae
Genus *Lioconcha* MÖRCH, 1853
(type-species: *Venus castrensis* LINNÉ by subsequent designation, STOLICZKA, 1870)
Subgenus *Sulcilioconcha* HABE, 1951
(type-species: *Cytherea philippinarum* HANLEY, by original designation)

Lioconcha (Sulcilioconcha) philippinaria (HANLEY)
Pl. 9, Figs. 7, 9, 11, 13 and 14 and Text-fig. 12

1844. *Cytherea philippinarum* HANLEY, Proc. Zool. Soc. London, p. 110.
1855. *Cytherea philippinarum,* SOWERBY, Thes. Conch. Vol. 2, p. 627, pl. 136, f. 176.
1920. *Cytherea (Lioconcha) molengraaffi* TESCH, Paläont. v. Timor, Lief. 8, p. 103, pl. 139, fs. 273 and 274.
1932. *Hysteroconcha (? Lamelliconcha) philippinarum,* PRASHAD, Monogr. 53c of Siboga Expedition, p. 217, pl. 6, fs. 7–10.
1951. *Lioconcha (Sulcilioconcha) philippinarum,* HABE, Illustr. Catalogue of Japanese shells, p. 158, fs. 356 and 357.

Material.—GK-L 6320 to 6326 and 6356 from one and same locality. Preservation is generally excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	L1 (mm)	H/L (%)	D/L (%)	L1/L (%)
6320	20.75	18.00	7.10	3.0	86.6	34.2	14.4
6322	17.65	15.20	ca 5.6	2.4	86.2	31.8	13.6
6323	13.15	11.55	4.40	1.4	87.7	33.4	10.6
6324	20.90	17.90	7.30	—	85.5	34.8	—
6356	18.30	16.30	6.45	—	89.0	35.3	—

specimen GK-L	∠U (degrees)	lamellae (per mm)	valve
6320	99.3	13/10 mm (10–20)	R
6322	111.5	—	R
6323	108.2	—	R
6324	101.4	13.5/10 mm	L
6356	94.3	14/10 mm	L

Descriptive remarks.—The shell is short veneriform with moderately rounded anterior margin, narrowly rounded posterior margin and broadly arcuate ventral one. The long postero-dorsal margin is slightly convex and the short antero-dorsal margin is concave in front of the umbo. The lunule is distinct and cordate but it is indistinct on some specimens especially on the left valves. The sculpture consists of the regular and lamellate concentric lirae. The inner margin is

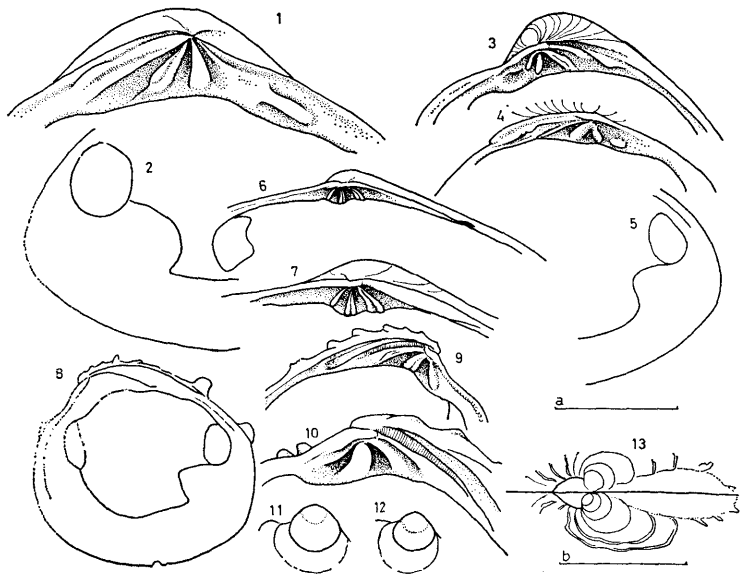

Fig. 12 1 and 2 *Meretrix meretrix* (LINNÉ), left valve, GK-L 6358
1: cardinal area. 2: posterior adductor muscle scar and pallial sinus.
3–5 *Lioconcha* (*Sulcilioconcha*) *philippinaria* (HANLEY)
3: cardinal area of right valve, GK-L 6320. 4: ditto, left valve, GK-L 6324. 5: pallial sinus on the same specimen as the preceding.
6 and 7 *Paphia* (*Paratapes*) *undulata neglecta* (MARTIN)
6: cardinal area of left valve, GK-L 6579. 7: ditto, left valve, GK-L 7455.
8–13 *Placamen calophylla* (PHILIPPI)
8: inner view showing adductor muscle scars and pallial line, right valve, GK-L 6591. 9: cardinal area of left valve, GK-L 6589. 10: ditto, right valve, GK-L 6586. 11: prodissoconch, GK-L 6590. 12: ditto, GK-L 6587. 13: lunule and escutcheon, GK-L 6591.
Unit bar a represents 8 mm for 1, 3–10 and 13 and 16 mm for 2 and bar b does 1 mm for 11 and 12.

smooth. The hinge is provided with three cardinals and the anterior and posterior laterals. 1 and 3a are short but erected and face each other. 3b is long, oblique, bifid and continuous to 3a just below the umbo. 2b is heavy and continuous to 2a forming reverted V shape and 4b is elongate and oblique. The anterior lateral is close to the cardinals and the posterior one, which is much weaker than the anterior one, is apart from the posterior cardinal. The anterior and posterior adductor muscle scars are respectively pear-shaped and elongate quadrate. The pallial sinus is very shallow.

Comparison.—The present specimens are featured by the trigonal outline with erected coarse lamellae and pitarine hinge and readily referred to *Sulciliioconcha* HABE, 1951. They are quite identical to *S. philippinaria* (HANLEY) living in the Southeast Asian waters.

Dione protophilippinarum NOETLING (1901, p. 209, pl. 13, fs. 5–10) from the Pliocene of Pakistan is clearly distinguished from the present species. Although the former is very variable in shell-form, even the most ovate specimen shows more accuminate anterior and posterior ends and narrower umbo than *S. philippinaria*. Furthermore the former has much closer and finer concentric threads than the latter as NOETLING pointed out.

TESCH described *Cytherea* (*Lioconcha*) *molengraaffi* on the basis of Pliocene fossils from Timor (1920, p. 103, pl. 139, fs. 273 and 274). It is so closely allied to the present species that the separation is unpractical. It should be better to regard them as conspecific.

Locality.—SKGS-73.

Horizons.—Pliocene of Timor and living in Southeast Asian waters. Upper part of the Ulian Formation of Panay.

Subfamily Dosiniinae

Genus *Dosinia* SCOPOLI, 1777

(type-species: *Chama dosin* ADANSON=*Venus concentrica* BORN, by monotypy, *fide* FISCHER-PIETTE, 1942)

synonym: *Dosinidia* DALL, 1902 (obj.)
Bonartemis IREDALE, 1929 (type-sp.: *B. stabilis* IREDALE by O. D.)
Pardosinia IREDALE, 1929 (type-sp.: *P. colorata* IREDALE by O. D.)
Fallartemis IREDALE, 1930 (type-sp.: *F. armina* IREDALE by O. D.)
Meridosinia IREDALE, 1930 (type-sp.: *M. nedigna* IREDALE by O. D.)
Semelartemis IREDALE, 1930 (type-sp.: *S. aetha* IREDALE by O. D.)

Subgenus *Phacosoma* JUKES-BROWNE, 1912

(type-species: *Artemis japonica* REEVE by original designation)

Dosinia (*Phacosoma*) *exasperata* (PHILIPPI)

Pl. 7, Figs. 1 and 4, pl. 8, Figs. 1, 2, and 4 and Text-fig. 13

1847. *Cytherea* (*Artemis*) *exasperata* PHILIPPI, Abbild. u. Beschreib. Bd. 3, p. 24, Tab. 8, f. 4.
1850. *Artemis exasperata*, REEVE, Conch. Icon. Vol. 6, *Artemis*, pl. 9, f. 49.
1855. *Artemis exasperata*, SOWERBY, Thes. Conch. Vol. 2, p. 670, pl. 143, f. 62.

Material.—GK-L 6581 and 7498. Two conjoined specimens. GK-L 6581 is preserved excellently, while GK-L 7498 is broken at the distal part.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	L1 (mm)	H/L (%)	D/L (%)	L1/L (%)	∠U (degrees)
6581	39.4	36.8	8.35	6.3	93.4	21.2	16.0	108.2

specimen GK-L	lamellae (per mm)	valve
6581	30/10(20/30)	R

Descriptive remarks.—The present specimen is characterized firstly by its surface sculpture. The growth lines on the main surface are dense and regularly spaced except on the ventral one-third, where the growth lines become coarser and more apart from one another. They change facies abruptly at the dorsal area (Pl. 7, f. 4). Many of the growth lines disappear and some are branching at the boundary between the main surface and the mentioned part. The growth lines are not only decreased in number, but also become fluting and erected there, especially near the very margin. Consequently the postero-dorsal margin is bounded by the regularly spaced scaly projections along the rim of the escutcheon. The lunule is laterally elongate cordiform and defined by the deeply incised marginal groove.

Comparison.—There are a few known species with fluting concentric lamellae at the antero- and postero-dorsal margins such as *Dosinia exasperata* (PHILIPPI), *D. sieboldii* (PHILIPPI) and *D. gruneri* (PHILIPPI) from Southwest Pacific region. Comparison of the detailed characteristics of the sculpture, shell-form and areas leads to the identification of the present specimen to *D. exasperata*. The others especially *D. sieboldii* should be treated as conspecific with *D. exasperata* and the distinction is at most at the subspecific level.

Locality.—SKGS-71.

Horizons.—Living in the Southeast Asian and Indian waters. Cabatuan Formation of Panay.

Subfamily Clementiinae

Genus *Clementia* GRAY, 1842

(type-species: *Venus papyracea* GRAY by subsequent designation, GRAY, 1847)

synonym: *Blainvillia* HUPÉ, 1854 (non ROBINEAU-DESVOIDY, 1830)

Subgenus *Clementia* (s. s.)

Clementia (*Clementia*) *papyracea* (GRAY)

Pl. 10, Figs. 16 and 18

1825. *Venus* ? *papyracea* GRAY, Ann. Philosophy, Vol. 25 (N. S. 9), p. 137.
1828. *Venus papyracea*, WOOD, Supple. index test, p. 5, pl. 2, f. 8.
1840. *Venus non-scripta* J. de C. SOWERBY, Trans. Geol. Soc. London, 2nd Ser., Vol. 5, pl. 25, f. 8.
1847. *Clementia papyracea*, GRAY, Proc. Zool. Soc. London, p. 184.
1849. *Venus hyalina Philippi*, Abbild. u. Beschrebi. Bd. 3, p. 83, Taf. 10, f. 6.

1852. *Clementia papyracea*, SOWERBY, Thes. Conch. Vol. 2, p. 700, pl. 151, f. 155.
1854. *Venus non scripta*, D'ARCHIAC et HAIME, Descr. anim. foss. group numm. inde., p. 246, pl. 17, fs. 7 and 7a.
1854. *Venus hyderabadensis* D'ARCHIAC et HAIME, ibid., p. 247, pl. 17, fs. 8 and 8a.
1854. *Venus astarteoides* D'ARCHIAC et HAIME, ibid., p. 247, pl. 18, fs. 1 et 1a.
1856–57. *Clementia papyracea*, H. and A. ADAMS, Genera of Moll. Vol. 2, p. 433, pl. 109, fs. 1 and 1a.
1862. *Clementia papyracea*, CHENU, Manuel de Conch. Tom. 2, p. 92, f. 410.
1872. *Clementia hyalina*, PFEIFFER, Veneracea in Conch. Cab. Bd. 9, p. 253, Taf. 31, fs. 9–13.
1872. *Clementia papyracea*, PFEIFFER, ibid., p. 254, Taf. 31, f. 16.
1879. *Venus* ? *non-scripta*, WOODWARD, Geol. Mag. N. S. Decade 2, Vol. 6, p. 442, pl. 11, f. 3.
1879. *Clementia papyracea*, MARTIN, Tertiärschichten a. Java, p. 99, Tab. 17, f. 6.
1913. *Clementia papyracea*, SMITH, Phil. Jour. Sci. Vol. 8, Sect. A, p. 272, pl. 7, f. 5.
1913. *Clementia papyracea*, JUKES-BROWNE, Ann. Mag. Nat. Hist. Ser. 8, Vol. 12, p. 61, pl. 1, fs. 3 and 4.
1915. *Venus non-scripta*, DOLLFUS, Paléont. voy. Celébès, p. 994, pl. 1, fs. 817, 818 and 818a.
1928. *Venus* (*Clementia*) *papyracea* and var., VREDENBURG, Mem. Geol. Surv. India, Vol. 50, p. 455, pl. 32, fs. 1–4.
1933. *Clementia* (*Clementia*) *nonscripta*, NOMURA, Sci. Rep. Tohoku Imp. Univ. 2nd Ser., Vol. 16, p. 98, pl. 3, f. 12.
1960. *Clementia papyracea*, SHUTO, Mem. Fac. Sci. Kyushu Univ. Ser. D, Vol. 9, No. 3, p. 140, pl. 13, fs. 8 and 11 and text-fs. 5, 6 and 9.

Material.—GK-L 6315. A single deformed specimen.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	Hd (mm)	∠U (degrees)	rugae (per mm)	valve
6315	49.8	34.1	12.85	30.7	118.4	6.5/20(10–30)	R

Remarks.—The specimen in hand is remarkably deformed to show laterally elongate outline. The early half shell, however, suggests the original feature. The hinge and pallial sinus can not be observed, but the shell-form and sculpture suggest that the specimen probably belongs to *Clementia papyracea* (GRAY).

Locality.—SKGS-73.

Horizons.—Neogene and Quaternary of the Indo-Southwest Pacific region. Upper part of the Ulian Formation in Panay.

Subfamily Tapetinae

Genus *Paphia* RÖDING, 1798

(type-species: *Paphia alapapilionis* RÖDING=*Venus rotundata* LINNÉ by subsequent designation, DALL, 1902)

synonmy: *Textrix* RÖMER, 1857 (non SUNDVALL, 1833 (obj.) by S. D., STOLICZKA, 1870)

Subgenus *Paratapes* STOLICZKA, 1870

(type-species: *Venus textrix* CHEMNITZ by original designation)

Paphia (*Paratapes*) *undulata neglecta* (MARTIN)

Pl. 7, Fig. 5 and Text-fig. 12

1919. *Tapes neglecta* MARTIN, Unsere Paläozoologische Kenntnis v. Java, p. 115, Taf. 1, fs. 8 and 8a.
1969. *Paphia neglecta*, COX, NUTTAL and TRUEMAN, in Treatise on Invertebrate Paleont. Part N, Vol. 1, p. 66, f. 56-3 and p. 71, f. 59-2.

Material.—GK-L 6578, 6579, 7455 and many other fragmental specimens from loc. SKGS-71. Fragments are also obtained from loc. SKGS-73.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	L1 (mm)	∠U (degrees)	valve
6578	—	19.5	5.25	13.6	9.65	—	L
6579	—	—	4.45	11.4	—	137.9	R

Descriptive remarks.—The shell is laterally elongate elliptical with almost straight antero- and postero-dorsal margins. The umbo is small. The anterior part is shorter than the posterior one. The sculpture consists of fine concentric lines and coarse oblique ones, the latter of which appears at the adolescent stage and becomes distinct at later stage. The hinge plate is small with radiating three cardinals. 1 and 3b on the right valve and 2a and 4b on the left valve are bifid, while 3a and 2b are simple. The adductor muscle scars are subequal and semicircular. The pallial sinus is moderately deep and quadrate. Colour pattern consists of the obliquely diagnoal rows of dark spots separated by narrow whitish lines.

Comparison.—The hinge and oblique sculpture of the present specimens indicate that they belong to *Paratapes* STOLICZKA, 1870. They are very closely allied to *Paphia* (*Paratapes*) *undulata* (BORN) (1778, p. 54) and *P.* (*P.*) *neglecta* (MARTIN) (1919, p. 115). The most apparent difference between the mentioned taxa is the colour pattern, which is obliquely diagonal rows of dark spots separated by narrower whitish lines on *P.* (*P.*) *neglecta* instead of whitish spots separated by dark lines on *P.* (*P.*) *undulata*. Concerning this point, the present specimens are identical to *P. neglecta*. It is, however, very doubtful whether or not the difference in color pattern is reliable for the basis of specific separation. The author prefers to treat *P. undulata* and *P. neglecta* as conspecific.

Localities.—SKGS-71 and 73.

Horizons.—Miocene and Lower Pliocene of Indonesian region. Cabatuan and the upper part of the Ulian Formation in Panay.

Subgenus *Eumarcia* IREDALE, 1924

(type-species: *Venus fumigata* SOWERBY by original designation)

Paphia (*Eumarcia*) *cheribonensis* OOSTINGH

Pl. 8, Figs. 20 and 21 and Text-fig. 7

1927. *Tapes* (*Protapes*) *textilis*, Van der MEER MOHR, Natuurk. Tijdschr. Ned.-Indië, Vol. 86, p. 206, pl. 1, f. 7.
1935. *Paphia* (*Paratapes*) *cheribonensis* OOSTINGH, Wetenschap. Meded. No. 26, p. 192, pl. 17, fs. 147a, b and 148.

Material.—GK-L 6580 from loc. SKGS-71 and GK-L 6317 from loc. SKGS-73. GK-L 6580 is perfect and 6217 is slightly broken at the anterior part. Both are conjoined.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	La (mm)	L1 (mm)	H/L (%)	D/L (%)	La/L (%)
6317	ca 57.3	32.25	9.7	17.1	13.95	56.3	16.9	29.8
6580	62.05	35.60	11.6	23.0	16.50	57.3	17.9	23.0

specimen GK-L	L1/L (%)	∠U (degrees)	valve
6317	24.3	134.2	R (conj.)
6580	26.6	133.1	R (conj.)

Descriptive remarks.—The outline of the present specimens is quite similar to that of the elongate type of *Paphia* such as *P. rotundata* (LINNÉ) and *P. lyrata* (PHILIPPI) with somewhat concave antero-dorsal side, slightly convex postero-dorsal one and broadly arcuate ventral one, but the shell-surface of the former is polished and almost smooth except for the very fine incremental lines. The test is thick and solid. The lunule is lanceolate and sharply defined. The escutcheon is more elongate and less defined than the lunule. The inner margin is smooth. The anterior adductor scar is rhomboid-oval. The hinge is not observed.

Comparison.—The present specimens should be included in the group of *Paphia* on the basis of the characteristic outline and areas, although the hinge can not be examined. Among the genera and subgenera of *Paphia* group, they are referalbe to *Eumarcia* IREDALE, 1924, by its sculpture. The present specimens are quite identical to *Paphia* (*Paratapes*) *cheribonensis* OOSTINGH (1935, p. 192, pl. 17, fs. 147a, b and 148), which is better included in *Eumarcia*.

Localities.—SKGS-71 and 73.

Horizons.—Pliocene of Java. Cabatuan and the upper part of the Ulian Formation in Panay.

Subfamily Chioninae

Genus *Placamen* IREDALE, 1925

(type-species: *Venus placida* PHILIPPI by original designation)

Placamen calophylla (PHILIPPI)

Pl. 8, Figs. 8–19 and Text-fig. 12

1836. *Venus calopylla* PHILIPPI, Archiv f. Naturgeschichte, Jahrg. 11, Heft 1, p. 229, pl. 8, f. 2.
1849. *Venus isabellina* PHILIPPI, Abbild. u. Beschreib., Bd. 3, p. 83, *Venus*, Taf. 10, f. 5.
1855. *Venus dysera*, SOWERBY, Thes. Conch. Vol. 2, p. 723, pl. 157, f. 119.
1855. *Venus calophylla*, SOWERBY, ibid., p. 724, pl. 160, f. 176.
1863. *Venus isabellina*, REEVE, Conch. Icon. Vol. 14, *Venus*, pl. 23, f. 112.
1863. *Venus calophylla*, REEVE, ibid., pl. 23, f. 114.
1869. *Venus isabellina*, PFEIFFER in MARTINI and CHEMNITZ, Conch. Cab. Bd. 11, Veneracea, p. 208, Taf.33, fs. 13–15.
1879–80. *Venus chlorotica*, MARTIN, Tertiärschichten a. Java, p. 98, Tab. 16, f. 9.

1913. *Chione* (*Venus*) *chlorotica*, SMITH (non PHILIPPI), Philip. Jour. Sci. Vol. 8, Sect. A, p. 273, pl. 7, fs. 7 and 8.
1920. *Venus* (*Chione*) *chlorotica*, TESCH (non PHILIPPI), Paläont. v. Timor, Lief. 8, p. 104, Taf. 139, fs. 275a and b.
1922. *Chione chlorotica*, DICKERSON (non PHILIPPI), Philip. Jour. Sci. Vol. 20, p. 228, pl. 11, f. 5.
1928. *Chione foliacea*, YOKOYAMA, Imp. Geol. Surv. Japan, Rep. No. 101, p. 80, pl. 7, f. 7.
1933. *Venus chlorotica*, NOMURA, Sci. Rep. Tohoku Imp. Univ. 2nd Ser., Vol. 16, p. 84, pl. 3, f. 17.
1948. *Venus* (*Clausinella*) *isabellina*, COX, Schweitz. Paläont. Abh. Bd. 66, p. 64, pl. 6, fs. 11a and 11b.
1966. *Placamen calophylla*, HABE and KOSUGE, Shells of the World in Colour, Vol. 2, p. 160, pl. 63, f. 2.

Material.—GK-L 6585 to 6591 from loc. SKGS-71 and GK-L 6357 from loc. SKGS-73. GK-L 6590 and 6591 are conjoined and the others are separated vlaves. Preservation is generally excellent.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	L1 (mm)	H/L (%)	D/L (%)	L1/L (%)	∠U (degrees)
6586	27.8	25.0	8.3	4.9	89.8	29.8	17.6	96.4
6588	22.3	21.0	6.1	3.95	94.1	27.3	17.7	81.6
6589	18.65	17.0	4.85	3.3	91.1	26.0	17.7	96.3
6591	14.4	13.4	3.2	2.8	92.9	22.2	19.4	110.2
6357	13.7	12.3	2.8	2.6	89.8	20.4	19.0	92.3

specimen GK-L	lamellae numb./4.6 mm*	valve
6586	5.1/6.1/8.7	R
6588	3.0/4.6/6.0	L
6589	2.4/3.6/4.6/3.7	L
6591	2.6/2.4/3.1	R
6357	2.4/4.0/4.0	L

* Number per first, second, third and fourth 4.6 mm from the ventral margin.

Descriptive remarks.—The shell is thick, solid and subtrigonal with long and arcuate postero-dorsal margin, concavo-convex antero-dorsal one and broadly rounded ventral one. The posterior margin is subtruncated at the juvenile stage but narrowly rounded at the adult. The lunule is cordate, sharply defined, slightly sunken except for the central part and sculptured by fine radial lines. The escutcheon is lanceolate, bordered by a sharp angulation and provided with fine lines. The main surface has very fine incremental striae and distantly spaced lamellae, which are particularly prominent at the margin of the lunule and escutcheon. The inner margin of the shell is finely crenulate except for the postero-dorsal part. The hinge plate is solid. 1 is trigonal and strong, 3a is thin and subparallel to the shell margin and 3b is oblong and very oblique. 2b is strong and shows a tendency for bifurcation and 2a and 4b are thinner and oblique. No laterals. The nymph is heavy and opisthodetic. The anterior adductor muscle scar is pear-shaped and the posterior one is quadrate. The pallial sinus is triangular and shallow. The prodissoconch I and II are clearly distinguished on some specimens.

prodissoconch I L=0.23 mm, II L=0.40 mm on GK-L 6590
I L=0.20 mm, II L=0.33 mm on GK-L 6587

Comparison.—The present specimens are featured by a solid trigonal shell with distantly spaced heavy lamellae. Their hinges consist of the heavy cardinals but are devoid of the laterals. They are identical to *Placamen calophylla* (PHILIPPI).

Venus isabellina PHILIPPI, *V. chlorotica* PHILIPPI and *V. calophylla* PHILIPPI have been confusingly cited and apparently "*V. chlorotica*" of some authors are synonymous with *V. isabellina*. *V. isabellina*, in turn, should be a synonym of *V. calophylla*, because there is no reasonable criterion to separate them at the species level.

Localities.—SKGS-71 and 73.

Horizons.—Neogene of Southeast Asian region and also living in the same area. Cabatuan and the upper part of the Ulian Formation in Panay.

Genus *Veremolpa* IREDALE, 1930

(type-species: *Veremolpa ethica* IREDALE, by original designation)

Veremolpa bataviana (MARTIN)

Pl. 4, Figs. 14, 15 and 19 and Text-fig. 13

1885. *Venus* (*Cryptogemma*) *bataviana* MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Be. 3, p. 207, Tab. 11, f. 207.

Material.—GK-L 6668. A single right valve. Preservation is moderate.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	radials	lamellae	valve
6668	6.1	5.4	1.8	88.5	29.5	92.9	16	6/2 mm	R

Descriptive remarks.—The shell is trigonal and solid. The umbo is prosocline. The antero- and postero-dorsal margins are shouldered near the umbo and obliquely truncated at the both ends. The main surface has regularly spaced radial ribs and distantly spaced concentric lamellae, which are distinctly lamellate on the axials. The ribs are increased in number as the shell grows by splitting and intercalation of new ones. The lunule and the escutcheon are sharply defined and sculptured with weak radials. The whole margin of the inner surface is crenulate. The cardinal teeth consist of heavy and trigonal 1, thin and rather weak 3a, being subparallel to the shell margin, and long and oblique 3b. No apparent laterals. The ligament is opisthodetic; its groove is deep. The anterior and the posterior adductor muscle scars are respectively elliptical and quadrate. The pallial line is remote from the margin and very shallowly sinuated.

Comparison.—The present specimen resembles *V. lionata* (SMITH) (1885, p. 126, pl. 3, fs. 7, 7a and 7b) in the general features, but is clearly distinguished from the latter. The former is much more solidly built and provided with closer lamellae and more branching ribs than the latter. In these features the present specimen is identical to *Venus bataviana* MARTIN.

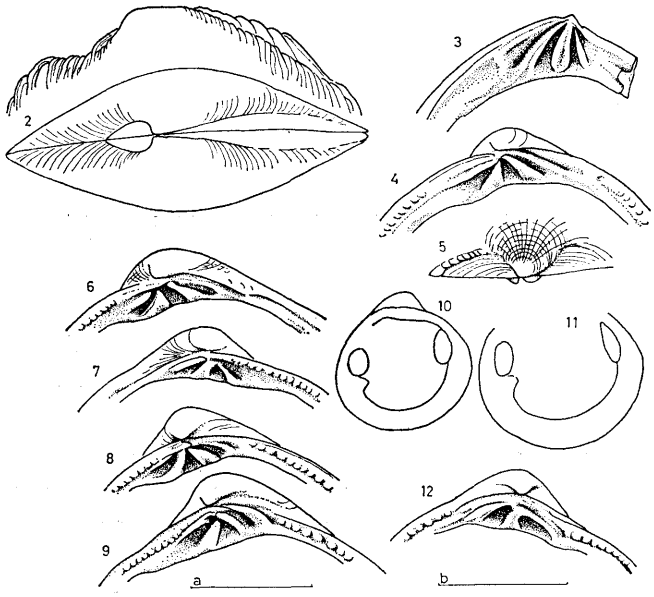

Fig. 13 1 and 2 *Dosinia* (*Phacosoma*) *exasperata* (PHILIPPI), GK-L 7498.
1: sculpture at the dorsal margin. 2: lunule and escutcheon.
3 *Circe rivularis* (BORN), cardinal area of left valve, GK-L 6218.
4 and 5 *Veremolpa bataviana* (MARTIN), right valve, GK-L 6668. 4: cardinal area. 5: umbonal view of cardinal area.
6 and 7 *Veremolpa trigonalis* (MARTIN)
6: cardinal area of right valve, GK-L 6735. 7: ditto, left valve, GK-L 6736.
8–12 *Veremolpa gonzalesi* sp. nov.
8: cardinal area of right valve, GK-L 7048. 9: ditto, right valve, GK-L 7053. 10: inner view showing adductor muscle scars and pallial line, left valve, GK-L 7052. 11: ditto, left valve, GK-L 7051. 12: cardinal area of left valve, GK-L 7054.
Unit bar a represents 4 mm for 5, 10 and 11 and 8 mm for 1, 2 and 3 and bar b does 2 mm for 4, 6, 7, 8, 9 and 12.

Locality.—SKGS-71.

Horizons.—Upper Miocene and Pliocene of Java. Cabatuan Formation of Panay.

Veremolpa trigonalis (MARTIN)

Pl. 9, Figs. 5, 6, 8, 10 and 12 and Text-fig. 13

1883. *Venus* (*Chione*) *trigonalis* MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 1, p. 251, Tab. 13, fs. 48, 48a and 48b.

Material.—GK-L 6735 and 6736. Preservation is almost perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	radials main	lamellae	valve
6735	5.95	5.30	1.90	89.0	31.9	114.1	49	9/2 mm(1–3)	R
6736	5.50	5.00	1.90	90.8	34.5	118.8	44	10/2 mm(1–3)	L

Descriptive remarks.—The shell is rhomboid in outline and remarkably inflated. The anterior margin is regularly rounded, while the posterior one is subtruncated. The radial ribs are fine and numerous. They are rather regularly spaced at first, but become somewhat irregular in consequence of intercalation of new ribs at later stages. The concentric lines are regularly spaced and equally lamellate at the early stage, but become close and inequidimensional at later stages. The lunule is distinct and provided with the radials and central swell, while the escutcheon is obscure. The inner margin is finely crenulate except for the postero-dorsal parts. The hinge is similar to that of *V. bataviana* but somewhat weaker. The pallial sinus is shallow and subtrigonal with the apex turning upward.

Comparison.—Comparing with *Venus (Chione) trigonalis* MARTIN (1883, p. 251, pl. 13, fs. 48, 48a and 48b) the present specimens are somewhat smaller and their radials are not perfectly splitted. These minor differences may be neglected considering the present specimens do not show the real gerontic feature.

The present specimens also show similar facies to *V. mindanensis* (SMITH) (1885, p. 130, pl. 3, fs. 4, 4a and 4b), but are readily distinguished from the latter in having wider and less sharply defined lunule with radials and less numerous radial ribs on the main surface.

Locality.—SKGS-74.

Horizons.—Upper Miocene to Pliocene of Indonesian region. Upper part of the Dingle Formation of Panay.

Veremolpa gonzalesi sp. nov.
Pl. 9, Figs. 1–4 and Text-fig. 13

? 1920. *Venus trigonalis,* TESCH (non MARTIN, 1883), Paläont. v. Timor, Lief. 8, p. 104, pl. 139, fs. 276a, b, 277a, and b.

Material.—Holotype: GK-L 7048 and paratypes: GK-L 7049 to 7081. Preservation is almost perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)
7048	5.95	5.45	2.00	91.5	33.6	106.6
7049	5.10	5.00	1.70	97.8	33.2	110.3
7050	3.90	3.90	1.25	100.0	32.2	114.9
7051	5.55	5.55	1.85	100.0	33.3	102.5
7053	5.70	5.60	1.90	98.2	33.3	102.1

specimen GK-L	radials main	radials total	radials lunule	valve
7048	12	44	3	R
7049	15	41	4	L
7050	14	27	2	R
7051	13	35+*	4	L
7053	13	32+*	3	R

* posterior axials being obsolete.

Diagnosis.—The shell is small, solid and obliquely rhomboid with the prosocline umbo and obliquely subtruncated posterior end. The radial ribs are roof-shaped to rounded at first and become smaller and separated by wider interspaces at the adolescent stage. They are increased in number by intercalation of new ribs and show tendency for denudation near the ventral margin and on the posterior part after adolescent stage. The concentric lines form the micro-granules on the ribs particularly those on the anterior part. The lunule is generally obsolete but is distinct on two specimens. The hinge is similar to that of *V. bataviana,* but 1 is remarkably oblique. The anterior adductor muscle scar is obliquely quadrate and larger than the quadrately oval posterior one. The pallial sinus is very shallow.

Comparison.—The present specimens are featured by widely separated roof-shaped radial ribs which are weakened at the distal part. The concentric lines are not so erected until the adolescent stage. In consequence the sculpture of the main surface is not squamate as on the majority of the genus. There is no other species comparable to the present specimens with diagnostic features mentioned above.

TESCH reported *Venus trigonalis* MARTIN (1920, p. 104, pl. 139, fs. 276a, b, 277a and b) from the Pliocene of Timor. The specimens seems very variable in morphology and he stated that some of his specimens well agreed with some of MARTIN's original specimens. Generally speaking the Pliocene specimens from Timor are, however, more trigonal than the Javan ones without expanded dorsal side and provided with gradually denuded radials. They may be separated from *V. trigonalis* and included in the present species.

Locality.—SKGS-72.

Horizons.—? Pliocene of Timor. Upper part of the Ulian Formation in Panay.

Order Myoida
Suborder Myina
Superfamily Myoidea
Family Corbulidae
Subfamily Corbulinae
Genus *Corbula* BRUGUIÈRE, 1797
(type-species: *Corbula sulcata* LAMARCK by subsequent designation, SCHMIDT, 1818)
synonym: *Aloidis* MEGERLE von MÜHLFELD, 1811, obj.
Subgenus *Corbula* s. s.

Corbula (Corbula) scaphoides HINDS
Pl. 10, Figs. 1, 3–6, 10 and 17 and Text-fig. 14

1843. *Corbula scaphoides* HINDS, Proc. Zool. Soc. London, p. 56.
1844. *Corbula scaphoides*, REEVE, Conch. Icon. Vol. 2, *Corbula*, pl. 13, f. 24.
1885. *Corbula scaphoides*, SMITH, Challenger Rep. Zool. Vol. 13, p. 32, pl. 7, fs. 3, 3a and 3b.
1885. *Corbula scaphoides*, MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. 3, p. 196, Tab. 10, f. 199.
1920. *Corbula scaphoides*, TESCH, Paläont. v. Timor, Lief. 8, p. 106, Taf. 140, fs. 281a, b, 282 and 283.
1961. *Anisocorbula scaphoides*, HABE, Colored Illust. Shells Japan, Vol. 2, p. 139, pl. 63, f. 1.

Material.—GK-L 6689 to 6707 and 6709. 6709 is conjoined and the others are separated valves. Preservation is moderate.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	valve
6689	20.30	16.1	7.95	79.3	39.2	86.3	R
6691	18.45	14.05	7.2	76.1	39.0	96.9	R
6692	19.15	13.2	6.4	68.9	33.4	130.6	L
6694	18.7	13.3	6.5	71.2	34.8	99.3	L
6695	15.6	11.0	5.55	70.4	35.6	103.4	L
6709	18.45	14.35	7.4*	77.7	30.2	86.6	R

* depth of the conjoined valves: 11.9 mm.

Descriptive remarks.—The shell is medium in size, very solid, inflated, inequilateral and inequivalve. The right valve is larger than the left one. The umbo is swollen and elevated. The posterior flexure is sharp on the left valve, while it is weak on the right valve. The concentric rugae are stronger on the right than on the left valve. The right valve has a triangular and large condrophore and a resilium pit. The socket of the condrophore and the resilium pit are separated from each other by a thin ridge on the left valve. A small knob is visible immediately behind the resilium pit of the left valve. The adductor muscle scars are subequal. The pallial line is entire.

Comparison.—The present specimens resemble *Solidicorbula* HABE, 1949, with the type species: *Corbula erythrodon* LAMARCK (O. D.), but the former is devoid of the knob at the posterior end of the left valve. Furhtermore the posterior adductor muscle scar is situated above the level of the posterior truncation on the present specimens.

Corbula tunicosulcata VREDENBURG (1925, p. 460, pl. 31, fs. 10–19) is extremely variable in morphology. The abbreviate form of the species closely resembles *C. scaphoides*, although the original author regarded it as the intermediate species between *C. rugosa* LAMARK and *C. tunicata* HINDS. *C. tunicosulcata* may be closer in phylogenetic relation to *C. scaphoides*.

Locality.—SKGS-74.

Horizons.—Upper Miocene, Pliocene and Quaternary of Southeast Asian region. Upper part of the Dingle Formation of Panay.

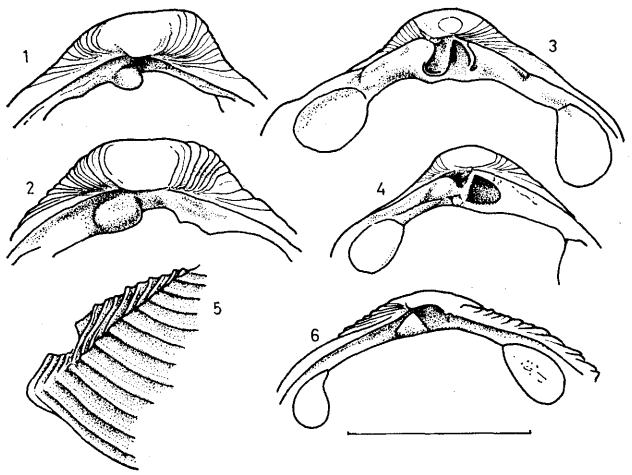

Fig. 14 1–4 *Corbula (Corbula) scaphoides* HINDS
1: cardinal area of right valve, GK-L 6691. 2: ditto, right valve, GK-L 6690. 3: ditto, left valve, GK-L 6692. 4: ditto, left valve, GK-L 6694.
5 and 6 *Corbula (Anisocorbula) socialis* MARTIN, right valve, GK-L 6708.
5: sculpture of posterior part. 6: cardinal area.
Unit bar represents 10 mm for all the figures.

Subgenus *Anisocorbula* IREDALE, 1930

(type-species: *Corbula macgillivrayi* SMITH by original designation)

Corbula (Anisocorbula) socialis MARTIN

Pl. 10, Figs. 7–9 and Text-fig. 14

1879. *Corbula socialis* MARTIN, Tertiärschichten a. Java, p. 92, Tab. 15, fs. 10, 10a, 10b and 10c.
? 1901. *Corbula socialis,* NOETLING, Mem. Geol. Surv. India, Palaeont. Indica N. S., Vol. 1, p. 239, pl. 16, fs. 3, 3a–e, 4, 4a, 5 and 5a–e.
1913. *Corbula socialis,* PRATT and SMITH, Philip. Jour. Sci. Vol. 8, p. 330, pl. 4, f. 5.
1920. *Corbula socialis,* TESCH, Paläont. v. Timor, Lief. 8, p. 217, fs. 124–126.
1922. *Corbula socialis,* DICKERSON, Philip. Jour. Sci. Vol. 20, p. 203, pl. 6, f. 11.
1924. *Corbula socialis,* COSSMANN, Journ. d. Conchyl. Tom. 68, p. 145, pl. 8, fs. 30–33.
1927. *Corbula socialis,* COX, Rep. Palaeont. Zanzibar Protext. p. 60, pl. 9, fs. 5a and b.
1927. *Corbula lamellata,* FISCHER, Paläont. v. Timor, Lief. 15, p. 131, Taf. 217, fs. 124–126.
1928. *Corbula persica* DOUGLAS, Contributions to Persian Palaeont. Vol. 3, p. 9, pl. 13, f. 1 (fide OOSTINGH, 1935).
1929. *Corbula tosana* YOKOYAMA, Imp. Geol. Surv. Japan, Rep. No. 104, p. 15, pl. 8, f. 1.
1930. *Corbula socialis,* COX, Glasgow Univ. Publ. Vol. 17, p. 111, pl. 13, f. 24 (fide OOSTINGH, 1935).

Material.—GK-L 6708. A single right valve. Preservation is almost perfect.

Measurements.—

specimen GK-L	L (mm)	H (mm)	D (mm)	H/L (%)	D/L (%)	∠U (degrees)	concentrics	valve
6708	19.95	12.70	5.50	63.6	27.6	123.5	8/8 mm (4–12)	R

Descriptive remarks.—The shell is medium in size, thick and solid. The shell-outline is elongately orbicular with narrowly rounded anterior margin and obliquely truncated posterior one. The ventral margin is broadly rounded with a weak sinuation posteriorly. The posterior ridge is very sharp to divide the pattern of the sculpture. The coarse concentric ribs of the main surface are sharply bent at the posterior ridge to continue to the weak upturned ribs of the posterior area. The condrophore is large, triangular and just below the umbo. The large resilium pit is behind the condrophore. The posterior adductor muscle scar is larger and slightly closer to the hinge than the anterior one. The pallial line is almost entire.

Comparison.—The present specimen is featured by the extremely sharp posterior angle where the concentric rugae abruptly bend. The rugae are distantly and regularly spaced on the main surface and their extension on the posterior surface consists of fine and close riblets. The laterally elongate elliptical outline with sinuated postero-ventral part and very low umbo is another diagnostic feature of the specimen. On the basis of these features the present specimen is identical to *Corbula socialis* MARTIN (1879, p. 92, pl. 15, f. 10).

Corbula socialis reported by NOETLING (1901, p. 239, pl. 16, fs. 3–5) from the Upper Miocene of Burma is provided with a thin right cardinal instead of trigonal tooth of the original specimen and furthermore its concentric rugae are finer and more numerous. Hence it is very doubtful that NOETLING's specimens really belong to *C. socialis.*

Corbula tosana YOKOYAMA (1929, p. 15, pl. 8, f. 1) from the Pliocene of Southwest Japan almost perfectly conforms with *C. socialis* except for the minor differences that the former has slightly shorter shell with slightly more numerous rugae. *Corbula lamellata* of FISCHER (1927, p. 131, pl. 217, fs. 124–126) has sharper rugae than *C. socialis* and is also provided with microscopic radials between the rugae, but does not show any basic difference. The present author prefers to include these "species" in *C. socialis.*

Locality.—SKGS-74.

Horizons.—Lower Miocene to Pliocene of Indo-West Pacific region. Upper part of the Dingle Formation in Panay.

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Tsugio SHUTO

Neogene Bivalves from Panay Island, the Philippines

Plate 1～10

Plate 1

Explanation of Plate 1

Figs. 1, 2 and 3. *Yoldia* (*Orthoyoldia*) *franciscoi* sp. nov. .....Page 6

1. (×5.2), the holotype, GK-L 7057, inner view, loc. SKGS-71.
2. (×4.4), the same specimen as the preceding, umbonal view.
3. (×5.2), the same specimen as the preceding, outer view.

Figs. 4, 5, 6 and 7. *Saccella panayensis* sp. nov. .....Page 8

4. (×4.4), paratype, GK-L 6636, outer view, loc. SKGS-71.
5. (×4.1), holotype, GK-L 6635, inner view, loc. the same as the preceding one.
6. (×4.1), the same specimen, outer view.
7. (×4.4), the same specimen, umbonal view.

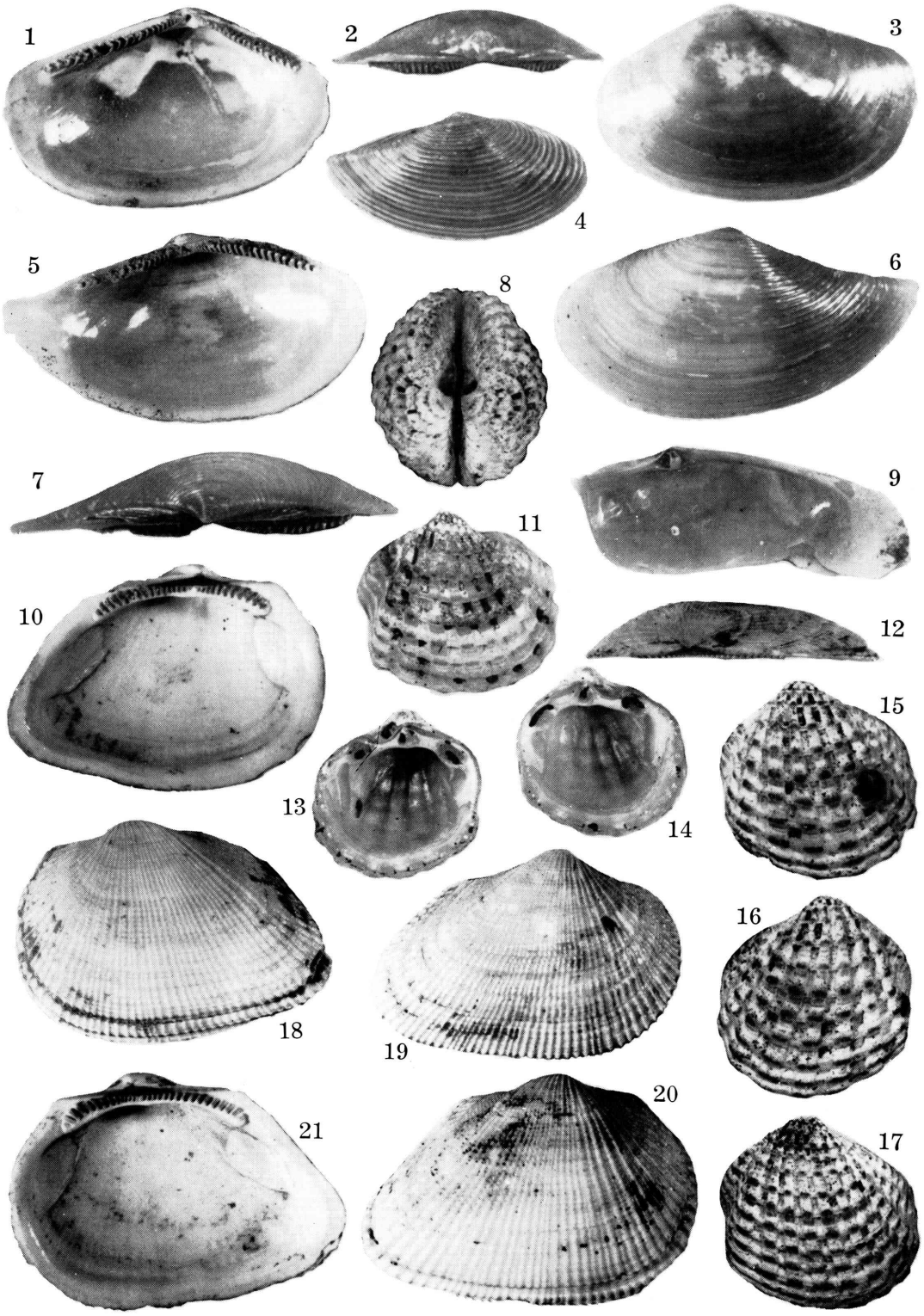
Fig. 8, 11, 13, 14, 15, 16 and 17. *Linga* (*Bellucina*) *gonzalesi* sp. nov. ...page 29

8. (×4.2), holotype, GK-L 6656, umbonal view, loc. SKGS-71.
11. (×4.1), paratype, GK-L 6655, outer view, loc. the same as the preceding.
13. (×3.5), right valve of GK-L 6656, inner view.
14. (×3.5), left valve of GK-L 6656, inner view.
15. (×4.2), right valve of GK-L 6656, outer view.
16. (×4.2), left valve of GK-L 6656, inner view.
17. (×4.1), paratype, GK-L 6652, right valve, outer view, loc. the same as the holotype.

Fig. 9. *Gari* (*Gari*) *pulchella* (LAMARCK), (×2.8), GK-L 6669, loc. SKGS-71 .....Page 49

Figs. 10, 12, 18, 19, 20 and 21. *Arcopsis bataviana* (MARTIN) .....Page 22

10. (×4.4), GK-L 7036, left valve, inner view.
12. (×4.0), GK-L 7035, right valve, umbonal view.
18. (×4,4), GK-L 7036, outer view.
19. (×4,4), GK-L 7037, right valve, outer view.
20. (×4.4), GK-L 7035, outer view.
21, (×4,4), the same specimen as the preceding, inner view. All the specimens came from loc. SKGS-72.



T. SHUTO: Neogene bivalves from Panay

Plate 2

Explanation of Plate 2

Figs. 1, 2, 3, 4, 5 and 6. *Anadara* (*Scapharca*) *pilula* (REEVE).....Page 11

1. (×1.9), GK-L 7479, left valve, inner view.
2. (×2.7), GK-L 6621, posterior view of conjoined valves.
3. (×1.9), same specimen as Fig. 1, outer view.
4. (×1.9), GK-L 7480, left valve, outer view.
5. (×1.9), GK-L 7481, right valve, outer view.
6. (×1.9), GK-L 7479, posterior view. All the specimens came from loc. SKGS-71.

Figs. 7, 8 and 14. *Anadara* (*Anadara*) *burnesi* (D'ARCHIAC et HAIME)...Page 20

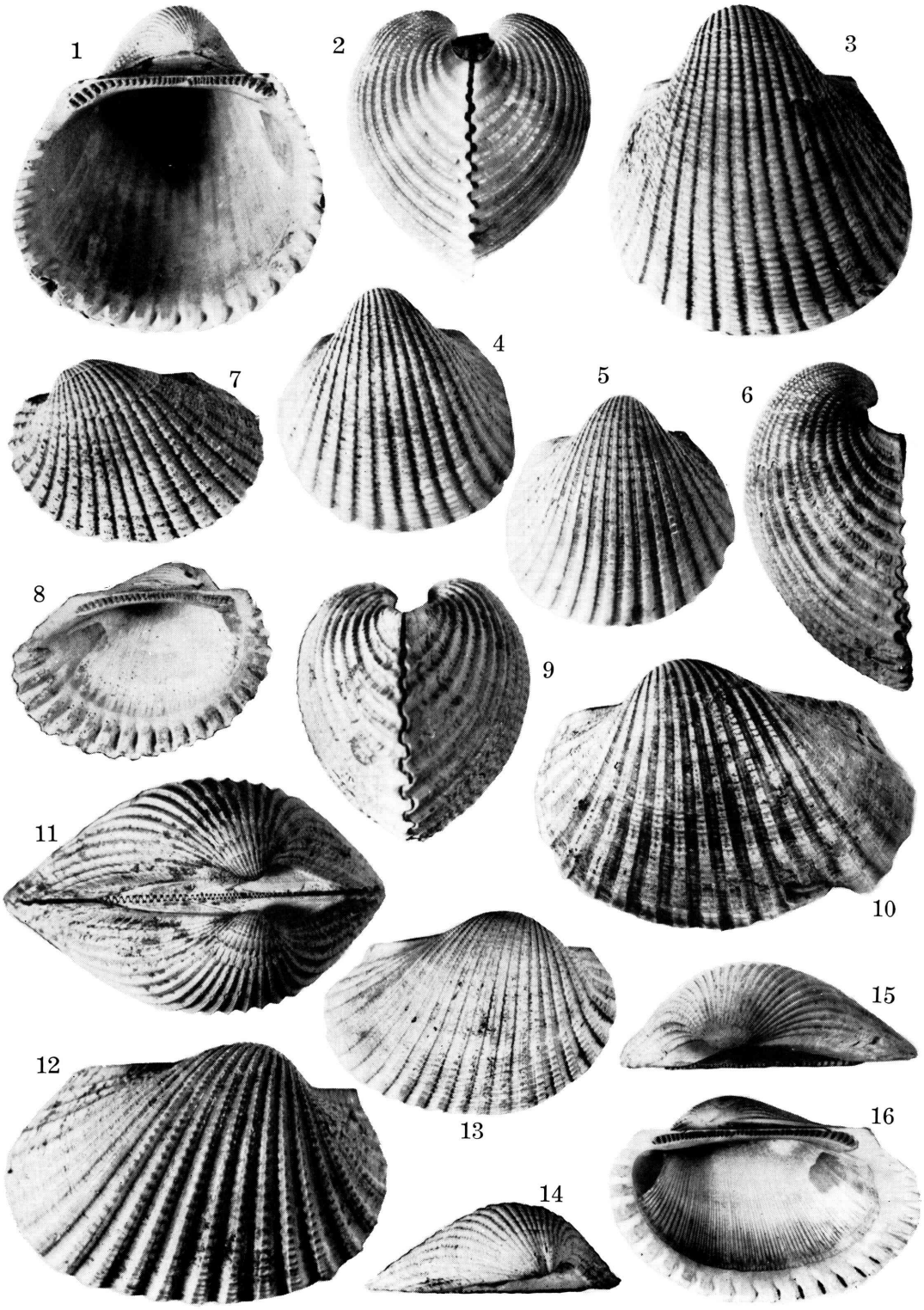
7. (×3.5), GK-L 6634, left valve, outer view, loc. SKGS-71.
8. (×3.5), the same specimen as the preceding, inner view.
14. (×3.5), the same specimen as the preceding, umbonal view.

Figs. 9, 11 and 12. *Anadara* (*Anadara*) *tambacana* (MARTIN).....Page 14

9. (×2.8), GK-L 7056, posterior view of conjoined valves, loc. SKGS-72.
11. (×2.8), the same specimen as the preceding, umbonal view.
12. (×2.8), the same specimen as the preceding, right outer view.

Figs. 10, 13, 15 and 16. *Anadara* (*Anadara*) *ferruginea* (REEVE).....Page 18

10. (×1.55), GK-L 7453, left valve, outer view, loc. SKGS-71.
13. (×1.62), GK-L 7055, right valve, outer view, loc. SKGS-72.
15. (×1.62), the same specimen as the preceding, umbonal view.
16. (×1.62), the same specimen as the preceding, inner view.



T. SHUTO: Neogene bivalves from Panay

Plate 3

Explanation of Plate 3

Figs. 1, 2, 3, 7, 9 and 15. *Anadara (Anadara) dichotoma* (DESHAYES)... Page 16

1. (×4.5), GK-L 6710, left valve, inner view.
2. (×4.6), GK-L 6674, right valve, outer view.
3. (×4.5), the same specimen as Fig. 1, outer view.
7. (×4.5), the same specimen as the preceding, umbonal view.
9. (×4.5), GK-L 6711, right valve, outer view.
15. (×3.3), GK-L 6673, left valve, outer view. All the specimens came from loc. SKGS-74.

Figs. 4, 8 and 16. *Anadara* sp. ..... Page 21

4. (×4.5), GK-L 6672, left valve, umbonal view, loc. SKGS-74.
8. (×4.5), the same specimen as the preceding, outer view.
16. (×4.5), the same specimen as the preceding, inner view.

Figs. 5, 12 and 13. *Anadara (Scapharca) gendinganensis* (MARTIN)... Page 13

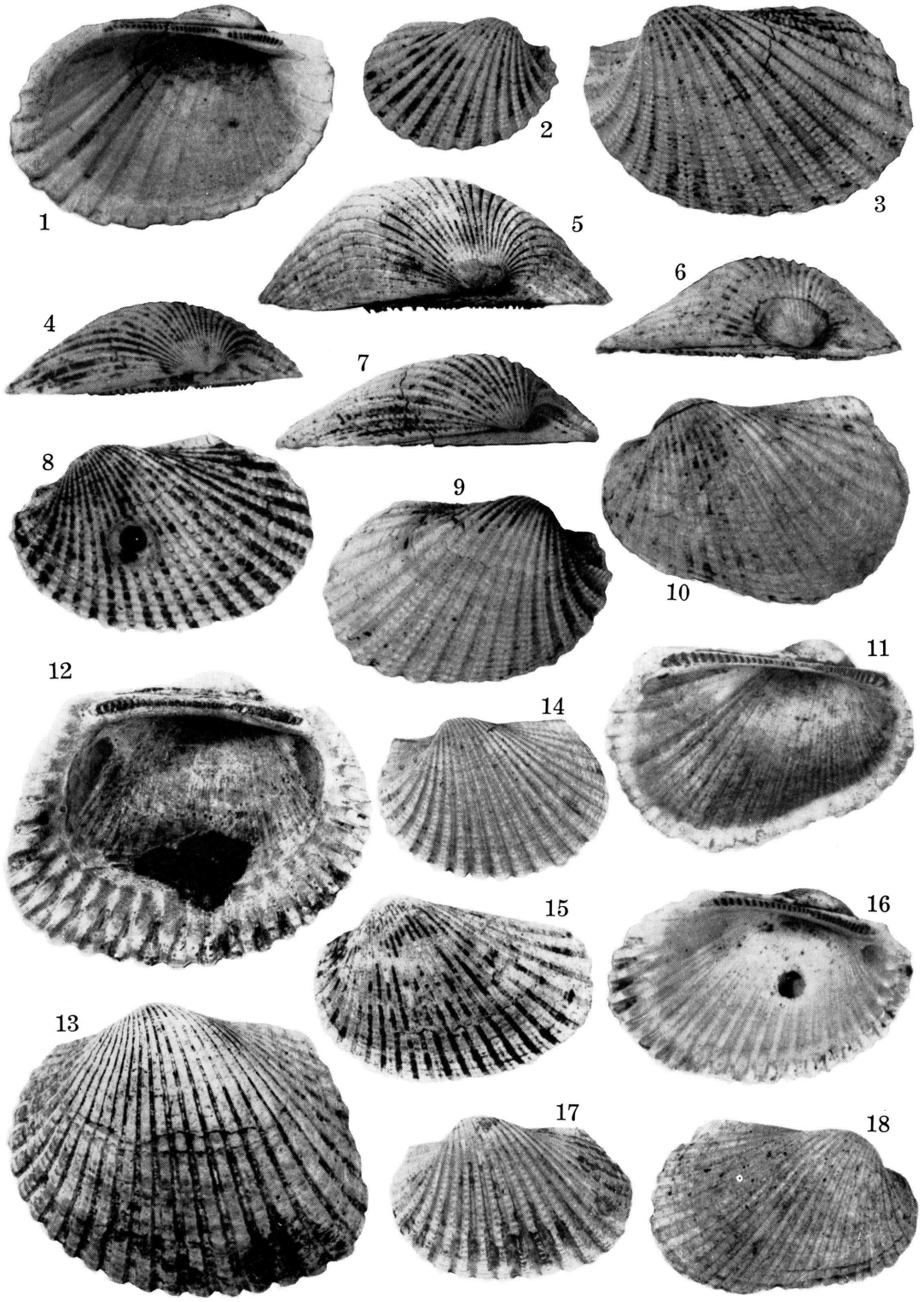
5. (×2.38), GK-L 6363, left valve, umbonal view, loc. SKGS-73.
12. (×2.4), the same specimen as the preceding, inner view.
13. (×2.4), the same specimen as the preceding, outer view.

Figs. 6, 10, 11 and 18. *Anadara (Anadara) luzonica pterimorpha* subsp. nov. ..... Page 19

6. (×3.8), holotype, GK-L 6712, left valve, umbonal view, loc. SKGS-74.
10. (×3.8), the same specimen as the preceding, outer view.
11. (×3.8), the same specimen as the preceding, inner view.
18. (×4.8), paratype, GK-L 6713, right valve, outer view, loc. the same as the holotype.

Figs. 14 and 17. *Anadara (Anadara) tambacana* (MARTIN)..... Page 14

14. (×2.5), GK-L 6593, left valve, outer view, loc. SKGS-71.
17. (×1.8), GK-L 7056, left valve, outer view, loc. SKGS-74.



T. SHUTO: Neogene bivalves from Panay

Plate 4

Explanation of Plate 4

Figs. 1, 2, 3, 8 and 9. *Melaxinaea pectiniformis* LAMARCK ..... Page 25

1. (×2.75), GK-L 6679, right valve, outer view.
2. (×2.4), GK-L 6677, left valve, inner view.
3. (×2.4), the same specimen as the preceding, outer view.
8. (×2.8), GK-L 6680, left valve, outer view.
9. (×2.8), the same specimen as the preceding, inner view. All the specimens came from loc. SKGS-74.

Figs. 4, 5, 6, 7 and 10. *Striarca lamyi* (KOPERBERG)..... Page 24

4. (×4.4), GK-L 6716, right valve, umbonal view.
5. (×4.4), GK-L 6717, left valve, outer view.
6. (×4.4), the same specimen as Fig. 4, outer view.
7. (×4.4), the same specimen as the preceding, inner view.
10. (×4.4), GK-L 6718, right valve, inner view. All the specimens came from loc. SKGS-74.

Figs. 11, 12, 13, 16 and 18. *Cardiocardita javana* (MARTIN)..... Page 32

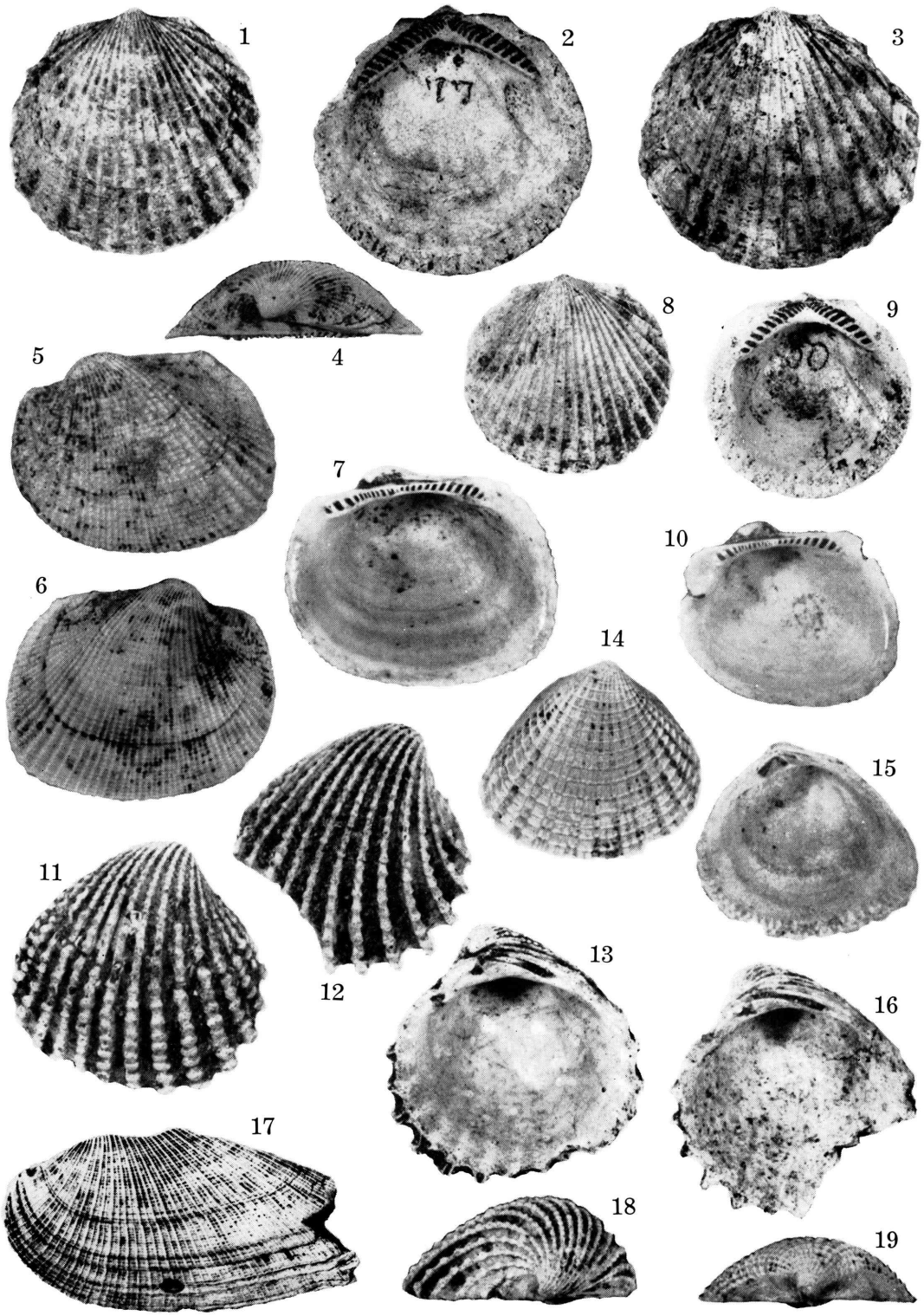
11. (×4.8), GK-L 6733, right valve, outer view.
12. (×4.8), GK-L 6734, right valve, outer view.
13. (×4.8), the same specimen as Fig. 11, inner view.
16. (×4.8), the same specimen as Fig. 12, inner view.
18. (×4.5), the same specimen as Fig. 11, umbonal view. Both specimens came from loc. SKGS-74.

Figs. 14, 15 and 19. *Veremolpha bataviana* (MARTIN)..... Page 62

14. (×4.7), GK-L 6668, right valve, outer view, loc. SKGS-71.
15. (×4.7), the same specimen as the preceding, inner view.
19. (×4.7), the same specimen as the preceding, umbonal view.

Fig. 17. *Trisidos* cfr. *semitorta* (LAMARCK)..... Page 9

(×1.26), GK-L 6675, left valve, outer view, loc. SKGS-74.



T. SHUTO: Neogene bivalves from Panay

Plate 5

Explanation of Plate 5

Figs. 1, 2 and 4. *Tellina* (*Arcopaginula*) sp. ..... Page 43

1. (×3.34), GK-L 7050, right valve, outer view.
2. (×3.39), the same specimen as the preceding, inner view.
4. (×3.38), the same specimen as the preceding, umbonal view. loc. SKGS-72.

Figs. 3, 5, 8 and 9. *Tellina* (*Punipagia*) *rotunda* MARTIN..... Page 38

3. (×5.5), GK-L 7044, right valve, outer view.
5. (×4.08), GK-L 7041, right valve, outer view.
8. (×4.08), the same specimen as the preceding, inner view.
9. (×4.5), GK-L 7043, right valve, outer view. All the specimens came from loc. SKGS-72.

Figs. 6 and 12. *Tellina* (*Laciolina*) *incarnate busuegoi* subsp. nov. ... Page 37

6. (×3.3), paratype, GK-L 6649, right valve, outer view.
12. (×3.3), the same specimen as the preceding, inner view, loc. SKGS-71.

Fig. 7, 10, 11 and 13. *Tellina* (*Punipagia*) *pudica* HANLEY..... Page 40

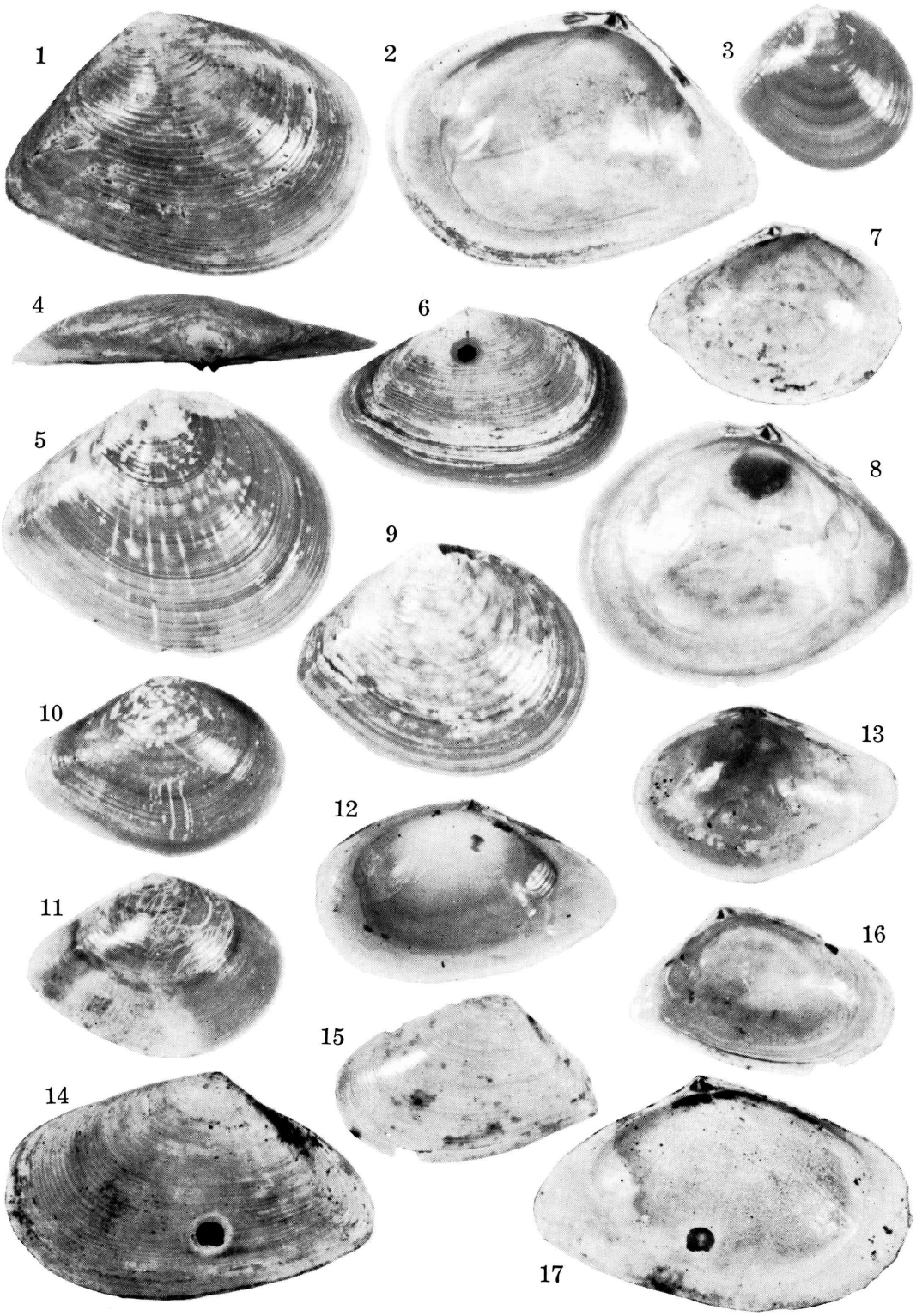
7. (×5.7), GK-L 6664, left valve, inner view.
10. (×5.7), GK-L 6660, right valve, outer view.
11. (×5.7), GK-L 6659, right valve, outer view.
13. (×5.7), the same specimen as Fig. 10, inner view. All the specimens came from loc. SGKS-71.

Figs. 14 and 17. *Tellina* (*Semelangulus*) sp. ..... Page 44

14. (×5.7), GK-L 6360, left valve, outer view.
17. (×5.8), the same specimen as the preceding, inner view, loc. SKGS-73.

Figs. 15 and 16. *Tellina* (*Moerella*) *nannodes* MARTIN ..... Page 44

15. (×5.5), GK-L 6644, left valve, outer view.
16. (×5.5), the same specimen as the preceding, inner view, loc. SKGS-71.



T. SHUTO: Neogene bivalves from Panay

Plate 6

Explanation of Plate 6

Figs. 1 and 4. *Tellina (Arcopaginula) inflata* GMELIN ..... Page 41
1. (×1.9), GK-L 6570, right valve, inner view.
4. (×1.9), the same specimen as the preceding, outer view, loc. SKGS-71.

Figs. 2, 3, 13 and 14. *Marikellia panayensis* sp. nov. ..... Page 31
2. (×4.8), paratype, GK-L 6642, left valve, inner view.
3. (×4,8), the same specimen as the preceding, outer view.
13. (×4.9), holotype, GK-L 6641, right valve, inner view.
14. (×4.9), the same specimen as the preceding, outer view. Both specimens came from loc. SKGS-71.

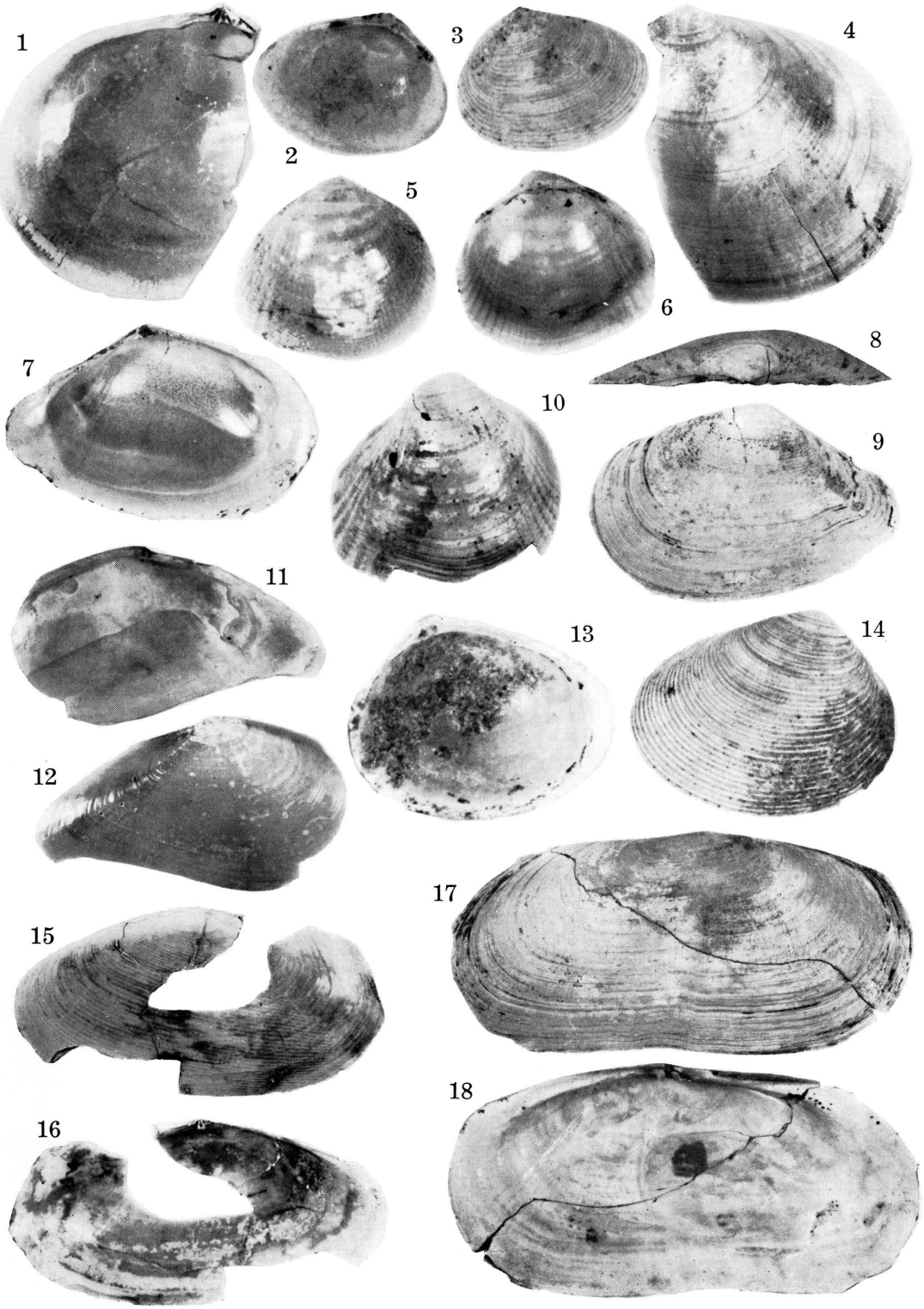
Figs. 5, 6 and 10. *Laevicardium (Fulvia)* sp. ..... Page 35
5. (×5.75), GK-L 6640, right valve, outer view.
6. (×5.75), the same specimen as the preceding, inner view.
10. (×5.75), GK-L 6639, right valve, outer view. Both specimens came from loc. SKGS-71.

Figs. 7, 8 and 9. *Tellina (Laciolina) incarnata busuegoi* subsp. nov. ... Page 37
7. (×3.2), paratype, GK-L 6645, left valve, inner view.
8. (×3.2), the same specimen as the preceding, umbonal view.
9. (×3.2), the same specimen as the preceding, outer view, loc. SKGS-71.

Figs. 11 and 12. *Tellina (Exotica)* sp. ..... Page 46
11. (×2.07), GK-L 6637, right valve, inner view.
12. (×2.07), the same specimen as the preceding, outer view, loc. SKGS-71.

Figs. 15 and 16. *Gari (Gari) pulchella* (LAMARCK) ..... Page 49
15. (×1.3), GK-L 6359, left valve, outer view.
16. (×1.3), the same specimen as the preceding, inner view, loc. SKGS-73.

Figs. 17 and 18. *Azorinus (Azorinus) abbreviatus* (GOULD) ..... Page 51
17. (×1.6), GK-L 6572, right valve, outer view.
18. (×1.6), the same specimen as the preceding, inner view, loc. SKGS-71.



T. SHUTO: Neogene bivalves from Panay

Plate 7

Explanation of Plate 7

Figs. 1 and 4. *Dosinia (Phacosoma) exasperata* (PHILIPPI) ..... Page 56

1. (×2.5), GK-L 7498, left valve, outer view.
4. (×3.2), GK-L 6581, right valve, sculpture of postero-dorsal margin. Both specimens came from loc. SKGS-71.

Figs. 2 and 3. *Protocardia* sp. ..... Page 37

2. (×8.1), GK-L 6451, left valve, inner view.
3. (×8.1), the same specimen as the preceding, outer view, loc. SKGS-73.

Fig. 5. *Paphia (Paratapes) undulata neglecta* (MARTIN) ..... Page 58
(×4.0), GK-L 7455, right valve, cardinal area, loc. SKGS-71.

Fig. 6. *Chlamys (Mimachlamys)* cfr. *singaporinus* (SOWERBY) ..... Page 27
(×1.3), GK-L 7454, left valve, outer view, loc. SKGS-71.

Figs. 7 and 8. *Ostrea (Ostrea) glomerata* GOULD ..... Page 28

7. (×0.93), GK-L 7524, right valve, inner view.
8. (×0.93), the same specimen as the preceding, outer view, loc. SKGS-72.

Figs. 9, 10 and 13. *Macoma (Austromacoma) telahabensis* (MARTIN) ... Page 48

9. (×0.83), GK-L 7451, left valve, outer view.
10. (×1.6), the same specimen as the preceding, left cardinal area and right outer surface.
13. (×0.83), GK-L 7452, left valve. Both specimens came from loc. SKGS-71.

Figs. 11 and 12. *Cardiocardita javana* (MARTIN) ..... Page 32

11. (×4.4), GK-L 6733, right valve, umbonal view.
12. (×6.3), the same specimen as the preceding, cardinal area, loc. SKGS-74.

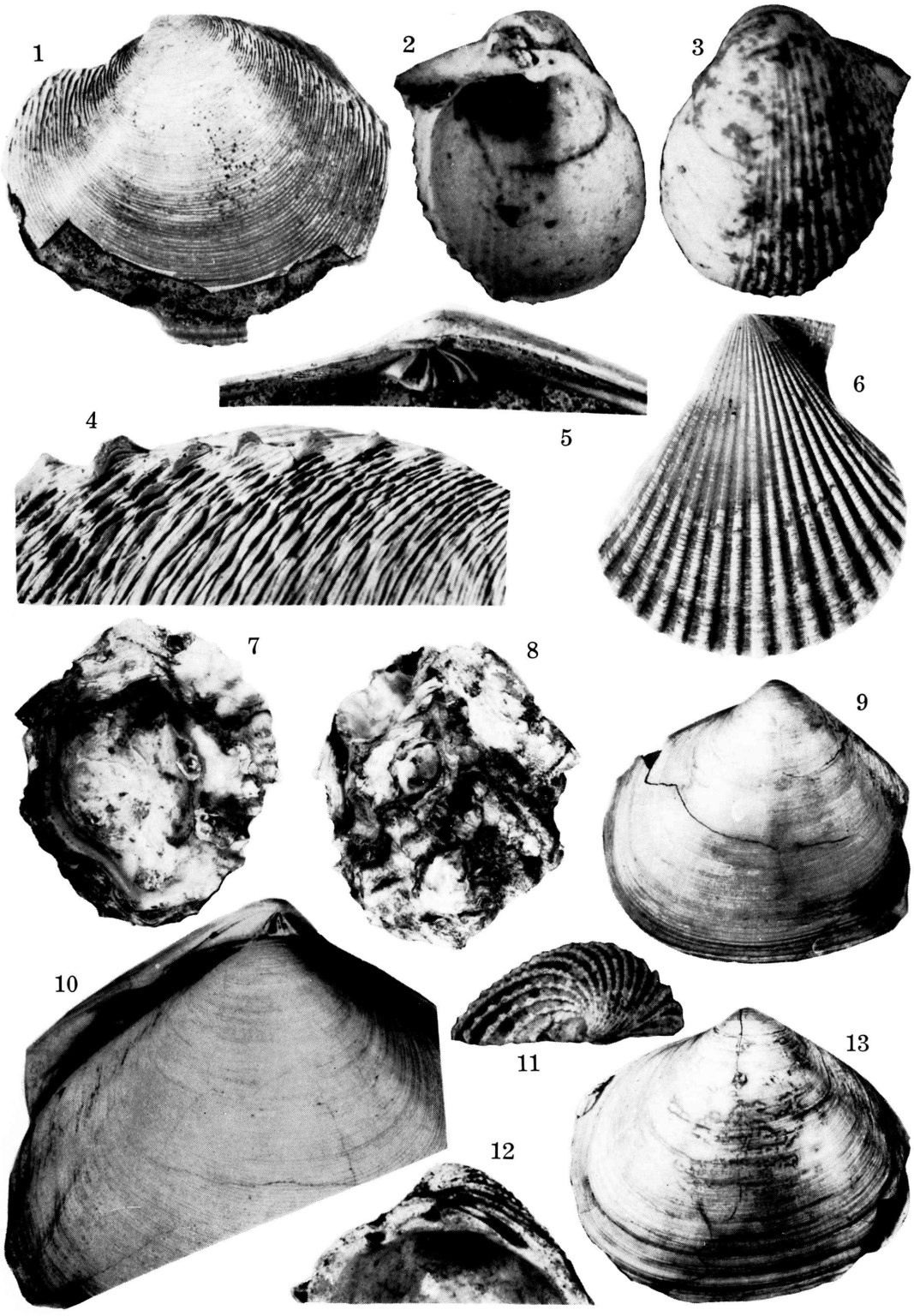


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Plate 8

Explanation of Plate 8

Figs. 1, 2 and 4, *Dosinia (Phacosoma) exasperata* (PHILIPPI).....Page 56

1. (×1.04), conjoined specimen, GK-L 6581, right view.
2. (×1.04), the same specimen as the preceding, left view.
4. (×1.04), the same specimen as the preceding, umbonal view, loc. SKGS-71.

Figs. 3 and 7. *Meretrix meretrix* (LINNÉ).....Page 53

3. (×1,07), GK-L 6358, left valve, inner view.
7. (×1.07), the same specimen as the preceding, outer view, loc. SKGS-73.

Figs. 5 and 6. *Circe rivularis* (BORN).....Page 52

5. (×2.5), GK-L 6318, left valve, outer view.
6. (×2.5), the same specimen as the preceding, inner view, loc. SKGS-73.

Figs. 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19. *Placamen calophylla* (PHILIPPI).....Page 60

8. (×1.6), GK-L 6588, left valve, umbonal view, loc. SKGS-71.
9. (×1.6), the same specimen as the preceding, inner view.
10. (×1.67), GK-L 6591, right valve, inner view, loc. SKGS-71.
11. (×2.2), GK-L 7231, left valve, outer view, loc. Miaoli, Western Taiwan.
12. (×1.67), the same specimen as Fig. 10, outer view.
13. (×1.65), GK-L 6589, left valve, outer view, loc. SKGS-71.
14. (×2.2), GK-L 7258, left valve, umbonal view, loc. Miaoli, Western Taiwan.
15. (×2.2), the same speciman as the preceding, inner view.
16. (×2.2), the same specimen as the preceding, outer view.
17. (×1.68), GK-L 6357, left valve, inner view, loc. SKGS-73.
18. (×1.68), the same specimen as the preceding, outer view.
19. (×1.64), the same specimen as Fig. 8, outer view.

Figs. 20 and 21. *Paphia (Eumarcia) cheribonensis* OOSTINGH.....Page 59

20. (×1.05), GK-L 6580, conjoined specimen, right view.
21. (×1.05), the same specimen as the preceding, umbonal view, loc. SKGS-71.

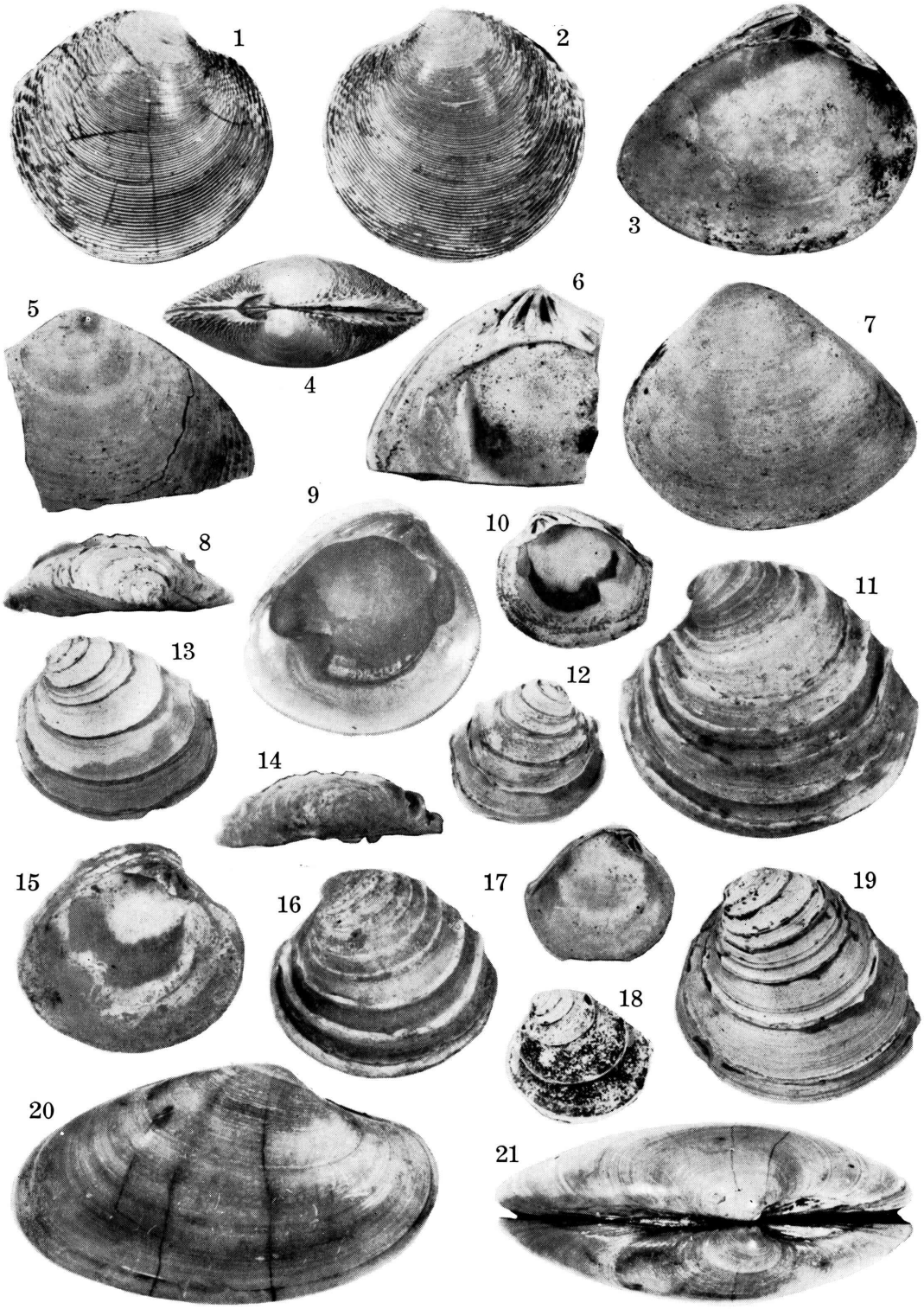

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Plate 9

Explanation of Plate 9

Figs. 1, 2, 3 and 4. *Veremolpha gonzalesi* sp. nov. ..... Page 64

1. (×7.7), paratype, GK-L 7053, right valve, outer view.
2. (×7.9), the same specimen as the preceding, inner view.
3. (×7.7), paratype, GK-L 7054, left valve, outer view.
4. (×7.7), holotype, GK-L 7048, right valve, outer view. All the specimens came from loc. SKGS-72.

Figs. 5, 6, 8, 10 and 12. *Veremolpa trigonalis* (MARTIN)..... Page 63

5. (×7.7), GK-L 6735, right valve, inner view.
6. (×8.0), GK-L 6736, left valve, inner view.
8. (×7.7), the same specimen as Fig. 5, outer view.
10. (×7.6), the same specimen as the preceding, umbonal view.
12. (×7.9), the same specimen as Fig. 6, outer view. Both specimens came from loc. SKGS-74.

Figs. 7, 9, 11, 13 and 14. *Lioconcha* (*Sulcilioconcha*) *philippinaria* (HANLEY) ..... Page 54

7. (×1.65), GK-L 6321, left valve, inner view.
9. (×1.65), GK-L 6320, right valve, inner view.
11. (×1.61), the same specimen as the preceding, umbonal view.
13. (×1.65), GK-L 6356, left valve, outer view.
14. (×1.64), the same specimen as Fig. 9, outer view. All the specimens came from loc. SKGS-73.

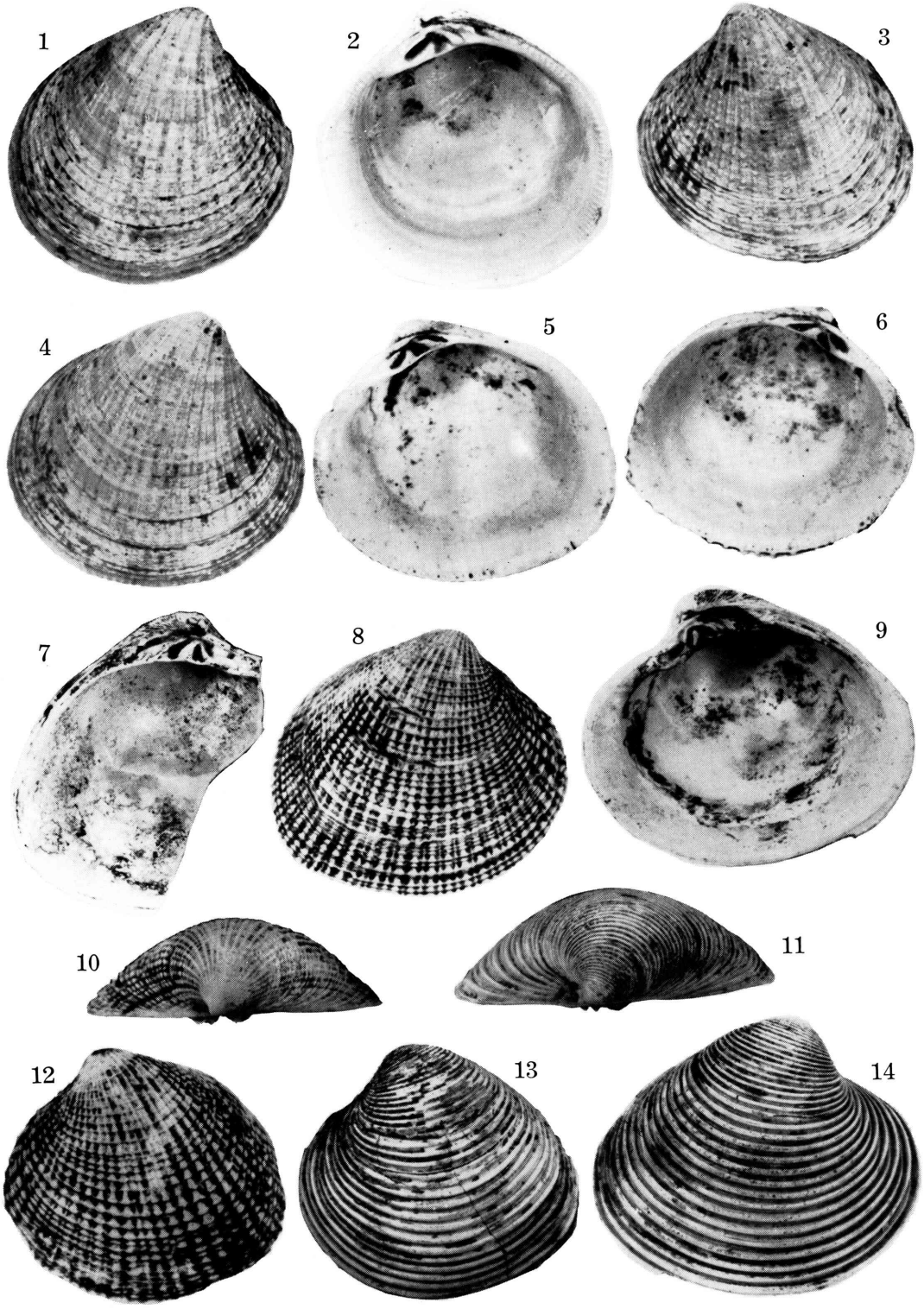

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Plate 10

Explanation of Plate 10

Figs. 1, 3, 4, 5, 6, 10 and 17. *Corbula* (*Corbula*) *scaphoides* HINDS...Page 66

1. (×2.2), GK-L 6693, left valve, outer view.
3. (×2.2), same specimen as the preceding, inner view.
4. (×2.2), GK-L 6709, right valve, outer view.
5. (×2.2), GK-L 6690, right valve, inner view.
6. (×2.2), the same specimen as the preceding, outer view.
10. (×2.2), the same specimen as Fig. 4, left valve, outer view.
17. (×2.2), the same specimen as the preceding, umbonal view. All the specimens came from loc. SKGS-74.

Figs. 2 and 15. *Gari* (*Gobraeus*) cfr. *crassula* (*Deshayes*).....Page 50

2. (×1.65), GK-L 6316, right valve, outer view.
15. (×1.65), the same specimen as the preceding, inner view, loc. SKGS-73.

Figs. 7, 8 and 9. *Corbula* (*Anisocorbula*) *socialis* MARTIN .....Page 67

7. (×2.2), GK-L 6708, right valve, outer view.
8. (×2.2), the same specimen as the preceding, inner view.
9. (×2.2), the same specimen as the preceding, sculpture of posterior part, loc. SKGS-74.

Fig. 11. *Tellina* (*Merisca*) *diaphana* (DESHAYES)..... **Page** 47
(×1.3), GK-L 6314, right valve, outer view, loc. SKGS-73.

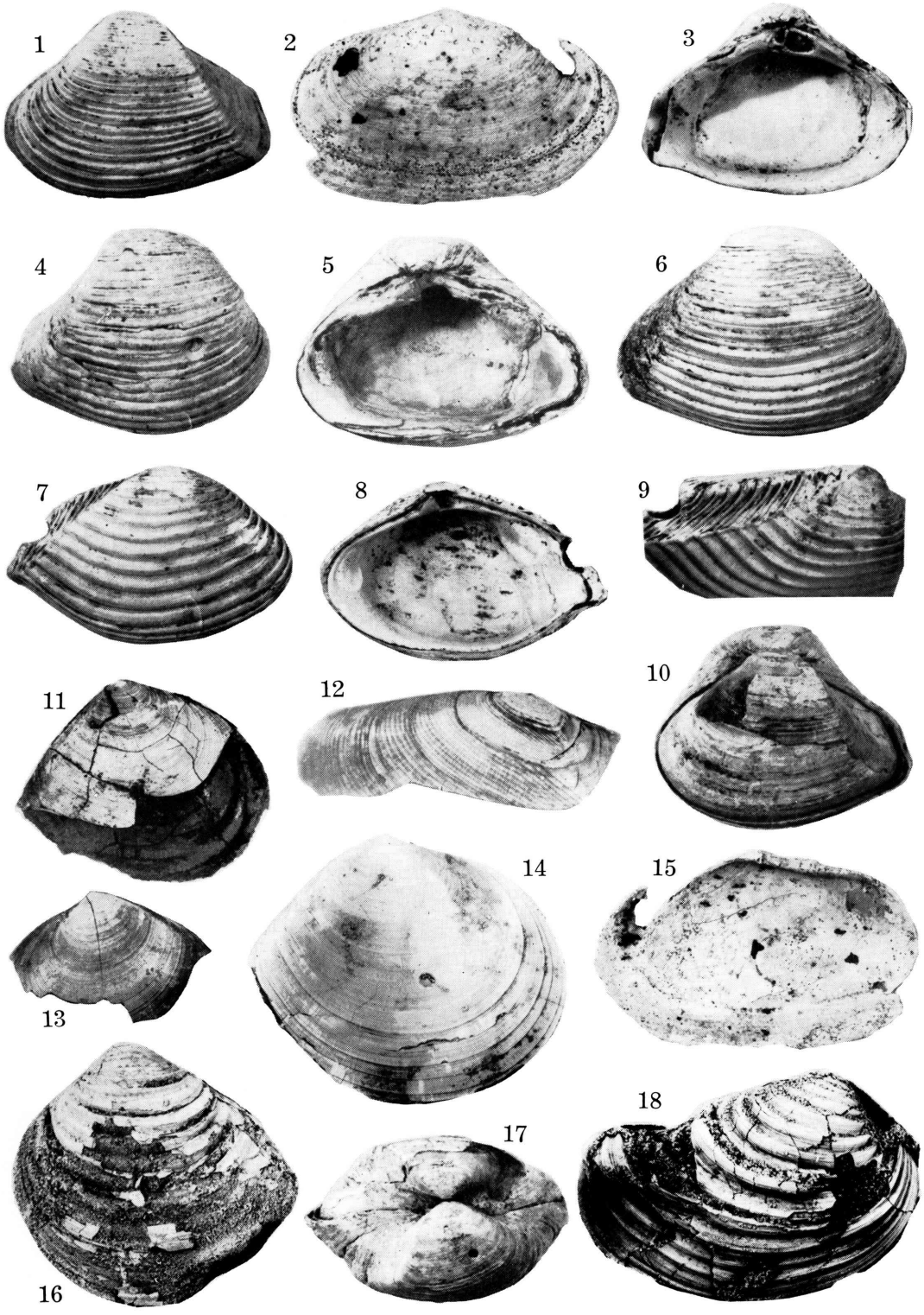
Fig. 12. *Gari* (*Gari*) *pulchella* (LAMARCK).....Page 49
(×2.7), GK-L 6669, left valve, outer view, loc. SKGS-71.

Figs. 13 and 14. *Tellina* (*Arcopaginula*) *inflata* GMELIN .....Page 41

13. (×1.25), GK-L 6667, right valve, outer view, loc. SKGS-71.
14. (×1.08), GK-L 6313, right valve, outer view, loc. SKGS-73.

Figi. 16 and 18. *Clementia* (*Clementia*) *papyracea* (GRAY) .....Page 57

16. (×1.0), GK-L 7260, left view of conjoined valves, loc. Miaoli, Western Taiwan.
18. (×1.04), GK-L 6315, right view of conjoined and deformed specimen, loc. SKGS-73.



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