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THE REMBANGIAN (MIDDLE MIOCENE) MOLLUSK-FAUNA OF JAVA, INDONESIA. I. ARCHAEOGASTROPODA

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Key-words: Taxonomy, Gastropods, Middle Miocene, Indonesia.

Riassunto. Il presente lavoro è il primo di una serie dedicata ai Molluschi rembangiani di Giava e rientra in un progetto che si propone di revisionare e discutere il piano Rembangiano, nonchè di rendere il più possibile completo il quadro di conoscenze relativo alla sua fauna fossile di molluschi. Vengono qui passate in rassegna tutte le specie di Archaeogastropoda incontrate finora per un totale di 22 taxa. Di essi, 8 erano già stati descritti dagli autori, mentre 14 sono di recente ritrovamento. Si propongono formalmente le nuove specie *Ilanga rebjongensis*, *Ethalia stefanoi*, *Pareuchelus pannekoeki* e *Leptothyra laddi*.

Abstract. The present paper is the first in a series dedicated to the Rembangian mollusks of Java. It is framed within a project aiming 1) to revise and discuss the Rembangian Stage and 2) to study Rembangian mollusks as completely as possible. All archaeogastropod species hitherto found (22) are recorded. Of these, 8 are formerly described forms, whereas 14 have been recovered during recent field investigations. The new species *Ilanga rebjongensis*, *Ethalia stefanoi*, *Pareuchelus pannekoeki* and *Leptothyra laddi* are proposed.

Introduction.

The present paper is the first in a series aiming to describe or cite all fossil mollusks collected from Rembangian (Middle Miocene) deposits of Rembang area in northeastern Java. It comes after a gap of more than 50 years during which no papers have been published on this subject. In fact, the Rembangian mollusks were dealt with primarily by Martin (1891-1906, 1900, 1907, 1912, 1919) and, later on, by Haanstra & Spiker (1932), Wanner & Hahn (1935) and Pannekoek (1936). The latter author, on the basis of previous papers and of newly collected material, provided an up-to-date list of 212 molluscan taxa for the stratigraphic unit which was currently named Rembang Beds. This fauna characterizes the Rembangian, a molluscan stage proposed by Oostingh (1938) who designated Sedan near Rembang as type-locality.

The fossils were obtained from one stratigraphic section and two spot localities in the Rembang anticlinorium, between the towns of Pamotan and Rengel (Fig. 1B). During field work, carried out in 1984, 1986 and 1992, several species included in Pannekoek's list were found along with a number of previously unrecorded ones. In order to make the study of Rembangian mollusks as complete as possible, Martin's collection (Nationaal Natuurhistorisch Museum, Leiden) has been examined as well, and those species not recovered during field investigations are incorporated and reviewed. Unfortunately, the present location of Wanner & Hahn's material is so far unknown to the present author. Pannekoek collection is kept in the Artis Geologisch Museum, Amsterdam, but is presently unavailable because of Dutch governamental restrictions (J.H. Werner, written communication, 1996).

This paper covers the archaeogastropods which are represented by a total of 18 species. Of these, 4 are identified as formerly described forms, 4 are described as new, 10 are possibly new but no attempt is made to name them because of the inadequacy of the material. The appendix records another 4 species, previously reported by Wanner & Hahn and Pannekoek, but not encountered during field work.

Geologic framework.

The investigated area belongs to the so-called Northeast Java Basin which extends from Semarang eastward to the Island of Madura (Fig. 1A). The basin, nearly 400 km long and 120 km wide, is bounded northward by the Java Sea, by a chain of volcanoes (Lawu, Wilis, Anjasmoro and Arjuno) to the south. The Northeast Java basin can be divided, from south to north, into four tectono-physiographic units, i.e. Kendeng Zone, Randublatung Depression, Rembang Zone and Java Sea shelf (Van Bemmelen, 1949; Sartono, 1992). Of these, only the Rembang Zone, where the concerned

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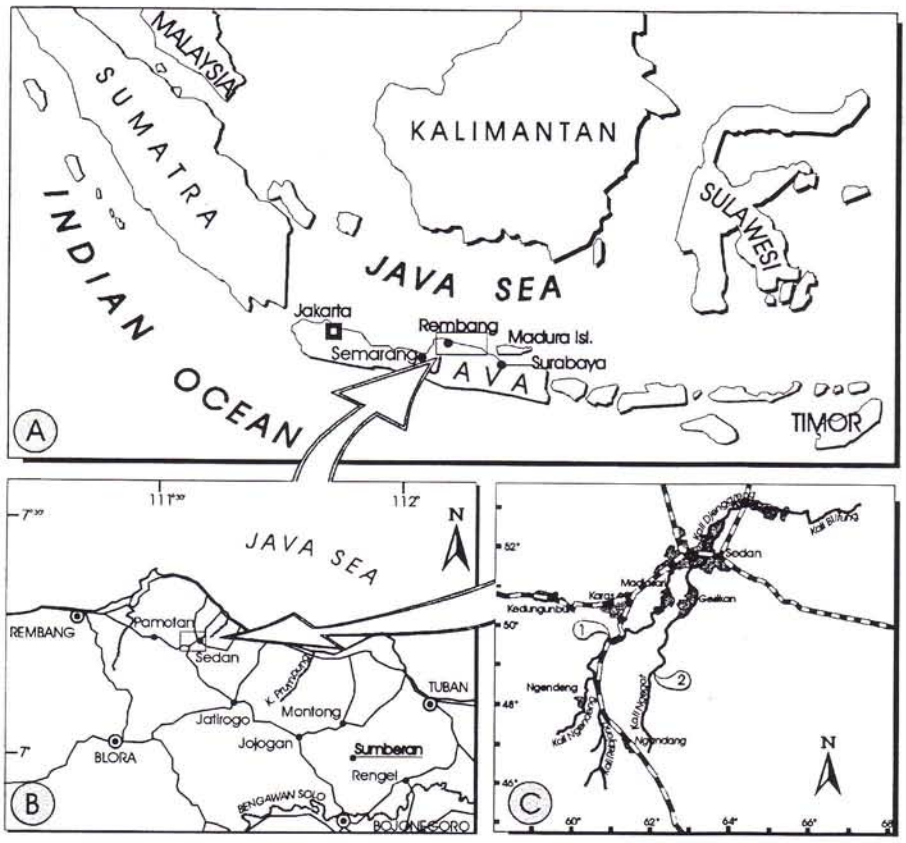


Fig. 1 - Map showing location of stratigraphic section and spot localities. 1) Kali Rebjong Section; 2) Locality RMG 2.

area is located, will be dealt with in terms of lithostratigraphy and correlations, focusing on Oligocene-Miocene units.

The sedimentary succession of the Rembang Zone, over 6000 m thick, is mainly composed of very fine to coarse terrigenous deposits and bioclastic limestones. According to Sartono (1992), it is completely devoid of pyroclastic rocks which, on the contrary, occur commonly in the Kendeng Zone and Randublatung Depression. This succession rests onto a Cretaceous metamorphic and granitic basement which was only met by offshore and inland wells (Sartono, 1992).

Table 1 summarizes the lithostratigraphic framework of Rembang Zone. Formation names (fifth column from left) are the most recent ones currently used by Indonesian geologists (cf. Kadar & Soeka, 1984; Sartono, 1992; Musliki, 1992; Skwarko, 1994). Age assignments largely draw on those proposed by Sartono (1992) on the basis of paleontological evidence, but also take into account data provided by Kadar & Soeka, Musliki and Skwarko. A total of 9 lithostratigraphic units of Oligocene to Late Miocene age have been considered which are shortly dealt with below; for further details reference can be made to the cited authors. From bottom to top, they are as follows.

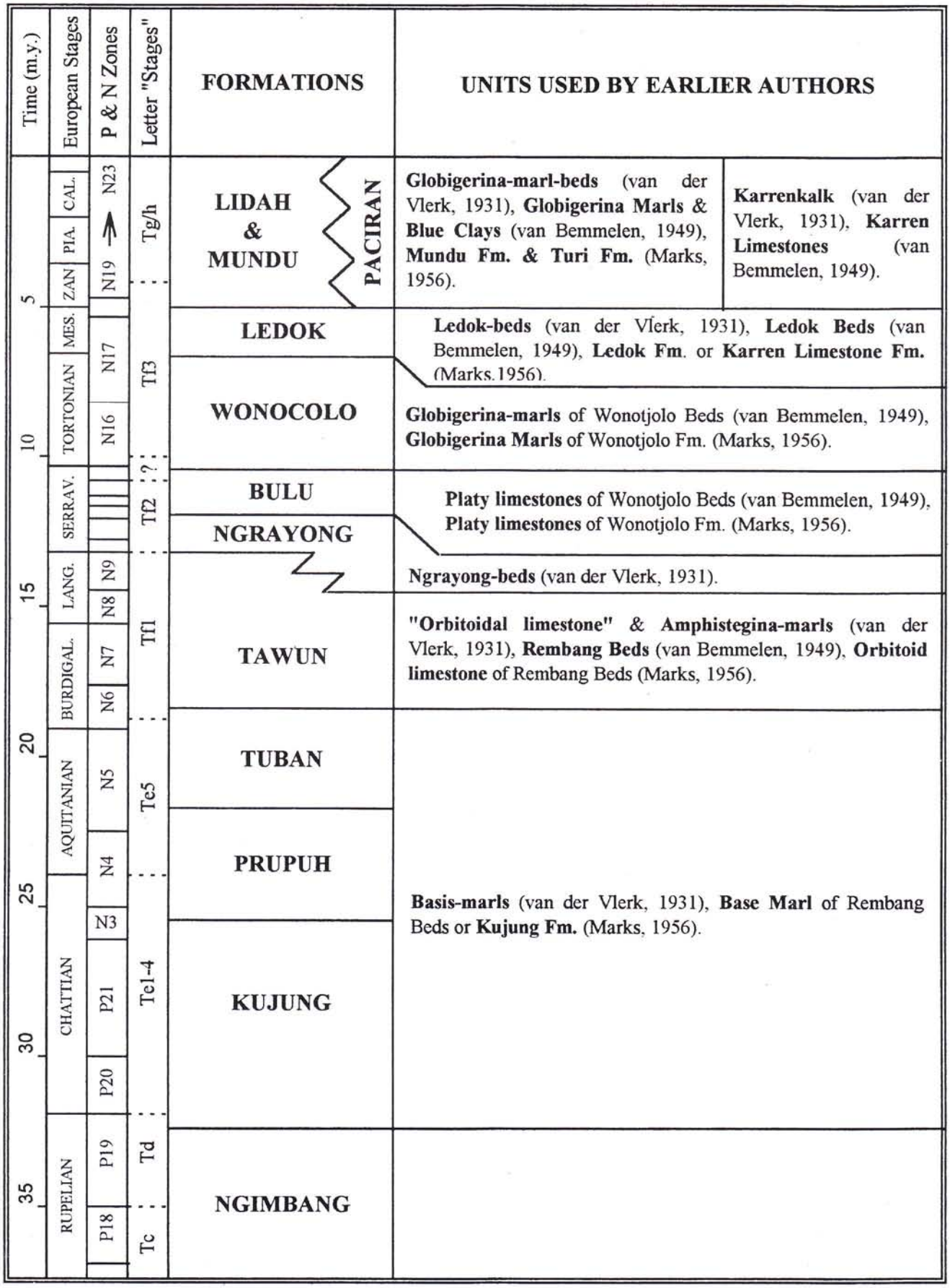
Ngimbang Formation. Inner shelf brown-grey sandstone and siltstone with coal lenses, limestone and marl intercalations. The larger foraminiferal assemblages point toward a Rupelian age. This unit, formerly called Pre-Kujung Formation, is known only from drill holes.

Kujung Formation. Outer shelf grey marl and marly claystone with intercalations of yellowish hard splintery bioclastic limestone and red fine sandstone. Thickness is estimated to exceed 1200 m. The abundant planktonic foraminiferal assemblages suggest a Late Oligocene age. This formation is the oldest one cropping out in the Rembang Zone; its basal part, however, is not exposed.

Prupuh Formation. Outer shelf grey thick-bedded bioclastic limestone rich in algae, planktonic and larger foraminifera. The exposed thickness is 70-80 m. The occurrence of *Spiroclypeus*, *Lepidocyclina sumatrensis*, *Globigerina ciperoensis*, *Globigerinoides primordius* and *G. immaturus* at different levels within the formation indicate Zones N3-N5, i.e. a very Late Oligocene to Early Aquitanian age.

Tuban Formation. Outer shelf monotonous grey claystone, with intercalations of limestone and sandstone, rich in algae, planktonic and larger foraminifera. Maximum thickness exceeds 700 m. The formation is regarded as of Late Aquitanian to Early Burdigalian age (N5-N6).

Tawun Formation. Outer to inner shelf grey sandstone and siltstone with intercalations of marl, claystone and limestone; lignite and plant remains are often observed in fine-grained lithofacies. The total thickness is



Tab. 1 - Lithostratigraphic framework of Rembang Zone. Scales in the left part and correlation with Letter Stages used in the Indo-Pacific Neogene are according to Adams (1984).

about 1300 m. The formation is richly fossiliferous: larger foraminifera occur abundantly throughout, megafossils, primarily mollusks, are more common in the upper part. The planktonic foraminifera recovered point toward a N6-N9 Zone assignment, i.e. a Burdigalian to Langhian age. The Tawun Formation basically corresponds to the Rembang Beds of earlier authors and, in particular, to the orbitoid limestone as intended by Marks (1956). It may be regarded as the stratotype of Oostingh's Rembangian Stage. The mollusk-faunas formerly described from the Rembangian (see introduction), as well as the material recovered by the present author and dealt with herein, were obtained from the Tawun Formation, primarily from its mid-upper part.

Ngrayong Formation. Near-shore yellowish, coarse-grained, quartz sandstone and sand, with occasional fossil mollusks. The unit has currently received a N10-N12 assignment, thus, a Serravallian age. It was regarded until recently as either a separate formation or the upper member of the Tawun Formation.

Bulu Formation. Inner shelf brown-grey thin-bedded limestone and sandy limestone bearing algae, planktonic and larger foraminifera, madreporarians, bryozoans, mollusks and echinoids. The foraminiferal assemblages suggest a mid-late Serravallian age (N12-N15).

Wonocolo Formation. Outer shelf grey marl, clayey to sandy, with calcarenite intercalations. The abundant planktonic foraminifera point toward a N15-N17 Zone assignment correlative of a Late Miocene (Tortonian) age.

Ledok Formation. Inner shelf to deltaic green glauconite sandstone alternating with sandy marl and bioturbated calcarenite; cross-bedding occurs commonly. The age, as based on planktonic foraminifera, is latest Miocene (Messinian).

The Oligo-Miocene succession is topped by Pliocene and Pleistocene marine deposits (Mundu, Paciran and Lidah formations).

The investigated localities.

The Middle Miocene deposits belonging to the Tawun Formation, as previously said, were examined and sampled at three locations in Sedan-Tuban area (Fig. 1B, C). Locality data, description of the outcropping lithologies and biostratigraphic framing are provided in the following.

Kali Rebjong Section. The section crops out southwest of the town of Sedan, along a stream named Kali Rebjong (formerly known as Kali Widodaren). It develops on the right bank of Kali Rebjong, where the road connecting Tuder to Sedan bridges the stream between the villages of Ngandang and Karas (Fig. 1C). The sequence, from bottom to top, is as follows (Fig. 2):

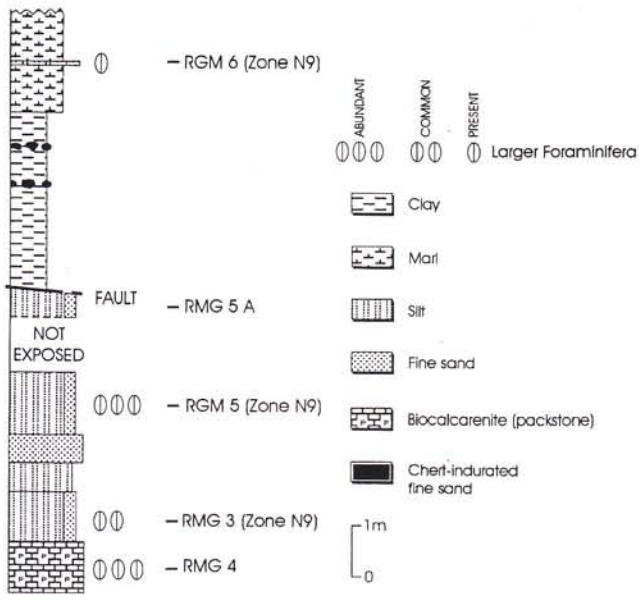


Fig. 2 - Columnar section in the Tawun Formation along Kali Rebjong, showing sampled horizons.

1) 1.00 m of biocalcarenite (packstone), fine, light brownish-grey, unbedded; the fossil contents mainly consist of densely packed larger foraminifera and include *Amphistegina* sp., *Cycloclypeus (Katacycloclypeus)* cf. *annulatus*, *Miogypsina (Lepidosemicyclina)* sp., *L. (Nephrolepidina)* sp., *Gypsina* sp. (sample RMG 4);
2) 1.00 m of silt with 25% of sand and nearly 7% of clay, grey, forming a single bed; the fossil fauna (sample RMG 3), very abundant and evenly distributed throughout, consists of mollusks and both smaller and larger foraminifera; among these latter, *Cycloclypeus (Katacycloclypeus) annulatus* occurs frequently with large specimens;
3) 0.60 m of silt, slightly clayey, blackish, with abundant mica; the fossil contents consist of carbonized plant debris and of exceedingly scarce, badly fragmented thin-shelled bivalves;
4) 0.60 m of sand, fine to very fine, micaceous, reddish-brown;
5) 2.25 m of silt with 27% of fine sand and 3% of clay, grey, unbedded; the fossil fauna is very abundant (samples RMG 5, RMG 5A) and includes foraminifera, madreporarians, bryozoans, and mollusks; once again the frequent occurrence of *Cycloclypeus (Katacycloclypeus) annulatus* is noted;
— fault —
6) 3.50 m of clay, blackish, with two horizons (2 and 2.80 m above the base of the level) of large chert-indurated concretions of very fine sand;
7) 2.00 m of marl, grey, poorly bedded; a fossil-bearing layer, 0.10 m thick, is intercalated in the middle and consists of light-brown silt with 29% of fine sand; it yielded (sample RMG 6) a very rich mollusk-fauna, echinoid spines, bryozoans, and foraminifera.

The sequence is topped by an erosional surface and covered by floodplain deposits of Kali Rebjong.

The planktonic foraminifera recovered from sample RMG 3, are represented by scarce specimens of *Globigerina praebulloides*, *Globigerinella obesa*, *Globigerinoides quadrilobatus*, *G. trilobus* and have no age-diagnostic value. Sample RMG 5 yielded a rich and significant microfauna including *Dentoglobigerina altispira*, *D. baroemoenensis*, *D. larmeui*, *Globigerina praebulloides*, *G. woodi*, *Globigerinella obesa*, *Globigerinoides bisphericus*, *G.*

cf. *obliquus*, *G. quadrilobatus*, *G. trilobus*, *Orbulina suturalis*, *Paragloborotalia acrostoma*, *P. siakensis*, and *Praeorbulina glomerosa curva*. This assemblage suggests a basal N9 zonal assignment and points toward a Late Langhian age. Sample RMG 6 contains *Dentoglobigerina baroemoenensis*, *Globigerinoides quadrilobatus*, *G. trilobus*, *Orbulina suturalis*, *Praeorbulina glomerosa circularis* and establishes the same zonal and age assignment as the previous one (Violanti, written comm., 1994).

Locality RMG 2. The site is located in the forest on east side of Kali Ngegot, approximately halfway between the villages of Ngandang and Gesikan (Fig. 1C). There, a small section is exposed which consists of 4 m of grey clayey marl overlain by 0.70 m of yellow-reddish fine sand. The clayey marl bears abundant mollusks evenly distributed throughout (sample RMG 2C). The sand also contains mollusks and plenty of the scleractinian coral *Cycloseris decipiens* (sample RMG 2S). Sample RMG 2C yielded a rich planktonic foraminiferal assemblage including *Dentoglobigerina baroemoenensis, D. globularis, D.* cf. *larmeui, Globigerina* cf. *praebulloides, Globigerinoides quadrilobatus, G. sacculifer, G. trilobus, Neogloboquadrina continuosa, Paragloborotalia siakensis, Praeorbulina glomerosa glomerosa, P. glomerosa circularis.* The microfauna can be referred to Zone N8, thus suggesting an Early Langhian age (Violanti, written comm., 1994).

Sumberan. The spot is positioned east of the village of Sumberan (Fig. 1B), approximately in between localities 152 and 155 of Wanner & Hahn (1935). The exposure, about 2.5 m thick, consists of ocher fine unbedded sand, rich in larger foraminifera, bryozoans and mollusks. The planktonic foraminiferal assemblage obtained is characterized by *Dentoglobigerina globularis, D. larmeui, Globigerinella obesa, Globigerinoides bisphericus, G. trilobus, Orbulina suturalis, Praeorbulina transitoria*. It suggests a basal N9 zonal assignment and a Late Langhian age (Violanti, written comm., 1994).

It is notable that the age of the considered outcrops ranges from Zone N8 to N9 (Langhian in terms of Mediterranean stage ages), that means a upper Tf1 age. The Rembangian mollusk-fauna is likeky to be restricted to this span of time, but a final statement in this respect must await the study of other relevant localities which have already been sampled. It is the purpose of the present author to revise and discuss the Rembangian Stage in a forthcoming paper.

Systematic paleontology

The classification adopted in this account largely draws on that followed in the Treatise on Invertebrate Paleontology, Part I, Mollusca 1 (Moore R.C., Ed., 1960), with modifications according to more recently proposed changes (see Beu & Ponder, 1979; Ponder, 1985; Herbert, 1987; Hickman & McLean, 1990).

The studied material is housed in the Museo di Paleontologia dell'Università, Milan, Italy (MPUM in the following). Abbreviations for other institutions are: NNML, Nationaal Natuurhistorisch Museum, Leiden, The Netherlands; USNM, National Museum of Natural History (Smithsonian Institution), Washington DC, U.S.A.

Symbols for shell dimensions are: NW, number of whorls; PD, diameter of the protoconch; H, height of the shell; hs, height of the spire; hw, height of the body whorl; D, maximum diameter; MSA, mean spire angle.

Phylum **Mollusca**

Class Gastropoda Cuvier, 1797

Subclass Prosobranchia Milne Edwards, 1848

Order Archaeogastropoda Thiele, 1925

Superfamily *Fissurelloidea* Fleming, 1822

Family *Fissurellidae* Fleming, 1822

Subfamily *Emarginulinae* Gray, 1834

Genus *Emarginula* Lamarck, 1801

Subgenus *Emarginula* s.s.

Emarginula (Emarginula) sp.

Pl. 1, fig. 1

Occurrence. Kali Rebjong Section: RMG 3, 3 spms., MPUM 6766-6768. Only the adapical part is preserved.

Remarks. The apparently small shells in hand are relatively depressed, with a subcentral, distinctly rim-margined protoconch covered with irregular papillae. They bear 14 strong radial ribs alternating with slightly weaker ones, the total number being 29; a few incipient ribs are observable in some intervening spaces. The ribs are cancellated by overriding, regularly spaced collabral threads. The interstices are simple, with a pair of subcircular intritacalx pits.

The shells from Kali Rebjong appear to be unlike any Neogene to Recent species of *Emarginula* described from the Indo-Pacific, but the lack of complete adult specimens hinders any definitive decision in this respect. Some resemblance is noted with the Recent *Emarginula (Emarginula) montrouzieri* Souverbie, 1872 which exhibits similar sculptural features. The latter species, however, has a more depressed shell and more numerous radial ribs.

Superfamily *Trochoidea* Rafinesque, 1815
Family *Trochidae* Rafinesque, 1815
Subfamily *Calliostomatinae* Thiele, 1924
Genus *Calliostoma* Swainson, 1840
Subgenus *Tristichotrochus* Ikebe, 1942

Calliostoma (Tristichotrochus) sp. 1

Pl. 2, fig. 3; Text-fig. 3

Occurrence. Kali Rebjong Section: RMG 5, 1 spm., MPUM 6776. The protoconch is missing and the outer lip is badly damaged.

Remarks. The small anomphalous shell in hand is characterized by wide spiral angle (81°), slightly shouldered whorls, and distinctly beaded spiral cords and threads. The first preserved whorl bears 3 equal and equally spaced primary spirals; secondary and tertiary ones gradually intervene, the former soon reaching the same strenght of the primaries (Fig. 3). Ten spirals are counted on the fourth and last whorl. The somewhat shouldered whorls and the sculptural features are consistent with the assignment of the present specimen to the subgenus *Tristichotrochus* Ikebe, 1942.

Trochus (Calliostoma) malaianus Wanner & Hahn, 1935 (see appendix), described from the type-area of the Rembangian stage, shows a superficial resemblance to the present form in having basically similar ornamentation, but its spiral angle is markedly smaller and the whorls are clearly unshouldered. Some resemblance is noted also with the Recent *Calliostoma formosense* Smith, 1907 which, however, has a narrowly phaneromphalous shell.

Calliostoma (Tristichotrochus) sp. 2

Pl. 2, fig. 2

Occurrence. Sumberan: 2 spms., MPUM 6774-6775. One shell lacking the apical whorls and a juvenile specimen rather well preserved.

Remarks. The specimens in hand, provided with 3 primary spirals, do not compare closely with the characters of any Indo-Pacific species of *Tristichotrochus* described and/or figured in the literature. They exhibit a superficial resemblance to *Trochus (Eutrochus) jujubiniformis* Martin, 1883, but can be distinguished from it by their wider spiral angle, more narrowly rounded periphery of the whorls, and by the complete lack of umbilical depression.

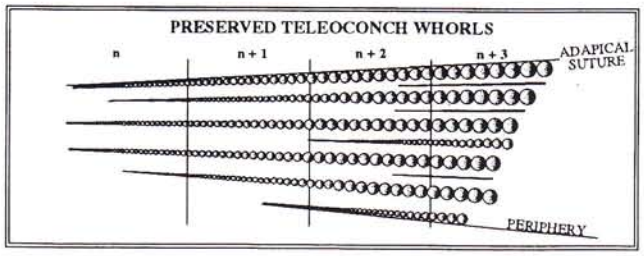


Fig. 3 - Development of teleoconch ornamentation in *Calliostoma (Tristichotrochus)* sp. 1. Whorl n is the first preserved whorl (presumably the second teleoconch whorl).

Subgenus *Fautor* Iredale, 1924

Calliostoma (Fautor) sp.

Pl. 1, fig. 2, 3

Occurrence. Kali Rebjong Section: RMG 3, 13 spms., MPUM 6769-6771; RMG 5, 1 spm., MPUM 6772; RMG 6, 3 spms., MPUM 6773. Only the larval shell and the earlier teleoconch whorls are preserved.

Remarks. The 1 whorled protoconch sculptured with network of interconnected hexagons and with a strong terminal varix closely resembles that of *Calliostoma (Fautor) consobrinum* (Powell, 1958) as figured by Marshall (1979); also the earlier teleoconch whorls are relatively similar. On this basis, the present specimens are assigned to the subgenus *Fautor* Iredale, 1924 of *Calliostoma*.

Genus *Astele* Swainson, 1855
Subgenus *Callistele* Cotton & Godfrey, 1935

Astele (Callistele) tenuistriata (Wanner & Hahn, 1935)

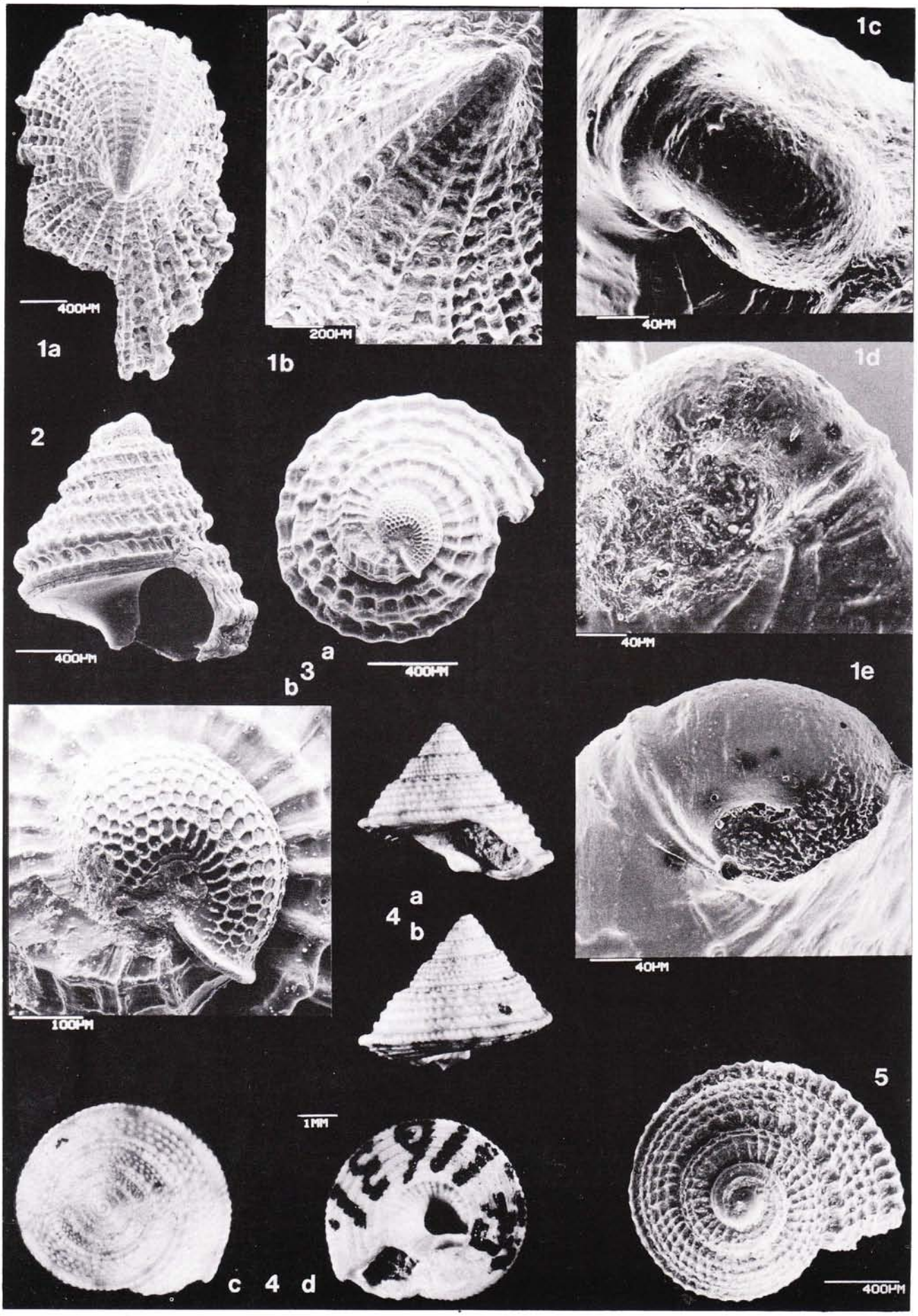
Pl. 2, fig. 4; Pl. 8, fig. 3

1935 *Trochus (Eutrochus) tenuistriatus* Wanner & Hahn, p. 265, pl. 20, fig. 17-20.

Occurrence. The present location of the original specimens is unknown. Kali Rebjong Section: RMG 3, 6 spms., MPUM 6777-6779. The material consists of variously preserved juvenile shells.

PLATE 1

Fig. 1 - *Emarginula (Emarginula)* sp. RMG 3. MPUM 6767; a) top view, b) detail of the selenizone. MPUM 6768; c-e) protoconch.
Fig. 2 - *Calliostoma (Fautor)* sp. RMG 3. MPUM 6770; apertural side.
Fig. 3 - *Calliostoma (Fautor)* sp. RMG 3. MPUM 6771; a) top view, b) protoconch.
Fig. 4 - *Gibbula (Enida) butaciana* (Martin, 1905). Holotype. Gunung Butak. NNML 11631; a) apertural side, b) abapertural side, c) top view, d) base.
Fig. 5 - *Gibbula (Enida) butaciana* (Martin, 1905). Sumberan. MPUM 6783; top view.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Remarks. The species has a 1 whorled, slightly deviated, apparently smooth protoconch. The teleoconch bears 4 beaded spirals, of equal strenght and evenly spaced, between the adapical suture and the peripheral cord. Crowded and somewhat raised growth markings are observable in the intervening furrows, and are more evident abapical to the periphery. The sculptural features and the narrow umbilicus are consistent with the assignment of the present taxon to the subgenus *Callistele* Cotton & Godfrey, 1935 of the genus *Astele* Swainson, 1855.

Distribution. *A. (Callistele) tenuistriata* (Wanner & Hahn) has been so far recorded only from the type-area of the Rembangian stage.

Astele (Callistele) sp.

Pl. 3, fig. 1; Pl. 8, fig. 4; Text-fig. 4

Occurrence. Sumberan: 3 spms., MPUM 6780-6781. The shell material is fairly well preserved.

Description. Shell small, not exceeding 5 mm in height, conical, with a gently cyrtoconoid spire which is 71% of the shell height. Protoconch small, made of 1 convex, apparently smooth whorl. The transition to the teleoconch is abruptly marked by the appearance of the adult sculpture. Teleoconch whorls flat-sided, meeting at flush sutures. Body whorl about 55% of the shell height, rather sharply angled at the periphery. Base slightly convex, with a narrow, smooth-sided umbilicus. Aperture quadrangular. Outer lip sharp, strongly prosocline. Inner lip less prosocline, imperceptibly undulating and everted.

The teleoconch sculpture starts with 3 spiral cords, the most abapical being peripheral. Additional spirals appear on the adapical one half of whorls, from whorl 1 to 3 (Fig. 4). On the fourth whorl the 5 cords between the adapical suture and the periphery appear to have reached the same strenght, whereas the peripheral one is stronger; all are coarsely beaded. Base with 10 spirals, beaded except for the one marginating the umbilicus. Prosocline, raised growth markings are observable all over.

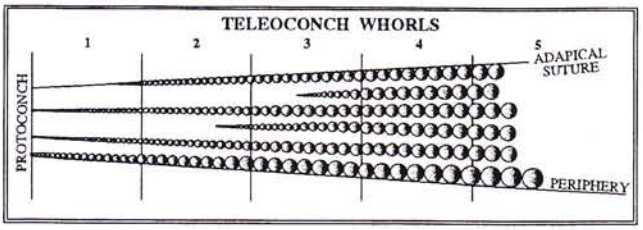


Fig. 4 - Development of teleoconch ornamentation in *Astele (Callistele)* sp.

Dimensions (mm):	NW	PD	H	hs	hw	D	MSA
MPUM 6780	6.50	0.244	4.46	3.17	2.44	3.83	49°

Remarks. The small shells in hand are characterized by the presence of 5 even, beaded spirals between the adapical suture and the peripheral cord. They fit in with the description of the subgenus *Callistele* of *Astele*, but do not resemble satisfactorily to any species of this genus reported on in the literature. *Astele (Callistele) engebiensis* Ladd, 1966, described from Early Miocene deposits of Eniwetok, bears 5 spirals too, but has wider apical angle, scalloped instead of cog-like periphery, and the spirals devoid of beads.

Subfamily *Solariellinae* Powell, 1951

Genus *Solariella* Wood, 1842

Solariella sp.

Pl. 4, fig. 3

Occurrence. Locality RMG 2: RMG 2C, 1 slightly worn specimen, MPUM 6795.

PLATE 2

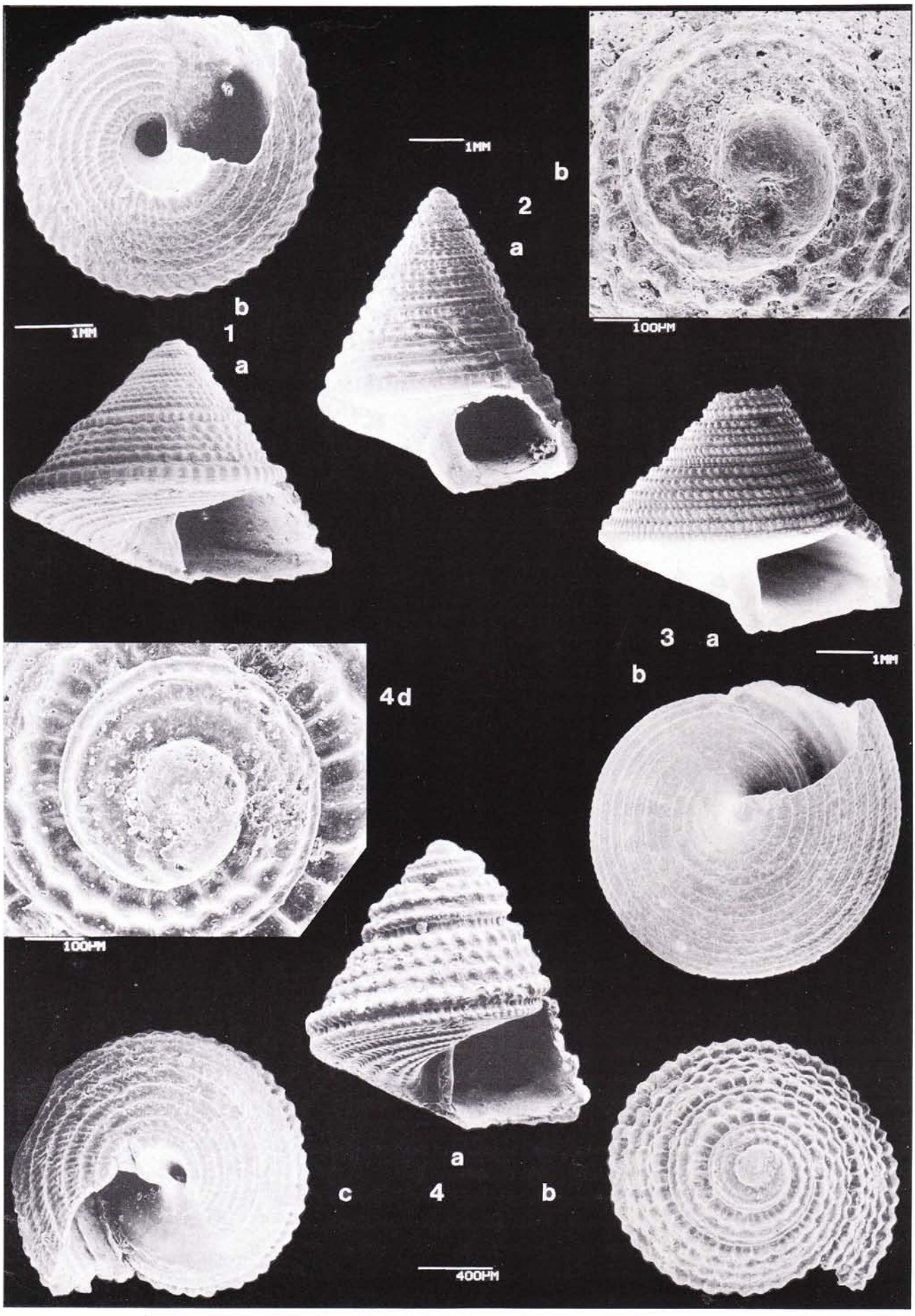
Fig. 1 - *Gibbula (Enida) butaciana* (Martin, 1905). Sumberan. MPUM 6782; a) apertural side, b) base.
Fig. 2 - *Calliostoma (Tristichotrochus)* sp. 2. Sumberan. MPUM 6774; a) apertural side, b) apical whorls.
Fig. 3 - *Calliostoma (Tristichotrochus)* sp. 1. RMG 5. MPUM 6776; a) apertural side, b) base.
Fig. 4 - *Astele (Callistele) tenuistriata* (Wanner & Hahn, 1935). RMG 3. MPUM 6779; a) apertural side, b) top view, c) base, d) protoconch.

PLATE 3

Fig. 1 - *Astele (Callistele)* sp. Sumberan. MPUM 6780; a) apertural side, b) apical whorls.
Fig. 2 - *Ethalia stefanoi* sp. n. Paratype. RMG 6. MPUM 6789; apertural side.
Fig. 3 - *Ethalia stefanoi* sp. n. Holotype. RMG 6. MPUM 6785; a) apertural side, b) top view, c) base, d) apical whorls, e) embryonic shell.
Fig. 4 - *Ethalia stefanoi* sp. n. Paratype. RMG 6. MPUM 6790; a) apertural side, b) top view, c) base, d) detail of pitted grooves.

PLATE 4

Fig. 1 - *Talopena* sp. RMG 5. MPUM 6794; a) apertural side, b) top view, c) base, d) umbilical cavity, e) apical whorls.
Fig. 2 - *Talopena* sp. RMG 5. MPUM 6793; a) apertural side, b) base.
Fig. 3 - *Solariella* sp. RMG 2C. MPUM 6795; a) apertural side, b) top view, c) base, d) apical whorls.


1MM
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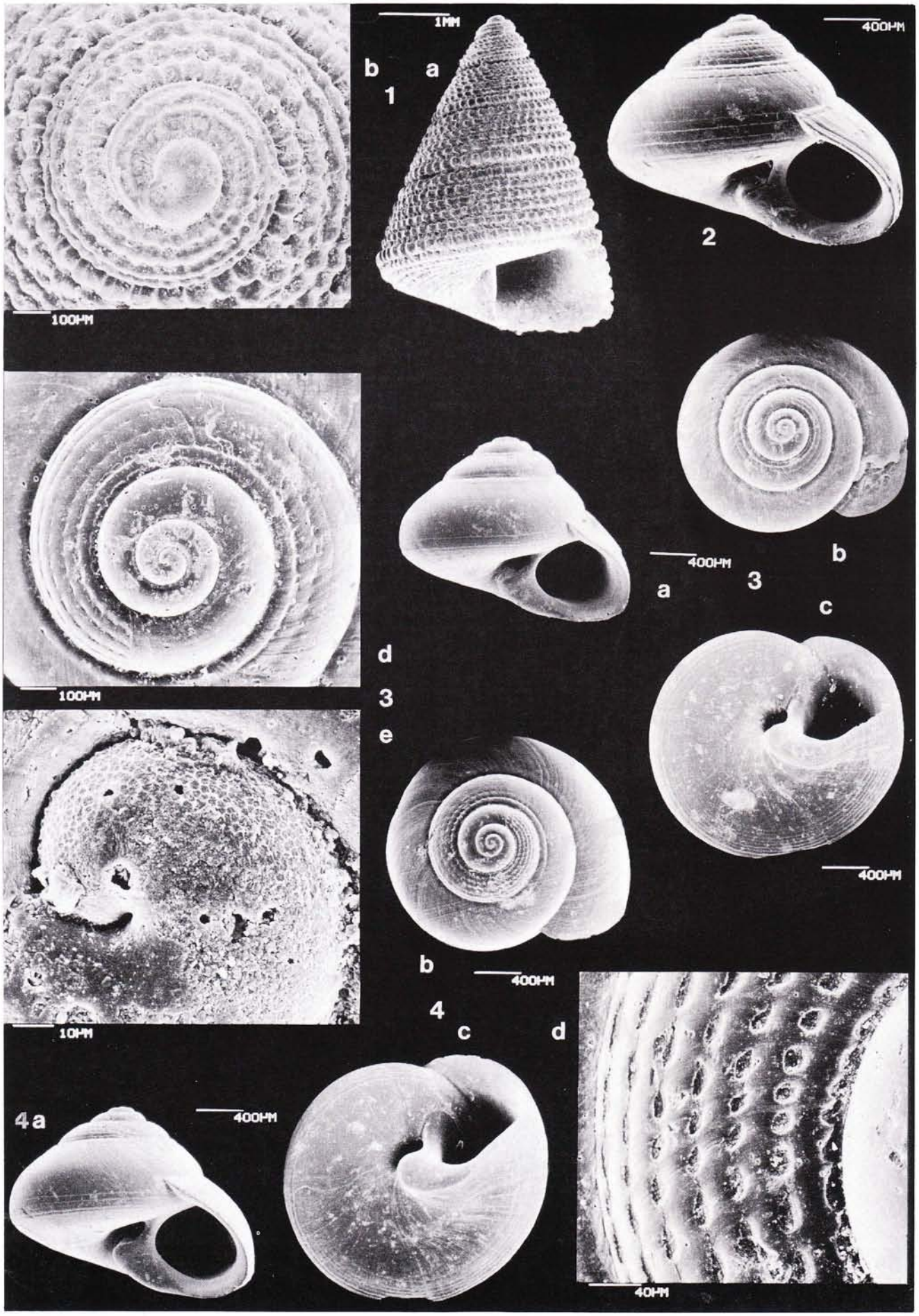
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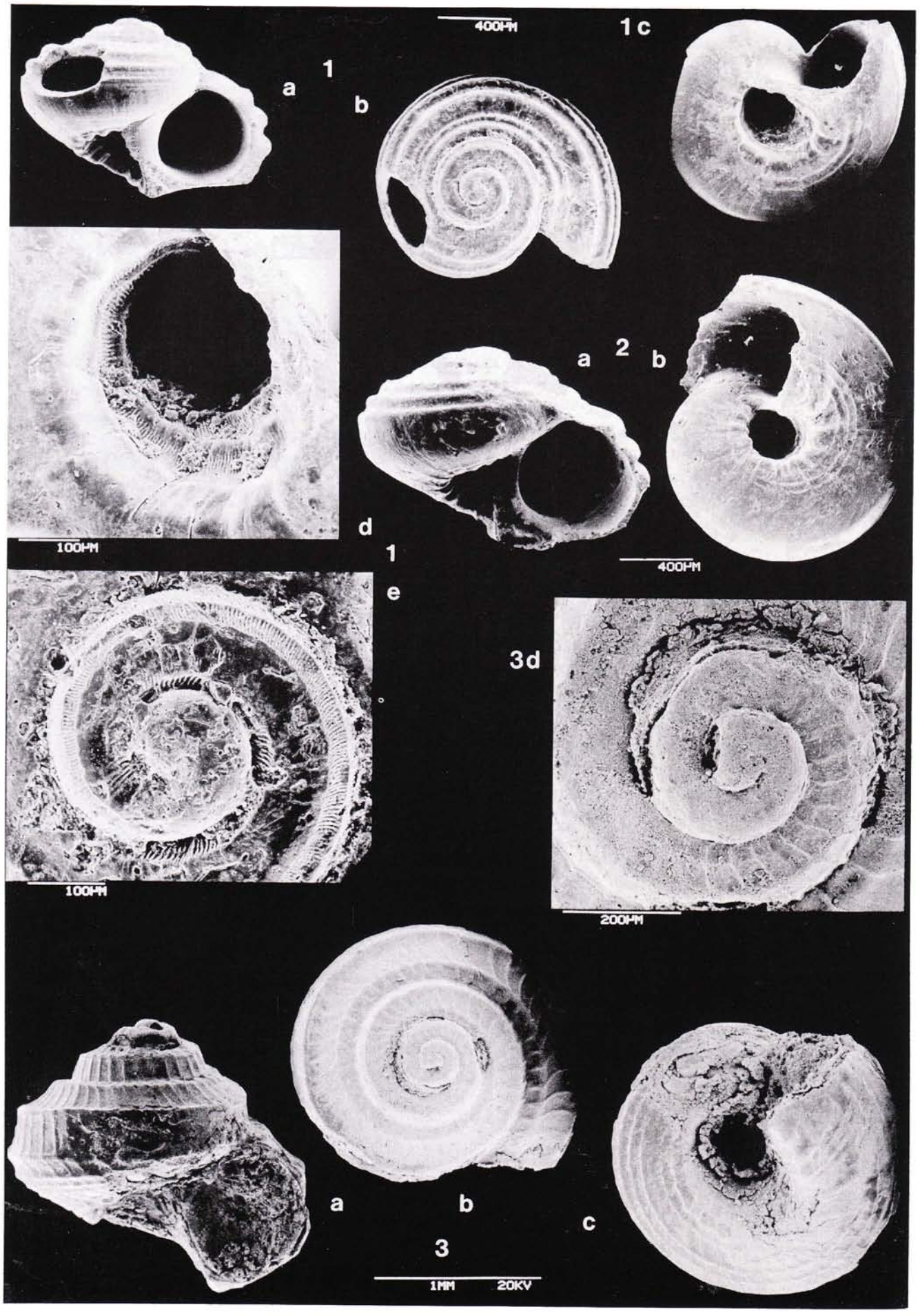
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Description. Shell very small, depressed turbiniform, with a low, gradate spire which is 45% of the shell height (3.8 mm). Protoconch consisting of slightly more than 1 whorl, smooth, not distinctly demarcated from the teleoconch. Spire whorls angulate, with a broad, shallowly concave shoulder slope and a narrow, horizontal subsutural shelf. They abut against the preceeding one at fine, straight sutures. Body whorl about 80% of the shell height, biangulate. The peripheral (abapical) angulation forms the boundary of the base which is gently convex, with a widely open, deep umbilicus. Aperture subquadrate. The outer lip arises at the level of the peripheral angulation and follows an irregularly arched course to meet the inner lip at nearly right angle. Inner lip bent in the middle, with a straight abapical part.

Sculpture consisting of a spiral ridge on the whorl angulation, crossed (not overridden) by numerous, prosocline, adapically flexed, fine collabral riblets. The body whorl bears a ridge on the peripheral angulation as well, 4 spiral cords are observed in between this latter and the umbilicus which is encircled by a row of beads; 39 ribs occur, extending within the umbilicus.

Remarks. The considered form seems to be unlike any other species of *Solariella* described from the Western Pacific; the material at hand, however, is not adequate to propose a new taxon. The Pliocene Indian *Solariella amblygoniata* Cossmann, 1910 appears to be the most closely related. It differs in having the abapical part of the spire whorls devoid of collabral riblets, and 6 basal spirals whereas the present form has 4.

Genus *Ilanga* Herbert, 1987

Ilanga rebjongensis sp. n.

Pl. 5, fig. 1-4; Pl. 8, fig. 2

Derivation of name. From the stream Kali Rebjong.

Holotype. Kali Rebjong Section: RMG 6, MPUM 6796; Pl. 5, fig. 1.

Paratypes. Kali Rebjong Section: RMG 3, 1 spm., MPUM 6797; RMG 6, 20 spms., MPUM 6798-6801.

Preservation. The material consists of variously preserved juvenile specimens with diagnostic features clearly observable.

Type-locality. Karas near Sedan, Central Java.

Horizon. Tawun Formation: levels RMG 3 and RMG 6 of Kali Rebjong Section. Zone N 9, Langhian.

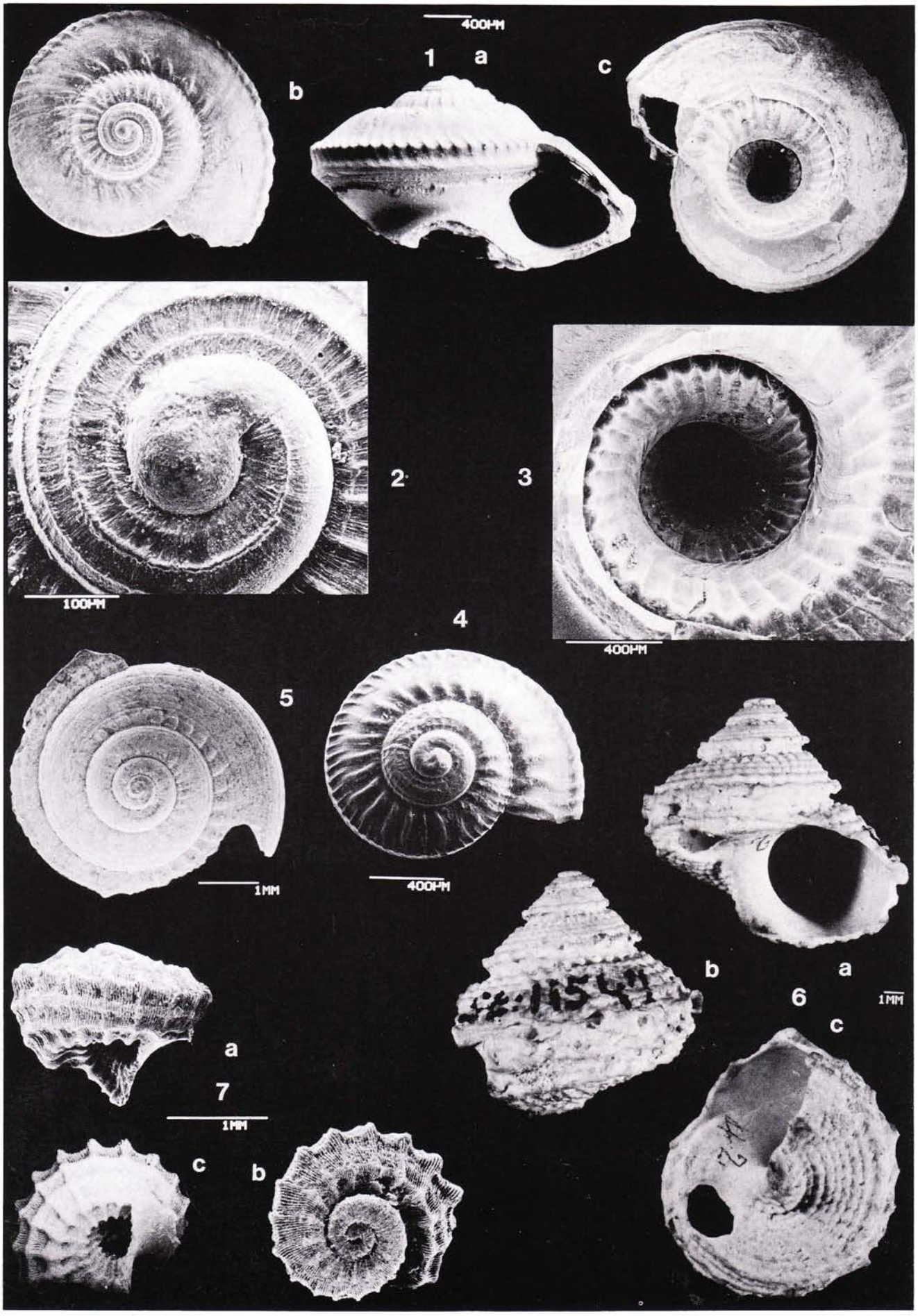
Diagnosis. Shell lenticular with a depressed conical spire. Protoconch 1 whorled, smooth. Body whorl biangulate peripherally. Base convex with a widely open and deep umbilical cavity. Aperture quadrangular. Sculpture of spiral ridges and collabral ribs, tending to vanish during growth.

Description. Shell small, hardly exceeding 6 mm in diameter, lenticular, with a depressed conical spire which averages 35% of the shell height. Protoconch typically solarielline, 1 whorled and smooth, distinctly rim-margined. The transition to the teleoconch is sharp, marked by the rim and by the appearance of a spiral just beyond it. Spire whorls gently convex, with maximum bending toward the adapical one third and with a quite narrow, sloping inward subsutural shelf. They meet at incised, slightly canaliculate sutures. Body whorl about 65% of the shell height, biangulate. The peripheral angulation is somewhat sharper than the one slightly abapical to it which bounds the convex, phaneromphalous base. Umbilicus widely open and deep. Aperture quadrangular, lying in a gently prosocline plane. The outer lip arises at the level of the peripheral angulation; its adapical and abapical parts are of equal length and form an angle of about 60°. Inner lip bent in the middle, with a straight abapical segment.

The teleoconch ornamentation starts with 1 spiral ridge placed at the adapical one third. After 1/4 of whorl 3 other ridges develop, 1 near the adapical suture, 2 in between the first ridge and the abapical suture. Ridges fade away short after the beginning of the second spire whorl. Straight, orthocline collabral riblets overriding the spirals start to be observable by the second whorl. They gradually change into slightly flexuous wrinkles which are more prominent adapically, giving the shoulder a somewhat noded aspect. Short riblets start to intervene on the abapical one third about at the middle of the second whorl. Thus, the periphery of whorls appears cog-like featured. It seems that the axials tend to vanish during growth. The base bears spiral cords crossed by arched, relatively raised growth markings. Strong collabral wrinkles are observable within the umbilical cavity.

PLATE 5

Fig. 1 - *Ilanga rebjongensis* sp. n. Holotype. RMG 6. MPUM 6796; a) apertural side, b) top view, c) base.
Fig. 2 - *Ilanga rebjongensis* sp. n. Paratype. RMG 6. MPUM 6798; protoconch.
Fig. 3 - *Ilanga rebjongensis* sp. n. Paratype. RMG 6. MPUM 6800; umbilical cavity.
Fig. 4 - *Ilanga rebjongensis* sp. n. Paratype. RMG 6. MPUM 6799; top view.
Fig. 5 - *Ilanga* sp. RMG 5. MPUM 6802; top view.
Fig. 6 - *Bolma (Bolma) granifera* (Martin, 1885). Holotype. Ngembak. NNML 11547; a) apertural side, b) abapertural side, c) base.
Fig. 7 - *Liotina (Dentarene)* sp. RMG 2C. MPUM 6803; a) apertural side, b) top view, c) base.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Ethalia stefanoi sp. n.

Pl. 3, fig. 2-4

Derivation of name. The species is named for my son Stefano.

Holotype. Kali Rebjong Section: RMG 6, MPUM 6785; Pl. 3, fig. 3.

Paratypes. Kali Rebjong Section: RMG 3, 17 spms., MPUM 6786; RMG 6, 39 spms., MPUM 6787-6790.

Preservation. The bulk of the shell material is perfectly preserved.

Type-locality. Karas near Sedan, Central Java.

Horizon. Tawun Formation; levels RMG 3 and RMG 6 of Kali Rebjong Section. Zone N 9, Langhian.

Diagnosis. Shell conical with a depressed, cyrtoconoid spire. Protoconch 3 and 1/8 whorled, with a reticulated tip. Teleoconch whorls moderately convex. Periphery subangular. Base almost flat, umbilicus partly filled with callus. Aperture subcircular. Surface with spiral striation except for some parts of the body whorl.

Description. Shell small, hardly exceeding 6 mm in height, conical, with a depressed cyrtoconoid spire which averages 45% of the shell height. Protoconch 3 and 1/8 whorled, low-conical, slightly rim-margined. The embryonic shell is made of 1 whorl and bears a reticulated pattern. The larval shell is smooth except for faint spiral grooves on the last half whorl. The transition to the teleoconch is abrupt, marked by the sudden appearance of the adult sculpture just beyond the protoconch margin. Teleoconch whorls gently convex, with maximum bending at the abapical one third. They meet at incised, adpressed sutures. Body whorl rapidly expanding, averaging 81% of the shell height, subangular at the periphery. Base nearly flat, with a deep, narrow umbilicus partly filled by a callus pad. Aperture subcircular, slightly angulated adapically. Outer lip prosocline, with a thin edge. Inner lip thick, with a callus extending from its mid-abapical part toward the umbilicus.

The teleoconch ornamentation consists of 5-6 regularly spaced, pitted grooves: pits are larger and deeper adapically. These grooves commonly tend to fade away during growth. The body whorl may be either smooth in the mid-adapical part or bear 1-2 grooves close to the adapical suture. Some specimens may retain more grooves. The peripheral band bears 2-4 grooves, the most adapical placed at the level of the suture, the lowermost, somewhat larger and deeper, bounding the base. A variable number of spiral grooves is observed on the peripheral part of the base, the rest being smooth.

Dimensions (mm):	NW	PD	H	hs	hw	D	MSA
MPUM 6785 (holotype)	5.40	0.590	1.60	0.75	1.27	2.03	93°
MPUM 6788	5.50	0.600	1.52	0.74	1.14	2.14	98°
MPUM 6789	5.50	0.593	1.62	0.72	1.39	2.13	96°
MPUM 6790	5.40	0.591	1.59	0.63	1.36	2.12	99°

Remarks. The newly described species is distinguished by its subangular periphery, almost flat base, and in being only partially spirally grooved. It is assigned to the genus *Ethalia* Adams & Adams, 1854 on the basis of its shell shape, umbilical characters, and very weak sculpture.

The Recent *Ethalia minolina* Melvill, 1897 has similar shape and ornamentation, and appears to be the most closely related species. *Ethalia stefanoi* sp. n. differs from it in that has a more distincly angular periphery and the greatest part of the later whorls devoid of spirals, whereas Melvill's taxon is "uniformly very closely filostriate". *Ethalia striolata* A. Adams, 1853 is allied too, but exhibits the periphery placed more adapically, a more convex base, and bears dense spiral grooves. *Ethalia subpulchella* McLean, 1960, described from Pliocene deposits of Okinawa, has a more depressed, smooth shell, with a tongue-shaped callus extending from the parietal wall nearly to close the umbilicus.

Genus *Talopena* Iredale, 1918

Talopena sp.

Pl. 4, fig. 1, 2

Occurrence. Kali Rebjong Section: RMG 3, 1 spm., MPUM 6791; RMG 5, 9 spms., MPUM 6792-6794. The small shells in hand are more or less broken, but the bulk of the characters can be observed; some specimens retain traces of color markings.

Remarks. The spirally ribbed upper part, the smooth base, the umbilicus bounded by a rib and with an internal ridge terminating just below the parietal wall are consistent with the assignment of the considered specimens to the genus *Talopena* Iredale, 1918. Compared with the type species *Monilea incerta* Iredale, 1912, the present material appears to have the spire lower, a distinctly concave shoulder, and the most abapical spiral giving a carinate aspect to the subangular periphery.

Family *Turbinidae* Rafinesque, 1815

Subfamily *Liotiinae* Adams & Adams, 1854

Genus *Liotina* Fischer, 1885

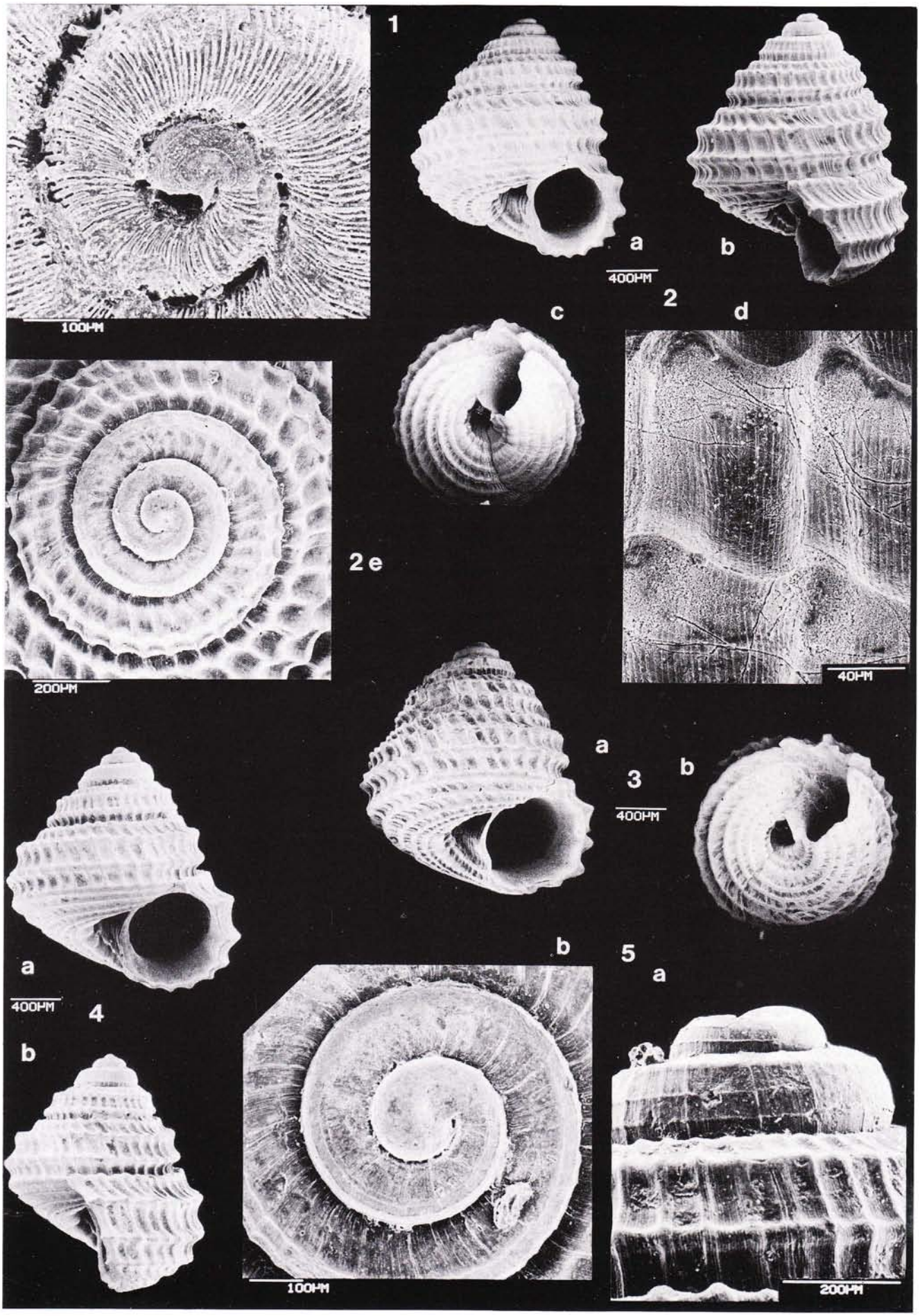
Subgenus *Dentarene* Iredale, 1929

Liotina (Dentarene) sp.

Pl. 5, fig. 7; Pl. 6, fig. 1

Occurrence. Locality RMG 2: RMG2C, 1 spm., MPUM 6803. A shell not fully grown, with the aperture badly damaged.

Remarks. The Rembangian specimen seems not to conform to any species of *Dentarene* reported on in the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1905 *Turbo (Senectus) pamotanensis* Martin, p. 275, pl. 41, fig. 665-665b.
1932 *Turbo pamotanensis* - Haanstra & Spiker, p. 1102.
non 1982 *Turbo pamotanensis* - Kanno, O'Hara & Caagusan, p. 93, pl. 17, fig. 2 (= *Turbo gemmatus* Reeve).

Occurrence. Gunung Butak: the holotype of *Turbo (Senectus) pamotanensis* Martin, NNML 11540; Ngampel: 5 spms. and 4 opercula, NNML 11539, 11541, 47228; Kali Rebjong Section: RMG 5, 1 spm., MPUM 6804. The preservation is mostly fair.

Description. As regards the teleoconch features, reference is made to Martin (1905) who provided a quite thorough account. Only the apical whorls are dealt with herein.

The protoconch is low-conical, made of 3 angulate whorls, the last subcarinate, and with a flattened tip. The transition to the teleoconch is abrupt, marked by the sudden appearance of 2 spirals and the row of knots marginating the adapical suture.

Dimensions (mm):	NW	PD	H	hs	hw	D	MSA
NNML 11540 (holotype)	6.75	1.40	16.85	7.81	13.54	14.80	79°
MPUM 6804	6.15	-	15.45	7.45	12.27	14.00	79°

Remarks. The species was originally based on the single available specimen from Gunung Butak which, thence, is the holotype by monotypy. The other specimens later on recovered at Ngampel by Martin are relevant ones, but are not eligible to be name-bearing types.

The shell from Kali Rebjong fully agrees with Martin's material. The Philippine specimen figured by Kanno et al. (1982) and referred to as *Turbo pamotanensis* Martin, 1905 actually belongs to *Turbo gemmatus* Reeve, 1848 in that has all spirals clearly beaded.

Turbo pamotanensis Martin appears to be exceedingly similar to *Turbo gemmatus* Reeve. In fact, it differs only in that has unbeaded spirals on the peripheral area of the body whorl whereas these spirals are distinctly beaded in Reeve's species. *Turbo pamotanensis* could be regarded as a subspecies of *Turbo gemmatus*, but a decision in this respect must await the comparison of relevant specimens, and the examination of respective apical whorls.

Distribution. *T. (Marmarostoma) pamotanensis* Martin is surely known only from Rembangian of Java. Its quotation from Pliocene (Bantamian) deposits of Sumatra (Martin, 1928) quite possibly refers to *Turbo gemmatus* Reeve.

Genus *Bolma* Risso, 1826
Subgenus *Bolma* s.s.

Bolma (Bolma) granifera (Martin, 1885)

Pl. 5, fig. 6

1885 *Turbo (Callopoma) granifer* Martin, p. 184, pl. 9, fig. 178.
1935 *Turbo (Callopoma) granifer* - Wanner & Hahn, p. 264.
1936 *Astralium (Lithopoma) graniferum* - Pannekoek, p. 60, pl. 3, fig. 40.

Occurrence. Ngembak: the holotype of *Turbo (Callopoma) granifer* Martin, NNML 11547. Its preservation is fair.

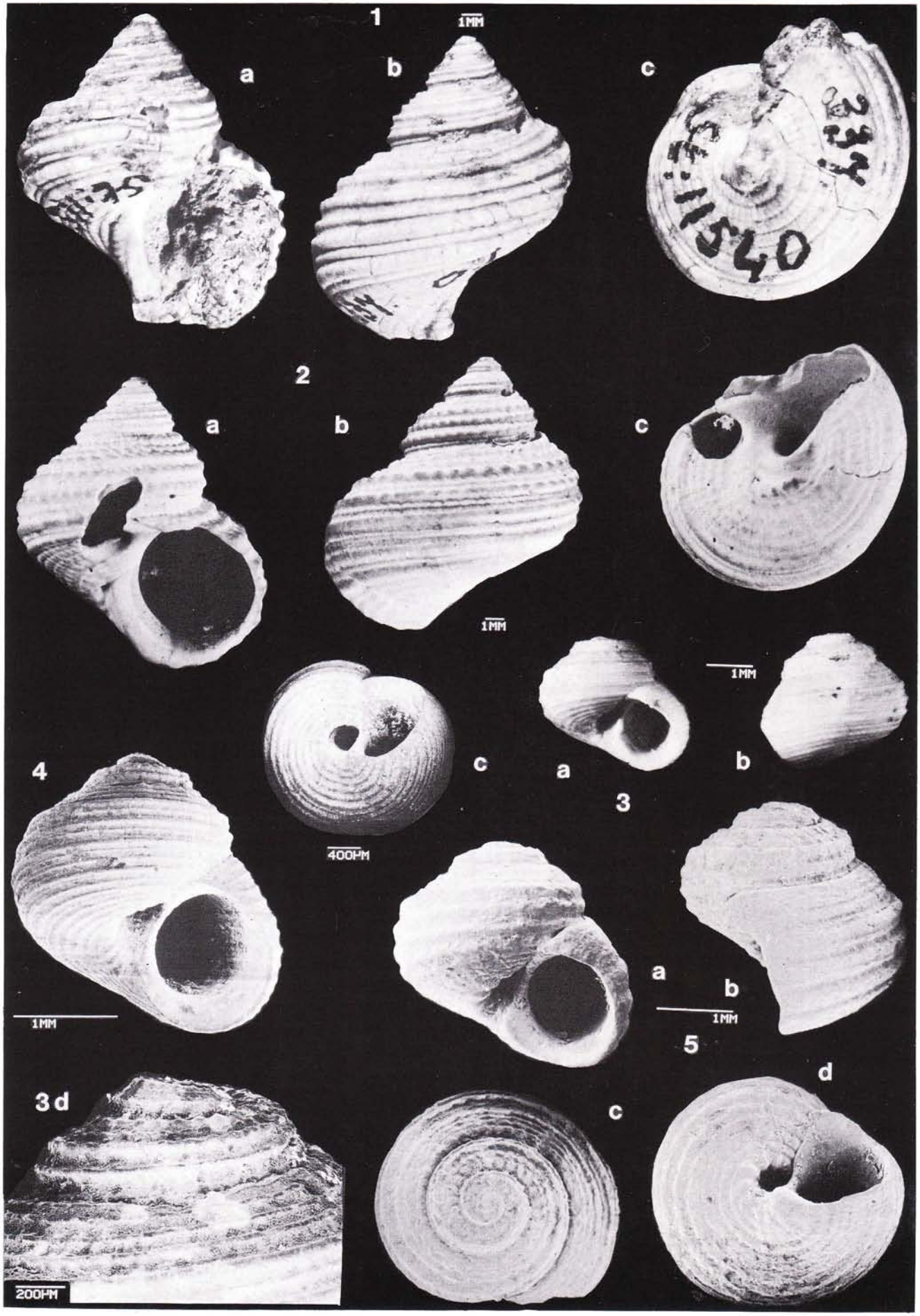
Description. Shell relatively small, turbinate, with a pagodiform spire which is about 45% of the shell height. Protoconch typical for the genus, of 2 angular whorls and with a broad, flat top. The transition to the teleoconch is marked by the quick sharpening of the peripheral angulation and by the appearance of nodules on this latter. Teleoconch whorls angular, with the periphery placed at the abapical 2/5. They are flat adapical to the periphery and exhibit a quite narrow sutural shelf. Sutures grooved. Body whorl about 61% of the shell height. Basal angulation weak. Base gently convex, anomphalous. Aperture subcircular, lying in a prosocline plane. Basal callus narrow, covering about a quarter of the base.

The teleoconch sculpture starts with 4 coarsely beaded spirals on the adapical part of whorls. The closest to the periphery appears first after half a whorl, the intermediate is discernible after 1 whorl, and the 2 most adapical after 1.5 whorls when a groove develops and divides the row of tubercles marginating the suture. The peripheral nodes soon change into short, scale-like, hollow spines; 19 are counted on the penultimate whorl. Another spiral bearing hollow spines comes into sight from the abapical suture on the second whorl. A weaker beaded cord is observed on the sutural shelf of the body whorl, and an incipient one is noted just before the outer lip, in between the two cords lying adapical to the periphery. The basal angulation bears a coarsely noded spiral. Abapical to it 9 beaded spirals of nearly equal strenght are counted.

Dimensions (mm):	NW	PD	H	hs	hw	D	MSA
NNML 11547 (holotype)	5.5	1.15	11.90	5.30	7.23	12.70	85°

PLATE 7

Fig. 1 - *Turbo (Marmarostoma) pamotanensis* Martin, 1905. Holotype. Gunung Butak. NNML 11540; a) apertural side, b) abapertural side, c) base.
Fig. 2 - *Turbo (Marmarostoma) pamotanensis* Martin, 1905. RMG 5. MPUM 6804; a) apertural side, b) abapertural side, c) base.
Fig. 3 - *Leptothyra laddi* sp. n. Holotype. Eniwetok. USNM 648312; a) apertural side, b) abapertural side, c) base, d) apical whorls.
Fig. 4 - *Leptothyra laddi* sp. n. Paratype. Eniwetok. USNM unnumbered; apertural side.
Fig. 5 - *Leptothyra laddi* sp. n. RMG 5. MPUM 6805; a) apertural side, b) labial side, c) top view, d) base.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Remarks. The single specimen from Ngembak, on which the species was originally based, is the holotype by monotypy. Martin's taxon matches the characters of the nominotypical subgenus of *Bolma* Risso, 1826 on account of distinct peribasal angulation and relatively even granular sculpture. *Bolma* is herein considered according to Beu & Ponder (1979).

Astralium (Bolma) kendengense Van Regteren Altena, 1938, described from Pleistocene deposits of East Java, differs from the present species essentially in having flush instead of grooved sutures. The more expanded parietal callus pad may be simply due to the growth stage, the Kendeng specimens being twice as large as the holotype of *Bolma (Bolma) granifera* (Martin, 1885). This latter is likely to be the ancestor of *Astralium (Bolma) kendengense*. Some related species are also present in Miocene units of northern Italy. *Trochus granosus* Borson, 1821, presumably of Burdigalian age, exhibits similar shape and sculptural features, and appears to be the most closely related. However, it slightly differs in having less distinctly grooved sutures and bears one more beaded spiral at the same growth stage, i.e. 5 instead of 4 on the third teleoconch whorl.

Distribution. *B. (Bolma) granifera* (Martin) is hitherto known from the type-area of the Rembangian stage.

Subfamily *Homalopomatinae* Keen, 1960

Genus *Leptothyra* Pease, 1869

Leptothyra laddi sp. n.

Pl. 7, fig. 3-5

1966 *Leptothyra* aff. *laeta* Ladd, p. 51, pl. 9, fig. 4-6.

Occurrence. Eniwetok and Bikini: 5 specimens dealt with by Ladd (1966) and referred to as *Leptothyra* aff. *laeta* Montrouzier, in USNM; Kali Rebjong Section: RMG 3, 1 spm., MPUM 6806; RMG 5, 1 spm., MPUM 6805.

Derivation of name. The species is named for H.S. Ladd.

Holotype. Eniwetok: drill hole K-1B, 957-968 ft, USNM 648312; the specimen figured by Ladd (1966) and refigured herein, Pl. 7, fig. 3.

Paratypes. Eniwetok: drill hole K-1B, 957-968 ft, USNM unnumbered; Kali Rebjong Section: RMG 3, 1 spm., MPUM 6806; RMG 5, 1 spm., MPUM 6805.

Preservation. The preservation is fair except for the somewhat abraded apical whorls.

Type-locality. Engebi, Eniwetok, Marshall Islands.

Horizon. Lagoonal limestone: drill-hole K-1B at 957-968 ft, Tf (Burdigalian or Langhian).

Diagnosis. Shell small, turbiniform, with a flat apex. Protoconch small, apparently 1 whorled. Teleoconch whorls shouldered, abutting. Base convex, with a deep, margined umbilicus. Aperture subcircular. Sculpture of spiral cords, beaded on earlier whorls. Four cords lying on the periphery of body whorl are distinctly stronger.

Description. Shell small, commonly less than 3 mm in height, turbiniform, with a low, apically flat, gradate spire which averages 35% of the shell height. Protoconch somewhat immersed, apparently made of 1 depressed whorl. Transition to teleoconch not observable because of abrasion. Spire whorls angulate, with a broad, straight shoulder slope and a nearly vertical abapical part. They abut against the preceeding one at slightly undulating, incised sutures. Body whorl inflated, about 89% of the shell height, inconspicuously shouldered toward the aperture. Base regularly convex, with a relatively narrow, deep umbilicus. Aperture subcircular, lying in a markedly prosocline plane and with a thick peristome. Outer and inner lip equally arched, the latter clearly everted abapically.

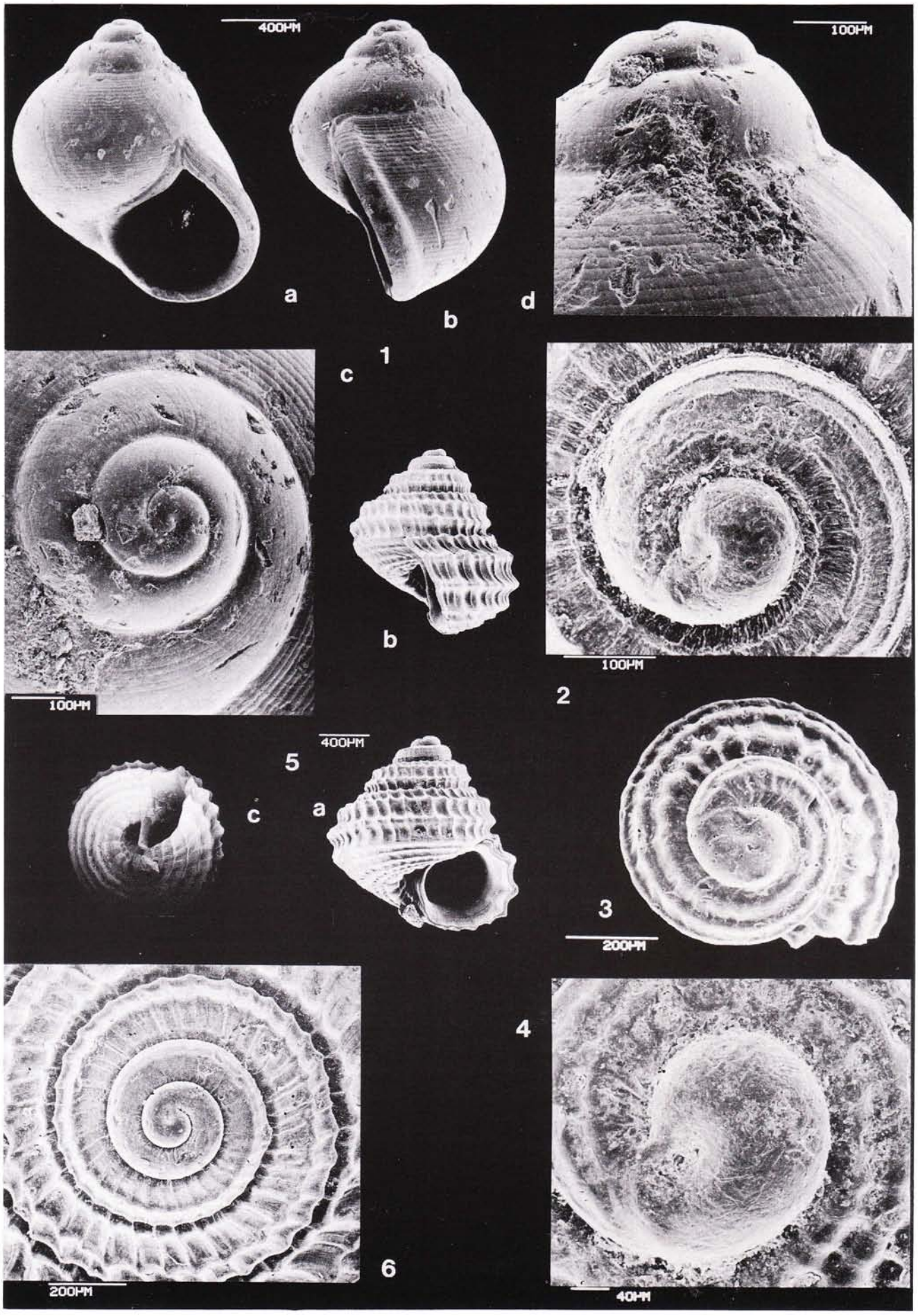
Sculpture consisting of spiral cords which are distinctly beaded on earlier whorls. The spirals on the shoulder slope gradually increase in number from 2 to 5 during growth. A stronger cord lies on the peripheral angulation and a further one, of equal strenght, is noted abapical to it. The wide, gently arched peripheral band of the body whorl bears 4 strong, equally spaced cords; 1 or 2 finer spirals commonly intervene. Nine weakly beaded cords occur on the base. The umbilicus is encircled by a row of coarse, axially elongate nodes which extend into it.

Dimensions (mm):	NW	PD	H	hs	hw	D	MSA
USNM 648312 (holotype)	4.50	0.276	2.88	0.96	2.59	3.25	100°
USNM (paratype)	-	-	2.66	1.00	2.36	-	92°
MPUM 6805 (paratype)	4.25	0.266	2.95	1.02	2.61	3.11	95°

Remarks. The two specimens from Eniwetok drill hole K-1B (holotype and paratype) appear to differ greatly from *Leptothyra laeta* (Montrouzier, 1863) in both whorl outline and sculpture. In fact, this species has

PLATE 8

Fig. 1 - *Putilla* sp. Sumberan. MPUM 6807; a) apertural side, b) labial side, c) apical whorls, d) transition to teleoconch.
Fig. 2 - *Ilanga rebjongensis* sp. n. Holotype. RMG 6. MPUM 6796; protoconch.
Fig. 3 - *Astele (Callistele) tenuistriata* (Wanner & Hahn, 1935). RMG 3. MPUM 6778; protoconch.
Fig. 4 - *Astele (Callistele)* sp. Sumberan. MPUM 6780; protoconch.
Fig. 5 - *Pareuchelus pannekoeki* sp. n. Paratype. RMG 2C. MPUM 7506; a) apertural side, b) labial side, c) base.
Fig. 6 - *Pareuchelus pannekoeki* sp. n. Paratype. RMG 2C. MPUM 7507; apical whorls.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narrowly shouldered, prominently rounded whorls, sculptured with numerous and even spiral threads. The Miocene Indonesian shells conform quite satisfactorily to the holotype in all their features. The other USNM specimens from Eniwetok drill hole E-1 (2 spms.) and Bikini drill hole 2B (1 spm.) have the earlier teleoconch whorls practically devoid of granulations, and the later whorls lacking any distinct shoulder. They are considered to belong to an undetermined species of *Leptothyra*.

The Recent *Leptothyra inepta* (Gould, 1861) and the Neogene *Leptothyra harlani* Ladd, 1966 are the most closely related species. The former differs in being markedly shouldered, with a nearly flattened periphery. The latter has a more depressed spire and the spiral surrounding the umbilicus more coarsely beaded.

Distribution. *L. laddi* sp. n. has been recorded so far (sub *Leptothyra* aff. *laeta* Montrouzier) from deposits on Eniwetok regarded by Ladd (1966) as of Te-f age, i.e. generally early-mid Miocene.

Family *Skeneidae* Clark, 1851

Genus *Putilla* A. Adams, 1867

Putilla sp.

Pl. 8, fig. 1

Occurrence. Sumberan: 1 spm., MPUM 6807. The preservation is fair.

Remarks. The small turbiniform, anomphalous shell in hand seems to belong to a previously undescribed species. It is distinguished by: 1) two whorled, broadly conical smooth protoconch bearing V-shaped growth lines, 2) wide D-shaped aperture angled and weakly channelled adapically, 3) outer lip prosocline with a moderate external varix and 4) regular, fine spiral sculpture of the teleoconch. The shell shape and apertural features are similar to those of *Putilla lucida* A. Adams, 1867, type species of the genus *Putilla* A. Adams, 1867 whereas the protoconch resembles that of the rissoid genus *Lucidestea* Laseron, 1956. In these circumstances, the present species is tentatively assigned to the genus *Putilla* which, according to Ponder (1985), is to be included in the archaeogastropod family Skeneidae.

APPENDIX

Four previously reported Rembangian species are considered separately herein. They were neither recovered during field work, nor was the present author able to see the former, often original, material from Dutch collections. Consequently, they are simply recorded, supplemented with essential information, original description, comments (translated from German) and figures, and some remarks. An attempt is also made to revise their generic assignment.

Calliostoma (Fautor) malaianus (Wanner & Hahn, 1935)

Text-fig. 5

1935 *Trochus (Calliostoma) malaianus* Wanner & Hahn, p. 264, pl. 20, fig. 13-16.

Rembangian material. The holotype (by original designation) and 1 paratype respectively from Sumberan and Gegunung.

Original description. Four middle whorls and the body whorl are preserved. They are flat-sided, well demarcated from each other, and bear 6 finely beaded primary spirals. The adapical spiral is more distinct being slightly wider and more coarsely beaded. It is bipartite by a furrow on the last 2 whorls. Secondary spirals intervene between pairs of primaries on 3 youngest whorls. The former increase in strenght during growth, becoming nearly as strong as the latter toward the end of the body whorl. Tertiary spirals occur on the body whorl. The base bears primary and secondary spirals beaded by crossing growth lines. Aperture quadrangular, nacreous layer well preserved. Deduced height 19 mm. Occurrence: Sumberan (Nr. 160), 1 specimen. A second specimen, consisting of 3 somewhat eroded intermediate whorls, exhibits a smaller spiral angle in respect to the holotype. The adapical spiral is of the same strenght of the others. The base bears even spirals. Occurrence: Gegunung (Prospect I).

Remarks. The relatively high spire, subcarinate periphery, thickened columellar margin and beaded spirals are consistent with the assignment of the present species to the subgenus *Fautor* Iredale, 1924 of *Calliostoma* Swainson, 1840.

The Pliocene shell from the island of Nias published by Wissema (1947; pl. 1, fig. 10) and referred to as *Calliostoma (Ampullotrochus) dyscritum* Cossmann, 1910 appears to be exceedingly similar to the type material of *Calliostoma (Fautor) malaianus* (Wanner & Hahn, 1935), in particular to the specimen of Wanner & Hahn's figure 13. In fact, shell shape, apertural characters, sculptural features and spiral angle (approximately 55°) are basically coincident, the unique difference being the number of spirals slightly greater in *Calliostoma (Fautor) malaianus*. It is not unlikely that the Pliocene and the Rembangian specimens are conspecific, but a

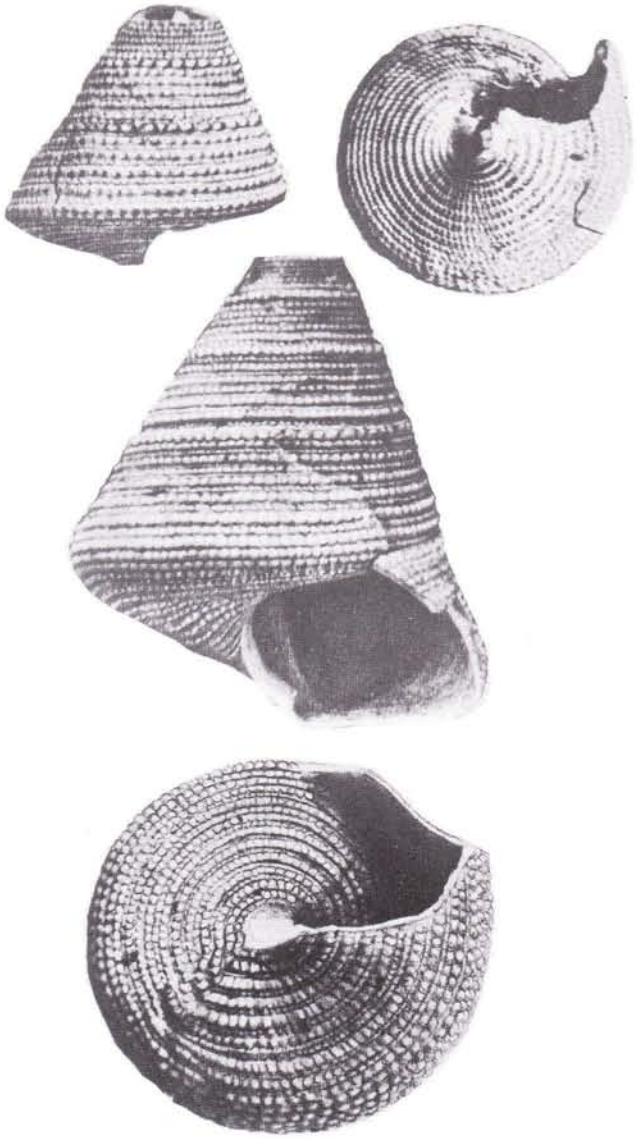

Fig. 5 - Original figures of *Trochus (Calliostoma) malaianus* Wanner & Hahn, 1935 [= *Calliostoma (Fautor) malaianus*]. Reproduced from Wanner & Hahn (1935).

decision implies the direct examination of the shell material dealt with by the cited authors. It is of note that Cossmann's species has a smaller spiral angle (45°) and the periphery of the whorls somewhat prominent beyond the abapical suture (see Cossmann, 1910, p. 80, pl. 5, fig. 24, 25).

Distribution. *C. (Fautor) malaianus* (Wanner & Hahn) has been so far recorded only from the type-area of the Rembangian stage.

Calliostoma (Fautor) martini (Pannekoek, 1936)

Text-fig. 6

1936 *Trochus (Tectus) martini* Pannekoek, p. 61, pl. 3, fig. 42, text-fig. 9.

Rembangian material. The single shell from Ngampel on which the species was based (holotype by monotypy).

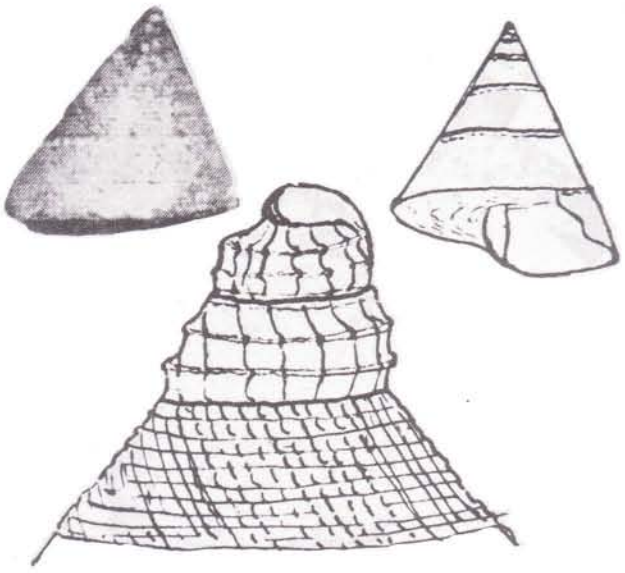

Fig. 6 - Original figures of *Trochus (Tectus) martini* Pannekoek, 1936 [= *Calliostoma (Fautor) martini*]. Reproduced from Pannekoek (1936).

Original description and comments. One specimen from Ngampel (Leiden Collection) 17 mm high, 11 mm in diameter. Protoconch 1 whorled, smooth except for fine growth lines. Teleoconch clearly demarcated from the protoconch. Earliest 1.5 whorls with 3 spirals crossed by collabral ribs; the intervening spaces between spirals and ribs are of equal breadth. The middle spiral gives the whorls an angulate aspect. Following 6 whorls flat-sided, with spiral rows of oblique, low tubercles. Secondary rows of granules intervene nearly all over. Four primary spirals are counted on oldest middle whorls and secondary ones are still very weak. The penultimate whorl bears 10 primaries and a weaker secondary in each intervening furrow. The adapical spiral constantly has somewhat coarser tubercles. Body whorl sculptured as the preceeding whorls, with a roundly angular periphery. Base flat, with about 20 fine spirals crossed by growth lines. Outer lip not preserved. Columella straight, smooth, slightly everted. Umbilicus wanting. Following Cossmann (Pal. Comp. XI, p. 168), the present species belongs to *Trochus* in that has outer and inner lips lying in different planes. This species differs from other *Trochus* species by its simple sculpture and simple columella.

Remarks. According to the description and the figures given by Pannekoek (1936), the species seems better allocated in the genus *Calliostoma* Swainson, 1840. The assignment to the subgenus *Fautor* Iredale, 1924 is made on the basis of the somewhat high, flat-sided spire, outline of the aperture and beaded spirals.

Distribution. *C. (Fautor) martini* (Pannekoek) has been hitherto recorded only from the type-area of the Rembangian stage.

Clanculus (Clanculus) rembangensis

(Wanner & Hahn, 1935)

Text-fig. 7

1935 *Trochus (Clanculus) rembangensis* Wanner & Hahn, p. 266, pl. 20, fig. 21-23.
1936 *Clanculus (Clanculopsis) rembangensis* - Pannekoek, p. 61.

Rembangian material. The syntypes (5 specimens and 2 fragments from Gegunung) and 2 shells from Lodan dealt with by Pannekoek (1936).

Original description and comments. The protoconch is followed by 5 convex middle whorls sculptured with 4 primary spirals. On the earliest 3 whorls only the subsutural cord is beaded, whereas on subsequent whorls all spirals bear granules. The subsutural cord is slightly stronger and somewhat distinct from other spirals. By the third whorl, secondary spirals intervene and, in some shells, may attain the same strenght of the primaries during growth. The body whorl of largest specimens bears 9 nearly equal and evenly spaced cords and additional intervening finer ones. Base nearly flat, with at least 7 more finely beaded cords. Umbilical cavity moderately large, not reaching the apex. Inner lip thin, with some ridges. Columella twisted adapically, with a corrugated rim and with a prominent abapical tooth. Outer lip straight-edged, with ridges on its inner side. The whole shell exhibits dense, oblique growth lines, especially well observable in the furrows between cords. One shell retains colour markings in form of narrow, collabral brown dashes. Length 4-11 mm, diameter 8-14 mm. Occurrence: Gegunung (Prospect I); 5 complete shells and 2 fragments. The nearest species is *C. corallinus* Gmelin from Pliocene of Messina, but its relationships with the present species are not strict enough to request detailed comparison.

Remarks. The present species, featured by its depressed spire and wide spiral angle (95°), seems to match the characters of *Clanculus* s.s. in having well developed apertural dentition, strong parietal ridges and a compound basal columellar tooth.

Distribution. *C. (Clanculus) rembangensis* (Wanner & Hahn) is so far known from the type-area of the Rembangian stage.

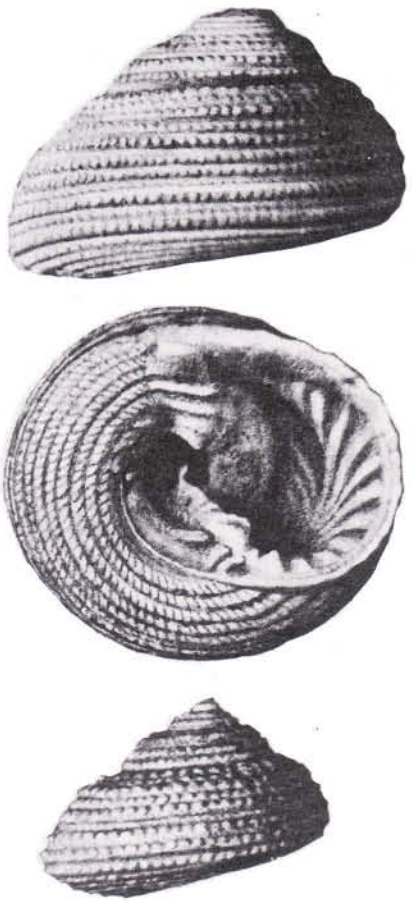

Fig. 7 - Original figures of *Trochus (Clanculus) rembangensis* Wanner & Hahn, 1935 [= *Clanculus (Clanculus) rembangensis*]. Reproduced from Wanner & Hahn (1935).

Angaria (Angaria) delphinus (Linnaeus, 1758)

Text-fig. 8

1758 *Turbo delphinus* Linnaeus, p. 764 (*non vidi*).
1920 *Delphinula laciniata* var. *atrata* - Tesch, p. 78, pl. 133, fig. 220.
1936 *Angaria (s.str.)* cf. *formosa* Pannekoek, p. 62, pl. 3, fig. 41.
1938 *Angaria (Angaria) delphinus* - Van Regteren Altena, p. 286 (see for further synonymy).
non 1941 *Angaria (Angaria) delphinus* - Beets, p. 17.
1950 *Angaria (Angaria) delphinus* - Beets, p. 306.
1960 *Angaria delphinus* - MacNeil, p. 29, pl. 16, fig. 6, 11, 12.
1966 *Angaria delphinus* - Ladd, p. 42, pl. 5, fig. 29-34.
1982 *Angaria delphinus* - Abbott & Dance, p. 51, fig. in lower middle row, middle.
1988 *Angaria delphinus* - Noda, p. 33, pl. 15, fig. 3.
1993 *Angaria (Angaria) delphinus* - Wilson, p. 96, pl. 7a, fig. 1, pl. 11, fig. 22.

Rembangian material. The single specimen from Sedan figured by Pannekoek (1936) as *Angaria* cf. *formosa* (Reeve).

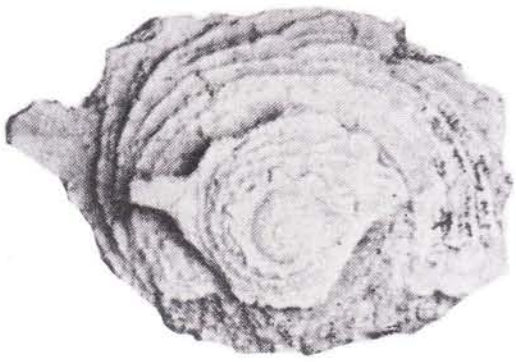

Fig. 8 - *Angaria (Angaria) delphinus* (Linnaeus, 1758). Reproduction of *Angaria* cf. *formosa* (Reeve) from Pannekoek (1936).

Remarks. Pannekoek (1936) did not provide any description of the Sedan shell and the figure she published is not to the best. Accordingly, the assignment of that specimen to *Angaria (Angaria) delphinus* (Linnaeus, 1758) is made on the authority of Beets (1950) who is supposed to have examined Pannekoek's specimen.

Distribution. *A. (Angaria) delphinus* (Linnaeus) has been recorded from Rembangian of Java, Miocene of Java (supposedly Preangerian) and Fiji (Tf), Pliocene of Java, Kalimantan and Guam (Tg/h), Pliocene of Okinawa, Pleistocene of Sumba and Timor. The species ranges today in the Southwest Pacific and Australian waters at shallow depths.

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