Neogene fossil tonnoidean gastropods of Indonesia

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Tonnoidean gastropods in K. Martin's and other collections in the Nationaal Natuurhistorisch Museum, Leiden (and a few other minor collections) are reidentified and classified. The resulting fauna of 99 species is very similar to that of the Indo-West Pacific today, 70% of species still inhabiting the Indonesian region. Species endemic to the Miocene and Pliocene rocks of Indonesia are *Bursa sangirana* sp. nov., and two new (unnamed) species similar to *Bursina ignobilis* (Beu); *Cassis depressior* Martin and *C. preangerensis* Martin; *Cypraecassis denseplicata* (Martin) and an unnamed species of *Cypraecassis*; *Sconsia martini* van Regteren Altena and *S. pulchra* Pannekoek; *Echinophoria vandervlerki* Martin (possibly a synonym of *E. wyvillei* (Watson)); *Phalium menkrawitense* Beets and *P. rembangense* (Martin); *Distorsio denseplicata* van Regteren Altena and *D. djunggranganensis* (Martin); *Biplex magnifica* (Martin), *B. pamotanensis* (Martin) and *B. perliberalis* (Beets); *Cymatium (Monoplex) gembacanum* (Martin) (?=*C. exaratum* (Reeve)), *C. rembangense* (Wanner & Hahn), and *C. tjaringinense* (Martin); *Cymatium (Ranularia) pseudopyrum* (Martin) and an unnamed species of *C. (Ranularia)*; *Cymatium (Septa) dharmai* sp. nov.; *Sassia (Cymatiella) fennemai* (Martin), *S. (C.) menkrawitensis* (Beets) and an unnamed species of *S. (Cymatiella)*; *Eudolium erbi* (Haanstra & Spiker), *E. errabundum* (Beets) and *E. pamotanense* (Martin); *Malea*(?) *papuana* (Beets); and *Sconsodolium* (gen. nov.) *rembangense* (Pannekoek). These 30 species (30% of the recorded fauna), and the generic groups *Sconsia*, *Sconsodolium* and *Sassia (Cymatiella),* are all "additional" tropical western Pacific taxa that became extinct before the present day (*Sconsia* and *Sassia (Cymatiella)* only locally), as a result of Pleistocene climate change.

Species previously included in *Bufonaria* Schumacher prove to belong in two distinct genera; species closely related to "*Bursa" nobilis* have a subcentral (rather than mid-left edge) opercular nucleus and are reclassified in *Bursina* Oyama. "*Sconsia" rembangensis* Pannekoek is an elongate, axially ridged cassid with a coarsely plicate inner lip; the new genus *Sconsodolium* is proposed for it. *Galeodea bituminata* (Martin) and *G. carolimartini* Beets are both earlier names for the western Pacific species (originally described in the Recent fauna) previously known as *G. echinophorella* Habe. *Eudolium javanum* (Martin) is an earlier name for the Indo-West Pacific species (originally described in the Recent fauna) previously known as *E. pyriforme* (G.B. Sowerby 3rd), whereas *E. bituminata* Martin is a synonym of the near-cosmopolitan species *E. bairdii* (Verrill & Smith). *Ranella spinosa* var. *granosa* Martin is either an earlier name for the western Pacific species (originally described in the Recent fauna) previously known as *Bufonaria perelegans* Beu, or a closely similar, but distinct, species. *Purpura bantamensis* Martin, *Cassis tegalensis* Martin, *Dolium losariense* Martin, and *Tritonium verbeeki* Boettger are all synonyms of *Cymatium (Linatella) cingulatum* (Lamarck).

Contents

Introduction

The Neogene molluscan fauna of Indonesia is important for the understanding of world molluscan biogeography, as it provides the only extensive, diverse fossil record of the tropical Neogene Indo-West Pacific fauna. For tonnoidean gastropods, with their very wide distributions conferred by a long planktotrophic larval life, this fossil record provides the only evidence of whether or not a species was present in the tropical Indo-West Pacific area relatively early in Neogene time and whether any "additional" Pacific taxa have become extinct before the present day. Of course, it safely can be assumed that not all species that inhabited Indonesia during Neogene time are represented in the fossil record, but the Indonesian fauna is the only record there is. Taxonomists also routinely should investigate the possibility that species living in the Indo-West Pacific region received names earlier as fossils in Indonesia than they did in the Recent fauna. Three examples are provided here of species of which the earliest name was provided for an Indonesian fossil, supplanting a name based on Recent material; *Galeodea bituminata* (Martin, 1933) (= *G. echinophorella* Habe, 1961), *Eudolium javanum* (Martin, 1879) (= *E. pyriforme* G.B. Sowerby 3rd, 1914) and *Bufonaria granosa* (Martin, 1884) (?= *B. perelegans* Beu, 1987). A popular introduction to some of the richly diverse molluscan fossils of Indonesia was provided by Dharma (2000).

The aims of this review are to provide a classification for the endemic tonnoidean species named from the Indonesian Neogene, and to clarify the fossil record of the Recent tropical Indo-West Pacific fauna. It includes the material described in many papers by Karl Martin, the "Kendeng beds" (not a currently used stratigraphical division) material reviewed by van Regteren Altena (1942), much material described by Beets, the Nias Island fauna described by Wissema (1947), and some undescribed collections, in other words, all the material available in the Nationaal Natuurhistorisch Museum/Naturalis, in Leiden (RGM). Extensive additions have been made from the collection of Bunjamin Dharma, in Jakarta, Indonesia, and from the Indonesian collections of Professor Elio Robba (Università di Milano-Bicocca). The family Ficidae is not included here, as Riedel (1994) has removed it to a superfamily of its own.

A very clear distinction is obvious in Indonesia (as in most other parts of the world) between the Paleogene and Neogene molluscan faunas. The Paleogene one consists almost entirely of extinct species, most of which have no obvious relatives in the Recent fauna. In contrast, the Neogene fauna (at least, of tonnoideans) consists largely of living species, along with a relatively small number of Indonesian Neogene endemic species and one genus, i.e., additional Indo-West Pacific taxa that did not survive into Recent times. In addition to the species listed here, many referred by Martin (in numerous papers) to *Hindsia, "Argobuccinum", etc.*, have been referred to the Ranellidae in the past, but actually are Buccinidae belonging in or closely related to *Nassaria* Link, 1807. These incorrectly assigned species are not included in the present catalogue. Most of the Indonesian molluscs included here also were included in the large computer catalogue by Skwarko & Sufiati (1994), but their list is highly uncritical in classification, taxonomic position and synonymy. The material has been reidentified for the present paper by examination of the actual collections. An appendix revises the taxonomic position of a few of the Buccinidae, Turbinellidae(?) and Conidae described in the Indonesian fauna (originally proposed within the Tonnoidea) by Martin and Beets, and lists the Indonesian fossil species of *Colubraria* (Buccinidae) that I am aware of.

Localities

Localities for the "Kendeng beds" faunas were listed by van Regteren Altena (1938, pp. 248-262), in two large tables that documented, respectively, the Mijnwezen Collection localities and Cosijn's Collection localities for Pleistocene molluscs from the upper Kendeng beds. These localities are referred to in the present work only by the numbers cited by van Regteren Altena and (as in van Regteren Altena's lists) are prefixed by M for Mijnwezen localities. Cosijn's localities have not been cited, as this section of the RGM collection at present bears registration numbers, but no localities (the localities can be found from the register); only the registration numbers and numbers of specimens are cited here. This is of little consequence, as all Cosijn's material is Pleistocene and was collected from a relatively small area near Bandungan in northern central Java.

Beets and most other authors on Indonesian fossil molluscs have described the locality details for their material. However, the locality data for much of the material described by Karl Martin in many papers are not so accessible. Much is stated briefly, with reference to a local village or stream name, without more detailed locality information. Most of these localities are updated here with information from the RGM Martin Collection type catalogue (van den Hoek Ostende *et al.,* 2002) and from Bunjamin Dharma, a private collector living in Jakarta. The current Indonesian locality names, provided by Dharma, are quoted below in square brackets following the names used by Martin and other early authors. The Indonesian word "Gunung" (hill) has been replaced by "Mount" uniformly throughout.

Junghuhn's localities – A particular mystery for workers on Indonesian fossils has been the localities for the collections made in Java by Franz Junghuhn, whose material was the subject of Martin's (1879-1880) first work on the Cenozoic molluscs of Indonesia. Martin in several papers referred only to Junghuhn's locality letters (K, L, O, *etc.*) without explaining the actual localities. Junghuhn's lettered localities actually refer to groups of his numbered localities in Java (for rocks and minerals as well as fossils). The groups originally were defined by Junghuhn (1853, *in* 1850-53, vol. 4, pp. 97-121) in the section on fossils in his geological description of Java. More importantly, a catalogue by Junghuhn (1854) lists the location of the 1369 localities he had collected up to that date, included in his lettered groups A-T (those in groups U-Z evidently having been collected after the book was published). The lettered localities also were shown on a hand-coloured A3 geological sketch map bound in the back of [some copies of?] Martin (1879-1880). Junghuhn provided a further list of the lettered, grouped localities in Herklots's (1854) description of fossil echinoderms of Java. The location of Junghuhn's localities is stated also (from Junghuhn's descriptions) by van den Hoek Ostende *et al.* (2002, under "Index of fossil localities") and is quoted here, largely translated loosely from

Junghuhn (*in* Herklots, 1854), and so is referred to by Junghuhn's letters in the present paper.

Junghuhn A – Western hills of the Residency of Bantam, close to the south coast of Java.
Junghuhn B – Calcareous banks on the west side of central Bantam; Mount Tanggil close to Sawarna, and others.
Junghuhn C – Eastern part of Jampang-Kulon, near the sea, between the rivers Ci Karang (Cikarang) and Ci Kaso (Cikaso), in the neighbourhood of the villages Pelabuhanratu and Landak.
Junghuhn D – Calcareous marl close to Cikaso, in the gorges of Cisoro and Cikaso.
Junghuhn E – The Goua tji-Kopea cave, close to the village of Dolog, in the interior of the Djampang tengah district.
Junghuhn F – North of Goua tji-Kopea, between Dolog and Sajaranten.
Junghuhn G – The valley of the Tji-Bouni, close to the village of Dougou, situated at the foot of the vertical face of Mount Brengbreng, in the Djampang tengah district.
Junghuhn H – Foot of the volcano Mount Karang, northeast of Soukanegara, the main town of the district, in the interior of Djampang wetan.
Junghuhn I/J – Gorge of the upper Ci Upih (Ciupih), near Kolamperes village, between Mount Brengbreng and the main town of Sindangbaran, in the district of Cidamar, southwestern Java.
Junghuhn K – Western part of Cidamar, southwestern Java. The uplifted country of the middle coast, to the north of Sindangbaran, cut by the ravines of Cikadou, Cibarak, Cisadea and others.
Junghuhn Kk – The coral bank Karang itam, situated in front of Mouara-Kelapa tjondong, i.e., the mouth of the stream Kelapa tjondong, between Oudjong Cikarang and Oudjong-Guaourouk, to the east of the Gending peninsula, in the Djampang keolon distict, on the south coast of Java.
Junghuhn L – Interior part of Cidamar, southwestern Java. The mountains cut by the ravines of Cidamar, Citaon and others, north of the village of Citaon and mainly west of the stream of the same name.
Junghuhn M – Eastern part of Cidamar, southwestern Java. To the west of Cingoumbout, which empties into the Cilajou, between the villages of Citaon and Ceringen.
Junghuhn N – Calcareous banks that form the external mountain ranges west of Bandung, in front of Radja mandala, close to the Cisitou river.
Junghuhn O – Southwestern part of the Bandung plateau, Rongga district south of the Citaroum gorge, between the first cataract of Courouk-Djompong and the Cilanang Gap near Nanggulan; passing from Lio Citjangkang westwards towards Mount Sela and principally in the Cilanang gorge (near Jogjakarta in south central Java).
Junghuhn P – "Calcareous bank in the eastern part of the promontory" [presumably the promontory referred to in the next locality group].
Junghuhn Pp – Close to the village of Campaka, below the village of Taringgoul (between Wanajasa and Pourwokerta), to the northeast of Mount Bourangrang, in the promontory at the northern foot of the volcanic chain north of Bandung.
Junghuhn Q – The Citaroum gap, close to Cikaok (residency of Krawang), north of Mount Parang, near the volcanoes Mounts Gede and Bourangrang, but more towards the north.
Junghuhn R – Mouth of the Tji-Karang (Cikarang) stream, east of Tjieri (Cieri) village, between the mouths of the rivers Tji-Kantang (Cikantang) and Tji-Laouteren (Cilauteren), in the Kendeng district, western Sukapura Regency.
Junghuhn S – The Goua-Linggomanik cave, on the plateau of neptunian mountains, limited to the west by the Cilaengan valley and to the east by the Cilongan valley; west of Desa-Dedel.
Junghuhn T – The wall of the valley of the Tji-Berem (Ciberem), in the Karang district, Sukapura Regency.
Junghuhn U – Right bank of the Ciwoulan, three miles southeast of the main town of Cibalong, district of Paroung, residency of Sukapura, where the foot of the western chain forms a group of rocks, entirely cut into perpendicular ravines.
Junghuhn V – Country east of the Ciwoulan valley, more to the interior than locality group U; on the slope of the mountain that forms a wide, flat plateau there.
Junghuhn W – A group of hills forming the eastern edge of the valley of Kali poutjang, the main town of the district of the same name, residency of Sukapura, and which separates it from Citandoui.

Junghuhn X – The Goua-Rempak cave, situated at the northeastern extremity of Nousa-Kambangan Island.

Junghuhn Y – Near the mountain named Tjelatjap (Cilacap) by Junghuhn, between Madura and Sonde (Sinde); principally from the bed of the Cimalo.

Junghuhn Z – The most northern Tertiary, in the Kouningan (Kuningan) region, Residence of Cheribon [Cirebon]; from Menengteng Gorge, the name given by the Javanese to the valley of the Cisangaroung or Kali-Losari; principally from the left side.

Other localities – Recent publications have provided new insight into the stratigraphy and ages of Indonesian Cenozoic rocks. Robba (1996, pp. 267-271) discussed localities and age for the Rembang fauna of Java, perhaps the most intensively studied of all Indonesian Cenozoic molluscan faunas. He concluded (from independent studies of planktonic Foraminifera) that they fall into planktonic foraminiferal zones N8 and N9 (Langhian Stage, Middle Miocene). More broadly, Skwarko (1994, pp. 3-73) included a large number of summary diagrams of the stratigraphy and ages of Indonesian Cenozoic successions in the introduction to his catalogue of Indonesian Cenozoic Mollusca. This summary provides an excellent entry into the large Indonesian literature, impelled by the oil exploration industry, on Cenozoic stratigraphy and ages that has revolutionised knowledge of this field since the classical works of Martin.

Other localities for material, listed below, collected from the Nyalindung [Njalindung] Formation in western Java by Professor Elio Robba (University of Milano-Bicocca; pers. comm.) have been supplied by Professor Robba, and are listed here and only referred to in the text by his field abbreviations: (1). Section near the village of Tjimerang (Cimerang), Sukabumi area, along the Cimerang River, approximately 500 m upstream from the bridge to the village, at the foot of Mount Buleud: (base) fossiliferous grey marl, 12 m thick; sample NJ4 at base, NJ3 from uppermost part; overlain by peaty layer 0.1 m thick, sample NJ2; overlain by grey clay with many *Turritella*, 0.5 m, sample NJ1; overlain by fossiliferous, yellowish marly limestone. Material not in place, collected from the foot of the outcrop, labelled NJ; material in the riverbed downstream at the village labelled NJR. (2). Section near the village of Cijarian, where the road from Bantargadung to Pasirsuren bridges an unnamed stream; cliff on left side of stream: (base) dark grey clayey silt, 3 m thick; sample CIJ1 from the basal part; overlain by blackish marl, 1.2 m; overlain by grey clay with many large *Turritella*, 2.0 m thick, sample CIJ3 from the middle part; overlain by the same lithology as the lowest bed, 1.5 m thick, sample CIJ4 from the middle part; overlain by a sandy bed, not reached, at top of cliff. Both these localities failed to yield age-diagnostic microfossils and have only a general Preangerian age (Middle Miocene, approximately Serravallian Stage).

Pliocene-Pleistocene extinctions of Indonesian species

One of the main interests of the Indonesian fossil fauna is the "additional" species occurring fossil there that did not survive to occupy the Indo-West Pacific province at present. As many as 30 species of tonnoideans are recorded here from Miocene and/or Pliocene rocks of Indonesia that apparently are extinct: *Bursa sangirana* sp. nov., and two unnamed new species similar to *Bursina ignobilis* (Beu, 1987); *Cassis depressior* Martin, 1879, and *C. preangerensis* Martin, 1899 (possibly a synonym of *C. cornuta* (Linné, 1758)); *Cypraecassis denseplicata* (Martin, 1916), and an unnamed species of *Cypraecassis*; *Sconsia* *martini* van Regteren Altena, 1942, and *S. pulchra* Pannekoek, 1936; *Sconsodolium rembangensis* (Pannekoek, 1936); *Echinophoria vandervlerki* Martin, 1933 (possibly a synonym of *E. wyvillei* (Watson, 1886)); *Phalium menkrawitense* Beets, 1941, and *P. rembangense* (Martin, 1899); *Distorsio denseplicata* van Regteren Altena, 1942, and *D. djunggranganensis* (Martin, 1916); *Biplex magnifica* (Martin, 1879), *B. pamotanensis* (Martin, 1899), and *B. perliberalis* (Beets, 1984); *Cymatium (Monoplex) gembacanum* (Martin, 1884) (?= *C. exaratum* (Reeve, 1844a)), *C. rembangense* (Wanner & Hahn, 1935), and *C. tjaringinense* (Martin, 1899); *Cymatium (Ranularia) pseudopyrum* (Martin, 1899), and *C. (Ranularia)* sp. nov.; *Cymatium (Septa) dharmai* sp. nov.; *Sassia (Cymatiella) fennemai* (Martin, 1899), *S. menkrawitensis* (Beets, 1941), and an unnamed species of *S. (Cymatiella)*; *Eudolium erbi* (Haanstra & Spiker, 1932), *E. errabundum* (Beets, 1943b), and *E. pamotanense* (Martin, 1899); and *Malea* (?) *papuana* (Beets, 1943b). Five of the new species are left in open nomenclature here, awaiting more material for an adequate description. It is likely that other extinct species remain unrecognised as yet. In a total Neogene tonnoidean fauna of 99 species recorded fossil in Indonesia and a total fauna of 216 living Indo-West Pacific species, this list of at least 30 extinct species is a surprisingly large addition (145 species of Bursidae, Personidae and Ranellidae listed by Beu, 1998, pp. 17-20; plus 49 species of Cassidae (Abbott, 1968; Beu, new data), seven species of Laubierinidae, and 15 species of Tonnidae). The extinct species comprise 30% of the Indonesian Neogene tonnoideans, and 12% of the total Indonesian Neogene plus living Indo-West Pacific fauna of 246 species of tonnoideans. Obviously, though, the 99 species recorded as fossils in Indonesia comprise only 40% of the total living Indo-West Pacific tonnoidean fauna; more of the living species can be expected to be collected in Indonesia in the future – and, indeed, Bunjamin Dharma (a private collector in Jakarta) has added four species to the Indonesian fauna during the last year, recorded here, but not recorded as fossils previously. Another aspect of this extinction to be kept in mind is that it removed the generic groups *Sconsia*, *Sconsodolium* gen. nov. and *Sassia (Cymatiella)* from the tropical Pacific fauna. This rendered the genus *Sconsodolium* extinct also, whereas *Sconsia* found a refuge in the western Atlantic and *Sassia (Cymatiella)* is still represented by several species living along the southern and eastern coasts of Australia.

Extinction of tropical Indo-Pacific species is an important phenomenon that implies significant Pleistocene climate change. Many studies in recent years have concluded that the frequent, rapid sea-level fluctuations caused by the glacial-interglacial oscillations of Pleistocene time (Chappell & Shackleton, 1986; Pillans *et al.*, 1998) caused major expansions and contractions of ranges and a marked level of extinction of benthic marine invertebrates in the tropical Indo-Pacific fauna (Stoddart, 1973, 1976; Taylor, 1978; Chevalier, 1979, 1981; Kohn, 1983; Potts, 1983, 1984, 1985; McManus, 1985; Crame, 1986; Newman, 1986; Paulay, 1990, 1991; Kohn & Arua, 1999). Sedentary taxa such as corals and benthic molluscs occupying small areas around low-lying islands obviously are adversely affected by the frequent regressions and transgressions, causing numerous extinctions. On the other hand, the frequent, rapid elevation and lowering of sea level, and the constriction and reopening of lagoons and bays, have provided numerous opportunities for allopatric speciation. Paulay (1990, 1991) demonstrated that Pleistocene glacial-interglacial oscillations altered species compositions and rearranged geographical distributions of the corals and bivalves inhabiting shallow water around coral reefs of the southwest Pacific. Coral reef gastropods, of course, would have been affected similarly. Kohn & Arua (1999) suggested a similarly dynamic biogeographical history for the gastropods inhabiting shallow subtidal soft sediments near these same islands. Presumably, during the sea-level oscillations of 100-130 m that have operated over the last *c.* 800 000 years, following the mid-Pleistocene climatic transition (Pisias & Moore, 1981; Berger & Jansen, 1994; Mudelsee & Schulz, 1997; Raymo, 1997; Raymo *et al.*, 1997), the maximum affect on the biota would take place in the intertidal zone and the effects would decrease progressively down to the maximum depth of the regression. Even taxa living in perhaps 100 m of water might have been affected by sea-level change. As with the Fijian fauna reported by Kohn & Arua (1999), the Indonesian fossil fauna studied here is almost entirely that of the shallow offshore soft substrates around Indonesia rather than the intertidal fauna of coral reefs. The notorious factor of the poor preservation of the intertidal fauna has as marked an effect in Indonesia as everywhere else. The Nias Island fauna reported by Wissema (1947) is an exception, as it includes such shallow-water taxa as *Distorsio anus* (Linné, 1758) and *Cymatium muricinum* (Röding, 1798), as well as some more offshore taxa; it seems to have been deposited in only slightly shallower water than the other Indonesian faunas. The present evidence of extinction in Indonesia of 30% of the tonnoideans, the gastropods with the most frequently and widely dispersed planktotrophic larvae, demonstrates again strongly that sea-level changes and the vagaries of larval dispersal between widely separated islands have greatly altered the distributions of benthic invertebrates during Pleistocene time.

Most of the taxa now seen to be "additonal" tropical Pacific ones in Indonesia have normal planktotrophic tonnoidean protoconchs and presumably were widely distributed in the tropical Pacific before their extinction. This includes *Sconsodolium rembangense* (Pannekoek), which has a large (4 mm diameter), smooth protoconch similar to that of *Cypraecassis.* In contrast, a few other taxa had protoconchs suggesting short planktonic lives or direct development; *Sconsia* has a small, one-whorl, bulbous, smooth protoconch as in all Recent *Galeodea* species, and the protoconch of *Sassia (Cymatiella)* species is very small and paucispiral, probably indicating lecithotrophic development. The extinction of these last two genera is therefore less surprising than that of *Bursa, Bufonaria* and *Cymatium* species, which apparently reacted to sea-level change in much the same way as any other molluscs. This emphasises that Pleistocene faunal change in the tropical Indo-Pacific affected the shallow offshore fauna as much as the intertidal one and planktotrophs as much as non-planktotrophs.

Abbreviations

Institutions cited in the text as repositories of material are abbreviated as follows:

AMS	Australian Museum, Sydney.
AMNH	American Museum of Natural History, New York.
ANSP	Academy of Natural Sciences, Philadelphia.
BMNH	The Natural History Museum, London.
GNS	New Zealand Institute of Geological & Nuclear Sciences, Lower Hutt.
IAUU	Instituut voor Aardwetenschappen, University of Utrecht.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge.
MGMD	Mineralogisch-Geologisch Museum, Delft.
MHNG	Muséum d'Histoire Naturelle de Genève.

MNHN	Muséum National d'Histoire Naturelle, Paris.
NMB	Naturhistorisches Museum Basel.
NMP	Natal Museum, Pietermaritzburg.
NSMT	National Science Museum, Tokyo.
RGM	Nationaal Natuurhistorisch Museum/Naturalis, Leiden.
SMF	Senckenberg Museum, Frankfurt am Main.
USNM	United States National Museum of Natural History, Washington D.C.
ZMC	University Zoological Museum, Copenhagen.

Dimensions of specimens are stated in the consistent order H (= height), D (= maximum diameter), in mm.

Synonymies are arranged in the briefest style that still allows some understanding of nomenclatural history; a query at the beginning of a synonymy entry indicates that I am uncertain whether this entry is correctly referred to the present species.

Systematic palaeontology

Superfamily Tonnoidea Suter, 1913 (1825)

Family Bursidae Thiele, 1925

Remarks – In addition to the Bursidae reviewed here, Martin (1928, table p. 8) recorded "*Ranella crassa* Dillwyn" from the Pliocene of Atjeh [Aceh], Sumatra. This name is a junior synonym of the Recent western Atlantic bursid *Marsupina bufo* (Bruguière, 1792), but I do not know which species Martin was referring to by this name. I have seen no material in collections from Indonesia so identified.

Genus *Bufonaria* Schumacher, 1817

Bufonaria Schumacher, 1817, p. 251. Type species (by subsequent designation, Herrmannsen, 1846, p. 135); *Bufonaria spinosa* Schumacher, 1817 (= *Gyrineum echinatum* Link, 1807), Miocene to Recent, central-northern Indo-West Pacific and Red Sea.

Chasmotheca Dall, 1904, p. 118. Type species: *Ranella foliata* Broderip, 1826, Recent, Indian Ocean.

Remarks – Until recently (Beu, 1981, 1987, 1998), I have used *Bufonaria* for an apparently uniform genus (apart from the Atlantic subgenus, *B. (Aspa)* H. & A. Adams, 1858, containing the single Recent species *B. marginata* Gmelin, 1791) for Indo-West Pacific species with a dorsoventrally compressed shape, with evenly granulose sculpture over the entire teleoconch, and with an operculum similar to that of the cassid Subfamily Phaliinae, i.e., fan-shaped, with the nucleus halfway along the columellar margin. However, examination of the NMP collection, containing many specimens with their operculum preserved, demonstrated that this apparently single group includes species with two markedly different operculum types. Typical *Bufonaria* (i.e., including the type species, *B. echinata* (Link, 1807)) has the fan-shaped operculum previously thought to characterise all these species. In contrast, those species with a rather elongate, biconic teleoconch shape, only small nodules at the periphery, and no spines on the posterior siphonal canals have an operculum with the nucleus situated slightly above and to the right of (towards the outer lip margin from) the mid-line of the operculum, very similar to that of the bursid genus *Tutufa*. In my opinion, this group constitutes a genus separate from both *Bursa* and *Bufonaria*. The earliest name for the group is *Bursina* Oyama, 1964 (see below). Most species of both these genera have been revised by Beu (1987, 1998). The species now classified in *Bufonaria (Bufonaria)* are:

Bufonaria (Bufonaria) cavitensis (Reeve, 1844b), Philippines (and northern Indonesia?).

cristinae Parth, 1989, Philippines (operculum not seen).

crumena (Lamarck, 1816), Indian Ocean and westernmost Pacific; Neogene, Indonesia.

echinata (Link, 1807), Indian Ocean, northern Pacific, and Red Sea; Neogene, Indonesia.

elegans (G.B. Sowerby 2nd, 1836, *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841), Andaman Sea-western Thailand-western Sumatra; Neogene, Indonesia.

granosa (Martin, 1884) (?= *perelegans* Beu, 1987), western Pacific; Neogene, Indonesia.

foliata (Broderip, 1826), Indian Ocean.

margaritula (Deshayes, 1832), Indo-West Pacific; Neogene, Indonesia.

rana (Linné, 1758) (= *albivaricosa* Reeve, 1844b, = *subgranosa* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841), western Pacific; Neogene, Indonesia.

thersites (Redfield, 1846), western Pacific.

Bufonaria (Bufonaria) crumena **(Lamarck, 1816)**

Figs. 1-5.

Ranella crumena Lamarck, 1816, pl. 412, fig. 3, "Liste des objets", p. 4; Lamarck, 1822, p. 151; Broderip, 1826, pl. 11, fig. 2; G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G. B. Sowerby 2nd, 1832-1841, pl. 88, fig. 9; Reeve, 1844b, pl. 4, fig. 17b (typical form only); Boettger, 1883, p. 149, pl. 5, fig. 14; pl. 6, fig. 1; Martin, 1899, p. 145; Martin, 1919, pp. 89, 122, 123, 126; Martin, 1928, p. 8; van der Vlerk, 1931, p. 240.

Ranella crumenoides "Blainville" Valenciennes, 1832, p. 297.

Ranella elegans. – Kiener, 1841, p. 4, pl. 3, fig. 1 (not *Ranella elegans* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G. B. Sowerby 2nd, 1832-1841).

Ranella crumena paucinodosa Boettger, 1883, p. 36, pl. 1, fig. 9a, b.

?*Ranella (s. str.)* sp. indet. – Icke & Martin, 1907, p. 238, pl. 15, figs. 19, 19a.

Ranella (Bursa) affinis. – Tesch, 1920, p. 42, pl. 129, fig. 154 (not *Ranella affinis* Broderip, 1833).

Bursa (Chasmotheca) crumena. – Oostingh, 1935, p. 61.

Bufonaria crumenoides. – Kilburn & Rippey, 1982, p. 72, pl. 16, fig. 13.

Bufonaria crumena. – Beu, 1987, p. 336, fig. 231-233.

Bufonaria (Bufonaria) crumena crumena. – Cossignani, 1994, p. 17, figs. pp. 17, 18.

Type material – *Ranella crumena* Lamarck, lectotype (of Beu, 1987, p. 336), MHNG 979/331, the specimen illustrated in dorsal view by Lamarck (1816, pl. 412, fig. 3). *Ranella crumena* var. *paucinodosa* Boettger, 1883, holotype (Fig. 5) SMF XII/2880a, "Eburnamergel, Pfahl 65, Seluma, Sumatra", Late Miocene (see *Tritonium verbeeki* Boettger, under *Cymatium cingulatum*; this material apparently was sent to Boettger by Verbeek). No type material seems to exist for *Ranella crumenoides* "Blainville" Valenciennes, 1832; certainly none is present in MNHN and it appears that Valenciennes's usage of the name was based on a museum label.

Other material examined – RGM 9876, Palaboean ratoe [Pelabuanratu], Java, Preanger [Priangan] (1 small, incomplete; Figs. 3, 4); RGM 9875, Bajah [Bayah], Residence of Bantam [Banten], Java, Pliocene (1 large, good; Figs. 1, 2); RGM (not recorded), Tjikeusik [Cikeusik], Residence of Bantam [Banten], Java (2 small); RGM 91 895, Tji Odeng [Ciodeng], Palabuan district, Java, Late Miocene (7 good); Robba's locality CIJ1, Cijarian, western Java, Preangerian, Middle Miocene (1, in Università di Milano-Bicocca); Cijarian, West Java, Late Miocene, collected & presented by B. Dharma (GNS WM 17242, 1; 1 in collection of B. Dharma); Bojong, West Java, Late Pliocene/Early Pleistocene, presented by B. Dharma (GNS WM 17243, 4); material from IAUU, received in RGM: Lubuq Sumung, Benkulen, Sumatra, leg. Erb (1 small).

Distribution – *Bufonaria crumena* lives now throughout the Indian Ocean and Gulf of Arabia, as far south as South Africa, but not in the Red Sea. Specimens occur off western and central Indonesia. In northern Indonesia and the Philippine Islands it is replaced by a much darker and less dorso-ventrally compressed form or species, *B. cavitensis* (Reeve, 1844b). Fossils of *B. crumena* are moderately common at some Miocene and Pliocene localities in Java.

Remarks – Beu (1987, p. 336) clarified the type material and synonymy, and illustrated the lectotype of *Ranella crumena* Lamarck. *Bufonaria crumena* is very distinctive because of its large size, its very short spire and wide shape, its large aperture with widely flared lips, and its fine sculpture apart from the row of large, pointed nodules around the periphery and down the varices. The specimen described by Boettger (1883, p. 36.) as "var. *paucinodosa*" (Fig. 5) is merely a small specimen, so that its normal-sized nodules appear relatively large in comparison with those of adult shells. It is curious that, although there are several specimens in collections from Java and Sumatra, there is no material of *Bufonaria crumena* in the large "Kendeng beds" collections described by van Regteren Altena (1942).

***Bufonaria (Bufonaria) echinata* (Link, 1807)**

Figs. 6-9.

Gyrineum echinatum Link, 1807, p. 123.
Ranella spinosa Lamarck, 1816, pl. 412, fig. 5a, b, "Liste des objets" p. 4; Lamarck, 1822, p. 152; Kiener, 1842, p. 7, pl. 5, figs. 1, 2; Reeve, 1844b, pl. 11, fig. 7; van der Vlerk, 1931, p. 24.
Bufonaria spinosa Schumacher, 1817, p. 252.
Bursa suensonii Mörch, 1853, p. 106 (Beu, 1987, p. 333).
Ranella (Bufonaria) spinosa var. – Martin, 1899, p. 147, pl. 23, figs. 343-345.
Bursa (Bufonaria) spinosa. – Cox, 1948, p. 41, pl. 3, fig. 8a, b; Skwarko & Sufiati, 1994, p. n1.
Bufonaria (Bufonaria) echinata. – Beu, 1985, p. 65; Cossignani, 1994, p. 20.
Bufonaria echinata. – Okutani, 2000, p. 271, pl. 134, fig. 14.

Type material – No material is known today from the collections of Link (1807) or Schumacher (1817). *Ranella spinosa* Lamarck, holotype MHNG 1098/81, a large (H 73.9, D 65.7 mm) unlocalised specimen. The holotype of *Ranella spinosa* Lamarck is here designated the neotype of both *Gyrineum echinatum* Link, 1807, and *Bufonaria spinosa* Schumacher, 1817. Beu (1987, p. 333) discussed the identity of *Bursa suensonii* Mörch, a synonym of *B. echinata*, and suggested that Mörch (1857, p. 20) may have disposed of the type material with the sale of the Suenson collection; two possible syntypes (labelled by Mörch) remain in ZMC.

Other material examined – RGM 9912, Tjiodeng [Ciodeng], Java, Preanger [Priangan] (2 good, illustrated by Martin, 1899, figs. 343, 344); RGM 9905, Junghuhn's locality O, Java (2 good, illustrated by Martin, 1899, figs. 345, 345a; Figs. 6-9); RGM 9908, Preanger [Priangan], "Javagruppe", no locality (1); RGM 9906, Tji Odeng [Ciodeng], Java, Preanger [Priangan] (3 good); RGM 9910, Tji Tangkil [Citangkil], Preanger [Priangan], Java, (2); RGM 9898-9, Tji Odeng [Ciodeng], Buitenzorg [Bogor], Java, Late Miocene (43 good); Robba's localities CIJ1 (1), CIJ3 (4), CIJ4 (14), Cijarian, western Java, Preangerian, Middle Miocene (all in Università di Milano-Bicocca); Cijarian, Pelabuhan Ratu, West Java, Late Miocene, collected by B. Dharma, presented by G. Kronenberg (GNS WM17197, 1); material from IAUU, received in RGM: Lubuq Kupang and Mas. Mambang, Saluma, Benkulen, Sumatra, leg. Erb (2); Lubuq, Mount Saluma, Benkulen, Sumatra, leg. Erb (5 + fragments); Pass. Bintuhan and Tg. Betuwa, Kauer, Benkulen, Sumatra (1 small); Togopi Formation (Pliocene-Pleistocene?), Dent Peninsular, North Borneo (NMB H.14426; 1, specimen illustrated by Cox, 1948, pl. 4, fig. 2a, b).

Distribution – *Bufonaria echinata* occurs throughout the northern and northwestern Indian Ocean, the Gulf of Arabia and the Red Sea. More rarely, specimens occur in the northwestern Pacific Ocean, as far north as southern Japan (Okutani, 2000). Fossils seem to have been reported only from Java and Sumatra.

Remarks – *Bufonaria echinata* is a very distinctive species, easily recognised by its very elongate shape for a *Bufonaria* species, its weakly sculptured surface apart from a peripheral row of small nodules, and the three rows of unusually long, narrow, recurved spines developed on the varices and posterior siphonal canals. It is common at many fossil localities in Indonesia.

Bufonaria (Bufonaria) elegans **(G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841)**

Figs. 10-15.

Ranella elegans G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, pl. 92, fig. 17; Martin, 1884, p. 137.

Gyrineum (Gyrineum) subgranosum. – Wissema, 1947, p. 160 (not *Ranella subgranosa* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841)

Bufonaria (Bufonaria) elegans. – Beu, 1987, figs. 207-210; Cossignani, 1994, pp. 21, 22.

Type material – *Ranella elegans* "Beck" G.B. Sowerby 2nd, three probable syntypes BMNH 20030451, Recent, from "Nicobar Islands". Although none of these specimens matches G.B. Sowerby 2nd's (1836, pl. 92, fig. 17) illustration exactly, no other possible type material exists in any museum I have consulted and the BMNH specimens are accepted as syntypes.

Other material examined – RGM 26 823, Tjibinong [Cibinong], Java (1, beautiful, Figs. 12, 13); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 222, 150+ good specimens; Figs. 10, 11), locality 42 (RGM 456 223, 19 good; Figs. 14, 15), locality 44 (3 small), locality 58 (2 small).

Distribution – At present, *Bufonaria elegans* has quite a limited distribution, as it occurs only in the eastern Bay of Bengal and northeastern Indian Ocean, between the Andaman Islands, western Thailand and the southwest coast of Sumatra. I have also seen records from the central western Indian Ocean that require confirmation. The only fossils I am aware of are those reported here from Nias Island and a single specimen from Java.

Remarks – There have been no previous authentic records of *Bufonaria elegans* as a fossil and so it is interesting to record many specimens from Nias Island, off the southwestern coast of Sumatra. Recent specimens are highly distinctive because of their bright colour pattern of three red-brown spiral bands around the peripheral nodule rows, contrasting strongly with the remainder of the pale fawn teleoconch surface. The teleoconch surface is quite strongly sculptured with granules on early spire whorls, but this fades out down the shell, so on the last two whorls the surface, between nodule rows, is almost smooth and lightly polished, much the most weakly sculptured of any *Bufonaria* species. Three rows of small, sharp nodules are present around the periphery, and small, sharp spines are present on the varices and at outer edge of the posterior siphonal canal. Similar but much larger specimens from the northern Pacific had been identified by this name (e.g., Habe & Kosuge, 1966, pl. 16, fig. 6), but Beu (1987, p. 328) pointed out that the Pacific species, *B. perelegans* Beu, 1987 [shown here to be a probable synonym of *B. granosa* (Martin, 1884)], is not only larger than *B. elegans*, but also more evenly, finely granulose, with smaller nodules than *B. elegans*, and much paler in colour, with a near-uniform white to pale fawn coloration.

Wissema (1947) identified the abundant, beautifully preserved material from Nias Island as "*Gyrineum subgranosum* (Sowerby)", but it agrees in every detail with the Recent specimens from the Andaman Sea, western Thailand and western Sumatra that form the living population of *Bufonaria elegans*. This is hardly surprising, as the fossil localities are alongside the living Sumatran specimens. In this case, the exact agreement in size, shape and sculpture leaves no doubt of the identification, despite the fossils lacking the brilliant colour pattern of Recent specimens. *Bufonaria subgranosa* is a moderately tall form that is now considered to be part of the variation of *B. rana* (Linné).

***Bufonaria (Bufonaria) granosa* (Martin, 1884)**

Figs. 16, 17.

Ranella leucostoma. – Martin, 1879, p. 55, pl. 10, figs. 4, 4a, b (not *Ranella leucostoma* Lamarck, 1822).

Ranella spinosa var. *granosa* Martin, 1884, p. 201, pl. 9, fig. 5.

?*Ranella (Argobuccinum) leuconostoma (sic)*. – Zwierzycki, 1915, p. 105.

Ranella (Bursa) subgranosa. – Tesch, 1915, p. 70, pl. 82, fig. 152a, b (not *Ranella subgranosa* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).

?*Argobuccinum leucostoma*. – van der Vlerk, 1931, p. 238; Skwarko & Sufiati, 1994, p. m4.

?*Ranella leuconostoma*. – van der Vlerk, 1931, p. 241.

Bufonaria perelegans Beu, 1987, p. 328, figs. 211-217; Cossignani, 1994, pp. 31, 32; Beu, 1998, p. 170, figs. 53f, h, 54; Beu, 1999, p. 46, fig. 87 (with further synonymy).
Bursa (Bufonaria) spinosa. – Skwarko & Sufiati, 1994, p. n1 (in part).

Type material – *Ranella spinosa* var. *granosa* Martin, holotype RGM 9907 (Figs. 16, 17), from Mount Sela, Java, Miocene. *Bufonaria perelegans* Beu, holotype USNM 849005, Recent, trawled, "deep water" off southwestern Taiwan; a range of paratypes from off Taiwan, Thailand and the Philippine Islands was listed by Beu (1987, p. 333).

Other material examined – RGM 9807, Junghuhn's locality L, Java, Preanger [Priangan] (1, internal mould, identified tentatively; identified by Martin (1879, p. 55, pl. 10, figs. 4, 4a, b) as "*Argobuccinum leucostoma*" (Lamarck), i.e., *Ranella australasia* Perry); Kalibeng layers (Late Pliocene), Sangiran, central Java (1 slightly more coarsely sculptured, referred tentatively, in collection of B. Dharma); Sangiran, central Java, Late Pliocene (1 excellent, height 70.6 mm, and several smaller in collection of B. Dharma, examined August 2004); material from IAUU, received in RGM: "Prfg. Jalang Abab, Pelembang", Sumatra, leg. Erb (4 juveniles); Kaju ragi, northern Sulawesi, Pleistocene, coll. Wichman (2); Weg Lamasin-Murmaten, northwestern Sulawesi, coll. Rutten (1, incomplete); Kembang manis Kauer, Benkulen, Sumatra (1, incomplete).

Distribution – *Bufonaria granosa* seems likely to be the medium to dark red-brown, smaller form, closely similar to *B. perelegans* Beu, 1987, recorded by Beu (1998) from New Caledonia and Vanuatu, and since observed in the collection of Han Raven (Den Haag) from northern Borneo. It is likely that this is a species distinct from the markedly larger, more finely sculptured, pale fawn and white species from the Philippine Islands, Taiwan and southern Japan, although specimens similar to Taiwan specimens of *B. perelegans* have also been seen from Queensland, Australia. A few fossil specimens are recorded here from Indonesia, and I have seen also several Pliocene specimens from Viti Levu, Fiji in AMS and in the collection of Andrew Grebneff (Geology Department, University of Otago).

Remarks – The holotype of *Ranella spinosa* var. *granosa* Martin is a typical wide, finely sculptured specimen of the small, southern form of the species I named *Bufonaria perelegans* (Beu, 1987, p. 328, figs. 211-217), with three rows of short spines around the last whorl and an otherwise evenly granulose surface. Therefore, *Bufonaria perelegans* possibly is a junior synonym of *B. granosa* (Martin).

Although the name *Bufonaria perelegans* was based on material from Taiwan and the Philippine Islands, where it is common, I later (Beu, 1998) identified a population by this name living in the lagoon of New Caledonia, where it is restricted to the mid-northeastern coast of the main island; living specimens were collected only in 52-70 m. I also recorded Recent specimens from Vanuatu, as well as Pliocene fossils from Fiji. I subsequently (Beu, 1999, p. 46) recorded the first specimen from southern Japan and I have since examined a specimen from southern Queensland, Australia, in the collection of Allan Limpus (Bundaberg). It seems likely that *B. granosa* is much more widely distributed in the western Pacific than I originally supposed. However, the occurrence of several subtly, but consistently, different forms (distinct species?) along the northern coast of Borneo (examined in the collection of Han Raven, Den Haag) throws a hard light on species distinctions in *Bufonaria*. It seems likely that *B. granosa* (Martin) is the valid name for the relatively small, elongate species in the Neogene of Java and living in the southwestern Pacific (where specimens have most of their exterior surfaces coloured dark reddish brown), whereas *B. perelegans* is an apparently distinct, larger and wider, more finely granulose, white and pale yellow-brown species living in the northwestern Pacific. As noted above, it is unclear whether *B. granosa* is an earler name for *B. perelegans.*

The excellent specimen from the Pliocene of Timor illustrated by Tesch (1915, pl. 82, fig. 152a, b), under the name *Ranella (Bursa) subgranosa*, is similar to *Bufonaria elegans* in most characters, but has slightly coarser sculpture than typical, northeastern Indian Ocean, Recent specimens of *B. elegans*. It particularly resembles the specimens I recorded from the Recent of New Caledonia as *B. perelegans*. The Timor fossil therefore seems best identified as *B. granosa*. Another specimen recorded here as a fossil from Indonesia is a poor but large internal mould documented by Martin (1879, p. 55) under the name *Argobuccinum leucostoma.* This is only tentatively identified, but more nearly resembles *B. granosa* than any other species. Zwierzycki (1915, p. 105) also recorded a specimen from Sumatra under the name "*Ranella (Argobuccinum) leuconostoma*", but it is impossible to tell which species he intended by this name. It is quite certain that *Ranella leucostoma* (Lamarck, 1822) [for which the valid name is *Ranella australasia* (Perry, 1811)] does not occur either fossil or Recent in the Indonesian region, as it is a temperate species limited to New Zealand and southern Australia.

Bufonaria (Bufonaria) margaritula (Deshayes, 1832)

Figs. 18-22.

Ranella margaritula Deshayes, 1832, p. 424, pl. 3, figs. 13-15; Kiener, 1841, p. 14, pl. 8, fig. 2; Reeve, 1844b, pl. 3, fig. 15; Martin, 1899, p. 146, pl. 23, figs. 337, 337a, 338, 339 (in part); Cossmann, 1903b, p. 154, pl. 5, figs. 22, 23; Zwierzycki, 1915, p. 109; Martin, 1919, pp. 88, 122, 132 (in part); van der Vlerk, 1931, p. 241.

Ranella neglecta G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2st, 1832-1841, pl. 93, fig. 22.

Ranella margaritula. – Martin, 1899, p. 146, pl. 23, figs. 337-339; Martin, 1919, pp. 88, 137; Fischer, 1927, p. 65; van der Vlerk, 1931, p. 241.

Bursa margaritula. – Schepman, 1909, p. 116.

Gyrineum pacator Iredale, 1931, p. 214, pl. 23, fig. 3.

Bursa (Bursa) margaritula. – van Regteren Altena, 1942, p. 109 (with further synonymy).

Chasmotheca margaritula. – Habe & Kosuge, 1966, p. 45, pl. 16, fig. 5.

Bufonaria (Bufonaria) margaritula. – Beu, 1987, p. 337, figs. 220, 234-244 (with further synonymy); Wilson, 1993, p. 225, pl. 43, fig. 3a, b ; Cossignani, 1994, p. 28.

Bursa (Bursa) koperbergae. – Skwarko & Sufiati, 1994, p. n1 (in part not *Bursa koperbergae* van Regteren Altena, 1942).

Bufonaria margaritula. – Okutani, 2000, p. 271, pl. 134, fig. 12.

Type material – No type material is known for either *Ranella margaritula* Deshayes, from the "rocks of the Malabar coast", India, or *Ranella neglecta* G.B. Sowerby 2nd, but their excellent illustrations of a presumed syntype of each name leave no doubt of the identity of the species to which their names apply. *Gyrineum pacator* Iredale, holotype AMS C.57799 (Beu, 1987, figs. 234-236), from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia.

Other material examined – RGM 9889, Ngembak, Residence of Semarang, Java (1, very incomplete); RGM 9888, Tjikeusik [Cikeusik], Java, Pliocene (3 good, including specimen illustrated by Martin, 1899, figs. 337, 338; Fig. 20); RGM 9890, Tjikeusik [Cikeusik], Residence of Bantam [Banten], Java (5 good); RGM 9892, Menengteng Gorge, Waled, Residence of Cheribon [Cirebon], Java (2); RGM 9891, Tjikeusik [Cikeusik], Residence of Bantam [Banten], Java, Pliocene (13 small); "Kendeng beds" material in Mijnwezen Collection: locality M90 (RGM 456 224, 1; Figs. 21, 22), M269 (1 good), M291-292 (8), M296 (1); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 223, 1 good; Figs. 18, 19); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 589 (2 poor), RGM 47 590 (1 good), RGM 46 591 (1 good), RGM 46 692 (1 poor); Bojong, Pandeglang, West Java, Late Pliocene/Early Pleistocene, collected by B. Dharma, presented by G. Kronenberg (GNS WM17198, 3); material from IAUU, received in RGM: "Lili rot wai Bobot, Ceram, coll. Rutten" (Pleistocene terrace?) (1 abraded).

Distribution – *Bufonaria margaritula* occurs in the northern Indian Ocean and throughout the western Pacific, from at least the Philippine Islands (and perhaps further north) south to Sydney harbour, New South Wales, Australia. Its range in the Indian Ocean is poorly known. Fossils are common in Indonesia.

Remarks – *Bufonaria margaritula* is the smallest species of the genus, of quite short, wide shape. Beu (1987, p. 337) revised the taxonomy and variation of this species, and pointed out that Iredale's (1931) species *Gyrineum pacator* (based on Recent material from Sydney Harbour, New South Wales, Australia) is a synonym. The only closely similar species is the much less common *B. thersites* (Redfield) (see below, and Beu, 1998, p. 171), which differs from *B. margaritula* in its significantly larger size, its still shorter and wider shape, its consistently and markedly paler coloration, with a yellow to orange rather than white aperture, and in developing a few particularly large, antero-posteriorly compressed nodules in the centre of the last few intervariceal intervals. I have seen only one Indonesian fossil specimen of *B. thersites,* but, not surprisingly, the much more common *B. margaritula* has an extensive fossil record in Indonesia.

Bufonaria (Bufonaria) rana **(Linné, 1758)**

Figs. 23-26.

Murex rana Linné, 1758, p. 748 (typical form only); Linné, 1767, p. 1216.

Ranella subgranosa "Beck" G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2st, 1832-1841, pl. 92, figs. 18; G.B. Sowerby 2nd, 1841, p. 52; Martin, 1899, p. 146; Martin, 1919, pp. 88, 125, 132, 141, 145; Martin, 1926, p. 10; van der Vlerk, 1931, p. 240; van der Vlerk, 1932, p. 111; Martin, 1932, p. 114; Kutassy, 1934, pp. 307, 315, pl. 6, figs. 14, 15; Oostingh, 1935, p. 226.

Ranella beckii Kiener, 1841, p. 5, pl. 4, fig. 1.

Ranella albivaricosa Reeve, 1844b, pl. 1, fig. 2; Reeve, 1844d, p. 136; A. Adams & Reeve, 1850, p. 37, pl. 13, fig. 4; van der Vlerk, 1931, p. 240.

Ranella interrupta Martin, 1884, p. 138, pl. 7, figs. 138, 138a, b.

Ranella (Bursa) subgranosa. – Fischer, 1927, p. 65.

Gyrineum scelestum Yokoyama, 1928, p. 44, pl. 3, figs. 5, 6.

Ranella (Apollon) subgranosa. – Koperberg, 1931, p. 121.

Bursa (Bursa) subgranosa. – van Regteren Altena, 1942, p. 112 (with further synonymy); Skwarko & Sufiati, 1994, p. n2; van den Hoek Ostende *et al.*, 2002, p. 36.

Bursa (Bufonaria) rana. – MacNeil, 1961, p. 60, pl. 13, fig. 5; Schmid & Walther, 1962, p. 258, pl. 26, fig. 13; Noda, 2002, p. 106, fig. 18-11a, b (as *Bufoneria* in fig. caption).

Bufonaria (Bufonaria) rana. – Beu, 1987, p. 333, figs. 222-228; Wilson, 1993, p. 226, pl. 43, fig. 1a, b; Cossignani, 1994, pp. 33-35; Parth, 1996, p. 132; Beu, 1999, p. 47, figs. 89-97 (with further synonymy).

Bufonaria (Bufonaria) subgranosa. – Cossignani, 1994, pp. 36, 37.

Bufonaria rana. – Okutani, 2000, p. 271, pl. 134, fig. 11.

Bufonaria perelegans. – Okutani, 2000, p. 271, pl. 134, fig. 13 (not *B. perelegans* Beu, 1987).

Type material – Lectotype (of Beu, 1987, p. 335) of *Murex rana* Linné, an unlocalised specimen marked "527" inside the aperture (species number for *Murex rana* in Linné, 1767), in Linné's collection, housed by the Linnean Society of London, Burlington House (Beu, 1987, figs. 223, 224). *Ranella subgranosa* "Beck" G.B. Sowerby 2nd, three probable syntypes BMNH 20030452, unlocalised. As with *Ranella elegans*, none of these specimens matches Sowerby's illustration exactly, but in the absence of any other possible types in any museum I have consulted, these specimens are accepted as syntypes. *Ranella albivaricosa* Reeve, six syntypes, labelled "Ceylon" [Sri Lanka]; three syntypes BMNH 1967651, three BMNH 1967652. Yokoyama (1928, p. 45) recorded specimens of *Gyrineum scelestum* from "upper Byoritz Beds: (1) Kizan, Byoritz Gai, (2) Nankwa, (3) Tenshi, Shiko Sho, (4) Goko, Shiko Sho, (5) Kyushoko, Enri Sho, all in Shinchik Province", Taiwan, and illustrated an almost complete specimen from Nankwa (Yokoyama, 1928, pl. 3, fig. 6) and a very incomplete one from Goko (Yokoyama, 1928, pl. 3, fig. 5), all without mentioning a type specimen. All these specimens therefore are syntypes; presumably in the Geological Survey of Japan (not seen).

Other material examined – RGM, Doekoe Penkal [Dukuh Pengkal], Residence of Madiun, Java (1); RGM 9887, Batavia, "II. 130 m" (2, juvenile); RGM 9880, Padas Malang, Residence of Madiun, Java, Pliocene (1); RGM 9878, Sonde, Residence of Madiun, Java, Pliocene (1, good); RGM 9881, Sonde, Java, Pliocene (1); RGM 9883, Tambak batoe [Tambakbatu], Residence of Surabaja, Java (2); RGM 9886, Menengteng Gorge, Waled, Residence of Cheribon [Cirebon], Java (1); RGM 9882, Sonde, Residence of Madiun, Java (3, fragmentary); RGM 9884, Tambakbatu, Residence of Surabaya, Java, Late Miocene (4 fragments and juveniles, syntypes of *Ranella interrupta* Martin, including juvenile illustrated by Martin, 1884, pl. 7, figs. 138, 138 a, b); "Kendeng beds" material in Mijnwezen Collection: locality M9 (1), M15a (2), M25 (1), M67 (2), M68 (1), M87 (1), M89 (2), M90 (4), M95 (3), M100 (1), M123 (3), M124 (1), M125 (8), M126 (4), M130 (2), M139 (6), M142 (1), M143 (10), M149 (1), M152 (4), M153 (6), M156 (11), M157 (4), M158 (1), M160 (2), M161 (4), M163 (RGM 456 227, 12; Figs. 25, 26), M164 (3), M166 (3), M167 (3), M171 (4), M173 (RGM 456 226; 14; Figs. 23, 24), M177 (2), M193 (1), M205 (1), M216 (22), M217 (13), M218 (2), M219 (3), M228 (5), M233 (2), M235 (5), M257 (2), M260 (2), M263 (1), M264 (23 good), M267 (1), M268 (fragments), M270 (1), M271 (1), M272 (1), M273 (6, + one identified as *B. koperbergae*), M274 (14), M278 (13, + 5 juveniles), M281 (13), M284 (11), M289 (2), M290 (1), M292 (1), M295 (1), M297 (1), M298 (6), M300 (3), M301 (2), M304 (4), M309 (1), M321 (2), M322 (1), M328 (9), M346 (8), M347 (11), M362 (1); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 604 (5), RGM 46 605 (7), RGM 46 606 (4), RGM 46 607 (1), RGM 46 608 (3), RGM 46 609 (13), RGM 46 610 (3), RGM 46 611

(1), RGM 46 612 (1), RGM 46 613 (2), RGM 46 614 (5), RGM 46 615 (4), RGM 46 616 (1), RGM 46 617 (8), RGM 46 618 (4), RGM 46 619 (5), RGM 46 620 (13), RGM 46 621 (2), RGM 46 622 (5), RGM 46 623 (2), RGM 46 624 (1 poor fragment), RGM 46 625 (8), RGM 46 626 (1 poor), RGM 46 627 (1), RGM 46 628 (3 poor), RGM 46 629 (2), RGM 46 630 (1), RGM 46 631 (1 poor), RGM 46 632 (1 poor), RGM 46 633 (1), RGM 46 634 (1), RGM 46 635 (6 poor), RGM 46 636 (9), RGM 46 638 (1 poor fragment), RGM 46 640 (3 poor), RGM 46 641 (3 poor), RGM 46 642 (10 good); RGM, Kali Klagen, prov. of Jawa Timur; outcrop on west bank of river and adjacent fields and road cuts on Perning-Sumbertengu Road, *c.* 3 km north of Klagenbandong; Pucangan Formation, volcanic facies, mollusc bed II, Early-Middle Pleistocene, coll. F.P. Wesselingh, Sept. 2001 (3); Sangiran, central Java, Late Pliocene, presented by B. Dharma (GNS WM 17240, 2; GNS WM 17469, 3); material from IAUU, received in RGM: Timmena River, south of Abaar near Sentana Lake, northern New Guinea, coll. Wichman (2).

Distribution – *Bufonaria rana* occurs commonly throughout the western Pacific from central Japan to Queensland, Australia, and throughout Indonesia. Fossils are common in both Japan and Indonesia.

Remarks – The range of variation of *Bufonaria rana* has long been a difficult question. Initially, I regarded *B. rana, B. subgranosa* and *B. albivaricosa* as three separate species (Beu, 1987), partly because the tall, narrow "*subgranosa* form" is now largely limited to the Philippine Islands (where, however, the short, wide "*rana* form" does not occur). Parth (1996, p. 132) suggested that *B. albivaricosa* and *B. subgranosa* merely are part of the variation of *B. rana*, which for some ecological reason consistently is taller in the Philippine Islands than elsewhere. This interpretation is supported by the occurrence of tall, narrow specimens among apparently "typical", short specimens of *B. rana* off southern Queensland, Australia, and by the enormous range of variation shown by the abundant fossils from Indonesia. Beu (1999) also confirmed this synonymy for the "*albivaricosa* form", based on a collection of Recent specimens from southwestern Japan. It now seems that this is a rather variable species, ranging from very short and wide to quite tall and narrow, occurring very widely throughout the western Pacific and in the northeastern Indian Ocean. Premonowati (1990, p. 42, fig. 29) illustrated a specimen of *B. rana* from Pliocene rocks in central Java, but seems to have identified it as "*Thais carinifera* (Lamarck)". *Bufonaria rana* is the most abundant tonnoidean in Indonesian fossil collections, as it is in shallow-water off-shore mollusc collections from the western Pacific at present.

The collection of Han Raven (Den Haag) contains very useful live-collected material from the north coast of Borneo for understanding the range of variation of *Bufonaria* species. The more common maculated white and pale red-brown species, quite variable in size (commonly 40-80 mm high) as well as in sculptural coarseness and in spire height, usually known as *Bufonaria rana,* has an operculum with coarse commarginal ridges on the outer surface. Relatively small (to *c.* 60 mm high), elongate specimens with a rather uniform, dark red-brown exterior and relatively weak granulose sculpture have an almost smooth operculum, and seem likely to represent a further, apparently unnamed species. The variation and distribution of *Bufonaria* species will need to be approached with care, and several species apparently remain unnamed.

Bufonaria (Bufonaria) thersites (Redfield, 1846)

Ranella thersites Redfield, 1846, p. 166, pl. 10, fig. 6a, b.

Ranella californica. – Tryon, 1880, p. 40 (in part not *Ranella californica* Hinds, 1843).

Gyrineum (Chasmotheca) cavitense. – Oyama & Takemura, 1960, *Gyrineum* figs. 3, 4 (not *Ranella cavitense* Reeve, 1844b).

Bursa nobilis. – Cernohorsky, 1967a, p. 314, pl. 42, fig. 5; Cernohorsky, 1967b, p. 46, pl. 2, fig. 6; Hinton, 1978, p. 32, fig. 1 (not *Ranella nobilis* Reeve, 1844b).

Bufonaria (Bufonaria) thersites. – Beu, 1987, p. 342, figs. 254-256; Cossignani, 1994, p. 38, illustr.

Bursa thersites. – Short & Potter, 1987, p. 44, pl. 21, fig. 1.

Bursa crumena. – Salvat *et al.*, 1988, p. 103, pl. 13, fig. 17 (not *Ranella crumena* Lamarck, 1816).

Bufonaria thersites. – Wilson, 1993, p. 226; Beu, 1998, p. 171, figs. 53b, d, e, 58a.

Type material. – *Ranella thersites*, location of type material not confirmed, presumably in the State Museum of New York, Albany; Beu (1998) designated the type locality as New Caledonia. Redfield's (1846, pl. 10, fig. 6a, b) coloured drawing leaves no doubt of the identity.

Other material examined. – Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma).

Distribution. – Beu (1998, p. 172) recorded specimens of *Bufonaria thersites* from the Philippine Islands south to northeastern Australia, New Caledonia, and Fiji. The 22 samples from New Caledonia were collected alive in 0-71 m. I also recorded Pliocene fossils from Fiji (2, AMS C302629), the only other fossils I am aware of. Recent specimens occur uncommonly in populations of the much more abundant *B. margaritula* and the single record from Java suggests that they also did so during Pliocene time.

Remarks. – A specimen from Sangiran, Java, in B. Dharma's collection, at first identified as *Bufonaria margaritula*, differs from that species in its less dorsoventrally compressed shape, its shorter spire, its more widely flared apertural lips, its more prominent nodules, and its longer and more out-turned posterior siphonal canals. The longer posterior canals produce the difference in appearance that first allowed the specimen to be identified as *B. thersites*, but this specimen does not bear the few, extremely prominent nodules on the dorsum of the last whorl that are present on many Recent specimens. Recent specimens are also distinctive because of their yellow to pale orange aperture, rather than the white one of *B. margaritula*.

Genus *Bursa* Röding, 1798

Bursa Röding, 1798, p. 128. Type species (by subsequent designation, Jousseaume, 1881, p. 174): *Bursa monitata* Röding, 1798 (= *Murex bufonius* Gmelin, 1791, by first reviser's action of Winckworth, 1945, p. 137), Recent, Indo-West Pacific.

Lampasopsis Jousseaume, 1881, p. 175. Type species (by original designation): *Ranella rhodostoma* G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, Miocene to Recent, Indo-West Pacific and Atlantic.

Lampadopsis Fischer, 1884, p. 656 (unjustified emendation of *Lampasopsis* Jousseaume, 1881).

Colubrellina Fischer, 1884, p. 656. Type species (by monotypy): *Ranella candisata* Lamarck (= *Tritonium candisatum* Röding, 1798 = *Murex conditus* Gmelin, 1791), Recent, western Pacific.

Pseudobursa Rovereto, 1899, p. 6. Unnecessary replacement name for *Bursa* Röding, 1798.

Bufonariella Thiele, 1929, p. 284. Type species (by monotypy): *Murex scrobilator* Linné, 1758, Pliocene to Recent, Mediterranean and West Africa; Pliocene-Pleistocene, Caribbean.

Annaperenna Iredale, 1936, p. 310. Type species (by original designation, Iredale, 1936, p. 337): *Ranella verrucosa* G.B. Sowerby 1st, 1825, Recent, southwest Pacific.

Dulcerana Oyama, 1964, p. 332. Type species (by original designation): *Tritonium granulare* Röding, 1798, Miocene to Recent, Indo-West Pacific and Atlantic [not available from Iredale, 1931, p. 213, no distinction from related taxa; or from Cotton, 1945, p. 261 (as *Dulcerona*, error)].

Tritonoranella Oyama, 1964, p. 332. Type species (by original designation): *Triton ranelloides* Reeve, 1844a, Pleistocene and Recent, southern Japan-Taiwan, Indian Ocean, South Africa, western and central Atlantic.

Bursa granularis (Röding, 1798)

Figs. 27, 28.

Tritonium granulare Röding, 1798, p. 127.
Tritonium jabick Röding, 1798, p. 127.
Biplex rubicola Perry, 1811, pl. 5, fig. 5.
Ranella granifera Lamarck, 1816, pl. 414, fig. 4, "Liste des objets" p. 4; Lamarck, 1822, p. 153; Reeve, 1844b, pl. 6, fig. 30; Martin, 1928, pp. 8, 25; van der Vlerk, 1931, p. 240.
Ranella affinis Broderip, 1833, p. 179.
Ranella livida Reeve, 1844b, pl. 6, fig. 28.
Ranella cubaniana Orbigny, 1842, p. 165, pl. 23, fig. 24.
Bursa cumingiana Dunker, 1862, p. 238.
Ranella affinis. – Martin, 1899, p. 147; Martin, 1919, pp. 88, 130; van der Vlerk, 1931, p. 240.
Gyrineum affine. – Schepman, 1907, p. 182.
Ranella (Bursa) affinis. – Tesch, 1920, p. 42, pl. 129, fig. 154a, b.
Bursa alfredensis Turton, 1932, p. 107, pl. 24, fig. 781.
Bursa kowiensis Turton, 1932, p. 108, pl. 24, fig. 782.
Bursa (Colubrellina) granularis. – van Regteren Altena, 1942, p. 107; Cossignani, 1994, pp. 75-78; Okutani, 2000, p. 269, pl. 133, fig. 1a, b.
Bursa (Colubrellina) corrugata. – van Regteren Altena, 1942, p. 107; Skwarko & Sufiati, 1994, p. n3 (not *Biplex corrugata* Perry, 1811).
Bursa cubaniana intermedia Nowell-Usticke, 1959, p. 62, pl. 3, fig. 13.
Bursa corrugata lineata Nowell-Usticke, 1959, pl. 3, fig. 12.
Bursa (Colubrellina) granulare. – Skwarko & Sufiati, 1994, p. n3.
Bursa granularis. – Wilson, 1993, p. 226, pl. 43, figs. 11a, b, 12; Beu, 1998, p. 150, figs. 48a-e, 58d (with long synonymy); Beu, 1999, p. 44, fig. 85 (with further synonymy).

Type material – The type material was reviewed by Beu (1998, p. 151). *Ranella granifera* Lamarck, lectotype (of Beu, 1998, p. 151) MHNG 1098/85/1, unlocalised; one paralectotype MHNG 1098/84, from "Mer Rouge", two paralectotypes MHNG 1098/85, unlocalised; Beu (1998) designated the type locality as the Red Sea. The lectotype of *Ranella granifera* Lamarck was designated by Beu (1998) as the neotype of *Tritonium granulare* Röding, of *Tritonium jabick* Röding and of *Biplex rubicola* Perry. *Ranella affinis* Broderip, three syntypes BMNH 1950.11.28.4-6, from "Annaa, Pacific Ocean". *Ranella cubaniana* d'Orbigny, holotype BMNH 1854.10.4.412, from "Ste Lucie", Caribbean. *Ranella livida* Reeve, three syntypes BMNH 1967657, from "Island of Annaa". *Bursa cumingiana* Dunker, two syntypes BMNH 1968530, from "New Caledonia". *Bursa alfredensis* and *B. kowiensis* of Turton, holotypes presumably in the collection from Port

Alfred, South Africa, presented to Oxford University Zoology Museum by Turton. *Bursa corrugata lineata* Nowell-Usticke, holotype AMNH 195427, from "Krause's Lagoon, St Croix", Caribbean. *Bursa cubaniana intermedia* Nowell-Usticke, type not recognised in Nowell-Usticke's collection, in AMNH.

Other material examined – RGM 9903, Selatjau [Selacau], Java, Preanger [Priangan] (1 good); "Kendeng beds" material in Mijnwezen Collection: locality M126 (RGM 456 228, 1 good, Figs. 27, 28; identified by van Regteren Altena (1942) as *Bursa corrugata* Perry); locality M189 (1 good); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 585 (1, incomplete); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (2, 1 excellent specimen and 1 incomplete); Citalahab, West Java, Late Miocene (3, in collection of B. Dharma); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Neke-Niki-Niki", Koperberg's thesis "pl. 129, fig. 154", identified as "*Ranella affinis* Brod." (1 small, good).

Distribution – *Bursa granularis* is extremely widely distributed, occurring throughout the Indo-West Pacific in its widest sense, from South Africa to Clipperton Island, eastern Pacific, including the Red Sea, and in the western Atlantic. Few fossils have been recorded other than those listed here, apart from several Pleistocene specimens in the western Atlantic (Beu, research in progress).

Remarks – Beu (1998, p. 150) reviewed the synonymy, range, variation and type material of *Bursa granularis*. In the modern fauna this highly variable species is the most abundant and among the most widespread of all tonnoideans. However, it is abundant only in the intertidal and shallow subtidal zones, and as this fauna is very poorly represented in the fossil record, *B. granularis* is a rare fossil. Its moderately tall shape, relatively weakly sculptured *Cymatium*-like appearance and weakly armed aperture are distinctive characters.

Van Regteren Altena (1942) identified one of the "Kendeng beds" specimens as *Bursa (Colubrellina) corrugata* (Perry), but this is a surprising record as there are no other reliable fossil or Recent records of *B. corrugata* from the Indo-West Pacific. Examination of the specimen confirmed that it is a normal specimen of *B. granularis*. Van Regteren Altena's identification evidently was based on a misunderstanding that *Ranella affinis* Broderip is a synonym of *B. corrugata* rather than of *B. granularis*, and so Martin's (1899, p. 147; 1919, pp. 88, 130) records under the name *Ranella affinis* were thought to refer to *B. corrugata*. *Bursa corrugata* occurs in the eastern Pacific and in the eastern and western Atlantic, but I am not aware of any authentic Indo-West Pacific records.

***Bursa latitudo* Garrard, 1961**

Figs. 29, 30.

Bursa latitudo Garrard, 1961, p. 15, pl. 2, fig. 2; Kay, 1979, p. 227, fig. 80H; Wilson, 1993, p. 227, pl. 43, fig. 13; Beu, 1998, p. 157, figs. 47a, c, 49h-j, 50a-h, 51a-f, 58g.

Bursa (Bufonariella) latitudo latitudo. – Beu, 1981, p. 287, fig. 16g-i.

Bursa (Bufonariella) latitudo wolfei Beu, 1981, p. 289, fig. 17a-f.

Bursa (Colubrellina) latitudo latitudo. – Beu, 1985, p. 64; Cossignani, 1994, p. 80.

Bursa (Colubrellina) latitudo wolfei. – Beu, 1985, p. 64; Cossignani, 1994, pp. 83-84.

Bursa nigrita. – Wells *et al.*, 1990, p. 40, pl. 19, fig. 123 (not *Tutufa nigrita* Mühlhäusser & Blöcher, 1979).

Type material – *Bursa latitudo* Garrard, holotype (Beu, 1998, fig. 49h, j) Museum of Victoria, Melbourne, F21111, trawled off Moreton Bay, Queensland, in 230 m. *Bursa latitudo wolfei* Beu, holotype Bernice Bishop Museum, Honolulu, BPBM 8936, from crab trap in 58 m, off Makahu, Hawaii; four paratypes listed by Beu (1998, p. 157).

Other material examined – Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 582 (1 incomplete, Figs. 29, 30); Sangiran, central Java, Late Pliocene (1, incomplete, in collection of B. Dharma).

Distribution – *Bursa latitudo* has now been collected from many offshore localities throughout the western Pacific, from the Philippine Islands and eastern Australia to the Marquesas and Tuamotu Islands. It is particularly abundant in quite deep water (230-660 m) around New Caledonia (Beu, 1998). The very similar species, *B. natalensis* Coelho and Matthews, 1970, is limited to the western Atlantic, and is markedly taller and narrower than *B. latitudo.* The two fossils listed here are the only ones I am aware of. However, the specimens from the Pendopo Oilfield, Sumatra, included below in *Tutufa bubo* (Linné, 1758) (Figs. 57-60), possibly also belong in *B. latitudo*; their identification is uncertain because of their incompleteness and small size.

Remarks – *Bursa latitudo* has been regarded as uncommon until recently, but this probably is because it lives well offshore, in *c.* 100-700 m, and most material has been collected by dredging. It proved to be abundant around New Caledonia on deep-water rock surfaces. It has low, thin varices that are offset, as in *Tutufa*; each growth increment is two-thirds of a whorl, or 240° around the spiral, as is also seen in *Bursa ranelloides* (Reeve), rather than the half-whorl increment, or *c.* 180-200°, of all other *Bursa* species. *Bursa latitudo* and *B. ranelloides* are similar in many other characters, including having red maculations on the parietal part of the inner lip. *Bursa latitudo* reaches a larger size than all but a few "giant" specimens of *B. ranelloides,* and has more numerous rows of finer, more closely spaced nodules than *B. ranelloides.* This produces a wider zone of more numerous nodule rows between the main peripheral rows in *B. latitudo* than in *B. ranelloides*. A further important character visible in Recent specimens is that the periostracum is calcified to form a finely cancellate, silky-looking intritacalx in *B. ranelloides*, whereas the very thin periostracum is of the more usual conchiolin type in *B. latitudo*.

The two fossil specimens seen are from the "Kendeng beds"; one was identified by van Regteren Altena (1942) as *Bursa rubeta*, i.e., one of the *Tutufa* species (most Kendeng/ Sangiran specimens actually are *T. oyamai* Habe). However, the relatively narrow shape, the low, unusually thin varices and the finely granulose sculpture demonstrate that the two specimens actually are *Bursa latitudo* (see Beu, 1981, 1998).

Bursa rosa **(Perry, 1811)**
Figs. 31-35.

Biplex rosa Perry, 1811, pl. 4, fig. 1.
Ranella siphonata Reeve, 1844b, pl. 7, fig. 38 (excluding variety b); Reeve, 1844d, p. 138.
Gyrineum siphonatum. – Schepman, 1907, p. 182.
Ranella siphonata. – van der Vlerk, 1931, p. 241.

Bursa mammata. – Habe, 1961, p. 47, pl. 24, fig. 2; Habe, 1964, p. 76, pl. 24, fig. 2 (not *Bursa mammata* Röding, 1798).

Bursa rosa. – Kay, 1979, p. 229, fig. 80E, F; Beu, 1985, p. 63; Wilson, 1993, p. 227, pl. 43, fig. 6a, b; Cossignani, 1994, pp. 58-59; Beu, 1998, p. 166, fig. 52i, j (with further synonymy); Okutani, 2000, p. 269, pl. 133, fig. 9.

Bursa bufonia dunkeri. – Ladd, 1982, p. 41, pl. 8, figs. 6, 7 only (in part not *Murex bufonius* Gmelin, 1791).

?*Ranella (Ranella) siphonata.* – Skwarko & Sufiati, 1994, p. n4.

Type material – No original material has been recognised from the works of Perry (1810, 1811). *Ranella siphonata* Reeve, lectotype of typical form, BMNH 1967658/1, from the Philippine Islands; with two paralectotypes, BMNH 1967658/2, 3. Beu (1998, p. 166) designated the lectotype as the neotype of *Biplex rosa* Perry.

Other material examined – Citalahab, West Java, Late Miocene (1, in collection of B. Dharma; Fig. 33); RGM 107 524, Kaju Ragi, Manado Island, Sulawesi (Pleistocene), specimen recorded by Schepman (1907) as *Gyrineum siphonatum* (Figs. 34, 35); material from IAUU, received in RGM: calcareous tuff and sandstone, near Wahai in northern Ceram, coll. Rutten (1, good, Figs. 31, 32).

Distribution – *Bursa rosa* occurs widely throughout the Indo-West Pacific region in the widest sense, from South and East Africa to Hawaii, and from southern Japan to Sydney, New South Wales, Australia. I am not aware of fossils other than those recorded here.

Remarks – *Bursa rosa* is the most common and widespread shallow-water *Bursa* species in the Indo-West Pacific fauna at present, other than the abundant *B. granularis*. It has a moderately tall spire (although significantly shorter than that of *B. granularis*), a very short anterior siphonal canal, short to quite long, semitubular posterior canals aligned in two rows up the spire, prominent transverse ridges on the apertural lips and coarse, irregular nodules on the peripheral angulation. A single specimen has been seen from Java, collected by B. Dharma. It is a relatively finely nodulous form which has a lightly corroded and polished surface, suggesting that it has been transported into the deposition site from a nearby shallower environment. Another specimen from a probably Pleistocene locality in northern Sulawesi agrees with Recent specimens in all details.

Bursa sangirana **sp. nov.**

Figs. 36-38.

Type material – Holotype RGM 456 230, one paratype GNS WM17456, and two paratypes in collection of B. Dharma; all from Kalibeng layers (Late Pliocene), Sangiran, central Java, presented by Bunjamin Dharma, October 2001. Precise localities are unknown for most of B. Dharma's material, as it was collected for him by local inhabitants, who provide only generalised localities.

Distribution – Known only by the type material.

Description – Shell thick and solid, of moderate size for genus, of typical *Bursa* shape, resembling that of *B. rosa* (Perry), with short spire (last whorl *c.* three quarters of shell height) and very short anterior siphonal canal directed weakly to right (in conventional apertural view), strongly to left (in dorsal view). Posterior siphonal canals widely open, short, not extending above varices (tips presumably severely abraded). Varices situated at each half-whorl down entire teleoconch, united to form ridge down opposing sides of shell; extremely thick and solid, width about equal to height, of rounded cross-section, moderately deeply excavated between spiral cords on abapertural face, but weakly excavated on apertural face; spiral cords not elevated where they cross varices. Dominant sculpture of large, rounded nodules in one peripheral row; three low nodules angulated by uppermost spiral cord in each intervariceal space on early spire whorls, nodules increasing in size down shell, two exceedingly large, rounded nodules in each intervariceal interval on last two whorls; nodules contract sharply to sutural ramp to produce deeply concave ramp. Spiral cords very low and ill-defined, slightly elevated over nodules, strongly elevated across abapertural faces of varices, showing 3 wide, widely spaced primary cords followed closely below by one narrower cord that fills space between lowest major cords and anterior siphonal canal; lower, closely spaced secondary cords cross much of shell surface, 6 on last whorl between anterior canal and base of ramp; interspaces and sutural ramp covered with many lower, narrower, more clearly defined, finely gemmate tertiary spiral threads; on anterior siphonal canal tertiary threads elevated into 6-7 coarser, more coarsely nodulous cords with many fine threads in interspaces. Crests of secondary cords weakly dimpled, producing "orange peel" appearance, which combined with gemmae on finer spiral sculpture produces finely and evenly granulose appearance over entire exterior. Aperture relatively large, oval, with deeply excavated columella; outer lip only weakly flared, bearing 8 low, short, clearly defined transverse ridges on interior; inner lip flared moderately widely, covering false umbilicus; crossed by many close, fine, low, weakly anastomosing transverse ridges over most of lip height, anterior area smooth apart from 3-4 more prominent transverse ridges. Protoconch not seen.

Dimensions – Holotype: H 41.7, D 31.9 mm; paratype in B. Dharma collection H 37.8, D 29.8 mm; paratype WM17456: H 37.5, D 28.7 mm.

Differentiation – *Bursa sangirana* sp. nov. most nearly resembles *B. rosa* (Perry) in most characters and has an almost identical aperture to that of *B. rosa*. It is also similar to *B. rosa* in size and general appearance. However, *B. sangirana* sp. nov. differs from *B. rosa* in its shorter and wider shape, with a notably shorter spire, in its very much thicker varices, more than twice as thick as those of *B. rosa* or, indeed, of any other *Bursa* species I am aware of, in having fewer, larger nodules in each intervariceal interval, and in having markedly finer, dimpled surface sculpture, producing a nearly smooth, "orange peel" appearance. The varices also are much thicker than those of similar-sized (juvenile) specimens of the much larger species *B. bufonia* (Gmelin). The sculpture of four relatively wide, low, convex-crested spiral cords, with the lower two much more closely spaced than the others, is similar to that of *B. rosa*, *B. bufonia* and *B. davidboschi* Beu, 1987, only, as other similar Recent *Bursa* species such as *B. tuberosissima* (Reeve) and *B. cruentata* (G.B. Sowerby 2nd) have narrower, more widely spaced spiral cords. The northern Indian Ocean and northwestern Pacific species *B. davidboschi* reaches a larger size than either *B. rosa* or *B. sangirana* sp. nov., is more dorso-ventrally compressed, and has more prominent spiral cords than either *B. rosa* or *B. sangirana*. No other Indo-West Pacific *Bursa* species are comparable with these species.

Remarks – As so few species of *Bursa* have been recorded as fossils from Indonesia, it is surprising to find that four specimens collected by Bunjamin Dharma from the Pliocene Kalibeng layers at Sangiran, in central Java, represent a previously unnamed species. The holotype of *B. sangirana* sp. nov. is unabraded (except for the spire apex) and remarkably clean, but had small areas of calcareous encrustation on the sutural ramp and several small polychaete tubes around posterior siphonal canals when collected. This low degree of abrasion and encrustation suggests that *B. sangirana* sp. nov. inhabited shallow subtidal hard substrates rather than intertidal coral reefs. However, the paratypes are significantly more abraded and bored than the holotype and were encrusted with polychaete tubes, bryozoans and small oysters when collected (although they have since been cleaned), but even these lacked encrusting calcareous algae.

Etymology – The species name reflects that of the type locality, Sangiran.

Genus *Bursina* Oyama, 1964

Bursina Oyama, 1964, p. 333. Type species (by original designation): *Ranella nobilis* Reeve, 1844, Recent, Indo-West Pacific.

Remarks – *Bursina* is the genus distinguished above from *Bufonaria,* because it has an operculum like that of *Tutufa* (with a near-central nucleus, above the anterior end and towards the right margin from the centre line) rather than that of *Bufonaria* (fan-shaped, with the nucleus halfway along the left, or columellar, margin). Species now referred to *Bursina* also have a rather distinctive teleoconch shape; all are moderately to highly elongate, with a biconic shape (an equally tall, conical spire and anterior end), with rather fine surface granules on the teleoconch, with only small nodules at the periphery (whereas some *Bufonaria* species have large spines), with no spines on the outer edge of the posterior siphonal canal (where most *Bufonaria* species bear spines), and most have the varices strictly united into a single ridge up the opposing edges of the shell and quite well expanded laterally. The exception is *B. fernandesi* (Beu), in which the varices are united on early spire whorls, but become widely offset (at each two-thirds of a whorl) over the last few whorls. The varices of *Bursina* species (particularly on the last 2-3 whorls) have a characteristic shape, with a low, pointed nodule on both the peripheral and the basal angulations, and a wide, evenly concave outline between the nodules. Species now referred to *Bursina* are:

Bursina borisbeckeri (Parth, 1996), Philippines and Indian Ocean (operculum not seen).

fernandesi (Beu, 1977), western Indian Ocean (south to off Park Rynie, Natal, South Africa; NMP, B 7863, "*Meiring Naudé*" Sta. XX18, 96 m).

fijiensis (Watson, 1881), western Pacific (Beu, 1998). This dorso-ventrally compressed "*Bursa*" species has the wide, binoded varices of *Bursina* and seems likely to be a tall-spired *Bursina* species.

gnorima (Melvill, 1918), northern Indian and Pacific Oceans; Neogene, Indonesia.

ignobilis (Beu, 1987), Indo-West Pacific (south to Zululand, South Africa); Neogene, Indonesia.

nobilis (Reeve, 1844b), Indo-West Pacific; Neogene, Indonesia.

Bursina gnorima **(Melvill, 1918)**

Figs. 39-41.

Bursa subgranosa. – Schepman, 1909, p. 117 (not *Ranella subgranosa* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).

Bursa gnorima Melvill, 1918, p. 138, pl. 4, fig. 1.

Ranella (Bursa) nobilis. – Tesch, 1920, p. 41, pl. 129, fig. 153a, b (not *Ranella nobilis* Reeve, 1844b).

Ranella (Apollon) nobilis subsp. *timorensis* Koperberg, 1931, p. 120 (junior primary homonym of *Ranella pulchra timorensis* Koperberg, 1931, p. 119).

Bursa (Bursa) koperbergae van Regteren Altena, 1942, p. 109, figs. 4a, b, 5 (with further synonymy; replacement name for *Ranella nobilis timorensis* Koperberg, preoccupied); Skwarko & Sufiati, 1994, p. n1.

?*Gyrineum (Chasmotheca) nobile*. – Shuto, 1969, p. 93, pl. 7, figs. 2, 7, 11; text-fig. 22 (incomplete; not *Ranella nobilis* Reeve, 1844b).

Bufonaria (Bufonaria) gnorima. – Beu, 1987, p. 340, figs. 218, 245-248; Cossignani, 1994, p. 26.

Bursa koperbergae. – Robba *et al.*, 1989, p. 78, pl. 1, fig. 4.

Type material – *Bursa gnorima* Melvill, lectotype (of Beu, 1987, p. 340), BMNH 1921.1.28.1, from Jask, Gulf of Oman, dredged by F.W. Townsend. *Bursa koperbergae* van Regteren Altena, lectotype formerly in Instituut voor Mijnbouwkunde, Delft, no. 13846 (van Regteren Altena, 1942, p. 110, fig. 4), from "Toi Osapi Soka or Nono Fatoe Fekoe, province of Amanoeban", Timor, Pliocene; presumably now in RGM, not seen.

Other material examined – "Kendeng beds" material in Mijnwezen Collection (all identified by van Regteren Altena (1942) as *Bursa koperbergae*): locality M67 (4), M100 (3), M109 (1), M112 (RGM 456 231, 1, good; Figs. 39, 40), M125 (3), M289 (5), M291 (4), M298 (2 poor), M333 (2 poor), M335 (1 fragment); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 586 (2 small), RGM 46 587 (1 excellent), RGM 46 593 (1 poor), RGM 46 594 (1), RGM 46 595 (1 poor), RGM 46 596 (1 small), RGM 46 597 (1 small), RGM 46 599 (2), RGM 46 600 (1 small), RGM 46 601 (1 small), RGM 46 602 (2 small); Kalibeng layers (Late Pliocene), Sangiran, central Java, Late Pliocene (GNS WM17434, 1; GNS WM17475, 2; and 2 in collection of B. Dharma); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Noil-Noni-Pene", Koperberg's thesis "pl. 129, fig. 153", identified as "*Ranella nobilis* Reeve" (1, good; apparently a syntype of *Ranella nobilis* var. *timorensis* Koperberg); material from IAUU, received in RGM: "*Ranella (Apollon) nobilis* subsp. *timorensis* Koperberg, loc. 5, Timor, 1933; don. Koperberg" (2, small, apparently further syntypes of *timorensis*).

Distribution – The distribution of *Bursina gnorima* is poorly known because of its deep-water habitat. It is known from the northern Indian Ocean and Gulf of Arabia, and throughout the central western Pacific in the Philippine Islands and Indonesia, but probably occurs much more widely.

Remarks – *Bursina gnorima* is a distinctive, evenly biconic species with lower peripheral nodules and markedly lower, less nodulous varices than all other *Bursina* species. Van Regteren Altena (1942) correctly recognised it as a distinct species, which he named *Bursa koperbergae*, and listed previous incorrect identifications of the species by Martin, Schepman, Tesch and others. This is another species that lives well offshore at present, in about 100-300 m, reflecting the offshore deposition sites of Indonesian Neogene rocks.

Bursina ignobilis **(Beu, 1987)**

Figs. 42-53.

Ranella elegans. – Martin, 1879, p. 55, pl. 10, fig. 3, 3a (in part not *Ranella elegans* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841); Martin, 1884, p. 137 (in part).

Ranella nobilis. – Martin, 1899, p. 146, pl. 23, figs. 340-342; Zwierzycki, 1915, p. 109; Martin, 1919, pp. 88, 126, 128, 130, 141; van der Vlerk, 1931, p. 241; van der Vlerk, 1932, p. 111; Martin, 1932, p. 114 (in part not *Ranella nobilis* Reeve, 1844b).

Bursa (Bursa) nobilis. – van Regteren Altena, 1942, p. 111 (not *Ranella nobilis* Reeve, 1844b).

Bursa (Colubrellina) nobilis. – Ladd, 1977, p. 35, pl. 12, figs. 1-3 (not *Ranella nobilis* Reeve, 1844b).

Bufonaria (Bufonaria) ignobilis Beu, 1987, p. 344, figs. 221, 257-263; Cossignani, 1994, p. 27; Beu, 1998, p. 167, fig. 53g.

Type material – *Bursina ignobilis*, holotype USNM 849010, from off Punta Engaño, Mactan Island, Cebu, Philippine Islands. Beu (1987, p. 346) listed paratypes from 11 localities, in the Philippine Islands, Indonesia and Madagascar.

Other material examined – RGM 9893, Junghuhn's locality O, Java, Preanger [Priangan] (one, with one *Ranella nobilis* Reeve); RGM 9899, Tji Angsana [Ciangsana], Java, Preanger [Priangan] (2, good; Figs. 50, 51); RGM 9894, Sonde, Java, Pliocene (1, incomplete, dorsal view illustrated by Martin as *Ranella nobilis* Reeve); RGM 9897, Tsjadasngampar [Cadasngampar], Java, Preanger [Priangan] (2); RGM 9896, Selatjau [Selacau], Java, Preanger [Priangan], Late Miocene (2); RGM 9901, Sonde [Sinde], Residence of Madiun, Java, Pliocene (2); RGM 9895, Tji Longan [Cilongan], Java, Preanger [Priangan] (2); RGM 47 065, Tji Angsana [Ciangsana], Java (1); RGM 47 081, Tji Boerial [Ciburial], Bandung, Java (1 small); RGM 9904, Djokdjo [Jogja], Java, Miocene (1); RGM 9900, Tji Boerial [Ciburial], Java, Preanger [Priangan] (3, very fragmentary); RGM 9898, "Javagruppe", Java, Preanger [Priangan] (no locality) (1 good); "Kendeng beds" material in Mijnwezen Collection: locality M252 (1), M257 (RGM 456 235, 3; Figs. 48, 49), M260 (RGM 456 234, 5; Figs. 46, 47); Sangiran, central Java, Late Pliocene (1 specimen in collection of B. Dharma); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 236, 3 good; Figs. 52, 53), locality 42 (1 small), locality 100 (1 small), locality 101 (2 poor); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (RGM 456 232-3, 88 good; Figs. 42-45).

Distribution – *Bursina ignobilis* occurs throughout the tropical Indian Ocean and the western Pacific. Recent collections from the Marquesas Islands, in eastern Polynesia, demonstrate that only *B. ignobilis* occurs there and *B. nobilis* seems not to occur so far to the east. Fossils are common in the richly diverse Pleistocene locality on Espiritu Santo

Island, Vanuatu (recorded by Ladd (1977, p. 35) as *Bursa nobilis*) and are moderately common in Indonesia.

Remarks – Naturally, all earlier authors have identified this species as *Bursina nobilis* (Reeve, 1844b), as I did not segregate *B. ignobilis* until 1987. However, *B. nobilis* reaches a much larger size (to more than 100 mm high, compared with *c.* 60 mm in *B. ignobilis*) and has a more coarsely granulose exterior than the more common *B. ignobilis*. Ladd (1977, 1982) recorded both *B. nobilis* (under the name *Bursa bufonia dunkeri* Kira; Ladd, 1982, p. 41, pl. 33, figs. 15, 16) and *B. ignobilis* (under the name *Bursa nobilis*; Ladd, 1977, p. 35, pl. 12, figs. 1-3) from the richly diverse Pleistocene shellbed in the Kere River, southern Espiritu Santo Island, Vanuatu. However, this is the only other authentic fossil record of *B. nobilis* I am aware of.

A single excellent specimen from Sangiran, central Java (Late Pliocene), in the collection of B. Dharma, is close to *Bufonaria ignobilis* in many characters. However, it differs in its wider shape, lower spire and much wider, subcircular aperture, and in having the axially aligned row of nodules to the left of the aperture more clearly developed than in *B. ignobilis*. Also, the aperture clearly retains a uniform yellow coloration that I have never observed in *B. ignobilis*. This, therefore, seems likely to represent another, unnamed species of *Bursina*, but more material is needed before it could be named. As with much of B. Dharma's recent Sangiran material, it has been added to this project too recently to be illustrated. A single specimen of typical *B. ignobilis* is also present in B. Dharma's collection from Sangiran, along with many specimens of the following species, so the Sangiran bursid fauna was unusually diverse.

***Bursina* aff. *ignobilis* (Beu, 1987)**

Fig. 54.

Material examined. – Sangiran, central Java, Late Pliocene (GNS WM17476, 3; many specimens in collection of B. Dharma).

Remarks. – Many specimens brought to light during 2004 by B. Dharma occur at Sangiran with several other similar *Bursina* species. They differ from *B. ignobilis* in their taller spires, narrower varices, less dorsoventrally compressed shape and fewer, lower peripheral nodules. These specimens seem to represent yet another unnamed species, similar to some of those collected in northern Borneo (Kalimantan) by Han Raven (Den Haag). This group requires reassessment in view of Raven's new material and is not considered further here.

***Bursina nobilis* (Reeve, 1844b)**

Figs. 55, 56.

Ranella nobilis Reeve, 1844b, pl. 4, fig. 16; Reeve, 1844d, p. 137; Martin, 1899, p. 146, pl. 23, figs. 340-343 (in part); van der Vlerk, 1931, p. 241.
Bursa (Bursa) nobilis. – van Regteren Altena, 1942, p. 111 (in part).
Bursina nobilis. – Oyama, 1964, pp. 330, 332.
Gyrineum nobilis. – Habe & Kosuge, 1966, p. 46, pl. 16, fig. 8.

Bursa bufonia dunkeri. – Ladd, 1982, p. 41, pl. 33, figs. 15, 16 (not pl. 8, figs. 6, 7 = *Bursa rosa* Perry, 1811; not *Bursa bufonia* Gmelin, 1791).

Bufonaria (Bufonaria) nobilis. – Beu, 1985, p. 65; Cossignani, 1994, p. 29-30.

Bufonaria nobilis. – Beu, 1998, p. 169, fig. 53a, c; Okutani, 2000, p. 271, pl. 134, fig. 15; Higo *et al.*, 2001, p. 49, fig. G1627.

Gyrineum (Chasmotheca) nolibis. – Skwarko & Sufiati, 1994, p. m14.

Type material – *Ranella nobilis* Reeve, holotype BMNH 1967655, an unlocalised specimen, *ex* Cuming Colln.; Beu (1998, p. 169) designated the type locality as Taiwan.

Other material examined – RGM 9893, Junghuhn's locality O, Java, Preanger [Priangan] (1 small specimen illustrated by Martin (1899, p. 146, pl. 23, figs. 340, 342) as *Ranella nobilis* Reeve; Figs. 55, 56; with 1 *B. ignobilis*).

Distribution – *Bursina nobilis* occurs uncommonly throughout the Indo-West Pacific region from southern Japan to eastern Australia (Swain Reefs, southeastern Queensland, specimen in collection of Allan Limpus) and from South Africa (off Mvoti River mouth, Natal, South Africa; NMP, S 1676, "*Meiring Naudé*" Sta. ZT4, 150 m) to New Caledonia. Recent collections in MNHN demonstrate that it is much more common around the Marquesas Islands in eastern Polynesia than elsewhere, so it probably occurs well offshore throughout the Indo-West Pacific region. Most fossils identified by this name are specimens of *B. ignobilis* or other, similar species, including *Bufonaria* species such as *B. margaritula* and *B. thersites*. Ladd (1982, pl. 33, figs. 15, 16) illustrated a typical specimen from the Pleistocene deposit at the Kere River, southern Espiritu Santo Island, Vanuatu and the specimen from Java illustrated by Martin (1899, p. 146, pl. 23, figs. 340, 342) as *Ranella nobilis* is confirmed as this species.

Remarks – *Bursina nobilis* differs from *B. ignobilis* in reaching a markedly larger maximum size (at least 110 mm, whereas few specimens of *B. ignobilis* exceed 60 mm), in its much more coarsely granulose exterior, between the rows of moderately large, sharp nodules, in the much darker brown (rather than cream maculated with brown flecks) coloration of almost all Recent specimens and in its more widely flared apertural lips than in *B. ignobilis*. *Bursina ignobilis* is moderately common in Indonesian Neogene fossil localities, whereas only a single specimen, referred to *B. nobilis* because of its coarse surface granules, has been examined in this study.

Genus *Tutufa* Jousseaume, 1881

Tutufa Jousseaume, 1881, p. 175. Type species (International Commission on Zoological Nomenclature, 1977, Opinion 1074): *Murex rana bubo* Linné, 1758, Pliocene to Recent, Indo-West Pacific.

Subgenus *Tutufa* Jousseaume, 1981 *sensu stricto*

Remarks – The genus *Tutufa* is characterised by its large size, by its relatively tall, narrow shape for a bursid, by having growth intervals of two-thirds of a whorl (i.e., varices are situated at each 240° around the spiral, rather than aligned up opposing sides of the shell as in most other Bursidae), and by its subcircular operculum, with the nucleus situated a little to the right of and anterior to the centre of the operculum. *Tutufa sensu stricto* contains relatively large species (with adult shells *c.* 150-430 mm high) in which the cephalic tentacles lack colour rings and the seminal groove is open. In contrast, the smaller species referred to *T. (Tutufella)* have two dark colour rings around each cephalic tentacle and have a closed seminal groove. These apparently quite major characters suggest that the subgenera of *Tutufa* possibly are not really closely related in a phylogenetic sense, i.e., they might well be distinct genera. More research is required to evaluate this possibility.

Tutufa (Tutufa) bubo **(Linné, 1758)**

Figs. 57-63.

Murex rana bubo Linné, 1758, p. 748.

Murex lampas Linné, 1758, p. 748 (in part, not including lectotype, Rondelet, 1555, p. 81 = *Charonia lampas*).

Bursa (Tutufa) rubeta var. *gigantea* E.A. Smith, 1914, p. 230, pl. 4, fig. 4 (only).

Triton lampas of many authors (e.g., Lamarck, 1822, p. 180, Reeve, 1844a, pl. 9, fig. 30a), not of Linné, 1758.

Tutufa (Tutufa) bubo. – Beu, 1981, p. 277, figs. 2d, 4a, 11b, 12f, 13, 14a, c-d; Beu, 1985, p. 66; Wilson, 1993, p. 228, pl. 43, fig. 16; Cossignani, 1994, pp. 98. 99; Beu, 1998, p. 172, fig. 55c (with further synonymy); Okutani, 2000, p. 271, pl. 134, fig. 19.

Type material – *Murex rana bubo* Linné, neotype designated by Beu (1981, p. 278) and lectotype of *Bursa rubeta* var. *gigantea* E.A. Smith, BMNH 1974147; paralectotype of *Bursa rubeta* var. *gigantea* BMNH 1914.6.29.1. The type locality is the Philippine Islands.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M149, Pleistocene (RGM 456 238, 1 good, last whorl missing; Fig. 63); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (RGM 456 237, 9 small, well preserved, but most fragmentary; Figs. 57-60); Sangiran, central Java, Late Pliocene, collected by B. Dharma (GNS WM17440, 1, incomplete); RGM 107 518, Kaju Ragi, Manado Island, Sulawesi, Pleistocene (1, excellent juvenile; Figs. 61, 62).

Distribution – *Tutufa bubo* occurs throughout most of the Indo-West Pacific region, from Mozambique to the Seychelles Islands, and from Tosa Bay, Shikoku, south to Minnie Waters, northern New South Wales, Australia (Beu, 1981, p. 280); a single specimen in a private collection is from the Three Kings Islands, northern New Zealand. It also occurs throughout much of Polynesia, as far east as the Marquesas Islands, although it has not been recorded from Hawaii. The specimens recorded here are the only fossils I am aware of.

Remarks – In the modern fauna, *Tutufa bubo* is easily recognisable by being the largest bursid and perhaps the fourth-largest tonnoidean (after *Charonia tritonis* (Linné), *Cassis cornuta* (Linné) and *Tonna melanostoma* (Jay)) in the Recent western Pacific fauna. However, the fossil material consists of small, juvenile specimens, recognisable by their offset rather than aligned varices, their strongly excavated columella, their relatively tall spire, and short last whorl and anterior canal, their shallow posterior siphonal canal, and their exterior sculpture of coarse, irregular nodules and granules.

The small (i.e., young), incomplete fossil material provides distinctions from the other species of *Tutufa* (*T. bufo* (Röding, 1798), *T. tenuigranosa* (E. A. Smith, 1914), *T. rubeta* (Linné, 1758), *T. oyamai*) and from *Bursa latitudo*. Early spire whorls of all these are surprisingly similar, with relatively finely, but irregularly, nodulose sculpture. On the first few spire whorls, the varices are aligned to form two ridges on opposing side of the spire. The most useful character seems to be the extent to which the varices remain aligned down the spire. On most species examined, including *B. latitudo*, the varices are strictly aligned on the first two whorls only, and begin to separate slightly on the third whorl, so by the fourth whorl they are well separated. The exception is *Tutufa bubo*, in which the varices remain strictly aligned on the third whorl and only begin to separate on the fourth. The small spire from Sangiran, central Java, is identified on these grounds as *T. bubo*.

Tutufa (Tutufa) tenuigranosa **(E.A. Smith, 1914)**

Bursa (Tutufa) rubeta var. *tenuigranosa* E.A. Smith, 1914, p. 231, pl. 4, fig. 6.
Bursa tenuigranosa. – Vanatta, 1914, p. 80; Hedley, 1916, p. 42.
Tutufa tenuigranosa. – Habe, 1973, p. 139, text-fig. 1.
Tutufa (Tutufella) tenuigranosa. – Beu, 1981, p. 285, fig. 15a-c.
Tutufa (Tutufa) tenuigranosa. – Beu, 1985, p. 66, fig. 53; Beu, 1987, p. 346; Wilson, 1993, p. 228, pl. 43, fig. 15; Cossignani, 1994, p. 103; Beu, 1998, p. 175, fig. 56b, c.
Tutufa (Tutufa) bubo form *tenuigranosa*. – Springsteen & Leobrera, 1986, p. 122, pl. 33, fig. 13.

Type material. – *Bursa (Tutufa) rubeta* var. *tenuigranosa*, lectotype (designated by Beu, 1981, p. 286) BMNH 1914.6.29.4, with several paralectotypes. Beu (1998) designated the type locality as Taiwan.

Other material examined. – Mount Butack, Rembang, central Java, Miocene, in collection of B. Dharma (1 large incomplete spire).

Distribution. – *Tutufa tenuigranosa* is recorded in the Recent fauna from Taiwan, the Philippine Islands and Indonesia; it seems to be limited to the most central western Pacific archipelagoes. A similar form with much weaker sculpture on early spire whorls occurs off northern Western Australia and Somalia, and seems to be an unnamed species limited to the Indian Ocean. The single fossil specimen recorded here is the only one I am aware of.

Remarks. – *Tutufa tenuigranosa* is easily recognised by its tall spire and narrow shape, its narrow peripheral row of nodules (similar to those of *T. oyamai*) and its finely sculptured surface, with narrow, clearly defined rows of small granules over the entire teleoconch, particularly obviously recognisable on the clearly defined, concave sutural ramp. It differs from *T. oyamai* in its much larger size, its taller spire and more elongate shape, its more finely and evenly sculptured inner lip with many close, fine transverse ridges, and its more coarsely ridged interior to the outer lip. The peripheral nodules of *T. oyamai* are relatively wide and bifid where they cross the varices, but much narrower, single and spirally elongate over the intervariceal intervals, whereas they are evenly wide and bifid over the entire periphery in *T. tenuigranosa*. Complete, well calcified specimens of *T. oyamai* also have a markedly longer posterior siphonal canal than *T. tenuigranosa*. A single Indonesian Miocene specimen brought to light recently by B. Dharma is typical of *T. tenuigranosa*, but is too recently discovered to be illustrated.

Subgenus *Tutufella* Beu, 1981

Lampas Schumacher, 1817, p. 252. Type species (by monotypy): *Lampas hians* Schumacher, 1817 (= *Murex rana rubeta* Linné, 1758), Recent, Indo-West Pacific. Junior homonym of *Lampas* Montfort, 1810 (Foraminifera).

Tutufella Beu, 1981, p. 260. Replacement name for *Lampas* Schumacher, 1817, preoccupied.

Tutufa (Tutufella) oyamai Habe, 1973

Figs. 64, 65.

Ranella (Lampas) lampas. – Martin, 1899, p. 148, pl. 23, figs. 346, 346a (not *Murex lampas* Linné, 1758).

Ranella lampas. – Schepman, 1907, p. 181; Martin, 1919, pp. 88, 132; van der Vlerk, 1931, p. 241.

Bursa (Ranella) rubeta. – van Regteren Altena, 1942, p. 108 (not *Tritonium rubeta* Röding, 1798).

Tutufa tenuigranosa. – Habe, 1961, p. 47, pl. 24, fig. 4; Habe, 1964, p. 76, pl. 24, fig. 4 (not *Bursa (Tutufa) rubeta* var. *tenuigranosa* E.A. Smith, 1914).

Tutufa oyamai Habe, 1973, p. 140, fig. 2; Wilson, 1993, p. 228, pl. 43, fig. 14a, b; Higo *et al.,* 2001, p. 49, fig. 1632.

Tutufa (Tutufella) oyamai. – Beu, 1981, p. 283, figs. 1f, i, l, q, 2e, 4b-f, 15d-i; Beu, 1985, p. 66, fig. 54; Cossignani, 1994, pp. 106-108; Beu, 1998, p. 177, fig. 55c; Okutani, 2000, p. 271, pl. 134, fig. 17 (not fig. 16, as in caption).

Type material – Holotype NSMT 42372, one paratype NSMT 42373, one paratype GNS WM11274, all from prawn trawlers, off Taiwan, South China Sea.

Other material examined – RGM 9913, Menengteng Gorge, Java, Pliocene (1, spire only, specimen illustrated by Martin as *Ranella lampas* Linné); "Kendeng beds" material in Mijnwezen Collection (all, including Cosijn Collection material, identified by van Regteren Altena (1942) as *Bursa rubeta* Röding): locality M129 (1), M218 (1 good), M278 (RGM 456 239, 1 good; Figs. 64, 65), M281 (1), M298 (1), M333 (2 poor); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 581 (1 good), RGM 46 583 (1, incomplete), RGM 46 584 (1 good); GNS WM 17251, Karas, Rembang, mid-Java, Middle Miocene (Robba, 1996), collected and presented by B. Dharma (1); Sangiran, central Java, Late Pliocene, collected and presented by B. Dharma (GNS WM17250, 1, + 2 in collection of B. Dharma).

Distribution – *Tutufa oyamai* occurs throughout the Indian Ocean and the western Pacific archipelagos, as far south as southern Mozambique and as far north as Oman in the Indian Ocean, and from Taiwan to northern Australia and New Caledonia (Beu, 1998). Although there are no records from Polynesia, some extension east of New Caledonia seems likely. Fossils are moderately common in Java, but seem not to be recorded from elsewhere.

Remarks – Nearly all the material from the Indonesian Tertiary identified by previous authors as "*Ranella lampas*" or "*Bursa rubeta*" proves to belong in *Tutufa oyamai*. This is not surprising, as material collected by Bunjamin Dharma has shown that this species is not rare at several Indonesian fossil localities. *Tutufa (Tutufella) oyamai* is recognisable by its offset varices, its small size (few fossil specimens are over about 60 mm high), its weakly ridged aperture and the quite finely granulose exterior. Many of the larger specimens have thin, widely flared lips forming an almost complete, circular, smooth-edged peristome, but these are probably egg-laying females; many other specimens have narrower lips with strongly digitate margins.

Tutufa (Tutufella) rubeta (Linné, 1758)

Murex rana rubeta Linné, 1758, p. 748; Linné, 1767, p. 1216; Gmelin, 1791, p. 3532.
Tritonium tuberosum Röding, 1798, p. 127.
Tritonium rubeta. – Röding, 1798, p. 128.
Biplex tuberculus Perry, 1811, pl. 4, fig. 3.
Triton lampas. – Lamarck, 1816, pl. 420, fig. 3a, b, "Liste des objets" p. 5; Lamarck, 1822, p. 180 (not *Murex lampas* Linné, 1758).
Lampas hians Schumacher, 1817, p. 252.
Murex lampas. – Wood, 1828, pl. 25, *Murex* fig. 28d (not *Murex lampas* Linné, 1758).
Tritonium lampas. – Anton, 1838, p. 83.
Triton lampas var. – Küster *in* Küster & Kobelt, 1871, p. 175, pl. 40, figs. 7, 8.
Lampas caledonensis Jousseaume, 1881, p. 177.
Bursa (Tutufa) rubeta, typical var. – E.A. Smith, 1914, p. 228, pl. 4, figs. 1, 2.
Bursa rubeta. – Vanatta, 1914, p. 80; Hedley, 1916, p. 41; Hinton, 1972, p. 14, pl. 6, fig. 23; pl. 7, fig. 2; Cernohorsky, 1972, p. 118, pl. 1, fig. 5; Drivas & Jay, 1988, p. 62, pl. 16, fig. 2; Salvat *et al.,* 1988, p. 103, pl. 13, fig. 16.
Tutufa rubeta. – Oyama & Takemura, 1963, *Tutufa* pl. 2, fig. 1; Habe & Kosuge, 1966, p. 46, pl. 16, fig. 8; Hinton, 1978, p. 31, fig. 2; Okutani, 1986, p. 116, 117, fig top row, 5th from left; Short & Potter, 1987, p. 44, pl. 21, fig. 5; Lai, 1987, p. 18, fig. 2.
Tutufa (Tutufella) rubeta. – Beu, 1981, p. 280, figs. 1b-c, e, j, k, 3, 4g-i, 5d, e, 7, 9c, 12b, c, 14d; Springsteen & Leobrera, 1986, p. 120, pl. 33, fig. 6a, b; Wilson, 1993, p. 228, pl. 43, fig. 18; Cossignani, 1994, pp. 109-110; Beu, 1998, p. 178, figs. 55b, 56a, 57b, d, e.

Type material. – *Lampas caledonensis*, lectotype (designated by Beu, 1998, p. 179) in MNHN, from Jousseaume's collection, type locality New Caledonia, with 4 paralectotypes; the lectotype was also designated by Beu (1998) as the neotype of *Murex rana rubeta* Linné, *Tritonium tuberosum* Röding, *Biplex tuberculus* Perry and *Lampas hians* Schumacher. Five specimens in Lamarck's collection, in MHNG, are labelled as syntypes of *Triton lampas* Lamarck, but the syntype illustrated by Lamarck (1816, pl. 420, fig. 3a, b) is not among them.

Other material examined.—Citalahab, West Java, Late Miocene, in collection of B. Dharma (1 incomplete, and 1 juvenile); Sangiran, central Java, Late Pliocene, in collection of B. Dharma (1 small). These new records by B. Dharma again came to light too late to be illustrated here.

Distribution. – Beu (1998) recorded the range of *Tutufa rubeta* as East Africa (perhaps as far south as Durban, South Africa) and throughout the Red Sea, as far east as French Polynesia (although there are no records from Hawaii), and from the Ryukyu Islands, southern Japan, to Coff's Harbour, northern New South Wales, Australia. I am not aware of any records of fossils other than the few reported here.

Remarks. – *Tutufa (Tutufella) rubeta* is distinguishable from other species of *Tutufa* by its relatively small size (adults *c.* 100-120 mm high, rarely to 150 mm), its relatively low nodules, without a large, prominent nodule on the shoulder of the varix as in *T. bubo*, its unevenly, but finely nodulous exterior (cream to red or brick red in Recent specimens), its complexly and entirely ridged inner lip, and in having two rows of short transverse ridges inside the outer lip, with a narrow smooth zone between them. The similar species *T. oyamai* has more prominent, narrower nodules around the periphery and a generally more finely sculptured surface than *T. rubeta*, and only one row of longer transverse ridges inside the outer lip.

Family Cassidae Latreille, 1825
Subfamily Cassinae Latreille, 1825
Genus *Cassis* Scopoli, 1777

Cassida Brünnich, 1772, p. 248. No included species. Junior homonym of *Cassida* Linné, 1758.

Cassis Scopoli, 1777, p. 393. Type species (by subsequent designation, Dall, 1909, p. 60): *Buccinum cornutum* Linné, 1758, Miocene to Recent, Indo-West Pacific.

Cassidea Bruguière, 1792, p. 414. Type species (by subsequent designation, Cossmann, 1903a, p. 123): *Buccinum cornutum* Linné, 1758.

Cassinia Rafinesque, 1815, p. 45 (emendation of *Cassis* Scopoli, 1777).

Goniogalea Mörch, 1857, p. 21; Mörch, 1877, p. 37. Type species (by subsequent designation, Cossmann, 1903a, p. 124): *Cassis madagascariensis* Lamarck, 1822, Pliocene to Recent, western Atlantic.

Cassisoma Rovereto, 1899, p. 107. Unnecessary replacement name for *Cassis* Klein, 1753, pre-Linnean.

Hypocassis Iredale, 1927, p. 322. Type species (by original designation, Iredale, 1927, p. 329): *Cassis bicarinata* var. *decresensis* Hedley, 1923 (= *Cassis fimbriata* Quoy & Gaimard, 1833), Recent, southern Australia.

Nannocassis Iredale, 1927, p. 322. Type species (by original designation, Iredale, 1927, p. 328): *Cassis nana* Tenison Woods, 1879, Recent, northern New South Wales and southern Queensland, Australia.

Remarks – The synonymy list, above, includes a minor group (*Hypocassis* Iredale, 1927) that has been maintained by most recent authors (e.g., Abbott, 1968; Bouchet, 1988; Kreipl, 1997), but was based largely on protoconch characters. In common with several other groups of southern Australian molluscs, such as species referred to *Sassia (Austrotriton), Cypraea (Notocypraea)* and *Athleta (Ternivoluta)*, some *Cassis* species have lost their planktotrophic larval development since they arrived in Australia and now have lecithotrophic development. This distinction in developmental mode is not now regarded as a generic character, and I can see no basis for maintaining *Hypocassis* or *Nannocassis* distinct from *Cassis sensu stricto.* In any case, the species formerly included in these "subgenera" closely resemble European fossil species of *Cassis sensu stricto* and the "subgenera" are not justified on morphological or phylogenetic grounds. Also, the whole question of subgeneric classification of Australian *Cassis* species has been complicated by the recent recognition of the southern Western Australian species *Cassis patamakanthini* by Parth (2000). This species closely resembles a miniature version of such European fossil species as *Cassis mammillaris* (Grateloup) and has a small protoconch similar to that of *Cassis cornuta*, even though it apparently is limited to a small area of the southern Western Australian shelf.

Cassis cornuta (Linné, 1758)
Figs. 66, 67.

Buccinum cornutum Linné, 1758, p. 735; Linné, 1767, p. 1198.
Cassidea cornuta. – Bruguière, 1792, p. 434.
Cassis caput-equinum Röding, 1798, p. 28.
Cassis hamata Röding, 1798, p. 29.
Cassis cornuta. – Martin, 1879, p. 45, pl. 8, figs. 5, 5a; Oostingh, 1925, p. 113 (with further synonymy); Iredale, 1927, p. 327; van der Vlerk, 1931, p. 241; Abbott, 1968, p. 47, pl. 3, figs. 1-4; pl. 22, figs. 3, 4; Okutani, 2000, p. 279, pl. 138, fig. 23.
Cassis (Cassis) cornuta. – Kreipl, 1997, p. 13, pl. 1, figs. 1-1e.

Type material – Abbott (1968, p. 48) did not resolve the type material. Dance (1967, p. 21) listed *Buccinum cornutum* among the species not represented by potential type material in Linné's collection in London and none was present when I examined the collection in 1999. Linné (1758, p. 735) cited three illustrations to represent *Buccinum cornutum*; Buonanni (1681, pl. 155), Rumphius (1705, pl. 23, fig. 1) and Gualtieri (1742, pl. 40, fig. D). These three illustrated specimens, therefore, are all syntypes of *Cassis cornuta*. I examined Gualtieri's collection, in the Museo di Storia Naturale e del Territorio, Università di Pisa, in the Certosa di Calci, outside Pisa, during January 2000. Unfortunately, the two juvenile specimens of *Cassis cornuta* illustrated by Gualtieri (1742, pl. 40, fig. C, D) are no longer present in the collection, although one large adult specimen is present, evidently not illustrated by Gualtieri. The specimen present is not a syntype of *Buccinum cornutum* Linné. No specimens are known today from the collections of Rumphius (Rumpf) or Buonanni and almost none are known from the collection catalogued by Röding (1798) (although Joost (1990) indicated that a few of Bolten's specimens, catalogued by Röding, remain in Schmidt's collection, in the Museums der Natur Gotha, Germany). The catalogue of Linnean specimens in the Zoological Museum of the University of Uppsala (Wallin, 1993, p. 49) lists one possible syntype of *Cassis cornuta* (UUZM 944) as present in the collection, from the donation of King Gustav IV Adolf of Sweden, and identified as *Cassis cornuta* by the well-known malacologist Nils Odhner. This, then, is the one potential syntype of *Cassis cornuta* in existence, although as noted by Beu (1998, p. 16, fig. 22) there is little or no evidence that the material in Uppsala actually consists of Linnean syntypes. Confirmation of the identity of the Uppsala specimen and determination of its status as a Linnean syntype is beyond the scope of this paper, as therefore is selection of a type specimen for *Cassis cornuta*.

Other material examined – RGM 9944, Junghuhn's locality O, Java, Preanger [Priangan], Late Miocene (1 good juvenile, Martin's illustrated specimen; Figs. 66, 67).

Distribution – *Cassis cornuta* occurs throughout the Indo-West Pacific region, from East Africa, Madagascar and the Red Sea to Hawaii and the Tuamotu Islands (Abbott, 1968, pl. 20). The specimen from Java seems to be the only recorded fossil.

Remarks – Only one specimen seems to be present in the RGM collections that has been referred to *Cassis cornuta* and that is Martin's (1879, pl. 8, figs. 5, 5a) illustrated juvenile specimen (illustration repeated by Abbott, 1968, pl. 22, fig. 3, 4). This specimen certainly has the small peripheral nodules and fine, cancellate sculpture between nodule rows that are characteristic of *C. cornuta*, and appears to be a typical juvenile specimen. However, it is possible that *Cassis preangerensis* Martin, 1899, is a synonym of *C. cornuta*, so that this species might well be more common in the Indonesian Tertiary than the recorded material would suggest.

***Cassis depressior* Martin, 1879**

Figs. 68-71.

Cassis depressior Martin, 1879, p. 44, pl. 8, fig. 4; Martin, 1883a, p. 219; van der Vlerk, 1931, p. 242; Abbott, 1968, p. 49, pl. 22, figs. 1, 2; Skwarko & Sufiati, 1994, p. k1; van den Hoek Ostende *et al.,* 2002, p. 32.

Type material – RGM 9947, Tji Lanang [Cilanang], Java, Late Miocene (1, the illustrated less complete syntype of Martin (1879), pl. 8, fig. 4, 4a; fairly large, cracked and poor; Figs. 68, 69); RGM 9948, Tji Longan [Cilongan], Java, Preanger [Priangan], Late Miocene (1, crushed, illustrated syntype of Martin); RGM 9949, Tji Boerial [Ciburial], Java, Preanger Reg (2 syntypes, very distorted; Figs. 70, 71).

Distribution – Cassis depressior is recorded only from Miocene rocks of Java.

Remarks – Cassis depressior has narrow, closely spaced axial ridgelets, but no spiral sculpture; the shape is much as in juvenile *C. cornuta*. The axial ridgelets are narrow and subtriangular in cross-section, with sharp crests, i.e., this species closely resembles an unnamed species (Beu, research in progress) from the Pliocene of Atlantic Panama. This is the most distinctive of Indo-West Pacific Neogene fossil *Cassis* species and definitely is distinct from *C. cornuta*.

***Cassis preangerensis* Martin, 1899**

Figs. 72, 73.

Cassis sensu stricto preangerensis Martin, 1899, p. 153, pl. 24, fig. 354.
Cassis preangerensis. – van der Vlerk, 1931, p. 242; Abbott, 1968, p. 49, pl. 21.
Cassis (Cassis) preangerensis. – Skwarko & Sufiati, 1994, p. k4; van den Hoek Ostende *et al.,* 2002, p. 32.

Type material **–** *Cassis preangerensis* Martin, holotype RGM 9946, Preanger [Priangan], Java, Late Miocene (Figs. 72, 73).

Other material examined. **–** Ciodeng, Palabuan district, Java, Late Miocene, in collection of B. Dharma (1 incomplete, similar to holotype).

Distribution – Known only by the holotype and one specimen in B. Dharma's collection, from Ciodeng. Both specimens are Miocene.

Remarks – The holotype of *Cassis preangerensis* and the one other specimen noted above are very similar to *C. cornuta* (Linné), but the nodules around the periphery are smaller and more clearly aligned into one spiral cord than in other material of *C. cornuta* I have seen, and the spiral and axial sculpture is a little more prominent and more closely spaced than in other material of *C. cornuta*. It is not certain that this is a species distinct from *C. cornuta* and more material is needed to clarify its status. In particular, adult specimens of most *Cassis* species are more clearly distinct than juvenile specimens and all these Indonesian species of *Cassis* will be more clearly understood once adult specimens are known.

Genus *Cypraecassis* Stutchbury, 1837

Cypraecassis Stutchbury, 1837, p. 214. Type species (by original designation): *Buccinum rufum* Linné, 1758, Recent, Indo-West Pacific.

Levenia Gray, 1847, p. 137. Type species (by monotypy): *Cassis coarctata* G.B. Sowerby 1st, 1825, Pleistocene and Recent, eastern Pacific.

Remarks – Now that Kreipl & Alf (2000) have recognised the additional eastern Pacific species *Cypraecassis wilmae*, which is intermediate in many characters between *C. (Levenia) coarctata* (G.B. Sowerby 1st) and species referred previously to *Cypraecassis sensu stricto*, there seems to be little point in maintaining the weakly defined subgenus *C. (Levenia)* for *C. coarctata* alone.

Cypraecassis denseplicata (Martin, 1916)

Figs. 74-76.

Cassis (Semicassis) denseplicata Martin, 1916, p. 243, pl. 2, figs. 42, 42a, 43.
Cassis denseplicata. – van der Vlerk, 1931, p. 242.
Phalium (Semicassis) denseplicatum. – Abbott, 1968, p. 139, pl. 125.
Semicassis denseplicata. – Skwarko & Sufiati, 1994, p. k9; van den Hoek Ostende *et al.*, 2002, p. 34.

Type material – *Cassis denseplicata*, RGM 9980, Kali Kemejing, West Progo Mountains, Late Miocene (3 syntypes, quite large, height to *c.* 35 mm); RGM 9981, Mount Spolong, Residence of Jogjakarta (6 syntypes, small and incomplete, some disintegrated since illustrated by Martin (1916); RGM 47 051, Mount Spolong, en Kali Kemejing, Java, Late Miocene (2 syntypes, the larger quite good; Figs. 74-76).

Distribution – Known only by the type material.

Remarks – "*Cassis*" *denseplicata* is a highly distinctive, ovoid *Cypraecassis* species with strongly convex spire outlines and with the most obvious sculpture consisting of prominent, narrow, closely spaced axial ridges, but also with 2-3 spiral grooves on the sutural ramp, a very strongly twisted siphonal canal and prominent, long, transverse ridges crossing the inner lip. The outer lip is unusually strongly flared outwards for a *Cypraecassis* species. Most of the RGM material appears to be from one locality and is in a hard, fine-grained, pale grey matrix resembling concrete. However, the material from Mount Spolong (RGM 9981) is in a softer matrix and has largely disintegrated since Martin described it. Abbott (1968, p. 139), presumably following Martin's original position in *Cassis (Semicassis)*, referred this species to *Phalium (Semicassis),* but there is no doubt that it is a close relative of *Cypraecassis testiculus* (Linné, 1758) (Miocene to Recent, Caribbean; Recent, West Africa). This, then, appears to be a further species group that has become extinct in the tropical Pacific since Miocene time.

Cypraecassis rufa (Linné, 1758)

Buccinum rufum Linné, 1758, p. 736; Linné, 1767, p. 1198.
Buccinum pullum Born, 1778, p. 236.
Buccinum ventricosum Gmelin, 1791, p. 3476.
Buccinum pennatum Gmelin, 1791, p. 3476.
Cassis rufescens Röding, 1798, p. 29.
Cassis tuberosa Röding, 1798, p. 28 (not *Cassis tuberosa* (Linné, 1758)).
Cassis labiata Perry, 1811, pl. 33, fig. 4 (not *Cassidea labiata* Perry, 1811).
Cassis rufa. – Lamarck, 1822, p. 224; Reeve, 1848a, pl. 8, fig. 20a-c.
Cypraecassis rufa. – Stutchbury, 1837, p. 214, fig. 22a, b; Iredale, 1927, p. 330; Abbott, 1968, p. 70, pl. 3, fig. 10; pl. 4, figs. 10-12; pls. 44-46; Kreipl, 1997, p. 20, pl. 6, figs. 10-10b.

Type material – Linné's collection, housed by the Linnean Society of London in Burlington House, includes one good, rather small adult specimen (H 101.1, D 73.3 mm) of *Cypraecassis rufa*, identified as *Buccinum rufum* Linné, and marked both "385" (the species number for *B. rufum* in the 10th edition of "*Systema naturae*") and "446" (the species number for *B. rufum* in the 12th edition). As Linné (1758, p. 736) referred to four illustrations, two of which are not available to me (and so their identity cannot be confirmed), and all four must be construed as syntypes of *Buccinum rufum*, the specimen in Linné's collection in London is here designated the lectotype of *Buccinum rufum* Linné, 1758. This specimen is also here designated the neotype of *Buccinum ventricosum* Gmelin, 1791, *Buccinum pennatum* Gmelin, 1791, *Cassis rufescens* Röding, 1798, *Cassis tuberosa* Röding, 1798 (not of Linné, 1758) and *Cassis labiata* Perry, 1811. The type locality is designated here as Ambon Island (Amboina), Indonesia. The holotype of *Buccinum pullum* Born, 1778 (an immature specimen of *C. rufa* that has not yet secreted the ventral callus shield), remains in Naturhistorisches Museum Wien, along with all the other material described by Born (1778, 1780).

Other material examined – Citalahab, Java, Miocene (1, in collection of B. Dharma); Karas, Rembang, Java, Middle Miocene (2 incomplete, in collection of B. Dharma).

Distribution – In the Recent fauna, *Cypraecassis rufa* occurs throughout the Indo-West Pacific region in its widest sense, from East Africa to the Marquesas Islands (Abbott, 1968). It is considerably more common in East Africa than anywhere further to the east. Fossils of two similar species with more numerous nodule rows on the last whorl – possibly synonymous, but requiring further study – were recorded by Abbott (1968, p. 71) from Miocene rocks of Pemba Island, Zanzibar, East Africa. Abbott (1968, p. 70) noted of *C. rufa,* "Fossil records – none known to me". As far as I am aware, there are no records of a similar taxon from Indonesia other than the specimens recorded here.

Remarks – A single specimen of a *Cypraecassis* species collected by Bunjamin Dharma very late in this study, during June 2003 (and so not able to be illustrated here) resemble *C. rufa* closely in all characters, including its heavy, laterally protruding, obviously adult ventral callus shield, but is only 35 mm high. The sculpture is identical to that of the much larger Recent specimens of *C. rufa*. I have not observed adult, heavily callused Recent specimens of *C. rufa* smaller than 65 mm in height and most adults are in the range of 100-140 mm high, reaching 185 mm (Abbott, 1968, p. 69). It seems likely, therefore, that this specimen represents an unnamed species distinct from *C. rufa*. More material is required to evaluate the characters of the apparently new species. Two further specimens from Karas, Rembang, Java, added by B. Dharma even more recently (August 2004) are larger, although very incomplete, and resemble *C. rufa* still more closely, suggesting that all these are just fossil specimens of *C. rufa*. More, complete material is required to evaluate this record fully.

It is interesting for the biogeographical history of *Cypraecassis* that the Indonesian specimens closely resemble central and western American fossil and Recent species of *Cypraecassis*, such as *C. chipolana* Duerr, 2001 (late Early Miocene, Chipola Formation, Florida, USA) and *C. wilmae* Kreipl & Alf, 2000 (Pliocene-Recent, eastern Pacific). These similarities suggest a much closer phylogenetic relationship between the Indo-West Pacific and American species of *Cypraecassis* than was suspected previously.

Cypraecassis sp.

Material examined. – Karas, Rembang, central Java, Middle Miocene (1, in collection of B. Dharma).

Remarks. – The single specimen collected to date of this apparently undescribed species of *Cypraecassis* is incomplete, and seen only in dorsal view, in a digital image sent by B. Dharma in February 2002. Nevertheless, it is clear that it is an important new contribution to the diversity of Pacific *Cypraecassis* species, as it is narrowly oval, moderate-sized, with a well thickened, but narrow, terminal varix (not the huge ventral callus shield of *C. rufa*) and dominantly spiral sculpture. It resembles the Atlantic species group of *C. testiculus* (Linné, 1758) more closely than any other Pacific specimens I have seen. It bears about 12-14 low, narrow, weakly nodulous spiral cords, with interspaces each about the same width as one cord, on the remaining last third of the last whorl. More material must once again be found before this species can be named. A further closely similar specimen in the collection of Dr Bernard Landau, from the late Early Miocene locality of Cantaure, Paraguana Peninsula, Venezuela, will be described as a new species (Beu, research in progress).

Genus *Galeodea* Link, 1807

Galeodea Link, 1807, p. 113. Type species (by monotypy): *Buccinum echinophorum* Linné, 1758, Miocene to Recent, southern Europe and Mediterranean.

Morio Montfort, 1810, p. 479. Type species (by monotypy): *Buccinum echinophorum* Linné, 1758.

Cassidaria Lamarck, 1816, "Liste des objets dans les planches de cette livraison", p. 3. Type species (by subsequent designation, Woodward, 1851, p. 115): *Buccinum echinophorum* Linné, 1758.

Remarks – Several other synonyms of *Galeodea* are not listed here. Beu (2005) is revising the Recent deep-water Cassidae and provides a full synonymy of *Galeodea*.

Galeodea bituminata (Martin, 1933)

Figs. 77-80.

Purpura mancinella(?). – Martin, 1879, p. 42, pl. 8, fig. 11 (not *Purpura mancinella* Lamarck, 1822).
Morio spec. – Martin, 1899, p. 158.
Purpura (Thalessa) mancinella var. – Martin, 1899, p. 134, pl. 21, fig. 309.
Morio echinophora. – W.D. Smith, 1910, p. 329 (not *Buccinum echinophorum* Linné, 1758).
Cassidaria echinophora? – W.D. Smith, 1913, p. 263, pl. 4, fig. 5 (not *Buccinum echinophorum* Linné, 1758).
(?)*Cassidaria* spec. indet. – Martin, 1919, p. 89; van der Vlerk, 1931, p. 241.
Cassidea (Semicassis) bituminata Martin, 1933, p. 28, pl. 4, fig. 28.
Galeodea echinophorella Hirase, 1934, p. 1, frontispiece, fig. 10 (*nomen nudum*); Kuroda & Habe, 1952, p. 58 (*nomen nudum*); Habe, 1961, p. 44, pl. 21, fig. 2; Springsteen & Leobrera, 1986, p. 102, pl. 27, fig. 12; Wilson, 1993, p. 231, pl. 38, fig. 6a, b; Kreipl, 1997, p. 25, pl. 8, fig. 16; Okutani, 2000, p. 273, pl. 135, fig. 2; Higo *et al.,* 2001, p. 46, fig. G1543.
Phalium (Semicassis) bituminatum. – Beets, 1943a, p. 277, pl. 28, fig. 58.
Galeodea carolimartini Beets, 1943b, p. 437, figs. 1-3; Skwarko & Sufiati, 1994, p. k5.
Phalium (Echinophoria) bituminatum. – Abbott, 1968, p. 102.
Galeodea marginalba Yamamoto & Sakurai, 1977, p. 103, text-fig. 1; Hasegawa & Saito, 1995, p. 31, pl. 4, fig. 2; Higo *et al.*, 2001, p. 47, fig. G1544.
Galeodea noharai Noda, 1980, p. 17, pl. 6, fig. 17a, b; pl. 11, fig. 19.
Galeodea echinophorella suzumai Sakurai, 1984, p. 129, fig. 2; Hasegawa & Saito, 1995, p. 33, pl. 4, fig. 1; Higo *et al.*, 2001, p. 47, fig. G1543s.
Semicassis bituminata. – Skwarko & Sufiati, 1994, p. k9.
Morio pamotanensis. – Noda, 2002, p. 106, fig. 17-10 (not *Morio pamotanensis* Martin, 1899).

Type material – *Cassidaria bituminata* Martin, holotype RGM 456 182, from Waisiu, Buton Island, in bituminous sandstone, Late Miocene (Figs. 77, 78). *Galeodea carolimartini* Beets, holotype RGM 456 183, from Tji Guleh [Ciguleh], Sangkulirang, northern Kutei, Kalimantan [East Borneo], Late Miocene (Figs. 79, 80). *Galeodea echinophorella* Habe; the specimen illustrated by Habe (1961, pl. 21, fig. 2; NSMT, Mo 44913) is labelled "type", and is accepted as the holotype of *Galeodea echinophorella* Habe, 1961. It is labelled "Tosa Province, Kochi Prefecture, Shikoku". *Galeodea marginalba* Yamamoto & Sakurai, holotype NSMT, Mo.70271, from the East China Sea, in 360 m, 27°-28°50′ N, 125°50′-126° E (Yamamoto & Sakurai, 1977). *Galeodea noharai* Noda, holotype in Institute of Geoscience, University of Tsukuba, no. IGUT 10156, from Shinzato Formation (Pliocene), locality 415, southern cliff of Shore Golf Links, 1 km northwest of Kuteken, Chinen-mura, Shimajiri-gun, Okinawa, Japan. *Galeodea echinophorella suzumai* Sakurai, holotype NSMT, Mo.70288, with one paratype, NSMT-Mo.70289 (Hasegawa & Saito, 1995, p. 33), from off Kuriya, Fukui Pref., Sea of Japan.

Other material examined – RGM, Waisiu, Buton Island, in bituminous sandstone, Late Miocene (1, incomplete, 5 rows of small nodules). Smith's (1910, 1913) records from Pliocene rocks of the Philippines are confirmed by a beautifully preserved specimen in RGM (locality ANDA 6: east end of coastal cliff section in front of Anda township, 16° 17.41′ N, 119° 56.19′ E, Cabarruyen Island, Pangasinan, Philippines, coll. A.W. Janssen, 6 May 2001). The beautifully preserved bathyal fauna of Buton Island has been accepted as Pliocene in age on the basis of Foraminifera, but Janssen (1999) reported that Buton pteropods indicate a Late Miocene age, which is therefore adopted throughout this paper.

Distribution – *Galeodea bituminata* occurs throughout the western Pacific from southern Japan to northwestern Australia, New Caledonia and many of the islands of Polynesia. Fossils are recorded widely from the Philippine Islands, Indonesia and Fiji.

Remarks – Abbott (1968, p. 102) placed *Cassidea bituminata* in *Echinophoria,* and considered it to be similar to *E. carnosa* Kuroda & Habe *in* Habe, 1961 (Recent, Japan), differing only in its lower spire and larger nodules inside the outer lip than those of *E. carnosa*. The holotype (Martin, 1933, pl. 4, fig. 28; Figs. 77, 78) is a very incomplete specimen, with the inner lip and anterior end missing. Abbott apparently had not seen the illustration by Beets (1943a, p. 277, pl. 28, fig. 58) of a complete specimen. This illustration (of a specimen I have not seen, in the Mijnbouwkundig Institut, Delft) shows a small shell (height 36.7 mm) with 5 rows of small nodules around the last whorl and an anterior siphonal canal that is only weakly twisted; it is a specimen of a *Galeodea* species. It is clear that this is an earlier name for the small, widespread species of *Galeodea* that, in the Recent Indo-West Pacific fauna, previously has been known as *Galeodea echinophorella* Habe, 1961. I have examined another slightly incomplete specimen from the type locality (asphaltic turbidite deposits at Waisiu, Buton Island, Late Miocene) in RGM and this confirms the specific identity. The RGM specimen is intermediate in shape and nodule prominence between the specimen illustrated by Beets (1943a, pl. 28, fig. 58) and the holotype of *Galeodea carolimartini* Beets (1943b, p. 437, fig. 1-3; Figs. 79, 80). It is now clear that *Galeodea carolimartini* also is an earlier name for the Recent species usually known as *G. echinophorella* and that *G. carolimartini* is a further synonym of *G. bituminata.*

Galeodea bituminata is distinctive because of its small size, its moderately tall spire, its numerous (3-5 on most specimens) rows of small nodules around the periphery, its moderately long, only weakly twisted anterior canal and its narrow collar extending from the inner lip of the aperture, on most specimens. Few fossil specimens are recorded, probably because Recent records are mostly from depths of *c.* 200-700 m, i.e., it lives in water deeper than the deposition sites of most Indonesian Neogene rocks. Beets (1953) re-examined ideas on the age and depositional environment of the Buton Island deposit, which previously had been considered to be an “unusual” shallow-water facies of Oligocene age. Beets pointed out the deep-water environments at present of many of the taxa occurring fossil in the Buton deposit and recognised this as a Pliocene deep-water fauna; a following paper on the foraminiferal fauna supports the age, although, as noted above, pteropods indicate that the age is actually Late Miocene. I am grateful to Han Raven (Den Haag) for pointing out that the deposit containing the fossils on Buton Island is an asphalt-impregnated turbidite, probably transported out into very deep water. Beets’s interpretation is strongly supported by the presence of such molluscan genera as *Euciroa* (*“Unio” sparsa* Martin, 1933), *Calliotectum* (= *Butonius* Martin, 1933; Bouchet & Poppe, 1995), and diverse large Turridae *sensu lato*, along with the cassids *Galeodea bituminata* and *Echinophoria vandervlerki* (close to *E. wyvillei* Watson, 1886), and the tonnid *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881). The Buton asphaltic turbidite deposit evidently was deposited in a depth of at least 300 m.

Genus *Sconsia* Gray, 1847

Sconsia Gray, 1847, p. 137. Type species (by original designation): *Cassidaria striata* Lamarck, 1816 (junior secondary homonym of *Sconsia striata* (J. Sowerby, 1812 *in* J. Sowerby & J. de C. Sowerby, 1812-1846) = *Sconsia grayi* A. Adams, 1855, Pleistocene and Recent, western Atlantic.

?*Morionassa* Sacco, 1890, p. 74. Type species (by original designation): *Morionassa amplectens* Sacco, 1890 (aberrant?), Miocene, Italy.

Galeodosconsia Sacco, 1890, p. 69. Type species (by original designation): *Cassidaria striatula* Bellardi & Michelotti, 1840, Miocene, Italy.

Remarks – Tracey (1992) and Beu (2005) showed that the name *Sconsia striata* (Lamarck) is a junior secondary homonym of *S. striata* (J. Sowerby), and so the valid name for the type species of *Sconsia* is *S. grayi* (A. Adams). The two Indonesian species of *Sconsia* listed here resemble *S. grayi* quite closely and appear to be the only Neogene species recorded in the Indo-West Pacific. They represent one of the two areas that the previously much more widespread genus *Sconsia* became restricted to during Neogene time (*Sconsia rembangensis* Pannekoek is transferred below to the new genus *Sconsodolium*). Subsequent further restriction after the closure of the Panama seaway has seen *Sconsia* become limited to the western Atlantic Ocean at present.

Sconsia martini van Regteren Altena, 1942

Figs. 81, 82.

Cassidaria striata. – Martin, 1884, p. 139 (not *Cassidaria striata* Lamarck, 1816).

Morio (Sconsia) striata. – Martin, 1899, p. 158, pl. 24, figs. 366, 367; Skwarko & Sufiati, 1994, p. y15 (not *Cassidaria striata* Lamarck, 1816).

Sconsia striata. – Martin, 1919, p. 9; van der Vlerk, 1931, p. 242; Pannekoek, 1936, p. 7 (not *Cassidaria striata* Lamarck, 1816).

Sconsia martini van Regteren Altena, 1942, p. 90, fig. 1; Skwarko & Sufiati, 1994, p. k11; van den Hoek Ostende *et al*., 2002, p. 33.

Type material – *Sconsia martini* van Regteren Altena, holotype RGM 10 002 (Figs. 81, 82), Ngembak, Semarang, Java, "Kendeng beds", Late Miocene-Pliocene; paratype, RGM 10 000, "Priangan v. h. Preanger", Java, Late Miocene; paratype, RGM 9999, Madiun, Java (specimen illustrated by Martin as *Morio striata* Lamarck); 2 paratypes, RGM, "Kendeng beds" material in Mijnwezen Collection, 1 each in localities M251 and M260.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: M260 (1, excellent juvenile); Sangiran, central Java, Late Pliocene (3 in collection of B. Dharma; GNS WM17473, 1).

Distribution – *Sconsia martini* is recorded only from Late Miocene to Late Pliocene rocks of Java.

Remarks – Van Regteren Altena (1942, p. 91) pointed out that, although *Sconsia martini* closely resembles *S. grayi*, it differs in its consistently smaller size, its more numerous, lower and wider spiral cords, and its greater inflation at the same size, so that the aperture is wider at the anterior end, and the anterior siphonal canal is shorter than in

S. grayi. The sculpture is decussate on spire whorls, but the axial ridgelets and grooves fade out over the last whorl. The largest specimen available to van Regteren Altena was only 33.5 mm high and 21 mm in diameter, much smaller than the height of *c.* 75 mm reached by *S. grayi*, but a specimen recently acquired from Sangiran by B. Dharma is 53.1 mm high and is very similar to *S. grayi* in most characters. However, this specimen remains narrowly and evenly oval in shape, with a shorter anterior siphonal canal than in *S. grayi*. The outer lip is markedly thickened, with coarser and more prominent transverse ridges than in *S. grayi*, and the lower columellar area of the inner lip bear 8 or 9 prominent, long, transverse ridges I have not observed on any other *Sconsia* specimens.

Sconsia pulchra Pannekoek, 1936

Figs. 83, 84.

Sconsia striata. – Wanner & Hahn, 1935, p. 257, pl. 19, fig. 21 (not *Cassidaria striata* Lamarck, 1816; van Regteren Altena, 1942, pp. 92, 93).

Sconsia pulchra Pannekoek, 1936, p. 44, pl. 2, figs. 22-24; Skwarko & Sufiati, 1994, p. k11.

Type material – Sconsia rembangensis Pannekoek, 13 syntypes RGM 9997, Rembang, Java, Rembang Formation, Middle Miocene (Figs. 83, 84).

Distribution – Known only by the type material.

Remarks – Van Regteren Altena (1942, pp. 92-93) pointed out that *Sconsia pulchra* differs from *S. martini* in its fewer, wider spiral cords, in the axial sculpture persisting on the dorsum of the last whorl (rather than fading out over the dorsum, as in *S. martini*), and in the outer lip being more widely flared. On these grounds, van Regteren Altena (1942) referred the Rembang specimen illustrated by Wanner & Hahn (1935, pl. 19, fig. 21) to *S. pulchra* rather than *S. martini*. It seems feasible that the Middle Miocene (Rembang Formation) species *S. pulchra* was the direct ancestor of the Late Miocene-Pliocene species *S. martini*.

Genus *Sconsodolium* gen. nov.

Type species – Sconsia rembangensis Pannekoek, 1936, Miocene, Java.

Diagnosis – A genus of relatively narrow, elongate Cassidae(?) with a subcylindrical last whorl, with a straight columella and anterior siphonal canal, with a large, superficially smooth, low-turbiniform protoconch similar to those of species of *Cypraecassis* Stutchbury, 1837, and bearing prominent, narrow axial ridgelets, particularly well raised over the crests of the spiral cords; with spiral sculpture of low, moderately wide, relatively elevated, convex-crested cords similar to those of *Semicassis*; and bearing very prominent, high, narrow transverse ridges down the entire inner lip. Gender neuter.

Remarks – *"Sconsia" rembangensis* Pannekoek is an exceedingly distinctive species and its combination of characters indicates that it belongs in a previously unnamed genus, probably to be referred to the Cassidae Cassinae, although I have also considered a possible position in the Tonnidae. Like *Cypraecassis* and all taxa referred here to the Tonnidae, it has a large, superficially smooth protoconch (although it is *c.* 4 mm in diameter, smaller than in most Tonnidae), and an unusually straight columella and anterior canal, with little sign of a flexure at the junction of the columella and canal. It also bears fine, sharp, well-raised axial ridgelets similar to those of *Tonna* and *Eudolium,* although these are much more prominent where they cross the crests of the spiral cords than in any tonnid I am aware of. Perhaps the most distinctive character is the elongate, subcylindrical shape of the last whorl, more nearly resembling that of *Sconsia* than that of *Eudolium*. The spiral cords also are distinctive, being unusually clearly defined and well raised, only moderately wide, but rather closely spaced and with prominently convex crests; they more nearly resemble those of *Semicassis* and *Malea* than those of *Tonna*. The outer lip bears a moderately prominent varix, with many narrow, transverse ridges on its ventral surface. The most distinctive character of all is the very prominent, high and narrow, widely spaced transverse ridges on the inner lip, thickened over their outer edges so that they have undercut sides. They are only a little less prominent than those of *Malea*. However, the transverse ridges of *Malea* are situated on unique, prominent callosities on the mid-columellar region and the base of the columella; such callosities are absent from *Sconsodolium rembangense*, in which the transverse ridges occur over the entire height of the lip. The relationships of *S. rembangense* are concluded to be with *Sconsia* and *Cypraecassis* rather than with *Eudolium*, but examination of a larger number of more complete specimens would help understanding of this rare species.

Etymology – The generic name reflects the combination of characters of the new genus, which is shaped like *Sconsia,* but has a protoconch and straight columella similar to those of *Tonna* (represented by the out-dated but familiar synonym *Dolium*).

***Sconsodolium rembangense* (Pannekoek, 1936)**
Figs. 85-88.

Sconsia rembangensis Pannekoek, 1936, p. 45, pl. 2, figs. 25, 25a-d; Skwarko & Sufiati, 1994, p. k11; van den Hoek Ostende *et al.,* 2002, p. 34.

Type material – *Sconsia rembangensis* Pannekoek, illustrated syntype (Fig. 85-88) and 1 poorly preserved syntype, RGM 9998, Rembang, Java, "Ngampel u. Panowan", Middle Miocene.

Distribution – Known only by the type material.

Remarks – The type material of *Sconsia rembangensis* has a completely straight columella and anterior canal, a large, low-turbiniform protoconch similar to those of *Tonna* and *Cypraecassis*, and axial sculpture of prominent, narrow ridgelets (as shown in Pannekoek's (1936, fig. 25d) illustration). It is placed in the new genus *Sconsodolium* because it combines the tall shape and long, subcylindrical last whorl of *Sconsia* with well-raised, wide spiral cords with strongly convex crests, and very prominent, narrow, transverse ridges in the inner lip. Pannekoek (1936, p. 46) compared this species only with *Cassidea (Semicassis) oligocalantica* Vredenburg (1925, p. 263, pl. 3, figs. 3-5; pl. 4, fig. 4), which has similar coarse axial ridges to those of *S. rembangense* and might well be congeneric. Apertural and protoconch characters are not visible in Vredenburg's illustrations to confirm the relationship. However, Vredenburg (1925) described the protoconch as "small" and *C. oligocalantica* seems more likely to be a species of *Semicassis* than of *Sconsodolium*.

Subfamily Phaliinae Beu, 1981

Genus *Casmaria* H. & A. Adams, 1853

Casmaria H. & A. Adams, 1853, p. 216. Type species (by subsequent designation, Harris, 1897, p. 200): *Buccinum vibex* Linné, 1758 (= *Buccinum erinaceus* Linné, 1758), Recent, Indo-West Pacific.

Casmeria Jousseaume, 1888, p. 190. Type species (by monotypy): *Cassis torquata* Reeve, 1848a (= *Buccinum ponderosum* Gmelin, 1791), Recent, Indo-West Pacific.

Casmaria erinaceus (Linné, 1758)

Figs. 89-92.

Buccinum erinaceus Linné, 1758, p. 736; Linné, 1767, p. 1199.
Buccinum vibex Linné, 1758, p. 737; Linné, 1767, p. 1200.
Cassis denticulata Röding, 1798, p. 32.
Phalium edentulum Link, 1807, p. 363.
Cassis vibex. – Schepman, 1907, p. 182; Tesch, 1920, p. 44, pl. 129, fig. 158a, b; van der Vlerk, 1931, p. 242; Skwarko & Sufiati, 1994, p. k3.
Cassis (Cassidea) vibex. – Oostingh, 1925, p. 118.
Semicassis (Casmaria) vibex. – Wissema, 1947, p. 143.
Casmaria erinaceus erinaceus. – Abbott, 1968, p. 190, pl. 14, figs. 7-12 (with further synonymy); Wilson, 1993, p. 231, pl. 38, fig. 2a-c.
Casmaria erinacea erinacea. – Kreipl, 1997, p. 43, pl. 15, figs. 45-45b.
Casmaria erinacea. – Okutani, 2000, p. 273, pl. 135, fig. 7.

Type material – Abbott (1968, p. 191) did little to resolve the type material. Linné's collection, housed by the Linnean Society of London in Burlington House, includes three apparent syntypes each of *Buccinum erinaceus* and *Buccinum vibex*. All six specimens lack a spiral row of colour spots around the base of the last whorl and conform to *Casmaria erinaceus* as interpreted by Abbott (1968). The three syntypes of *Buccinum erinaceus* include two unmarked shells (H 44.2, D 24.2 mm; H 34.1, D 20.8 mm) and one specimen (H 34.8, D 20.6 mm) marked "452" (the number for *Buccinum erinaceus* in Linné, 1767, p. 1199) on the parietal area of the inner lip; all three have a row of low, narrow, axially elongate nodules around the periphery. The three syntypes of *Buccinum vibex* all are unmarked and all lack peripheral nodules (H 47.1, D 27.4 mm; H 34.0, D 20.0 mm; H 29.6, H 18.2 mm). In view of the other illustrations cited for these species by Linné (1758), some of them not certainly identifiable, and of possible further syntypes in Uppsala, Sweden, the specimen marked "451" is here designated as the lectotype of *Buccinum erinaceus* Linné, 1758. The lectotype of *Buccinum erinaceus* also is here designated the neotype of *Cassis denticulata* Röding, 1798, and *Phalium edentulum* Link, 1807.

Material examined – Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 240, 2, 1 good (Figs. 91, 92) and 1 incomplete); RGM 107 525, Kaju Ragi, Manado Island, Sulawesi, Pleistocene (1 good, Figs. 89, 90).

Distribution – *Casmaria erinaceus* occurs throughout the Indo-West Pacific region. Abbott (1968, pl. 179) recognised three geographic subspecies: *C. erinaceus erinaceus* in the Indian Ocean and Red Sea, occurring as far east as New Caledonia, Vanuatu, and the Gilbert and Marshall Islands in the western Pacific; the weakly differentiated subspecies *C. erinaceus kalosmodix* (Melvill, 1883) further to the east, as far east as Hawaii, the Marquesas Islands and Pitcairn; and the distinctive subspecies (or, more probably, distinct species) *C. erinaceus vibexmexicana* (Stearns, 1894) in the eastern Pacific. Few fossils are known, however. The specimens of *Casmaria erinaceus* from Nias Island, therefore, are particularly interesting. Pleistocene specimens have been recorded also from Sulawesi (Schepman, 1907), Timor (Tesch, 1920, p. 44) and Oahu, Hawaii (Ostergaard, 1928, p. 5).

Remarks – *Casmaria* is almost unknown as a fossil, presumably (as with several other taxa that are common in the Recent fauna, but rare as fossils, in Indonesia) because of its shallow-water, near-shore habitat and the poor preservation of this habitat in the fossil record. The fossils throw a hard light on the taxonomy of the genus, as interpreted by Abbott (1968). The most significant and unvaried character used by Abbott to distinguish *Casmaria erinaceus* from *C. ponderosa* (Gmelin, 1791) is the row of dark maculations around the base of the last whorl in *C. ponderosa*, but absent from *C. erinaceus*. All other characters have at least some overlap between these supposed species. It is therefore uncertain whether the uncoloured Nias fossil specimens are *C. erinaceus* (as appears likely from their relatively tall and narrow shape) or *C. ponderosa*. Understanding of this genus (if, indeed, it is a genus distinct from *Semicassis*) is beyond simple analysis of shell characters, because of the few distinguishing characters these shells display, and will require molecular techniques for a satisfactory result.

The specific epithet *erinaceus* (Latin, a hedgehog) is a noun, and should not be declined to agree with the generic name.

Genus *Echinophoria* Sacco, 1890

Echinophoria Sacco, 1890, p. 39. Type species (by subsequent designation, Dall, 1909, p. 62): *Cassis intermedia* Brocchi, 1814, Miocene-Pliocene, Italy.

Trachydolium Howe, 1926, p. 303. Type species (by monotypy): *Galeodea dalli* Dickerson, 1917, Oligocene, Washington, USA.

Euspinacassis Finlay, 1926, p. 230. Type species (by original designation): *Euspinacassis pollens* Finlay, 1926, Early Miocene, New Zealand.

Shichiheia Hatai & Nisiyama, 1949, p. 93. Type species (by original designation): *Shichiheia etchuensis* Hatai & Nisiyama, 1949, Miocene, Japan.

Bathygalea Woodring & Olsson, 1957, p. 22. Type species (by original designation): *Cassis coronadoi* Crosse, 1867, Recent, western Atlantic.

Miogalea Woodring & Olsson, 1957, p. 22. Type species (by original designation): *Cassis (Phalium) dalli* Anderson, 1929 (junior secondary homonym of *Galeodea dalli* Dickerson, 1917) = *Echinophoria andersoni* (Abbott, 1968) (= *Bathygalea (Miogalea) hadra* Woodring & Olsson, 1957), Miocene-Pliocene, Caribbean.

Mariacassis Petuch, 1988, p. 17. Type species (by original designation): *Cassis caelatura* Conrad, 1830, Pliocene, St Marys Formation, Maryland, USA.

Echinophoria vandervlerki (Martin, 1933)

Figs. 93, 94.

Cassidea (Semicassis) vandervlerki Martin, 1933, p. 27, pl. 4, figs. 27, 27a.
Phalium (Semicassis) vandervlerki. – Beets, 1953, p. 244.
Phalium (Echinophoria) vandervlerki – Abbott, 1968, p. 102, pl. 84.
Semicassis vandervlerki. – Skwarko & Sufiati, 1994, p. k10.

Type material – *Cassidea (Semicassis) vandervlerki* Martin, holotype RGM 14 222, in bituminous shale (Late Miocene), Waisiu, Buton Island, Indonesia (Figs. 93, 94).

Other material examined – Waisiu, Buton Island, Late Miocene (NMB H.17885, 1).

Remarks – I have seen only the holotype and one other specimen of *Echinophoria vandervlerki*. Although the beautifully preserved holotype was described in "*Cassidea (Semicassis)*", it is a typical species of *Echinophoria*. It very closely resembles (and perhaps is a synonym of) the Recent Indo-West Pacific species *E. wyvillei* (Watson, 1886), as was also noted by Abbott (1968, p. 102). It has at least six narrow, nodulous spiral cords on the last whorl, more than in any specimens I have seen of the large, thin-shelled Recent species of *Echinophoria,* but the holotype of *E. vandervlerki* is a small, immature specimen, and better knowledge of the variation of *E. wyvillei* may well show that these names are synonyms. Beets (1953, p. 244) recorded another specimen from Buton, similar to the holotype in size, in NMB. Photographs of this specimen, kindly sent by René Panchaud (Basel), show that it is still largely enclosed in asphaltic shale, but clearly also has at least six rows of nodules on the last whorl.

Genus *Phalium* Link, 1807

Phalium Link, 1807, p. 112. Type species (by subsequent designation, Dall, 1909, p. 62): *Buccinum glaucum* Linné, 1758, Miocene to Recent, Indo-West Pacific.
Bezoardica Schumacher, 1817, pp. 75, 248. Type species (by subsequent designation, Cossmann, 1903a, pp. 121, 128): *Buccinum glaucum* Linné, 1758. [Gray (1847, p. 137) designated *Buccinum glaucum* Linné as type species of "*Bezoardica* α Schum. 1817" but also designated *Buccinum areola* Linné as type species of "*Bezoardica* β Schum." and, as Abbott (1968) pointed out, these designations are invalid].
Bezoardicella Habe, 1961, p. 43. Type species (by subsequent designation, Abbott, 1968, p. 80): *Buccinum decussatum* Linné, 1758, Miocene to Recent, Indo-West Pacific.

Phalium areola (Linné, 1758)

Fig. 95.

Buccinum areola Linné, 1758, p. 736; Linné, 1767, p. 1199.
Cassidea areola. – Bruguière, 1792, p. 423.
Cassis alea Röding, 1798, p. 31.
Phalium areola. – Link, 1807, p. 112; Abbott, 1968, p. 87, pl. 7, figs. 5-7; pls. 61, 63; Wilson, 1993, p. 232, pl. 37, fig. 3a, b; Kreipl, 1997, p. 33, pl. 11, figs. 29-29d.
Phalium clathratum Link, 1807, p. 113.
Phalium extinctum Link, 1807, p. 112.
Phalium sulcatum Link, 1807, p. 113.
Cassis areola. – Lamarck, 1816, pl. 407, fig. 3a, b, "Liste des objets", p. 3; Lamarck, 1822, p. 222.

Bezoardica areolata Schumacher, 1817, p. 248.
Cassis glaucoides Martin, 1879, p. 45, pl. 8, fig. 8.
Cassis (Phalium) areola. – Oostingh, 1925, p. 116.
Phalium agnitum Iredale, 1927, p. 332, pl. 32, fig. 10.
Semicassis (Semicassis) vavakuana Ladd, 1934, p. 222, pl. 39, fig. 12.
Phalium (Phalium) glaucoides. – van Regteren Altena & Beets, 1945, p. 40, figs. 2, 3; Skwarko & Sufiati, 1994, p. k8; van den Hoek Ostende *et al.*, 2002, p. 34.
Bezoardicella areola. – Habe, 1961, p. 43, pl. 20, fig. 8.
Phalium (Phalium) areola vavakuana (sic). – Abbott, 1968, p. 88.
Phalium (Phalium) areola glaucoides. – Abbott, 1968, p. 89.
Phalium (Semicassis) vavakuana. – Ladd, 1977, p. 32, pl. 10, figs. 7, 8.
Phalium (Bezoardicella) areola. – Okutani, 2000, p. 277, pl. 137, fig. 18.

Type material – Linné's collection in London includes four apparent syntypes of *Buccinum areola* Linné, all unmarked (H 71.4, D 46.9 mm; H 68.1, D 43.8 mm; H 51.5, D 33.5 mm; H 45.5, D 28.2 mm). All are the species identified as *Phalium areola* by Abbott (1968), almost smooth, with five rows of large rectangular red-brown maculations on a pale cream to fawn ground on the last whorl. The second-largest of the syntypes in Linné's collection is here designated the neotype of *Cassis alea* Röding, 1798, *Phalium clathratum* Link, 1807, *Phalium extinctum* Link, 1807, *Phalium sulcatum* Link, 1807, and *Bezoardica areolata* Schumacher, 1817. *Cassis glaucoides* Martin, holotype RGM 9982, Junghuhn's locality K, Java (Fig. 95). *Phalium agnitum* Iredale, 1927, holotype AMS C.53269, from "Western Australia". *Semicassis (Semicassis) vavakuana* Ladd, 1934, holotype and paratype in Bernice P. Bishop Museum, Honolulu, holotype BPBM Geol. 1206, paratype BPBM Geol. 1207, from right bank of Wailoa River 1.6 km west of Nasongo, Viti Levu, Fiji, from Suva Formation (Miocene).

Distribution – *Phalium areola* lives at present in the Indo-West Pacific from East Africa eastward to Samoa and the Gilbert Islands, and from Kyushu, southern Japan, southward to central eastern Australia (Broken Bay, New South Wales; Abbott, 1968, p. 88). Fossils are recorded from Neogene rocks of Taiwan, Java and Fiji.

Remarks – The only Indonesian fossil specimen assigned to *Phalium areola* is the holotype of *Cassis glaucoides* Martin (Fig. 95), a juvenile specimen with the ventral side still hidden in matrix. Abbott (1968, p. 89) commented that he found it "difficult" to distinguish it from juvenile specimens of *P. areola* of the same size. He considered that the holotype differs from Recent specimens of *P. areola* in having a slightly shorter spire and more prominent beading on the axial riblets on the sutural ramp. These differences are very subtle and intergrade when a range of Recent specimens is examined. It seems likely that *P. glaucoides* (Martin) is simply based on a specimen of *P. areola*, but comparison of better material is required to confirm this status. The juvenile illustrated by van Regteren Altena & Beets (1945, p. 40, figs. 2, 3) is a better-preserved specimen more definitely assignable to *P. areola*. The situation is identical with *Semicassis vavakuana* Ladd (1934, p. 222) from the Pliocene of Fiji; the holotype was illustrated again by Ladd (1977, p. 32, pl. 10, figs. 7, 8) and clearly is a small, abraded specimen of *P. areola*.

Phalium decussatum **(Linné, 1758)**

Figs. 96, 97.

Buccinum decussatum Linné, 1758, p. 736; Linné, 1767, p. 1199.
Cassidea decussata. – Bruguière, 1792, p. 425.
Cassis cancellata Röding, 1798, p. 31.
Cassis flammeolum Röding, 1798, p. 31.
Phalium decussatum. – Link, 1807, p. 112; Abbott, 1968, p. 91, pl. 7, figs. 8, 9; pl. 67; Kreipl, 1997, p. 35, pl. 12, figs. 32-32b.
Cassis decussata. – Lamarck, 1822, p. 223; Reeve, 1848a, pl. 2, fig. 4a-d; van der Vlerk, 1931, p. 242.
Cassis (Bezoardica) decussata. – Martin, 1899, p. 156, pl. 24, fig. 364.
Bezoardicella decussata. – Habe, 1961, p. 43, pl. 20, fig. 7.
Phalium decussata (sic). – Skwarko & Sufiati, 1994, p. k8.

Type material – Linné's collection in London contains two apparent syntypes of *Buccinum decussatum*. The larger (H 40.4, D 26.9 mm) is an immature specimen of *Phalium decussatum* as interpreted by Abbott (1968), marked "450" (the number for *Buccinum decussatum* in Linné, 1767) in ink inside and "450" in pencil on the outer lip, with five varices, spines on the upper shoulder of the terminal varix, and coarsely decussate axial and spiral sculpture over the entire exterior. The smaller specimen (H 36.8, D 24.6 mm) is unmarked, has only two varices and lacks spines on the shoulder, and despite the decussate sculpture might well be a juvenile specimen of a species distinct from *Phalium decussatum* (possibly *P. glaucum* Linné). The larger, marked syntype, therefore, is here designated the lectotype of *Buccinum decussatum* Linné. The lectotype of *Buccinum decussatum* is also here designated the neotype of both *Cassis cancellata* Röding, 1798, and *Cassis flammeolum* Röding, 1798.

Other material examined – RGM 9983, Bajah [Bayah], Bantam [Banten], Java, Pliocene (1, illustrated by Martin, 1899; Figs. 96, 97).

Distribution – *Phalium decussatum* lives now from Taiwan throughout the South China Sea and throughout Indonesia (Abbott, 1968, pl. 68). It seems likely that *Phalium cancellianum* Nomura (1935, p. 169, pl. 8, fig. 25a, b), from the Pliocene Byoritsu beds of Taiwan, is a further synonym of *P. decussatum*, despite its rather coarser sculpture, as again it is based on a juvenile specimen (holotype in Institute of Geology and Paleontology, Tohoku University, Sendai). Abbott (1968, p. 92) also recorded a specimen from a Pleistocene(?) deposit at Surabaya, Java.

Remarks – The one small specimen seen from Indonesia has the distinctive decussate axial and spiral sculpture of *Phalium decussatum*.

Phalium glaucum **(Linné, 1758)**

Figs. 98, 99.

Buccinum glaucum Linné, 1758, p. 737; Linné, 1767, p. 1200.
Phalium glaucum. – Link, 1807, p. 112; Iredale, 1927, p. 331; Wilson, 1993, p. 233, pl. 37, fig. 13a, b; Kreipl, 1997, p. 37, pl. 13, figs. 35-35b; Okutani, 2000, p. 277, pl. 137, fig. 17.
Bezoardica vulgaris Schumacher, 1817, p. 248.

Cassis glauca. – Lamarck, 1822, p. 221; Reeve, 1848a, pl. 12, fig. 33; Martin, 1881, p. 20; van der Vlerk, 1931, p. 242.

Cassis bezoar Gray, 1839, p. 121.

Semicassis (Bezoardica) cf. *glauca*. – Cossmann, 1903b, p. 161, pl. 6, fig. 8.

Semicassis (Bezoardica) strigata. – Cossmann, 1903b, p. 160, pl. 6, fig. 9 (not *Buccinum strigatum* Gmelin, 1791).

Cassis (Phalium) glauca. – Oostingh, 1925, p. 115.

Phalium (Phalium) glaucum. – van Regteren Altena, 1942, p. 93; Abbott, 1968, p. 81, pl. 7, figs. 10-12, pl. 9, figs. 55-57; pls. 55, 56.

Type material – Linné's collection in London contains three specimens isolated as apparent syntypes of *Buccinum glaucum* (H 88.5, D 60.2 mm; H 51.2, D 34.6 mm; H 33.8, D 21.2 mm), although none of them has been marked by Linné. All seem likely to be the smooth, fawnish grey species identified as *Phalium glaucum* by Abbott (1968), although the two smaller specimens are too small to be identifiable with certainty. The largest specimen has three large spines around the anterior end of the exterior of the terminal varix and certainly is *Phalium glaucum* of authors, but the others lack variceal spines. As the two smaller specimens are not certainly identifiable, the largest syntype is here designated the lectotype of *Buccinum glaucum* Linné. Abbott (1968, p. 82) designated the type locality as Ambon Island, Indonesia. The lectotype of *Buccinum glaucum* is also here designated the neotype of *Bezoardica vulgaris* Schumacher, 1817. I am not aware of any type material of *Cassis bezoar* Gray, 1839 (based on making available a non-binominal name by Humphrey), but no type is designated here because of the possibility that type material remains in a British museum.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M125, Pleistocene (RGM 456 241, 1, small; Figs. 98, 99).

Distribution – *Phalium glaucum* occurs in East Africa, the northern Indian Ocean and the western Pacific, from southern Japan to New Guinea, and perhaps northernmost Australia. Abbott (1968, pl. 82) was not aware of records from east of the westernmost Solomon Islands. Fossils have been reported from Pliocene rocks of Karikal, India (Cossmann, 1903b) and Java.

Remarks – The specimen from the Kendeng beds recorded by van Regteren Altena (1942, p. 93) appears to be a typical specimen of *Phalium glaucum*. It is small, incomplete and difficult to compare with adult Recent specimens, but agrees in sculptural details and in lacking varices before the last two whorls (Abbott, 1968, p. 89).

Phalium menkrawitense Beets, 1941

Figs. 100-103.

Phalium (Phalium) menkrawitense Beets, 1941, p. 85, pl. 4, figs. 180-186; Abbott, 1968, p. 89, pl. 64; Skwarko & Sufiati, 1994, p. k8.

Type material – *Phalium menkrawitense* Beets, holotype RGM 312 436 (Figs. 102, 103), with 1 paratype RGM 312 437 (Figs. 100, 101), from locality L114, Mangkalihat Peninsula, East Borneo (Miocene).

Distribution – Known only by the type material.

Remarks – *Phalium menkrawitense* is a distinctive, weakly sculptured species of true *Phalium*, with varices retained on the spire, an area of low axial ridges behind each varix, a subsutural spiral groove on spire whorls that fades out down the shell and sculpture on the last whorl of very narrow, shallow, widely spaced axial grooves; the surface is superficially smooth. As suggested by Abbott (1968, p. 89), the holotype (33.2 mm high) is "probably an immature specimen"; the incomplete paratype is 45 mm high, and fully grown adults probably were larger still.

***Phalium rembangense* (Martin, 1899)**

Figs. 104, 105.

Cassis (Semicassis) rembangensis Martin, 1899, p. 155, pl. 24, fig. 363; Pannekoek, 1936, p. 43.

Cassis rembangensis. – van der Vlerk, 1931, p. 242; Shuto, 1977, p. 134; Skwarko & Sufiati, 1994, p. k2; van den Hoek Ostende *et al.*, 2002, p. 33.

Phalium (Semicassis) bisulcatum. – Abbott, 1968, p. 130 (in part not *Cassis bisulcata* Schubert & Wagner, 1829).

Type material – *Cassis (Semicassis) rembangensis* Martin, one syntype RGM 9977, Sedan, Residence of Rembang, Java, Middle Miocene (Robba, 1996) (unidentifiable); one syntype RGM 9978, Ngampel, Residence of Rembang, Java, Middle Miocene (a juvenile of a *Phalium* species); two syntypes RGM 9976, Ngampel, Java, Rembang beds, Middle Miocene (including the syntype illustrated by Martin, 1899, pl. 24, fig. 363; Figs. 104, 105; apparently conspecific with RGM 9978).

Other material examined – RGM 9986, Kembang Sokkoh [Kembangsokoh], Residence of Jogjakarta, Java, Miocene? (1, fragment of a large *Phalium* with a subsutural cord).

Distribution – As interpreted here, *Phalium rembangense* is a species endemic to the Miocene rocks of Java. However, the material is poorly preserved and it is possible that *P. rembangense* is a further synonym of *P. glaucum*.

Remarks – Again, the only four specimens assigned to *Phalium rembangense* are three juveniles and a large fragment, with most of the teleoconch exterior smooth (apart from the varices that are retained on the last two whorls), but with a narrow spiral zone of spiral cords below the suture. Abbott (1968, p. 130) considered that the type material belongs in *Semicassis bisulcata* (Schubert & Wagner), but the varices retained on the last two whorls and the zone of spiral cords below the suture indicate a position in *Phalium*. This is possibly another synonym of *P. glaucum*, but adult material from the type locality is needed for comparison with Recent shells before its status is clear.

Genus *Semicassis* Mörch, 1853

Semicassis Mörch, 1853, p. 112. Type species (by subsequent designation, Harris, 1897, p. 198): *Cassis japonica* Reeve, 1848a (= *Cassis bisulcata* Schubert & Wagner, 1829), Miocene to Recent, Indo-West Pacific.

Faurotis Jousseaume, 1888, p. 188. Type species (by original designation): *Faurotis faurotis* Jousseaume, 1888, Recent, western Indian Ocean and Red Sea.

Tylocassis Woodring, 1928, p. 306. Type species (by original designation): *Buccinum inflatum* Shaw, 1811 (= *Buccinum granulatum* Born, 1778), Pleistocene and Recent, western Atlantic.

Xenophalium Iredale, 1927, p. 333. Type species (by original designation): *Xenophalium hedleyi* Iredale, 1927 (= *Cassidea royana* Iredale, 1914), Recent, southwest Pacific.

Xenogalea Iredale, 1927, p. 339. Type species (by original designation): *Cassis pyrum* Lamarck, 1822, Pleistocene and Recent, New Zealand and southeastern Australia.

Semicassis bisulcata **(Schubert & Wagner, 1829)**

Figs. 106-134.

Buccinum tessellatum Wood, 1825, p. 105, pl. 22, fig. 27 (not *Buccinum tessellatum* Gmelin, 1791).

?*Cassis scrobiculata* Menke, 1828, pp. 36, 86; Menke, 1830, pp. 63, 144 (*nomen oblitum*; Abbott, 1968, p. 128).

Cassis bisulcata Schubert & Wagner, 1829, p. 68, figs. 3081, 3082.

Cassis saburon. – Schubert & Wagner, 1829, p. 66, figs. 3077, 3078 (not *Cassidea saburon* Bruguière, 1792, according to Abbott, 1968, p. 128); Küster, 1857, p. 38, pl. 51, figs. 7, 8.

Cassis pila Reeve, 1848a, pl. 5, fig. 21a, pl. 9, fig. 21b; Küster, 1857, p. 39, pl. 51, figs. 9, 10; Martin, 1928, p. 8; Martin, 1932, p. 114.

Cassis japonica Reeve, 1848a, pl. 9, fig. 23b; van der Vlerk, 1931, p. 242.

Cassis nucleus Küster, 1857, p. 43, pl. 52, figs. 3, 4.

Cassis japonica var. *minor* Küster, 1857, p. 43, pl. 52, fig. 9.

Cassis pfeifferi Hidalgo, 1871, p. 226; Hidalgo, 1872, p. 143, pl. 7, fig. 2.

Cassis herklotsi Martin, 1879, p. 45, pl. 8, figs. 7, 7a; Martin, 1899, p. 155, pl. 24, figs. 360, 360a, 361, 361a; Martin, 1919, pp. 88, 141, 154; van der Vlerk, 1931, p. 242.

Faurotis bisulcata. – Jousseaume, 1888, p. 188.

Cassis (Semicassis) pila. – Martin, 1899, p. 154, pl. 24, figs. 356-359; Zwierzycki, 1915, p. 109; Tesch, 1920, p. 44, pl. 129, fig. 157a, b; van Regteren Altena, 1942, p. 95; Dey, 1962, p. 68, pl. 5, fig. 13.

Cassis booleyi G.B. Sowerby 3rd, 1900, p. 162, text-fig. p. 163.

Semicassis diuturna Iredale, 1927, p. 335, pl. 32, fig. 9.

Cassis (Semicassis) japonica var. *minor.* – Fischer, 1927, p. 61, pl. 212, figs. 28a, b, 29a, pl. 213, figs. 29b, 30a, b; Koperberg, 1931, p. 122.

Xenogalea nashi Iredale, 1931, p. 214, pl. 23, fig. 18.

Cassis pila var. – van der Vlerk, 1932, p. 111.

Phalium (Semicassis) pila. – van Regteren Altena, 1942, p. 93 (with further synonymy); van Regteren Altena & Beets, 1945, p. 40; Cox, 1948, p. 36, pl. 1, fig. 9a, b.

Phalium pila. – Yen, 1942, p. 214, pl. 17, fig. 105 (Reeve's illustrated syntype).

Phalium (Semicassis) japonicum herklotsi. – van Regteren Altena, 1942, p. 95 (with further synonymy); Cox, 1948, p. 37.

Phalium (Semicassis) dalrymplei Cox, 1948, p. 37, pl. 1, fig. 10a, b.

Semicassis persimilis "Kuroda" Kira, 1955, p. 43, pl. 21, fig. 3 (*nomen nudum*); Kira, 1959, p. 43, pl. 21, fig. 3.

Semicassis pila. – MacNeil, 1961, p. 58, pl. 13, figs. 2, 3.

Cassis (Semicassis) quilonensis Dey, 1962, p. 69, pl. 5, figs. 20, 26.

Phalium (Semicassis) bisulcatum bisulcatum. – Abbott, 1968, p. 126, pl. 8, figs. 13-21, pls. 105-114.

Cassis japonica herklotsi. – Skwarko & Sufiati, 1994, p. k2; van den Hoek Ostende *et al.*, 2002, p. 33.

Semicassis (Semicassis) bisulcata. – Wilson, 1993, p. 233, pl. 37, fig. 7a-c; Kreipl, 1997, p. 48, pl. 17, figs. 54-54g.

Semicassis bisulcata bisulcata. – Okutani, 2000, p. 275, pl. 136, fig. 10.

Semicassis bisulcata persimilis. – Okutani, 2000, p. 275, pl. 136, fig. 11.

Semicassis bisulcata japonica. – Okutani, 2000, p. 275, pl. 136, fig. 12.

Semicassis bisulcata pila. – Okutani, 2000, p. 275, pl. 136, fig. 13.

Semicassis japonica. – Higo *et al.*, 2001, p. 47, fig. G1553s.

Type material – I am not aware of the location of any type material of *Buccinum tessellatum* Wood or *Cassis scrobiculata* Menke, although Menke's type material might well still be in his collection, part of which was acquired recently by SMF. Abbott (1968, pp. 127, 129) stated that the specimen illustrated by Schubert & Wagner (1829, figs. 3081, 3082) as *Cassis bisulcata* is in ZMC; not seen. Abbott (1968, p. 129) identified this specimen as "the type", which possibly constitutes inadvertent designation of this specimen as the lectotype of *Cassis bisulcata.* Abbott designated the type locality as Port Blair, Andaman Islands. *Cassis pila* Reeve, three syntypes BMNH 1967667, from "China", relatively weakly sculptured specimens. *Cassis japonica* Reeve, seven syntypes BMNH 1967668, 1967669, 1967670, from "China & Japan", more strongly spirally sculptured specimens otherwise very similar to the last. *Cassis booleyi* G.B. Sowerby 3rd, 1900, holotype BMNH 1900.1.10.52, from Port Blair, Andaman Islands, a distinctive form with the last whorl nearly smooth. *Cassis herklotsi* Martin, two syntypes RGM 9968, Sonde, Java, Pliocene (illustrated by Martin, 1899, figs. 360, 361; Figs. 133, 134); two syntypes RGM 9969, from Sonde, Java, Pliocene (incomplete); three small syntypes RGM 9970, Sonde, Residence of Madiun, Java, Pliocene, including one illustrated syntype (Figs. 129, 130), RGM 9972, Junghuhn's locality R, Java, Preanger [Priangan] (illustrated in dorsal and ventral views by Martin, 1879, pl. 8, fig. 7, 7a; Figs. 131, 132). *Semicassis diuturna* Iredale, holotype AMS C.53268, from Port Stephens, New South Wales, Australia. *Xenogalea nashi* Iredale, holotype AMS C.57789, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia. *Phalium (Semicassis) dalrymplei* Cox, holotype NMB H.14419, from the Pliocene or, more probably, Pleistocene Togopi Formation, Dent Peninsula, North Borneo; a coarsely sculptured specimen of the "*herklotsi* form". I am not aware of the location of type material of the remaining names in the synonymy.

Other material examined – (a) Form "*pila*" or "*bisulcata*": RGM 9964, Menengteng Gorge, Residence of Cheribon [Cirebon], Java, Miocene (3); RGM 9955, Sonde, Java, Pliocene (3, all 3 illustrated by Martin as *Cassis pila* Reeve); RGM 9960, Junghuhn's locality L, Java, Miocene? (24 poor internal moulds); RGM 9963, Pangkal, Residence of Tegal, Java, age? (1); RGM 9965, Mount Gombel near Tjandi [Candi], Residence of Semarang, Java, Miocene? (1, poor); RGM 9967, Padas Malang [Padasmalang], Residence of Madiun, Java, Pliocene? (1, incomplete); RGM 9975, Junghuhn's locality O, Preanger [Priangan], Java (3 poor); RGM 9971, Sonde, Madiun, Java, Pliocene (7 good juvenile specimens); RGM 9966, Sonde, Java, Pliocene (8 good juvenile specimens); "Kendeng beds" material in Mijnwezen Collection: locality M67i (4), M68 (1), M95 (1), M98 (6), M107 (1), M110 (1), M112 (1), M125 (15), M157 (1), M161 (2), M163 (2), M167 (2), M189 (1), M216 (RGM 456 249, 5; Fig. 124), M217 (1), M252 (RGM 456 251, 3; Figs. 127, 128), M255 (RGM 456 250, 2; Figs. 125, 126), M257 (3), M260 (16), M261 (1), M273 (1), M281 (RGM 456 248, 2; Figs. 122, 123), M291 (2), M292 (2), M297 (6), M304 (4), M346 (2); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 552 (5 poor), RGM 46 554 (2 good), RGM 46 555 (2 poor), RGM 46 557 (1 poor), RGM 46 558 (1 poor), RGM 46 559 (3 poor), RGM 46 560 (1 large, incomplete); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 39, Pleistocene? (7 identified as *S. bisulcata*, 6 identified as *S. pila* Reeve; Figs. 108-110, 117-119), locality 78, Pliocene (1, good; Figs. 111, 112), locality 107, Pliocene (1 good; Figs. 113-114), locality 108, Late Pliocene (1 fragment); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (12, more fine sculpture than on most *S. bisulcata*; Figs. 120, 121); RGM 107 526, Kaju Ragi, Manado Island, Sulawesi, Pleistocene (1, Figs. 106, 107); Sangiran, central Java, Late Pliocene, presented by B. Dharma (GNS WM 17241, 1; GNS WM17479, 7); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Noil-Noni-Pene", Koperberg's thesis "pl. 129, fig. 157", identified as "*Cassis pila* (Reeve)" (1 small, incomplete); "Niki-Niki", Koperberg's thesis p. 122, identified as "*Cassis (Semicassis) japonica* aff. var. *minor*" (1, incomplete); material from IAUU, received in RGM: Kaju Ragi, Manado Island, N Sulawesi, Pleistocene, coll. Wichman (1, in fragments); Mas Mambang, Saluma, Benkulen, Sumatra (1); Togopi Formation (Pliocene-Pleistocene?), Dent Peninsula, North Borneo (NMB H.14418, 1, illustrated by Cox, 1948, pl. 1, fig. 9a, b).

(b) Form "*herklotsi*": RGM 9973, Junghuhn's locality K, Java, Miocene (2 poor); "Kendeng beds" material in Mijnwezen Collection: locality M101 (2), M251 (3), M252 (2), M255 (9), M257 (9), M292 (1), M293 (1), M298 (3), M301 (9); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 107, Pliocene (1, incomplete, identified as *S. japonica herklotsi;* Figs. 115, 116).

Distribution – *Semicassis bisulcata* occurs widely in the Indo-West Pacific region, from East Africa (as far south as Durban, South Africa) and the Gulf of Arabia as far east as Fiji and the Marshall islands, and from central Japan south to southern New South Wales, Australia (Abbott, 1968, pl. 113). Fossils have been recorded from central Japan, Taiwan and the Philippine Islands, and are common in Indonesia.

Remarks – The taxonomy of the common, widespread, tropical *Semicassis* species living in the Indo-West Pacific at present, as set out by Abbott (1968), seems to me to be poorly based. As commented above under *Casmaria*, probably only molecular techniques will resolve the taxonomy of these species, as "hard and fast" characters are not discernible on the exterior of the teleoconch. Martin, van Regteren Altena and other authors distinguished several species in the Indonesian Tertiary, identifying most of the material as *Cassis pila* Reeve, *Cassis japonica* Reeve or the supposedly distinct *Cassis (Semicassis) herklotsi* Martin. Abbott (1968) regarded these forms as part of the variation of the one species *Semicassis bisulcata* (Schubert & Wagner), and this conclusion is followed here, somewhat tentatively. Material of the axially ridged form named *C. herklotsi* seems to intergrade with specimens in which the spiral sculpture is dominant, and van Regteren Altena (1942, p. 94) noted that these supposedly distinct species "are not always separable".

Cassidae?, genus unknown

"Semicassis" lagenaeformis (Boettger, 1883)

Cassis (Semicassis) lagenaeformis Boettger, 1883, p. 192, pl. 8, fig. 5; Zwierzycki, 1915, p. 105.
Cassis lagenaeformis. – van der Vlerk, 1931, p. 242.
Semicassis lagenaeformis. – Skwarko & Sufiati, 1994, p. k9.

Type material – *Cassis (Semicassis) lagenaeformis* Boettger, holotype in SMF, from Nias Island, south of Sumatra, apparently Miocene rather than from the beautifully preserved Pliocene and Pleistocene material described by Wissema (1947).

Distribution – Known only by the holotype. Zwierzycki (1915, p. 105) recorded a species from Sumatra under the name *Semicassis lagenaeformis*, but I have not seen his material and it is impossible to tell which species he intended by this name.

Remarks – The holotype of "*Cassis*" *lagenaeformis* is a very poor internal cast, lacking all shell material. It lacks all characters that might allow it to be classified, even to family. The shape suggests that it is just as likely to be a species of *Bufonaria* (Bursidae) as a species of Cassidae. It may be possible to collect more material from the type locality to identify this species, but at present its position is unknown.

Family Personidae Gray, 1854

Genus *Distorsio* Röding, 1798

Distorsio Röding, 1798, p. 133. Type species (by subsequent designation, Pilsbry, 1922, p. 347): *Murex anus* Linné, 1758, Pliocene to Recent, Indo-West Pacific.

Distortrix Link, 1807, p. 122. Type species (by subsequent designation, Dall, 1904, p. 133): *Murex anus* Linné, 1758.

Persona Montfort, 1810, p. 603. Type species (by monotypy): *Murex anus* Linné, 1758.

Distorta Perry, 1811, caption to pl. 2. Type species (by subsequent designation, Emerson & Puffer, 1953, p. 96): *Distorta rotunda* Perry, 1811 (= *Murex anus* Linné, 1758).

Rhysema Clench & Turner, 1957, p. 236. Type species (by original designation): *Triton clathratum* Lamarck, 1816, Miocene to Recent, western Atlantic Ocean.

Distorsio anus **(Linné, 1758)**

Figs. 135, 136.

Murex anus Linné, 1758, p. 750; Linné, 1767, p. 1218.

Distorta rotunda Perry, 1811, pl. 10, fig. 2.

Distorta rugosa Schumacher, 1817, p. 249.

Distorsio anus. – Röding, 1798, p. 133; Wissema, 1947, p. 152; Beu, 1985, p. 62; Henning & Hemmen, 1993, p. 135, pl. 27, fig. 1; Wilson, 1993, p. 239, pl. 40, fig. 21a, b; Kronenberg, 1994, p. 63, fig. 5, pl. 1, fig. 1, pl. 2, fig. 4; Beu, 1998, p. 182, figs. 58o, 59a, b (with further synonymy); Okutani, 2000, p. 293, pl. 145, *Distorsio* fig. 1.

Type material – *Murex anus* Linné, lectotype (designated by Beu, 1998, p. 183) the specimen marked "539" in Linné's collection in London, with one paralectotype; two further paralectotypes in the Uppsala University Zoological Museum. Beu (1998) also designated the lectotype of *Murex anus* as the neotype of *Distorta rotunda* Perry and *Distorta rugosa* Schumacher.

Other material examined – Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 252, 1, good, but with polychaete or sponge drill-holes, i.e., probably transported down-slope from its living site; Figs. 135, 136); material from IAUU, received in RGM: calcareous tuff and sandstone near Wahai, northern Sulawesi, Pleistocene, coll. Rutten (1, good adult); Beneden Toluarang, river near Ma. Kapata, north Sulawesi, Pleistocene, coll. Rutten (1, incomplete juvenile).

Distribution – *Distorsio anus* occurs very widely throughout the Indo-West Pacific region, from Natal, South Africa and East Africa to the Red Sea, as far east as Hawaii, the Marquesas Islands and Pitcairn Island, and from Kii Peninsula, Honshu, Japan, south to North Solitary Island, northern New South Wales, Australia. Fossils are rare and I am aware of few other than those recorded here.

Remarks – The wide shape, the bright colour pattern of red-brown spiral bands, the very distorted coiling, the strongly dorsally directed siphonal canal and the extremely wide ventral shield (hiding all but the spire tip in ventral view) make *Distorsio anus* a very distinctive species. The three fossil specimens recorded here (from Nias and northern Sulawesi, probably all Pleistocene) are particularly interesting, as fossils of this species are rare.

***Distorsio decipiens* (Reeve, 1844a)**

Figs. 137-142.

Triton decipiens Reeve, 1844a, pl. 20, fig. 102; Reeve, 1844c, p. 121.
Persona (Distortrix) reticulata. – Tesch, 1915, p. 69, pl. 82, fig. 151a, b (not *Murex reticularis* Linné, 1758).
Persona (Distorsio) reticulata keuneni Koperberg, 1931, p. 118.
Distorsio cancellina. – van Regteren Altena, 1942, p. 105 (in part).
Distorsio (Distorsio) reticulatus decipiens. – Shuto, 1969, p. 89, pl. 7, figs. 9, 10.
Distorsio decipiens. – Beu, 1985, p. 62; Henning & Hemmen, 1993, p. 138, pl. 27, fig. 5; Wilson, 1993, p. 239; Kronenberg, 1994, p. 72, fig. 11, pl. 3, fig. 3; Beu, 1998, p. 185, figs. 58m, 61g-k, 63a-e (with further synonymy); Okutani, 2000, p. 293, pl. 145, *Distorsio* fig. 4; Higo *et al.*, 2001, p. 49, fig. G1610.

Type material – *Triton decipiens* Reeve, lectotype (of Beu, 1998, p. 185) and two paralectotypes BMNH 1984162, from "Island of Mindanao", Philippines. One apparent paralectotype MCZ 188158, from "Mindanao, Philippines", *ex* C.B. Adams Collection. Two specimens (syntypes?) from Koperberg's (1931) material of *Persona (Distorsio) reticulata* subsp. *keuneni*, from the Pliocene of Timor, recently have been received in RGM from MGMD. These specimens (one in Fig. 141, 142; *ex* Delft reg. TUD 13834) are specimens of *Distorsio decipiens* (Reeve), so presumably this is the identity of all Koperberg's material; one is labelled as the original of Koperberg's thesis "pl. 82, fig. 151".

Other material examined – "Kendeng beds" material in the Mijnwezen Collection: locality M82a (1), M139 (2), M143 (1), M171 (1), M173 (4 good), M212 (RGM 456 254, 1; Figs. 139, 140), M227 (1); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 571 (1 poor), RGM 46 572 (1 small), RGM 46 575 (1 incomplete), RGM 46 579 (3 poor); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 102, Pliocene-Pleistocene (RGM 456 253, 1 good, slightly incomplete; Figs. 137, 138); Pasir Ipis, West Java, Middle Miocene, presented by B. Dharma (IGNS, WM17468, 1).

Distribution – *Distorsio decipiens* occurs throughout the Indo-West Pacific region, from Natal, South Africa and East Africa east to the Solomon Islands (the eastern limit is unclear as yet), and from Kii Peninsula, Honshu, Japan, south to Queensland, Australia and New Caledonia. Fossils have been recorded from Pliocene rocks of Okinawa, southern Japan and the Philippine Islands, and some of the specimens from Indonesia previously identified as "*Distorsio cancellina*" are reidentified here as *D. decipiens*.

Remarks – This species previously has been identified as "*Distorsio cancellina* (de Roissy)" by both van Regteren Altena (1942) and Wissema (1947) (see under *Distorsio reticularis* for comments on that name). The specimen from the Pliocene of Timor illustrated by Tesch (1915, pl. 82, fig. 151a, b) also seems to be a short specimen of *D. decipiens*. It differs from *D. reticularis* in its straighter columella and siphonal canal, directed slightly to the right rather than to the left, the paler colour of Recent specimens (apart from a red-brown aperture on some specimens), the "hunched" appearance produced by the prominent spiral cord on the sutural ramp riding up over the terminal varix, the two quite closely spaced spiral cords around the periphery, separated from lower cords by a slightly wider interspace than between the peripheral two, and the generally more prominent spiral and axial sculpture. *Distorsio decipiens* occurs widely in the Indo-West Pacific Recent fauna sympatrically with *D. reticularis* (Linné) (although, in many cases, in slightly deeper water), leaving no doubt that these are distinct species.

Skwarko & Sufiati (1994, p. m13) suggested by the position in synonymy that Koperberg's (1931, p. 118) name *Persona (Distorsio) reticulata* subsp. *keuneni* might have been based on specimens of *Distorsio perdistorta*, in which case it would be an earlier name for *D. perdistorta*. However, there is nothing in Koperberg's description to indicate this possibility and the suggestion by Skwarko & Sufiati probably was based solely on the provenance from Timor. The syntypes recently received in RGM are *D. decipiens.*

Distorsio denseplicata **van Regteren Altena, 1942**
Figs. 143, 144.

Distorsio cancellina (de Roissy) var. *denseplicata* van Regteren Altena, 1942, p. 106, fig. 3.

Type material – Distorsio cancellina var. *denseplicata*, holotype RGM 456 256, "Kendeng beds" material in Mijnwezen Collection: locality M25, Solo River northwest of Padasmalang (Figs. 143, 144).

Distribution – Known only by the holotype.

Remarks – Van Regteren Altena (1942) described this species under the name "*Distorsio cancellina* var. *denseplicata*", but the single known specimen has several unique characters that distinguish it from *Distorsio reticularis*, the species referred to by van Regteren Altena by the name "*Distorsio cancellina*". It has unique, closely spaced, wide, flat-topped, prominent axial costae and spiral cords, with unusually narrow interspaces, as well as an obvious spiral thread in each of the three peripheral spiral interspaces. It also has a narrow, horizontal sutural ramp that I have not observed in any other *Distorsio* species. This appears to be a very distinctive, extinct species. Unfortunately, the very incomplete holotype still seems to be the only known specimen.

Distorsio djunggranganensis **(Martin, 1916)**
Fig. 145.

Persona djunggranganensis Martin, 1916, p. 242, pl. 2, fig. 41; van der Vlerk, 1931, p. 240.
Distorsio djunggranganensis. – Skwarko & Sufiati, 1994, p. m12; Beu, 1998, p. 198, fig. 60a, b; van den Hoek Ostende *et al.*, 2002, p. 35.

Type material – *Persona djunggranganensis* Martin, holotype RGM 9818, Mount Spolong, West Progo Mountains, Java, Miocene (Beu, 1998, fig. 60a, b).

Other material examined – Karas, Rembang, mid-Java, Middle Miocene (1 specimen in collection of Bunjamin Dharma; Fig. 145); material received in RGM from IAUU: Rembang, Java, Miocene, leg. Erb (1, small, incomplete).

Distribution – *Distorsio djunggranganensis* is recorded only from Miocene rocks of Java.

Remarks – As pointed out by Beu (1998), *Distorsio djunggranganensis* is very similar to *D. habei* Lewis, but has a shorter anterior siphonal canal recurved and directed to the left, rather than nearly straight and directed slightly to the right as in *D. habei*. Beu (1998) therefore doubted whether it is distinct from *D. habei*. However, another specimen in the collection of Bunjamin Dharma is closely similar to the holotype in size, shape and sculpture (but better preserved and aragonitic rather than calcitic), and agrees with it in anterior canal characters. Another, incomplete specimen recently received in RGM from the IAUUenschappen, Utrecht, agrees with these two in essential characters. The three Indonesian fossil specimens also are much smaller than adult Recent specimens of *D. habei*. It seems likely, then, that this is a species distinct from *D. habei*.

Distorsio perdistorta Fulton, 1938

Distorsio perdistorta Fulton, 1938, p. 55, pl. 13, figs. 3, 3a; Henning & Hemmen, 1993, p. 145, pl. 30, fig. 4; Kronenberg, 1994, p. 88, fig. 20, pl. 3, fig. 2; Beu, 1998, p. 194, fig. 59i-l (with further synonymy); Okutani, 2000, p. 293, pl. 145, *Distorsio* fig. 3.

Distorsio (Rhysema) horrida Kuroda & Habe *in* Habe, 1961, p. 46, pl. 23, fig. 3, appendix p. 17; Habe, 1964, p. 74, pl. 23, fig. 3.

Distorsio (Rhysema) perdistorta. – Robba *et al.*, 1989, p. 77; Skwarko & Sufiati, 1994, p. m13.

Distorsio horrida. – Higo *et al.*, 2001, p. 49, fig. G1609s.

Type material – *Distorsio perdistorta* Fulton, holotype BMNH 1938.7.13.13, from "Kii, Japan". *Distorsio (Rhysema) horrida* Kuroda & Habe, holotype and one paratype NSMT 39788, from Tosa Bay, Shikoku, Japan.

Other material examined – Università di Milano-Bicocca no. 6414, Oe Sapi, Tinu, near Atambua, Timor, Pleistocene (2; recorded by Robba *et al.*, 1989, p. 77).

Distribution – *Distorsio perdistorta* is very widely distributed throughout the Indo-West Pacific and Atlantic regions, and is the only species of *Distorsio* to occur in both major oceans. Specimens are recorded from Natal, South Africa, east to the Marquesas Islands (material in MNHN), and from central Japan to New Caledonia in the Pacific, from Florida to southern Brazil, and off West Africa from the Canary Islands to Angola. The only fossils I am aware of are those recorded here.

Remarks – *Distorsio perdistorta* is very distinctive because of its strongly and evenly inflated whorls with no peripheral angulation, its uniform, even sculpture with no spiral cords raised above their neighbours and its very strongly distorted coiling. The specimens from the Pleistocene of Timor reported by Robba *et al.* (1989) are too fragmentary for certain identification, but appear likely to be *D. perdistorta*.

***Distorsio reticularis* (Linné, 1758)**

Figs. 146-151.

Murex reticularis Linné, 1758, p. 749; Linné, 1767, p. 1218.

Distorsio reticulata Röding, 1798, p. 133; Emerson & Puffer, 1953, p. 102; Beets, 1986b, p. 110; Wilson, 1993, p. 239, pl. 40, fig. 22a, b; Skwarko & Sufiati, 1994, p. m12; van den Hoek Ostende *et al.*, 2002, p. 35.

Murex cancellinus. – de Roissy, 1805, p. 56 (not *Murex cancellinus* Lamarck, 1803).

Distorta acuta Perry, 1811, pl. 10, fig. 1.

Murex mulus Dillwyn, 1817, p. 704.

Triton cancellinus. – Reeve, 1844a, pl. 12, fig. 45.

Nassa(?) *lamonganana* Martin, 1884, p. 125, pl. 7, fig. 128.

Persona reticulata. – Martin, 1899, p. 145, pl. 23, fig. 336; Martin, 1919, pp. 87, 122, 130, 141, 145; Fischer, 1921, p. 244; Fischer, 1927, pp. 33, 65; Martin, 1928, p. 8; van der Vlerk, 1931, p. 240.

Persona metableta Cossmann, 1903b, p. 159, pl. 6, figs. 4, 5.

Persona cancellina. – Martin, 1926, p. 10; Martin, 1932, p. 114 (not *Murex cancellinus* Lamarck, 1803).

Distorsio francesae Iredale, 1931, p. 213, pl. 23, fig. 2.

Distorsio cancellina. – Oostingh, 1935, p. 226; van Regteren Altena, 1942, p. 105 (with long further synonymy).

Distorsio (Distorsio) reticulatus reticulatus. – Shuto, 1969, p. 90, pl. 4, fig. 8.

Distorsio (Distorsio) reticularis. – Beu, 1987, p. 314, figs. 151, 152.

Distorsio reticularis. – Henning & Hemmen, 1993, p. 146, pl. 27, figs. 3, 4, 6; Kronenberg, 1994, p. 90, fig. 21, pl. 1, figs. 8, 12a, b, pl. 3, figs. 7-9; Beu, 1998, p. 195, figs. 58l, 63f-k, 64a-g (with further synonymy); Beu, 1999, p. 54, figs. 100, 101 (with further synonymy); Okutani, 2000, p. 293, pl. 145, *Distorsio* fig. 2.

Type material – *Murex reticularis* Linné, lectotype (of Beu, 1987, p. 314, figs. 151, 152) in Linné's collection in London. Beu (1998) also designated this specimen the neotype of *Distorsio reticulata* Röding and *Distorta acuta* Perry. The type locality was designated by Kronenberg (1994, p. 90) as Ambon Island, Indonesia. *Murex mulus* Dillwyn, lectotype of Dean (1936, p. 231) in National Museum of Wales, Cardiff, accession no. NMW 1928.82.15 (Beu, 1998). *Nassa*(?) *lamonganana* Martin, holotype RGM 9816, from Tambak batoe [Tambakbatu], Residence of Surabaya, Java. *Persona metableta* Cossmann, no type material known, not in Cossmann Collection, Laboratoire de Paléontologie, MNHN. *Distorsio francesae* Iredale, holotype AMS C.57795, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia.

Other material examined – RGM 9813, Sonde, Java, Pliocene (1; Figs. 150, 151); RGM 9814, Selatjau [Selacau], Java, Late Miocene (1, small juvenile, protoconch illustrated by Martin, "fig. 4: 1"); RGM, Tjikeusik [Cikeusik], Residence of Bantam [Banten], Java (1, abraded); RGM 9815, Sonde, Residence of Madiun, Java, Pliocene (2); "Kendeng beds" material in Mijnwezen Collection: locality M67 (1), M98 (1, poor), M101 (3), M134 (1), M163 (1, good), M168 (1 large, poor), M216 (1), M228 (1), M251 (1), M252 (2 good), M255 (1), M257 (1), M260 (RGM 456 258, 19 good; Figs. 148, 149), M278 (6), M298 (4); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 573 (2 poor), RGM 46 574

(1 good), RGM 46 576 (1 good), RGM 46 577 (4 small), RGM 46 578 (4 good), RGM 46 580 (2 good); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 39, Pleistocene? (RGM 456 257, 14; Figs. 146, 147), locality 42, Pleistocene (1), locality 44, Pleistocene? (1), locality 77, Pliocene-Pleistocene (2); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (1 juvenile); Pasir Ipis, Cirebon, central Java, mid-Pliocene, presented by B. Dharma (GNS WM 17237, 1); Sangiran, central Java, Late Pliocene, presented by B. Dharma (GNS WM17478, 3; + many in collection of B. Dharma).

Distribution – *Distorsio reticularis* is much the most common *Distorsio* species throughout the Indo-West Pacific region, from Natal, South Africa and East Africa to New Caledonia and the Solomon Islands, and from Sagami Bay, Honshu, Japan, south to Sydney Harbour, Australia. Fossils have been reported widely from southern India, the Ryukyu Islands and Taiwan to the Philippine Islands, Vanuatu (Espiritu Santo Island) and Indonesia.

Remarks – Most of the material identified as *Distorsio "cancellina* (de Roissy)" in the "Kendeng beds" collections described by van Regteren Altena (1942) is referred here to *Distorsio reticularis*, although a few of van Regteren Altena's specimens are referred above to *D. decipiens*. Beu (1998, pp. 197-199) discussed the application of the name *D. cancellina*, pointed out that it dates from Lamarck (1803) rather than de Roissy (1805), and repeated Deshayes's (1865, p. 302) conclusion that the long-lost holotype probably was a specimen from Asti, Italy (Pliocene), i.e., it is an earlier name for the European fossil species usually known as *D. tortuosa* Borson. Landau *et al.* (2004, p. 73, pl. 6, fig. 1a-d) recently designated a neotype for *Murex cancellinus*, a specimen of the species usually known as *Distorsio tortuosa*, from the Pliocene of Asti, Italy (BMNH Palaeontology Dept., GG 24158). Beu (1987, p. 314) showed that the earliest name for the present Indo-West Pacific species is *D. reticularis* (Linné, 1758) and clarified Linné's type material. The name *D. reticularis* (in some cases spelled *D. reticulata*) has been used most frequently for this species by Martin and other authors on Indonesian fossils. Martin's (1884, p. 145) holotype of *Nassa*(?) *lamonganana* is a juvenile specimen of *Distorsio reticularis*.

Distorsio reticularis is recognisable by its very generalised, elongate *Distorsio* shape and sculpture, with cancellate, equally prominent, narrow axial ridges and spiral cords, weakly differentiated into a more closely spaced peripheral pair of cords in most specimens, and with the long, almost straight, narrow anterior siphonal canal weakly and irregularly recurved and deflected weakly to the left, rather than very straight and deflected to the right as in *D. decipiens*. It also lacks the "hunched" appearance formed by the very prominent peripheral pair of spiral cords and the prominent subsutural cord raised markedly over the terminal varix in *D. decipiens*. Unlike the usually white *D. decipiens*, with a red-brown apertural shield in a few specimens, most specimens of *D. reticularis* are cream to yellow-brown, with a uniform pale yellow to pinkish red-brown aperture, including its interior.

Family Ranellidae Gray, 1854
Subfamily Ranellinae Gray, 1854
Genus *Biplex* Perry, 1810

Biplex Perry, 1810, signature M7, text to pl. 23 (no included species); Perry, 1811, explanation to pls. 4, 5 (10 species included). Type species (by subsequent designation, Gray, 1847, p. 133): *Biplex perca* Perry, 1811, Miocene to Recent, western Pacific.

Remarks – *Biplex* is an extremely distinctive genus, with its widely expanded varices united up the opposing sides of the shell to form unique, very prominent "wings". The species were revised by Beu (1998), including the Indonesian fossils, and Martin's types are not reillustrated here. Dr P. Bouchet (MNHN, Paris; pers. comm., November 2001) pointed out that Perry's generic names *Monoplex, Biplex, Triplex, Hexaplex* and *Polyplex* were established with valid diagnoses by Perry (1810, signature M7), although Perry did not include species in any of these genera until his later, more familiar book, "*Conchology*" (Perry, 1811). Petit (2003) evaluated all Perry's molluscan taxa and reached the same conclusion.

Biplex magnifica (Martin, 1879)

Ranella magnifica Martin, 1879, p. 53, pl. 10, figs. 1, 1a, b; Zwierzicki, 1915, p. 109; van der Vlerk, 1931, p. 241; van der Vlerk, 1932, p. 111.
Biplex magnifica. – MacNeil, 1961, p. 59; Beu, 1998, p. 26, fig. 3b, c.
Apollon (Biplex) magnifica. – Skwarko & Sufiati, 1994, p. m2.
Apollon (Biplex) magnificus. – van den Hoek Ostende *et al.*, 2002, p. 34.

Type material – *Ranella magnifica* Martin, holotype RGM 9935, from Junghuhn's locality K, Tji Badak [Cibadak], inland from Sindangberang, in the western part of the Cidamar district, southern coast of southwestern Java (see list above), Miocene (illustrated by Beu, 1998, fig. 3b, c).

Distribution – Known only by the holotype.

Remarks – Although *Biplex magnifica* still seems to be known only by the holotype, it is a very distinctive, large, inflated *Biplex* with most unusually narrow, weakly expanded varices and with the teleoconch whorls less dorsoventrally compressed than in other *Biplex* species. Zwierzycki (1915, p. 109) recorded two specimens as "*Ranella magnifica* Mart." from a locality in Sumatra and van der Vlerk (1932, p. 111) identified a specimen as "*Ranella magnifica*" from the Pliocene of Sumatra, but I have not seen this material and its identity is uncertain; these records possibly refer to more common *Biplex* species.

Biplex pamotanensis (Martin, 1899)
Figs. 156-163.

Ranella pamotanensis Martin, 1899, p. 151, pl. 23, figs. 352, 352a-c; Siemon, 1929, p. 52; van der Vlerk, 1931, p. 241.

Ranella (Biplex) pamotanensis. – Wanner & Hahn, 1935, p. 257.
Argobuccinum (Biplex) pamotanensis. – Pannekoek, 1936, p. 43.
Apollon pamotanensis. – Shuto, 1977, p. 134.
Apollon (Biplex) pamotanensis. – Skwarko & Sufiati, 1994, p. m3; van den Hoek Ostende *et al.*, 2002, p. 34.
Biplex pamotanensis. – Beu, 1998, p. 28, fig. 3d, e, g, h.

Type material – *Ranella pomotanensis* Martin, lectotype (Beu, 1998, p. 28, fig. 3g, h) RGM 9936, from Mount Butak, Rembang beds, Late Miocene (Martin's illustrated syntype); one paralectotype RGM 9937, Ngampel, Java, Preanger [Priangan], Middle Miocene (poor, crushed); three small paralectotypes RGM 9938, Panowan River, Residence of Rembang, Java; one paralectotype RGM 9940, Rembang beds, Java, Middle Miocene; one paralectotype RGM 9939, Mount Butak, Rembang, Java, Late Miocene. The lectotype, some paralectotypes and another excellent specimen were illustrated by Beu (1998, fig. 3d, e, g, h)

Other material examined – RGM 47 068, Ngampel, Rembang, Java, Middle Miocene (1, the excellent large specimen illustrated by Beu, 1998, figs. 3d, e); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (RGM 456 261, 456 262, 35 specimens, Figs. 156-163; taller and more strongly digitate around the variceal margins than typical *B. pamotanensis*); material from IAUU, received in RGM: "Sedan, Res. Rembang, Java, coll. Erb" (3 good).

Distribution – *Biplex pamotanensis* is recorded only from Miocene rocks of Java, although a very similar form occurs also in Late Miocene(?) rocks of Sumatra.

Remarks – Beu (1998) pointed out that *Biplex pamotanensis* is the most distinctive of the large *Biplex* species, because of its short, wide shape, and its very widely expanded varices (the widest of all *Biplex* species) with little in the way of spines around the outer margin, in contrast to the strongly digitate margin of all other species. Specimens from the Pendopo Oilfield, Sumatra, have slightly taller spires than typical Rembang specimens, with weakly digitate variceal margins, and possibly represent another, unnamed species. However, all are small and immature, and comparison of adults is required before the status of this form is clear.

***Biplex perca* Perry, 1811**
Figs. 152, 153.

Biplex perca Perry, 1811, pl. 4, fig. 5; Jousseaume, 1879, p. 4; MacNeil, 1961, p. 59, pl. 2, fig. 10, pl. 8, fig. 9, pl. 13, fig. 4; Noda, 1988, p. 40, pl. 17, figs. 15, 16; Wilson, 1993, p. 242; Beu, 1998, p. 28, figs. 4a-e, g-i, 6c; Beu, 1999, p. 3, fig. 2 (with further synonymy); Okutani, 2000, p. 285, pl. 141, fig. 3.
Ranella pulchra. – Reeve, 1844b, pl. 8, fig. 47; Martin, 1919, pp. 88, 137; van der Vlerk, 1931, p. 241 (not *Ranella pulchra* G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).
Ranella (Eupleura) pulchra var. – Martin, 1884, p. 135, pl. 7, fig. 136.
Gyrineum (Biplex) perca. – Pilsbry, 1895, p. 48; van Regteren Altena, 1942, p. 100; Cox, 1948, p. 41, pl. 4, fig. 3a, b; Beu, 1985, p. 57; Henning & Hemmen, 1993, p. 31, pl. 4, fig. 6.
Ranella (Biplex) pulchra. – Tesch, 1920, p. 43, pl. 129, fig. 156a, b.
Gyrineum (Biplex) perca prisca Makiyama, 1927, p. 71, pl. 3, fig. 1b.
Gyrineum perca edgerleyi Richards, 1933, p. 57, pl. 6, fig. 2.

Apollon (Biplex) perca. – Wissema, 1947, p. 145; Shuto, 1969, p. 88, pl. 7, figs. 6, 13, 16, text-fig. 22; Skwarko & Sufiati, 1994, p. m3.
Biplex perca edgerleyi. – Higo *et al.*, 2001, p. 47, fig. G1570s.

Type material – *Biplex perca* Perry, neotype designated by Beu (1998, p. 28), the specimen illustrated by Reeve (1844b, pl. 8, fig. 47), BMNH 1995225/1, from "Japan"; Beu (1998) designated the type locality as Sagami Bay, Honshu. *Gyrineum (Biplex) perca prisca* Makiyama, holotype in Geology Department, Kyoto University, GK no. 301, from the Pliocene of Tennoyama, Shizuoka Prefecture, Japan. *Gyrineum perca edgerleyi* Richards, holotype in Delaware Museum of Natural History, Wilmington, no. 195251, from "Japan" (Higo *et al.*, 2001, pl. 47, fig. G1570s).

Other material examined – RGM 9933, Ngembak, Surabaya, Java (1, specimen illustrated by Martin as "*Ranella pulchra* Gray, var."); RGM 9934, Ngampel, Java, Miocene (1, one whorl and varices illustrated by Martin); "Kendeng beds" material in Mijnwezen Collection: locality M67 (2), M251 (2), M252 (1), M257 (1), M333 (1); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 102, Pliocene-Pleistocene (1, incomplete); locality 108 (RGM 456 259, 9 good; Figs. 152, 153); material from IAUU, received in RGM: "Beneden Toluarang, river south of Ma. Kapata, northern Sulawesi, coll. Rutten" (1). The specimen from the Togopi Formation (Pliocene-Pleistocene?), Dent Peninsular, North Borneo, illustrated by Cox (1948, pl. 4, fig. 2a, b) has been examined (NMB H.14425) and is an incomplete, juvenile specimen of *B. perca*.

Distribution – *Biplex perca* occurs throughout the central Western Pacific archipelagos, from Boso Peninsula, Honshu, Japan, to northern Australia and (rarely) New Caledonia. Similar, but consistently wider, specimens from further westward, off southern India and the northwestern Indian Ocean, were named by Beu (1998, p. 22) as the separate species *B. bozzettii*. Specimens of *B. perca* are particularly common around the Philippine Islands and Indonesia. Miocene and Pliocene fossils are moderately common in southern Japan, Okinawa, Taiwan, the Philippines and Indonesia.

Remarks – *Biplex perca* is the largest, tallest-spired, most widespread and most common of the *Biplex* species. Its wide, thin varices with strongly digitate margins are highly distinctive. Nevertheless, it is represented by surprisingly few specimens in the Indonesian collections. Premonowati (1990, p. 42, fig. 28) illustrated a specimen of *B. perca* from Pliocene rocks in central Java, but seems to have identified it as "*Murex verbeeki bentarsiensis* n. subsp.", a *nomen nudum.*

***Biplex perliberalis* (Beets, 1984)**

Apollon (Biplex) perliberalis Beets, 1984, p. 58, pl. 3, figs. 8, 9; Skwarko & Sufiati, 1994, p. m3.
Biplex perliberalis. – Beu, 1998, p. 31, fig. 3f, i.

Type material – *Apollon (Biplex) perliberalis*, holotype RGM 315 217 (Beu, 1998, fig. 3f, i), from Mandul Island, northeast Kalimantan Timur (i.e., East Borneo), Late Miocene (Preangerian).

Distribution – Known only by the holotype.

Remarks – This small species (H 18.8 mm) is similar to *Biplex pulchella* (G. B. Sowerby 1st, 1825) in most characters, but has rather narrower varices and much more prominent sculpture. *Biplex pulchella* is a small, extremely dorsoventrally compressed species that occurs now from central Queensland, Australia (at least as far south as Gladstone) around the northern coast of Australia and into western Papua New Guinea. Schepman (1909, p. 116) recorded a specimen from "*Siboga*" Sta. 162, 18 m, "between Loslos and Broken-islands, west coast of Salawatti", off the western tip of New Guinea. So although *B. pulchella* has been regarded as an Australian species, it is not surprising to discover a close relative in the Miocene of Borneo.

Biplex pulchra **(G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841)**

Figs. 154, 155.

Ranella pulchra G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, pl. 93, fig. 19.
Biplex pulchra. – Jousseaume, 1879, p. 4; Wilson, 1993, p. 242, pl. 40, fig. 5b; Beu, 1998, p. 32, figs. 4f, 5a-m, 6a, b; Okutani, 2000, p. 285, pl. 141, fig. 4.
Ranella (Eupleura) pulchra var. – Martin, 1884, p. 135, pl. 7, fig. 136.
Gyrineum (Biplex) perca var. *aculeata* Schepman, 1909, p. 115, pl. 10, fig. 1a-c.
Bursa (Biplex) microstoma Fulton, 1930, p. 16, pl. 2, figs. 2, 3.
Ranella (Biplex) pulchra timorensis Koperberg, 1931, p. 119 (in part).
Apollon (Biplex) microstoma. – Wissema, 1947, p. 146, pl. 6, fig. 136.
Biplex perca. – Ladd, 1977, p. 33, pl. 11, figs. 3, 4 (not *Biplex perca* Perry, 1811).
Gyrineum (Biplex) pulchrum. – Beu, 1985, p. 57, fig. 8; Henning & Hemmen, 1993, p. 32, pl. 4, fig. 7.

Type material – Beu (1998, p. 34) designated Fulton's (1930, pl. 2, figs. 2, 3) illustrated syntype of *Bursa (Biplex) microstoma* (BMNH 1930.4.2.2) to be the lectotype of *Bursa microstoma* and neotype of *Ranella pulchra* G.B. Sowerby 1st; one paralectotype of *Bursa (Biplex) microstoma* in NMW; both from "Hong Kong". *Gyrineum (Biplex) perca* var. *aculeata* Schepman, lectotype (of Beu, 1998, p. 34), ZMA 309001, with two paralectotypes ZMA 309002, all from "*Siboga*" Sta. 289, 112 m, Timor Sea, Indonesia; one paralectotype ZMA 309003, from "*Siboga*" Sta. 95, 522 m, Sulu Sea, Indonesia.

Beu (1998, figs. 5i-m) illustrated several of Koperberg's specimens (all presumed syntypes) of *Ranella (Biplex) pulchra* subsp. *timorensis*. All are specimens of *Biplex pulchra* and the specimen illustrated by Beu (1998, fig. 5m) was designated the lectotype. However, Koperberg's material from the Pliocene of Timor received recently in RGM from MGMD, includes one specimen from "Noil-Besi", labelled as the original of Koperbeg's "thesis pl. 129, fig. 156", identified as "*Ranella pulchra*"; this is a fairly complete, coarsely granulose specimen of *B. perca* (Perry).

Other material examined – Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 77, Pliocene-Pleistocene (1 small, incomplete), locality 94, Late Pliocene (RGM 456 260, 1 good; Figs. 154, 155), locality 108, Late Pliocene (2, good, including specimen illustrated by Wissema, 1947, pl. 6, fig. 136); Sangiran, central Java, Late Pliocene (GNS WM17439, 1; GNS WM17471, 4; 1 in collection of B. Dharma); Pasir Ipis, Cirebon, West Java, Pliocene (1, in collection of B. Dharma).

Distribution – *Biplex pulchra* occurs throughout the western Pacific archipelagos from southern Japan to northern Australia and New Caledonia. The northernmost locality in Japan is Enshu Nada, Wakayama Prefecture, southern Honshu, whereas *B. perca* occurs as far north as Boso Peninsula, central Honshu.

Remarks – *Biplex pulchra* is similar to *B. perca* in most characters, differing in its smaller size, its narrower shape, its more strongly digitate variceal margins and its more obviously channelled suture (Beu, 1998). Over much of their range at present, *B. perca* is much the more common of the two, although *B. pulchra* occurs further to the southeast than *B. perca* and is not uncommon in New Caledonia, where *B. perca* is exceedingly rare (Beu, 1998). As is the case at present around Indonesia, *B. perca* is the more common species in the fossil material available for this study.

Genus Gyrineum Link, 1807

Gyrineum Link, 1807, p. 123. Type species (by subsequent designation, Dall, 1904, p. 131): *Gyrineum verrucosum* Link, 1807 (= *Murex gyrinus* Linné, 1758), Pliocene to Recent, Indo-West Pacific.

Apollon Montfort, 1810, p. 571. Type species (by monotypy): *Murex gyrinus* Linné, 1758.

Gyrinella Dall, 1924, p. 89. Type species (by original designation): *Ranella pusilla* Broderip, 1833, Recent, French Polynesia (misidentified type species? – presumably intended for *G. lacunatum* (Mighels, 1845), Indo-West Pacific).

Remarks – The Recent species of *Gyrineum* were revised by Beu (1998) and this review is followed here.

Gyrineum bituberculare (Lamarck, 1816)

Figs. 164-167.

Ranella bituberculatis Lamarck, 1816, pl. 412, fig. 6, "Liste des objets" p. 4; Lamarck, 1822, p. 153; Kiener, 1841, pl. 6, fig. 2; Reeve, 1844b, pl. 7, fig. 40; Martin, 1884, p. 136; Martin, 1919, pp. 88, 130, 131, 141; Fischer, 1927, p. 33; Martin, 1928, p. 8; Siemon, 1929, p. 54; van der Vlerk, 1931, p. 240; van der Vlerk, 1932, p. 111; Haanstra & Spiker, 1932, p. 1314.

Ranella cuspidata Reeve, 1844b, pl. 8, fig. 48; Reeve, 1844d, p. 139.

Bursa fusco-costata Dunker, 1862, p. 239; Dunker, 1863-1864, p. 57, pl. 19, figs. 1, 2.

Ranella? *tritonoides* Woodward, 1879, p. 539, pl. 14, fig. 7; van der Vlerk, 1931, p. 240.

Ranella anjarensis Martin, 1884, p. 137, pl. 7, fig. 137; van der Vlerk, 1931, p. 240.

Ranella raninoides Martin, 1883a, p. 203, pl. 9, fig. 6; van der Vlerk, 1931, p. 240.

Ranella (Apollo) bituberculatis. – Martin, 1899, p. 149, pl. 23, figs. 349, 350, 350a, 351; Icke & Martin, 1907, p. 237; Tesch, 1920, p. 43, pl. 129, fig. 155a, b; Wanner & Hahn, 1935, p. 257.

Ranella karikalensis Cossmann, 1903b, p. 156, pl. 5, figs. 20, 21.

Gyrineum bituberculare. – Schepman, 1907, p. 182; Schepman, 1909, p. 114; van Regteren Altena, 1942, p. 96 (with further synonymy); Cox, 1948, p. 40, pl. 3, fig. 6a, b; Ladd, 1977, p. 33, pl. 12, figs. 7, 9; Beu, 1985, p. 56; Henning & Hemmen, 1993, p. 25, pl. 3, figs. 4, 5; Wilson, 1993, p. 241, pl. 40, fig. 7; Beu, 1998, p. 38, figs. 6l, m, 8a-k, 9a-j (with further synonymy).

Argobuccinum (Gyrineum) cf. *bituberculare*. – Pannekoek, 1936, p. 43.

Argobuccinum (Gyrineum) bituberculare. – Beets, 1941, p. 88 (with further synonymy).

Apollon (Apollon) bituberculare. – Wissema, 1947, p. 143.

Apollon bituberculatis. – Beets, 1950a, p. 245; Poppenoe & Kleinpell, 1978, pl. 5, fig. 6b; Beets, 1981, pp. 20, 23, 26; Beets, 1984, p. 58; Skwarko & Sufiati, 1994, p. m1.

Apollon osawanoensis Tsuda, 1959, p. 87, pl. 4, figs. 9, 10.

Apollon minoense Itoigawa, 1960, p. 284, pl. 5, fig. 4a, b.
Argobuccinum anjarense. – Dey, 1962, p. 75.
Bursa (Ranella) tritonoides. – Skwarko & Sufiati, 1994, p. n4.
Bursa (Ranella) anjarensis. – Skwarko & Sufiati, 1994, p. n4; van den Hoek Ostende *et al.*, 2002, p. 36.
Gyrineum pusillum. – Noda, 2002, p. 106, figs. 18-9a, b, 10a, b, 13a, b (not *Ranella pusilla* Broderip, 1833).
Apollon (Apollon) bitubercularis. – van den Hoek Ostende *et al.*, 2002, p. 34.

Type material – *Ranella bitubercularis* Lamarck, lectotype of Beu (1998, p. 38) and one paralectotype, MHNG 1098/89, unlocalised; Beu (1998) designated the type locality as Bohol, Philippine Islands. *Ranella cuspidata* Reeve, lectotype (of Beu, 1998, p. 38) BMNH 1967663/1, with two paralectotypes BMNH 1967663/2, 3, from “Capul and Ticao”, Philippines. *Bursa fuscocostata* Dunker, holotype BMNH 1968531, labelled “California” (wrong, probably from the Philippine Islands). *Ranella anjarensis* Martin, holotype RGM 9932, late Quaternary, “Banjar Anjar, Residency of Surabaya”, Java. *Ranella raninoides* Martin, lectotype (of Beu, 1998, p. 39) RGM 9922, from Tji Longan [Cilongan], Java, Preanger [Priangan]; it remains unclear how many other specimens originally were available to Martin. *Ranella karikalensis* Cossmann, two presumed syntypes in Collection Cossmann, Laboratoire de Paléontologie, MNHN, labelled “Karikal [southern India, Pliocene] *dedit* M. Bonnet”. *Apollon osawanoensis* Tsuda, holotype in Department of Geology & Mineralogy, Kyoto University, JC 140044, from “Kurosedani Miocene”, Japan. *Apollon minoense* Itoigawa, holotype in Department of Earth Sciences, Nagoya Universit, ESN 20063, from “Oidawara Miocene”, Japan. *Ranella tritonoides* Woodward, location of type material not known to me.

Other material examined – RGM 9920, Selatjau [Selacau], Java, Preanger [Priangan] (3); RGM 9921, Selatjau [Selacau], Java, Preanger [Priangan] (1); RGM 47 052, Ngampel, Rembang, Java, Middle Miocene (Robba, 1996) (1); RGM 9926, Sonde, Java, Pliocene (1); RGM 9919, Selatjau [Selacau], Java, Preanger [Priangan], Late Miocene (3 good, including Martin’s (1899, figs. 350, 351) 2 illustrated specimens of *Ranella bitubercularis*); RGM 9927, Padas Malang [Padasmalang], Residence of Madiun, Java, Pliocene (1); RGM 9925, Tjadasngampar [Cadasngampar], Java, Preanger [Priangan] (3); RGM 9923, Tjilindung [Cilindung], Java, Preanger [Priangan] (1); RGM 9928, Ngampel, Java, Rembang beds, Middle? Miocene (5); RGM 9929, Djokjo [Jogjakarta], Java, Miocene (1); RGM 9924, Tjadasngampar [Cadasngampar], Preanger [Priangan], Late Miocene (3); “Kendeng beds” material in Mijnwezen Collection: locality M125 (RGM 456 264, 7; Figs. 166, 167), M143 (1), M173 (1), M193 (2), M260 (2), M278 (4), M281 (1), M304 (1); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 567 (1 small, identified by van Regteren Altena (1942) as *G. gyrinum*), RGM 46 568 (1 small, identified by van Regteren Altena (1942) as *G. gyrinum*), RGM 46 569 (1 good, large), RGM 46 570 (1 good); Nias Island, Sumatra, Pleistocene?, Schroeder’s collection described by Wissema (1947): locality A, West Muröy (1), locality 39 (54 good), locality 42 (44 good), locality 43a (1), locality 44 (3), locality 58 (1), locality 100 (7 good); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (RGM 456 263, 48 good; Figs. 164, 165); Citalahab, West Java, Late Miocene, collected and presented by B. Dharma (GNS WM 17248, 2); Pasir Ipis, Cirebon, West Java, Pliocene (2, in collection of B. Dharma); Nyalindung, West Java, Middle Miocene, presented by B. Dharma (GNS WM17485, 3); Sangiran, central Java, Late Pliocene, presented by B. Dharma (GNS WM17474, 3); Robba’s localities

CIJ4 (1), NJ (2), NJR (4), Tjimerang and Cijarian, western Java, Preangerian, Middle Miocene; all in Università di Milano-Bicocca); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Niol-Noni-Pene", the original of Koperberg's thesis "pl. 129, fig. 155", identified as "*Ranella bitubercularis*" (1 good); material from IAUU, received in RGM: Pleistocene, Kaju Ragi, Manado Island, northern Sulawesi (2 good); "Prufgat Talang Abab, Palembang", Sumatra (7 + fragments); Togopi Formation (Pliocene-Pleistocene?), Dent Peninsular, North Borneo (NMB H.14423/1, 1, illustrated by Cox, 1948, pl. 3, fig. 6a, b).

Distribution – *Gyrineum bituberculare* lives now throughout the western Pacific archipelagos from Taiwan and the Philippine Islands to Torres Strait and the far northwestern shelf of Western Australia, and westwards along the coasts of Asia to southern India. Fossils have been reported widely from Miocene to Pleistocene rocks of central Japan, Okinawa, Taiwan, the Philippine Islands, India and throughout Indonesia.

Remarks – *Gyrineum bituberculare* is probably the second-most common fossil tonnoidean gastropod in Indonesia (as shown by the many references to fossils, not all listed above), exceeded in abundance only by *Bufonaria rana*. It is easily recognised by its large size for a *Gyrineum* species (many specimens reach 50 mm high), its elongate shape, with a tall spire and long anterior canal, and its prominent sculpture, with relatively few axial costae. The sculpture, however, is highly variable, ranging from many fine, close axial costae and spiral cords forming an evenly cancellate surface (as in the holotype of *Ranella anjarensis* Martin) through to only one or two very prominent axial costae per intervariceal interval.

Gyrineum gyrinum (Linné, 1758)

Figs. 168-171.

Murex gyrinus Linné, 1758, p. 748; Linné, 1767, p. 1216; Gmelin, 1791, p. 3531.

Gyrineum verrucosum Link, 1807, p. 123.

Biplex variegata Perry, 1811, pl. 5, fig. 2.

Ranella ranina Lamarck, 1816, pl. 412, fig. 2a, b, "Liste des objets" p. 4; Lamarck, 1822, p. 154; Kiener, 1841, p. 28, pl. 2, fig. 3; Deshayes, 1843, p. 549.

Ranella gyrinus. – Reeve, 1844b, pl. 8, fig. 49; Küster & Kobelt, 1871, p. 152, pl. 40, figs. 4-6.

Ranella (Argobuccinum) gyrina. – Tryon, 1880, p. 43, pl. 23, fig. 78.

Ranella (Apollo) gyrina. – Martin, 1899, p. 149, pl. 23, figs. 347, 347a.

Gyrineum gyrinus. – Schepman, 1907, p. 182; van Regteren Altena, 1942, p. 98.

Gyrineum gyrinum. – Schepman, 1909, p. 114; Okutani, 1986, pp. 112, 113, top right fig.; Wilson, 1993, p. 241, pl. 40, fig. 6.

Ranella gyrina. – Martin, 1919, p. 137; van der Vlerk, 1931, p. 241.

Argobuccinum (Gyrineum) gyrinum. – Beets, 1941, p. 195.

Apollon (Apollon) gyrinus. – Wissema, 1947, p. 144; Beets, 1983, p. 29; Skwarko & Sufiati, 1994, p. m4.

Apollon (Apollon) gyrinum. – Oyama & Takemura, 1959, *Apollon* pl. 2, figs. 7, 8.

Apollon (Apollon) gyrinum robusta. – Oyama & Takemura, 1959, *Apollon* pl. 2, figs. 9, 10 (not *Gyrinum natator* var. *robusta* Fulton, 1936).

Apollon gyrinus. – Habe, 1961, p. 45, pl. 22, fig. 1; Habe, 1964, p. 71, pl. 22, fig. 1.

Gyrineum (Gyrineum) gyrinum gyrinum. – Beu, 1985, p. 56; Henning & Hemmen, 1993, p. 24, pl. 3, fig. 2.

Gyrineum gyrinum gyrinum. – Beu, 1998, p. 44, fig. 10k, m-p.

Type material – *Murex gyrinus* Linné, lectotype (of Beu, 1998, p. 44) and one paralectotype in Linné's collection in London, both marked "528" in their apertures; the lectotype is the larger (H 24.4, D 17.0 mm); three further paralectotypes are present in the Uppsala University Zoological Museum. Beu (1998) designated the type locality as Ambon Island, Indonesia. Beu (1998) designated the lectotype also as the neotype of both *Gyrineum verrucosum* Link and *Biplex variegata* Perry. *Ranella ranina* Lamarck, lectotype (of Beu, 1998, p. 44) MHNG 1898/88/1 (H 29.1, D 20.0 mm), with two paralectotypes, MHNG 1098/88/2, 3.

Other material examined – RGM 9914, Ngembak, Java, Miocene (1, specimen illustrated by Martin as *Ranella gyrina* Linné); "Kendeng beds" material in Mijnwezen Collection: locality M175 (1, identified by van Regteren Altena as *G. gyrinum*); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 265, 2 good, Figs. 170, 171); locality 76 (1, small, recorded by Wissema as *G. gyrinum*); locality 100 (2 good, recorded by Wissema as *G. gyrinum*); RGM 107 521, Kaju Ragi, Manado Island, Sulawesi (100+ excellent, coloured; Figs. 168, 169).

Distribution – *Gyrineum gyrinum* occurs throughout the Indo-West Pacific region, including the Red Sea (Wellens & Wils, 1996), although it seems to be rare in the Indian Ocean and is not recorded from as far east as Hawaii. Specimens occur as far north as the Amami Islands, southern Japan, and as far south as the Bunker Group, southernmost Great Barrier Reef, Australia, and are common at New Caledonia. Fossils are rare, however, and the few listed here are the only confirmed ones I am aware of.

Remarks – *Gyrineum gyrinum* is identifiable by its short, wide shape for a *Gyrineum* species, with a very short anterior siphonal canal, by its prominent, wide varices, and by its unusually coarse sculpture of four rows of rounded nodules around the periphery. There are from three to eight nodules in each intervariceal interval. Recent specimens are particularly easily identified by their bright colour pattern of alternating dark brown, yellow and bright white spiral bands. *Gyrineum gyrinum* is one of the most common *Gyrineum* species in the modern fauna (recorded from 137 stations around New Caledonia), but lives in shallow water (intertidal to 68 m around New Caledonia; Beu, 1998). Consequently, the deeper-living species *G. bituberculare* is much more commonly represented than *G. gyrinum* in the fossil fauna of Indonesia.

***Gyrineum lacunatum* (Mighels, 1845)**
Figs. 176-179.

Ranella pusilla. – Reeve, 1844b, pl. 8, fig. 44a, b (not *Ranella pusilla* Broderip, 1833).
Triton lacunatum Mighels, 1845, p. 24; Johnson, 1949, p. 226.
Ranella sagitta Küster *in* Küster & Kobelt, 1871, p. 147, pl. 38a, fig. 6.
Ranella chemnitzii Küster *in* Küster & Kobelt, 1871, p. 148, pl. 39, figs. 3, 4.
Ranella polychloros Tapparone-Canefri, 1875, p. 1028.
Ranella junghuhni Martin, 1879, p. 54, pl. 10, figs. 2, 2a, b; Martin, 1919, p. 88; van der Vlerk, 1931, p. 241.
Ranella (Apollo) gyrina. – Martin, 1899, p. 149, pl. 23, figs. 347, 347a.
Ranella (Apollo) junghuhni. – Martin, 1899, p. 150.

Gyrineum pusillum. – Schepman, 1909, p. 115; Kay, 1979, p. 226, fig. 79G, H; Beu, 1985, p. 56; Henning & Hemmen, 1993, p. 29, pl. 4, fig. 2; Okutani, 2000, p. 285, pl. 141, fig. 9.
Ranella gyrina. – Martin, 1919, pp. 88, 137; van der Vlerk, 1931, p. 241 (in part not *Murex gyrinus* Linné, 1758).
Apollon facetus Iredale, 1936, p. 309, pl. 24, fig. 3.
Apollon deliberatus Iredale, 1936, p. 310, pl. 24, fig. 4.
Argobuccinum (Gyrineum) gyrinum. – Beets, 1941, p. 195 (not *Murex gyrinus* Linné, 1758).
Gyrineum (Gyrineum) gyrinum. – van Regteren Altena, 1942, p. 98 (in part not *Murex gyrinus* Linné, 1758).
Gyrineum (Gyrineum) junghuhni. – van Regteren Altena, 1942, p. 98; Skwarko & Sufiati, 1994, p. m14; van den Hoek Ostende *et al.*, 2002, p. 34.
Apollon pusillus cuspidataeformis Kira, 1956, p. 122, fig. 2.
Gyrineum lacunatum – Wilson, 1993, p. 241, pl. 40, fig. 8a-c; Beu, 1998, p. 49, figs. 6j, k, 13a-o, 14a-h; Okutani, 2000, p. 285, pl. 141, fig. 10.
Apollon (Apollon) gyrinus. – Skwarko & Sufiati, 1994, p. m2 (in part not *Murex gyrinus* Linné, 1758).
Gyrineum nanshaensis Zhang, 2004, p. 158, fig. 1.

Type material – *Triton lacunatum* Mighels, neotype (of Beu, 1998, p. 51; the specimen illustrated by Reeve, 1844b, pl. 8, fig. 44), BMNH 1986096/1, with five other specimens formerly regarded as syntypes of *Ranella pusilla* Broderip, BMNH 19860996/2-6, from the Philippine Islands; Beu (1998) designated the neotype also to be the neotype of *Ranella sagitta* Küster and *Ranella chemnitzii* Küster. *Ranella polychloros* Tapparone-Canefri, type material not seen, presumably in Museo Civico di Storia Naturale "Giacomo Doria", in Genoa; from Wokan, Aru Islands, Indonesia. *Ranella junghuhni* Martin, holotype RGM 9931, from Junghuhn's locality H, Java, Miocene (illustrated by Martin, 1879, pl. 10, fig. 2, and by Beu, 1998, fig. 13 f, g). *Apollon deliberatus* Iredale, lectotype (of Beu, 1998, p. 51) AMS C.60682, with 65 paralectotypes (62 AMS C.116449, 3 GNS WM 14606), from 15 m, off Lindeman Island, Queensland, Australia. *Apollon facetus* Iredale, holotype AMS C.60681, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia. *Apollon pusillus cuspidataeformis* Kira, location of type material not known, not included by Higo *et al.* (2001); from a small islet off Nagashima, Mie Prefecture, Japan. *Gyrineum nanshaensis* Zhang, holotype in Marine Biology Museum, Chinese Academy of Sciences, Qingdao, no. M39875; Recent, from Zhubi reef, Nansha Islands, southern China (Zhang, 2004); not seen, but the coloured illustration shows a normal purple and white specimen of *G. lacunatum*.

Other material examined – Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 566 (1, abraded, identified by van Regteren Altena (1942) as *G. junghuhni*); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (RGM 456 268, 51 good; Figs. 176, 177); Robba's Nyalindung Formation locality NJ4, Tjimerang, western Java, Preangerian, Middle Miocene (1, in Università di Milano-Bicocca); Citalahab, West Java, Late Miocene, collected and presented by B. Dharma (GNS WM17247, 1); Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma; GNS WM17470, 3); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 100 (2, with 1 *G. wilmerianum*); locality 153 (RGM 456 269, 1 good, Figs. 178, 179); material from IAUU, received in RGM: calcareous tuff and sandstone, near Wahai in northern Sulawesi, coll. Rutten (1 good).

Distribution – *Gyrineum lacunatum* occupies the entire Indo-West Pacific region, from Port Alfred, South Africa, East Africa, and the Red Sea (Wellens & Wils, 1996) eastwards to Hawaii and the Marquesas Islands (abundant material in MNHN), and from the Izu peninsula, Honshu, Japan, south to Sydney, Australia, and Lord Howe Island. However, again, fossils are rare and the few listed here are the only ones I am aware of.

Remarks – Beu (1998) demonstrated that the real *Gyrineum pusillum* (Broderip) is a white to uniform pale pink species with a few-whorled protoconch, restricted to eastern Polynesia (and perhaps intergrading with the supposedly distinct western Pacific species *G. roseum* Reeve, 1844a). The earliest name for the multicoloured, abundant Indo-West Pacific species with a protoconch of 2-2.5 whorls that has usually been known as *G. pusillum* is *G. lacunatum* (Mighels, 1845). This is the most common *Gyrineum* species in the Indo-West Pacific Recent fauna (e.g., Beu (1998) recorded it from 186 samples from around New Caledonia), but is largely a shallow-water species, mostly collected in 10-50 m around New Caledonia. So, again, the great rarity of *G. lacunatum* in the fossil record of Indonesia probably results largely from the poor fossil record of the nearshore fauna. The holotype of *Ranella junghuhni* Martin is a typical, if slightly water-worn, specimen of *G. lacunatum* at the finely and evenly cancellate end of the range of sculptural variation demonstrated by this species. Most of the fossil specimens from Indonesia assigned by earlier authors such as Beets and van Regteren Altena to *G. gyrinum* (Linné, 1758) also are specimens of *G. lacunatum*.

***Gyrineum natator* (Röding, 1798)**

Figs. 180-183.

Tritonium natator Röding, 1798, p. 127.

Gyrineum natator. – Link, 1807, p. 123; Beu, 1998, p. 57, figs. 6h, 16a-i; Beu, 1999, p. 6, fig. 6 (with further synonymy); Okutani, 2000, p. 285, pl. 141, fig. 5.

Biplex elegans Perry, 1811, pl. 5, fig. 3.

Ranella tuberculata Broderip, 1833, p. 179; G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, pl. 89, fig. 13; Kiener, 1841, p. 27, pl. 12, fig. 2; Reeve, 1844b, pl. 7, fig. 36; Martin, 1884, p. 137; Martin, 1919, pp. 137, 146; Martin, 1928, p. 8; van der Vlerk, 1931, p. 241.

Ranella olivator Mörch, 1853, p. 106.

Ranella tubercularis (sic). – Noetling, 1895, p. 31, pl. 7, figs. 1, 1a-c; Vredenburg, 1921, pp. 270, 289; Vredenburg, 1925, p. 251.

Ranella (Apollo) tuberculata. – Martin, 1899, p. 149, pl. 23, figs. 348, 348a.

?*Ranella prototubercularis* Noetling, 1901, p. 306, pl. 20, figs. 9, 9a-d.

Gyrineum natator var. *robusta* Fulton, 1936, p. 10, pl. 2, fig. 4.

Gyrineum (Gyrineum) natator. – van Regteren Altena, 1942, p. 99; Beu, 1985, p. 56, fig. 7; Henning & Hemmen, 1993, p. 28, pl. 3, fig. 1; Skwarko & Sufiati, 1994, p. m15.

Apollon (Apollon) natator. – Beets, 1950b, p. 293.

Type material – *Ranella tuberculata* Broderip, lectotype (of Beu, 1998, p. 57) BMNH 1968534/1 (H 48.6, D 28.2 mm; Beu, 1998, fig. 16d, e), with two paralectotypes, labelled “Bombay” and “Malacca”. Beu (1998) designated the lectotype also as the neotype of both *Tritonium natator* Röding and *Biplex elegans* Perry, and the lectotype of *Ranella olivator* Mörch. The status of the names *Ranella tubercularis* (error for *R. tuberculata*?) and *R. prototubercularis* of Noetling was discussed by Vredenburg (1921, pp. 270, 298; 1925, p. 251), but remains uncertain and only examination of the type material (presumably in the Geological Survey of India, Calcutta) can clarify it. *Gyrineum natator robustum* Fulton, holotype BMNH 19365263, from "Japan".

Other material examined – RGM 9916, 9917, Bandjar Anjar [Banjaranyar], Residence of Surabaya, Java, Pleistocene (2); RGM 9915, Kalang Anjar, Java, Pliocene (1, illustrated by Martin, 1899, figs. 348, 348a, as *Ranella tuberculata* Broderip; Figs. 182, 183); RGM 9918, Ngembak, Residence of Semarang, Miocene (1); "Kendeng beds" material in Mijnwezen Collection: locality M176 (RGM 456 270, 1, Figs. 180, 181), M189 (1), M196 (2).

Distribution – *Gyrineum natator* clearly has a much wider range than was known to me previously (Beu, 1998). Specimens are recorded from the Red Sea by Wellens & Wils (1996) (examined, AGB), from the Arabian Gulf by Bosch *et al.* (1995) and from the Seto inland sea, Japan (Beu, 1999). In the western Pacific archipelagos, it seems to extend as far south as New Guinea. The eastern-most records in Indonesia are from Bali and the Sulu Sea. Therefore, it has an unusual distribution, from southernmost Honshu, Japan, south to New Guinea, westwards along the coasts of Asia and Arabia to the Red Sea, and southwards down the coast of East Africa to Beira, Mozambique. However, there appear to be no records from the central Indian Ocean islands, Western Australia or the Philippines.

Remarks – *Gyrineum natator* is easily recognised by its large size (many specimens are up to 50 mm high), its unusually strongly stepped spire outlines and its sculpture of several rows of small, spirally elongate nodules. The sutural ramp and the nodules angling the shoulder edge on each varix are much better developed than in all other *Gyrineum* species. This is another species that occurs today in the northwestern Pacific Ocean, as far north as southern Japan, and throughout much or all of the Indian Ocean (as far south as Mozambique) and Arabian Gulf, but not in the southwestern Pacific or Polynesia.

***Gyrineum wilmerianum* Preston, 1908**

Figs. 172-175, 184, 185.

Gyrineum wilmerianum Preston, 1908, p. 195, pl. 15, fig. 37.

Apollon (Apollon) gyrinus. – Wissema, 1947, p. 144 (not *Murex gyrinus* Linné, 1758).

Gyrineum (Gyrineum) gyrinum wilmerianum. – Beu, 1985, p. 56; Henning & Hemmen, 1993, p. 25, pl. 3, fig. 3.

Gyrineum gyrinum wilmerianum. – Beu, 1998, p. 45, fig. 10d, i, j, l.

Type material – Preston (1908, p. 194) stated that the type material of all species described in his paper is in the Indian Museum, Calcutta; not seen. The type locality is "Andaman Islands", collected by Colonel L. W. Wilmer.

Other material examined – Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (1), locality 42 (RGM 456 266, 456 267, 13 good, some large; Figs. 172-175, 184, 185), locality 44 (1 large), locality 100 (1 small, + 2 *G. lacunatum*), locality 151 (2, incomplete).

Distribution – *Gyrineum wilmerianum* occurs now only in the Indian Ocean, where its range is poorly known. I have seen material only from Mauritius and Réunion, and from the eastern coasts in Sumatra and southern Java (material presented by B. Dharma). The fossils recorded here are the only ones I am aware of.

Remarks – Specimens from Nias Island, Sumatra, recorded by Wissema (1947) as *Gyrineum gyrinum* (Linné), more closely resemble the present-day Indian Ocean species *G. wilmerianum* in their sculpture of more prominent, rounded nodules. However, this identification is difficult to confirm without the colour pattern, which provides the most useful distinguishing characters in Recent specimens. The fossils should be examined under ultraviolet light to see whether a colour pattern is preserved. Recent specimens of *G. wilmerianum* lack the yellow spiral bands, and the clear separation of the white, dark brown and yellow bands of *G. gyrinum*, and instead have fewer, wider, more blended, red-brown and white spiral bands.

The status of this form remains unclear. I previously (Beu, 1998) have regarded it as a geographic subspecies of *Gyrineum gyrinum* (Linné, 1758). However, the opinion of some correspondents that *G. gyrinum* occurs in the Indian Ocean (if rarely) and the record of *G. gyrinum* from the Mauritius by Drivas & Jay (1988, p. 64) suggest that *G. wilmerianum* is a distinct species limited to the Indian Ocean. As with *Bufonaria elegans*, the Nias Island fossils were collected within the present-day range of the species.

Subfamily Cymatiinae Iredale, 1913 (1854)

Genus *Charonia* Gistel, 1847

Tritonium Röding, 1798, p. 125. Type species (by subsequent designation, Cossmann, 1903a, p. 90): *Murex tritonis* Linné, 1758, Miocene to Recent, Indo-West Pacific (junior homonym of *Tritonium* Müller, 1776).

Triton Montfort, 1810, p. 587. Type species (by monotypy): *Murex tritonis* Linné, 1758 (junior homonym of *Triton* Linné, 1758 and *Triton* Laurenti, 1768).

Charonia Gistel, 1847, p. 559; 1848, p. 170. Type species (by subsequent designation, Clench & Turner, 1957, p. 193): *Murex tritonis* Linné, 1758 (senior homonym of *Charonia* Mabille, 1886, p. 280 = *Concholepas*).

Buccinatorium Mörch, 1877, p. 26. Type species (by subsequent designation, Clench & Turner, 1957, p. 193): *Triton nobile* Conrad, 1849 (= *Triton variegatum* Lamarck, 1816), Miocene to Recent, Atlantic and Mediterranean.

Semiranella de Gregorio, 1880, p. 99. Type species (by original designation): *Triton (Semiranella) gemmellari* de Gregorio, 1880 (= *Charonia lampas* Linné, 1758; Beu 1998, p. 66), Eocene to Recent, Europe-Mediterranean-Atlantic, South Africa, Australia-New Zealand, Japan-Philippines.

Eutritonium Cossmann, 1904, p. 123. Type species (by original designation): *Murex tritonis* Linné, 1758.

Charonia tritonis (Linné, 1758)

Fig. 186.

Murex tritonis Linné, 1758, p. 754; Linné, 1767, p. 1222.
Tritonium tritonis. – Röding, 1798, p. 125.
Triton marmoratum Link, 1807, p. 122.
Triton tritonis. – Montfort, 1810, p. 587 (in part).
Lampusia tritonis. – Schumacher, 1817, p. 250.
Triton variegatum Lamarck, 1822, p. 178 (in part); Kiener, 1842, p. 28, pl. 2.

Triton variegatus. – Reeve, 1844a, pl. 2, fig. 3b (in part; not fig. 3a).
Triton imbricata W.H.D. Adams, 1868, p. 268, fig. 1; Beu, 1971, p. 102, fig. 1.
Charonia tritonis. – Iredale, 1913, p. 55; Wilson, 1993, p. 243, pl. 41, fig. 14; Beu, 1998, p. 66, fig. 20a (with further synonymy); Okutani, 2000, p. 291, pl. 145, fig. 41.
Charonia tritonis tritonis. – Beu, 1970, p. 208, pl. 1, figs. 1-4; Henning & Hemmen, 1993, p. 43, pl. 7, fig. 1.

Type material – *Murex tritonis* Linné, lectotype (of Beu, 1998, p. 68), the sole specimen in Linné's collection in London; two paralectotypes are present in the Uppsala University Zoological Museum. Beu (1998) designated the type locality as Ambon Island, Indonesia. Beu (1998) designated the lectotype of *Murex tritonis* also as the neotype of both *Triton marmoratum* Link and *Triton imbricata* W.H.D. Adams.

Other material examined – RGM 9810, Tji Boerial [Ciburial], Java, Preanger [Priangan] (1, quite large abraded spire, H 134.8, D 70.7 mm, "*Triton* sp. 3" of Martin's identifications; Beu, 1998, p. 73; Fig. 186).

Distribution – *Charonia tritonis* occurs throughout the Indo-West Pacific region, from East Africa and the Red Sea to Hawaii, Pitcairn and Easter Island and, rarely, in the eastern Pacific (Galapagos Islands and Cocos Island; Emerson, 1991). Specimens are recorded from Kyushu, Japan, southwards to southern Queensland, Australia, Lord Howe Island and perhaps to northernmost New Zealand (two apparently authentic records). The Miocene record here from Java seems to be the sole fossil one earlier than Pleistocene in the Indo-West Pacific.

Remarks – The giant "Triton's trumpet", *Charonia tritonis*, reaching nearly 500 mm in height, needs little description. However, although it is very familiar in the modern fauna, there are very few records as a fossil and so the Miocene specimen listed here is important for the biogeography of the genus.

Genus *Cymatium* Röding, 1798

Cymatium Röding, 1798, p. 129. Type species (by subsequent designation, Dall, 1904, p. 133): *Murex femorale* Linné, 1758, Pleistocene and Recent, western Atlantic.
Lotorium Montfort, 1810, p. 583. Type species (by monotypy): *Lotorium lotor* Montfort, 1810 (= *Murex femorale* Linné, 1758).
Tritocurrus Lesson, 1842, column 65. Type species (by monotypy): *Trito currus (sic) amphytridis* Lesson, 1842 (= *Triton tigrinum* Broderip, 1833), Recent, eastern Pacific.
Nyctilochus Gistel, 1848, p. xi. Type species (by subsequent designation, Beu, 1970, p. 206): *Triton tigrinum* Broderip, 1833.

Remarks – Beu (1998) reviewed the synonymy and subgenera of *Cymatium*, and this review is followed here.

Subgenus *Gelagna* Schaufuss, 1869

Lagena "Klein" Mörch, 1853, p. 110. Type species (by subsequent designation, Dall, 1904, p. 139): *Triton clandestinum* Lamarck, 1816 (= *Murex succinctus* Linné, 1771), Miocene to Recent, Indo-West Pacific and Atlantic. Junior homonym of *Lagena* Walker & Boys, 1784, *Lagena* Röding, 1798, and *Lagena*

Schumacher, 1817.

Gelagna Schaufuss, 1869, p. 3. Type species (by subsequent designation, Iredale, 1917, p. 325): *Triton clandestinum* Lamarck, 1816 (= *Murex succinctus* Linné, 1771).

Paralagena Dall, 1904, p. 132. Replacement name for *Lagena* Mörch, 1853, preoccupied.

Cymatium (Gelagna) succinctum (Linné, 1771)

Fig. 187.

Murex succinctus Linné, 1771, p. 551; Hanley, 1855, p. 456.

Buccinum caudatum var. β. – Gmelin, 1791, p. 3471.

Neptunea doliata Röding, 1798, p. 116.

Triton clandestinum Lamarck, 1816, pl. 433, fig. 1; "Liste des objets", p. 8; Lamarck, 1822, p. 187; Kiener, 1842, p. 35, pl. 11, fig. 2; Deshayes, 1843, p. 639.

Murex clandesstinus. – Dillwyn, 1817, p. 723.

Triton clandestinus. – Reeve, 1844a, pl. 4, fig. 13; Küster & Kobelt, 1871, p. 184, pl. 52, figs. 5, 6.

Ranularia (Lagena) clandestinus. – Mörch, 1853, p. 110.

Tritonium (Gelagna) clandestinum. – Schauffuss, 1869, p. 29.

Triton (Linatella) clandestinus. – Tryon, 1880, p. 15, pl. 9, fig. 58.

Tritonium (Lagena) clandestinum. – Tapparone-Canefri, 1881, p. 37.

Triton confinis Brancsik, 1896, p. 211, pl. 5, fig. 1a, b.

Argobuccinum succinctum. – Hedley, 1908, p. 456.

Gelagna clandestina. – Hirase, 1934, p. 66, pl. 96, fig. 2; Habe, 1961, p. 45, pl. 22, fig. 12; Habe, 1964, p. 72, pl. 22, fig. 12.

Cymatium clandestinum. – Kuroda & Habe, 1952, p. 51; Weaver, 1966, p. 108, pl. 27, bottom right 2 figs.

Gelagna succincta. – Rippingale & McMichael, 1963, p. 63, pl. 6, fig. 28; Abbott & Dance, 1982, p. 125; Salvat *et al.*, 1988, p. 103, pl. 13, fig. 5; Lai, 1989, p. 126, fig. 52.

Gelagna cynocephala. – Habe & Kosuge, 1966, p. 61, pl. 24, fig. 5 (not *Cymatium (Ranularia) cynocephalum* (Lamarck, 1816)).

Linatella clandestina. – Cernohorsky, 1967a, p. 325, pl. 46, fig. 26; Bosch *et al.*, 1982, p. 80, lower fig.

Cymatium (Linatella) clandestinum. – Kilias, 1973, p. 125, fig. 91; Kay, 1979, p. 220, fig. 79A; Bernard, 1981, p. 17, right fig.

Cymatium (Linatella) succinctum. – Bernard, 1984, p. 60, pl. 22, fig. 94.

Linatella (Gelagna) succincta. – Beu & Cernohorsky, 1986, p. 257, figs. 28-33; Rios, 1985, p. 77, pl. 27, fig. 338; Springsteen & Leobrera, 1986, p. 112, pl. 30, fig. 15; Henning & Hemmen, 1993, p. 110, pl. 20, figs. 5, 6.

Cymatium (Gelagna) succinctum. – Wilson, 1993, p. 244, pl. 41, fig. 3; Beu, 1998, p. 79, figs. 23e, 24a-c.

Type material — *Murex succinctus*, lectotype (designated by Beu, 1998, p. 80, fig. 24a-c) in Linné's collection, Linnean Society of London; 2 paralectotypes in Uppsala University Zoology Museum (Wallin, 1993); the lectotype was also designated the neotype of *Neptunea doliata* Röding, 1798, by Beu (1998). *Triton clandestinum*, lectotype (designated by Beu & Cernohorsky, 1986, p. 258) MHNG 1100/16/2, with 2 paralectotypes, MHNG 1100/16/1, 1100/16/3. *Triton confinis*, drawing repeated by Beu & Cernohorsky (1986, fig. 33), types said to be in "Musei budapestini", from Astrolabe Bay, Papua New Guinea.

Other material examined – Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma; Fig. 187).

Distribution – *Cymatium succinctum* (Linné, 1771) is widespread, but uncommon, throughout the Indo-West Pacific, from the Red Sea and the eastern Indian Ocean to

Hawaii and French Polynesia, and from Okinawa, southern Japan, to Fitzroy Island, southern Queensland; at the Galapagos Islands (Emerson, 1991, p. 68) and rarely in the Atlantic (Gabon; Bernard, 1981, 1984; Bahia, Brazil; Rios, 1994; one specimen seen from Guadeloupe, Antilles, in collection of D. Lamy). Fossils are rare and the present record may well be the first; the only other one I am aware of is a Pleistocene fossil from the Red Sea (Beu & Taviani, research in progress).

Remarks – *Cymatium succinctum* is extremely distinctive because of its evenly inflated, strongly rounded whorls, its long, narrow, straight anterior siphonal canal and its very simple spiral sculpture of smooth, relatively wide, flat-topped, polished, straight-sided spiral cords with wide, flat-bottomed interspaces; the cords are dark brown, on a pale brown background, in Recent specimens. Only the terminal varix is developed on most specimens, although a few have an extra varix, and it evidently is secreted at most later growth pauses, but normally is dissolved again. A single excellent, small specimen (H 33.2, D 19.2 mm) was recently (July 2004) found at Sangiran, Java, by B. Dharma's collectors, adding an interesting, highly distinctive species to the Indonesian fauna (Fig. 187).

Subgenus *Gutturnium* Mörch, 1853

Gutturnium Mörch, 1853, p. 109. Type species (by subsequent designation, Dall, 1904, p. 133): *Triton tuberosum* Lamarck, 1822 (= *Distorsio muricina* Röding, 1798), Miocene to Recent, Indo-West Pacific and eastern and western Atlantic.

Afrocanidea Connolly, 1929, p. 178. Type species (by original designation): *Afrocanidea gemma* Connolly, 1929 (= larval shell of *Distorsio muricina* Röding, 1798).

Cymatium (Gutturnium) muricinum (Röding, 1798)

Figs. 188, 189.

Distorsio muricina Röding, 1798 p. 133.
Tritonium nodulus Link, 1807, p. 122.
Triton tuberosum Lamarck, 1822, p. 185; Kiener, 1842, p. 12, pl. 14, fig. 2; Reeve, 1844a, pl. 1, fig. 1a, b.
Ranella gyrinata Risso, 1826, p. 203, pl. 8, fig. 115; Arnaud, 1978, p. 119.
Triton crispus Reeve, 1844a, pl. 17, fig. 68.
Triton antillarum Orbigny, 1842, p. 161, pl. 23, fig. 20.
Triton pyriformis Conrad, 1849, p. 211.
Litiopa obesa C.B. Adams, 1850, p. 71.
Triton productum Gould, 1852, p. 240; Johnson, 1964, p. 132.
Triton albocingulatus Deshayes, 1863, p. E113.
Tritonium (Gutturnium) tuberosum. – Martin, 1884, p. 129.
Afrocanidea gemma Connolly, 1929, p. 178.
Eutritonium tuberosum. – van der Vlerk, 1931, p. 239.
Cymatium (Gutturnium) tuberosum. – Wissema, 1947, p. 151.
Cymatium (Gutturnium) muricinum. – Clench & Turner, 1957, p. 225, pl. 112, figs. 5, 6; pl. 113, fig. 8; pl. 126, figs. 1-3; pl. 127; Beu, 1985, p. 58, fig. 13; Henning & Hemmen, 1993, p. 53, pl. 11, figs. 4, 5; Wilson, 1993, p. 244, pl. 41, fig. 6; Beu, 1998, p. 81, figs. 23d, 25; Beu, 1999, p. 15, fig. 25 (with further synonymy); Okutani, 2000, p. 289, pl. 143, fig. 24.
Cymatium (Ranularia) muricinum. – Ladd, 1982, p. 41, pl. 7, figs. 9, 10.
Charonia tuberosum. – Skwarko & Sufiati, 1994, p. m6.

Type material – *Triton tuberosum* Lamarck, lectotype (of Beu, 1998, p. 81) MHNG 1100/4/2, the specimen illustrated by Kiener (1842, pl. 14, fig. 2), with two paralectotypes, MHNG 1100/4/1, 3; type locality designated by Beu (1998, p. 81) as Ambon Island, Indonesia. The lectotype was designated by Beu (1998) as also the neotype of both *Distorsio muricina* Röding and *Tritonium nodulus* Link. *Ranella gyrinata* Risso, lectotype designated by Arnaud (1978, p. 119) in MNHN, supposedly from the Mediterranean Sea. *Triton crispus* Reeve, holotype BMNH 196739, without locality. *Triton antillarum* d'Orbigny, lectotype (of Beu, 1998, p. 81) BMNH 1854.10.4.406/1, with one paralectotype, labelled "Martinique". *Triton pyriformis* Conrad, no type material known to me. *Litiopa obesa* C.B. Adams, holotype MCZ 186594, from Panama. *Triton productum* Gould, no type material remaining (Johnson, 1964, p. 132); Beu (1998, p. 81) designated the lectotype of *Triton tuberosum* Lamarck as the neotype of *Triton productum. Triton albocingulatus* Deshayes, three syntypes in MNHN, from Réunion; the largest (H 53.6, H 29.5 mm) was designated the lectotype by Beu (1998, p. 81). *Afrocanidea gemma* Connolly, holotype BMNH 1937.12.30.4936, supposedly from the Shimbi Hills, Kenya, a mislocalised larval shell.

Other material examined – Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 42 (RGM 456 271, 3 good, Figs. 188, 189).

Distribution – *Cymatium muricinum* occurs very widely throughout the Indo-West Pacific region and the Atlantic. In the Indo-West Pacific, it ranges from Natal, South Africa, East Africa and the Red Sea to Hawaii, and rarely as far east as the Galapagos Islands and mainland Panama, and from southern Honshu, Japan, south to southern Queensland, Australia. In the Atlantic, it ranges from Florida south to Paraná, Brazil, and at the Canary Islands and Cape Verde Islands. The few fossils recorded here are the only ones I am aware of.

Remarks – *Cymatium muricinum* is recognisable by its moderately low spire, moderately long anterior canal and rounded, well inflated last whorl, by its strongly thickened aperture with smooth, well reflected lips and by its irregularly nodulous, rather rough-looking exterior. Its protoconch also is distinctive, as it is a little shorter, wider and with a less deeply impressed suture than most *Cymatium* protoconchs. This is another intertidal to shallow subtidal species with a sparse fossil record.

Subgenus *Linatella* Gray, 1857

Linatella Gray, 1857, p. 39. Type species (by monotypy): "*L. cingulata*" (= *Cassidaria cingulata* Lamarck, 1822), Miocene to Recent, Indo-West Pacific and Atlantic.

Cymatium (Linatella) cingulatum (Lamarck, 1822)
Figs. 190-197.

Buccinum caudatum Gmelin, 1791, p. 347 (secondary homonym of *Murex caudatum*, Gmelin, 1791 = *Cymatium (Ranularia) caudatum*).

Fusus cutaceus Lamarck, 1816, pl. 427, fig. 4a, b, "Liste des objets" p. 6 (secondary homonym of *Murex cutaceus* Linné, 1767 = *Cymatium* or *Cabestana cutaceum*).

Cassidaria cingulata Lamarck, 1822, p. 216.
Fusus voigtii Anton, 1838, p. 77; Philippi, 1844, vol. 1, p. 107, *Fusus* pl. 1, fig. 1.
Triton undosum Kiener, 1842, p. 44, pl. 6, fig. 2.
Ranularia (Lagena) rostratus "Martini" Mörch, 1853, p. 110.
Triton (Linatella) poulsenii Mörch, 1877, p. 33.
?*Tritonium (Cabestana) verbeeki* Boettger, 1883, p. 37, pl. 1, fig. 10a, b.
Purpura (Polytropa) bantamensis Martin, 1899, p. 135, pl. 21, figs. 310, 310a, 311.
Cassis (Semicassis) tegalensis Martin, 1899, p. 156, pl. 24, fig. 363.
Dolium losariense Martin, 1899, p. 163, pl. 24, figs. 377, 378; van der Vlerk, 1931, p. 243.
Eutritonium cingulatum. – Martin, 1926, pp. 10, 16.
Cymatium (Linatella) krenkeli Cox, 1930, p. 118, pl. 12, figs. 20, 21a, b.
Cymatium (Linatella) floridanum Mansfield, 1930, p. 94, pl. 12, fig. 10.
?*Eutritonium verbeeki*. – van der Vlerk, 1931, p. 239.
Cassis tegalensis. – van der Vlerk, 1931, p. 242; Skwarko & Sufiati, 1994, p. k3.
Cymatium (Linatella) cingulatum. – Oostingh, 1935, p. 61; Hu, 1992, p. 763, pl. 125, figs. 33, 35; Skwarko & Sufiati, 1994, p. m11; Beu, 1999, p. 16, figs. 27-30 (with further synonymy).
Cassis cf. *tegalensis*. – Pannekoek, 1936, p. 43.
Cymatium (Linatella) cingulatum peninsulum M. Smith, 1937, p. 113, pl. 1, fig. 2, pl. 44, fig. 5.
Linatella neptunia Garrard, 1963, p. 43, pl. 7, figs. 7, 8.
Linatella (Linatella) caudata. – Beu & Cernohorsky, 1986, p. 244, figs. 1, 2, 5-22 (with further synonymy); Henning & Hemmen, 1993, p. 107, pl. 20, fig. 3.
Neptunea szukouensis Hu & Tao, 1991, p. 340, pl. 60, figs. 1, 2; Tao & Hu, 1992, p. 1446, pl. 250, figs. 7, 9.
Cymatium andoi. – Tao & Hu, 1992, p. 1441, pl. 249, figs. 19, 20 only (in part not *Cymatium andoi* Nomura = *C. pileare* Linné, 1758).
Cymatium (Linatella) cutaceum. – Wilson, 1993, p. 244, pl. 41, fig. 7; Beu, 1998, p. 83; Okutani, 2000, p. 291, pl. 144, fig. 38.
Tonna losariense. – Skwarko & Sufiati, 1994, p. k12.
?*Charonia verbeeki*. – Skwarko & Sufiati, 1994, p. m6.
Semicassis sp. – Noda, 2002, p. 106, fig. 17-13.
Tonna losariensis. – van den Hoek Ostende *et al.*, 2002, p. 32.
Cassis tegalensis. – van den Hoek Ostende *et al.*, 2002, p. 33.

Type material – Neotype of *Buccinum caudatum* Gmelin and lectotype of both *Fusus cutaceus* Lamarck, 1816, and *Cassidaria cingulata* Lamarck, 1822 (all designated by Beu & Cernohorsky, 1986), MHNG 1100/74/1; type locality here designated as Bohol Island, Philippines. The location of the lectotype of *Fusus voigtii* Anton is unknown (the specimen illustrated by Philippi, 1844, *Fusus* pl. 1, fig. 1). Schniebs (1997, 2000) listed and illustrated several of Anton's types, in Staatliches Museum für Tierkunde, Dresden, but although the holotype of *Fusus wiegmanni* Anton is present (Schniebs, 2000, fig. 7a, b), that of *Fusus voigtii* evidently is not. This specimen may well be in Philippi's collection, in the National Museum of Natural History, Santiago, Chile, but, as no type material of either *Tritonium contabulatum* Anton, 1838, or *T. munsteri* Anton, 1838, is present in Dresden, all three types may simply be lost. *Triton (Linatella) poulsenii* Mörch, 1877, type material unknown. *Tritonium (Cabestana) verbeeki* Boettger, holotype (Figs. 194, 195) SMF XII/2881a, "Eburnamergel von Pfahl 65 (Druchst. von Kampai), Seluma, Sumatra, Verbeek", Late Miocene. *Cassis tegalensis* Martin, holotype RGM 9979 (Figs. 190, 191), Pangkah, Residence of Tegal, Java, Pliocene; an abraded half-shell, anterior missing; its wide, flat-topped spiral cords and narrow axial ridges indicate that this is probably *Cymatium cingulatum*. *Dolium losariense* Martin, illustrated syntype RGM 10 038, Menengteng Gorge, Waled, Java, Pliocene, a spire of *C. cingulatum* (Figs. 192, 193); syntype RGM 10 039, Junghuhn's locality L, Java, Preanger [Priangan], a very poor, distorted mould of *C. cingulatum*; 2 syntypes RGM 10 037, Menengteng Gorge, Cheribon [Cirebon], Java, Pliocene, one of them illustrated by Martin; incomplete, but undoubted specimens of *C. cingulatum* (Figs. 196, 197). *Purpura (Polytropa) bantamensis* Martin, 1899, lectotype (designated by Beu & Cernohorsky, 1986), RGM 9726, from "Tji Keusik [Cikeusik], Java", with 2 paralectotypes, all from the Pliocene Bantam Formation. *Cymatium (Linatella) krenkeli* Cox, 1930, holotype (S4456) and 3 paratypes in Hunterian Museum, University of Glasgow, from Pliocene of Mombassa I, Kenya, East Africa. *Cymatium (Linatella) floridanum* Mansfield, 1930, holotype USNM 370 465, from the Late Miocene Choctawhatchee Formation, Florida. *Cymatium (Linatella) cingulatum peninsulum* M. Smith, 1937, holotype in "Florida State Museum, Gainesville" (Clench & Turner, 1957, p. 199), not seen; presumably the specimen illustrated by M. Smith (1937, pl. 1, fig. 2), from Lake Worth, Florida. *Linatella neptunia* Garrard, 1963, holotype AMS C.62552, from 55 m, off Southport, Queensland; with 4 paratypes. *Neptunea szukouensis* Hu & Tao, 1991, holotype (not seen; an incomplete, but normal, specimen of *C. cingulatum*) in National Museum of Natural Sciences, Taichung, Taiwan, NMNS 000568, from Si-gou layer (Pleistocene), Heng-Chun terrace, Heng-Chun Peninsula, Taiwan.

Other material examined – RGM 10 029, Menengteng Gorge, Cheribon [Cirebon], Java, Pliocene (1, small *Cymatium cingulatum* with rather rounded periphery, identified and illustrated by Martin as *Dolium variegatum*); Pasir Ipis, Cirebon, central Java, collected and presented by B. Dharma (GNS WM17238, 1).

Distribution – Though nowhere very common, *Cymatium cingulatum* occurs widely throughout the Indo-West Pacific province from East Africa and the Red Sea east to Hawaii, and from southern Japan (quite common in Yamaguchi Prefecture, on the southern Japan Sea coast of Honshu; Beu, 1999) to northern New Zealand (one authentic record; Beu & Cernohorsky, 1986). The southernmost South African material seen is from Knysna Lagoon, southern Cape Province, South Africa, on intertidal sand flats (NMP E.6331). Beu (1998, p. 17) did not report specimens from New Caledonia, although this was among the species he thought "eventually might be found" there; two specimens from New Caledonia now have been recognised in MNHN. In the western Atlantic it occurs from Chincoteague Inlet, Virginia south to Rio de Janeiro, Brazil. In the eastern Atlantic, *C. cingulatum* is common off the Canary Islands and a specimen is present in the California Academy of Sciences from the Cape Verde Islands. Fossils are widespread, but uncommon, throughout the Indo-West Pacific as well, from the Pliocene of Zanzibar (Cox, 1930), the Pleistocene of Taiwan, the Pliocene of Okinawa, and the Miocene and Pliocene of Java, to New Zealand (Pleistocene specimens reported by Beu, 1976; two Early Pliocene specimens also now have been recognised). In the Caribbean area, fossil specimens are again widespread, but uncommon, in Miocene to Pleistocene rocks.

Remarks – Probably no other tonnoidean has caused so much confusion about its relationships, variation and nomenclature as *Cymatium cingulatum*. As I continue to study tonnoidean collections, still more synonyms come to light; here I add the unexpected new synonyms *Dolium losariense* Martin, 1899, and *Cassis tegalensis* Martin, 1899, based on Indonesian Miocene specimens, as well as *Neptunea szukouensis* Hu & Tao, 1991. Martin (1899) also provided the synonym *Purpura bantamensis* and evidently did not realise he had recorded the same species under five different names. The type material of *Dolium losariense* certainly could be described as a tall-spired, *Tonna*-like shell with no axial sculpture, with a peripheral angulation (shoulder) and with variable, secondary spiral cords between the primary ones, but that also is a description of *C. cingulatum*. The shell also is thin and fragile, again more that expected of *Tonna* than of *Cymatium*. The main point is that this shell has a small, tall and narrow, typical *Cymatium* protoconch, rather than the relatively low, dome-shaped, very large one of *Tonna*. Identification of incomplete specimens as an unknown *Tonna* species also has been common in New Zealand, for specimens from the Te Piki Member (Pleistocene, oxygen isotope stage 7), near East Cape (Beu, 1976), as well as other, previously unrecognised specimens in New Zealand Early Pliocene rocks. It also is clear from the anatomy and the prominent periostracum that this is a *Cymatium* species.

The holotype of *Tritonium (Cabestana) verbeeki* Boettger (Figs. 194, 195) seems likely to be another specimen of *Cymatium cingulatum*, but has a relatively tall spire, unusually narrow, widely spaced spiral cords and a prominent varix before the terminal one (as occurs in a few Recent specimens of *C. cingulatum*), giving it an unusual appearance. However, these are within the range of variation of *C. cingulatum.* The one really unusual character is the weak, even, low axial ridgelets. The anterior canal is incomplete. Only more material can resolve the question of the identity of this specimen.

Subgenus *Monoplex* Perry, 1810

Monoplex Perry, 1810, signature M7 (no included species); Perry, 1811, explanation to pl. 3 (five species included). Type species (by subsequent designation, Dall, 1904, p. 134): *Monoplex australasiae* Perry, 1811 (= *Murex parthenopeus* von Salis Marschlins, 1793), Miocene to Recent, Mediterranean, Atlantic, South Africa, East Africa and Gulf of Arabia, Australia and New Zealand, Hawaii, southern Japan-Taiwan.

Lampusia Schumacher, 1817, p. 350. Type species (by subsequent designation, Herrmannsen, 1847, p. 575): *Murex pilearis* Linné, 1758, Miocene to Recent, Indo-West Pacific.

Cabestanimorpha Iredale, 1936, p. 307. Type species (by original designation, Iredale, 1936, p. 336): *Triton exaratus* Reeve, 1844a, Pleistocene to Recent, Australia-New Zealand-New Caledonia, southern Japan, Hawaii, Red Sea, Caribbean.

Dissentoma Pilsbry, 1945, p. 59. Type species (by original designation): *Dissentoma prima* Pilsbry, 1945 (= *Murex parthenopeus* von Salis Marschlins, 1793).

Cymatriton Clench & Turner, 1957, p. 210. Type species (by original designation): *Tritonium nicobaricum* Röding, 1798, Pleistocene to Recent, Indo-West Pacific and Atlantic.

Cymatium (Monoplex) aquatile (Reeve, 1844a)

Figs. 198-200.

Triton aquatilis Reeve, 1844a, pl. 7, fig. 24; Reeve, 1844c, p. 114.

?*Triton aquatile occidentale* Mörch, 1877, p. 19 (*nomen nudum*).

Cymatium (Septa) pileare. – Clench & Turner, 1957, p. 216 (in part).

? *Cymatium pileare* var. *cruzana* Nowell-Usticke, 1959, p. 60.

Cymatium bayeri. – Poppenoe & Kleinpell, 1978, pl. 5, fig. 61 (not *Cymatium bayeri* van Regteren Altena, 1942).

Cymatium (Septa) aquatile. – Wolfe, 1975, p. 6, figs. 3 left, 5 right; Kay, 1979, p. 220, fig. 76E (not 77A = *C. pileare*).

Cymatium (Monoplex) aquatile. – Beu, 1985, p. 58; Beu & Kay, 1988, p. 197, figs. 1, 12-16, 21-32; Henning & Hemmen, 1993, p. 61, pl. 14, fig. 5; Wilson, 1993, p. 245, pl. 41, fig. 2; Beu, 1998, p. 85, fig. 34a (with further synonymy); Okutani, 2000, p. 287, pl. 142, fig. 18; Higo *et al.*, 2001, p. 48, fig. G1579.

Cymatium pileare. – de Jong & Coomans, 1988, p. 69, fig. 379 (not *Murex pileare* Linné, 1758).

Type material – *Triton aquatilis* Reeve, lectotype (of Beu, 1998, p. 86), BMNH 1967626/1, with one paralectotype, from "Philippine Islands". *Triton aquatile occidentale* Mörch and *Cymatium pileare* var. *cruzana* Nowell-Usticke, no type material known.

Other material examined – RGM 9785, Tji Talahab [Citalahab], Java, Preanger [Priangan] (1 incomplete, in lot identified as *C. pileare*; Fig. 200); RGM 9787, Kembang Sokkoh [Kembangsokoh], Residence of Jogjakarta, Java (1, small); RGM 47 030, Ngampel, Rembang, Java, Middle Miocene (Robba, 1996) (1, small); RGM 9800, Menengteng Gorge, Waled, Cirebon, Java, Pliocene (1, illustrated paralectotype of *Triton pseudopyrum* Martin, 1899, fig. 330c); RGM 9789, Ngampel, Rembang, Middle Miocene (1); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (3, identified by Wissema as *C. pileare*); locality 42 (RGM 231 342, 1, paratype of *Cymatium (Lampusia) alasaense* Wissema; Figs. 198, 199); Cijarian, West Java, Miocene (1, in collection of B. Dharma); Ciodeng, Palabuan district, Java, Late Miocene (1, in collection of B. Dharma).

Distribution – *Cymatium aquatile* occurs throughout most of the tropical ocean, from eastern South Africa, East Africa and the Red Sea to Hawaii, and to Cocos Island in the eastern Pacific and, rarely, mainland western America; and from southern Japan to the southern Great Barrier Reef, Queensland, Australia. In the western Atlantic, it is recorded from Florida and the Bahamas to Curaçao and Trinidad, but an occurrence further south in northeastern South America is not confirmed. In the eastern Atlantic, it is recorded only from the Canary Islands and Cape Verde Islands. Fossils other than the Miocene to Pleistocene records from Indonesia are sparse, but there are a few Pleistocene records from the western Atlantic.

Remarks – *Cymatium aquatile* and *C. intermedium* (Pease) (see below) were confused with *C. pileare* by Clench & Turner (1957) (partly following the uncritical work of Tryon, 1880), and their very influential work has led to confusion over the status of these species ever since. Wolfe (1975), Kay (1979) and Beu & Kay (1988) distinguished these three species, and pointed out their distinct geographic ranges, which provide confirmation of their status as distinct species. De Jong & Coomans (1988, p. 69) again distinguished between the Atlantic species *C. martinianum* (d'Orbigny) and *C. aquatile* (which they called *C. pileare*), and these also certainly are distinct species. *Cymatium aquatile* has coarser spiral cords and nodules than *C. pileare*, but also is easily distinguished by the plain, pale orange aperture with short, rather coarse nodules inside the outer lip. In contrast, the larger and more elongate *C. pileare* has weaker external sculpture than *C. aquatile*, has narrower and much longer, more clearly parallel transverse ridges inside the outer lip, extending much further inside the aperture than in *C. aquatile* or *C. intermedium*, and in Recent specimens the inside of the outer lip is crimson to scarlet red in *C. pileare*, whereas the inner lip is dark brown to black, with very prominent, white transverse ridges. The protoconch of *C. pileare* is narrower and a little shorter than in *C. intermedium*, whereas that of *C. aquatile* is taller and wider and has a less deeply impressed suture than in *C. intermedium*. *Cymatium aquatile* occurs in both the Indo-West Pacific and Atlantic provinces, whereas *C. pileare* is replaced in the Atlantic by *C. martinianum* (Orbigny), but occurs throughout the Indo-West Pacific. Both *C. aquatile* and *C. pileare* are rare in Hawaii and eastern Polynesia. *Cymatium intermedium* occurs only in the Indo-West Pacific where, however, it is very rare other than in Hawaii and eastern Polynesia. Not surprisingly, *C. aquatile* has been confused with *C. pileare* in previous identifications of Indonesian fossil material.

Cymatium (Monoplex) gembacanum **(Martin, 1884)**

Figs. 231, 232.

Tritonium (Simpulum) gembacanum Martin, 1884, p. 129, pl. 7, fig. 131.

Cymatium pileare. – Beets, 1950c, p. 333; Skwarko & Sufiati, 1994, p. m18 (in part not *Murex pilearis* Linné, 1758).

Cymatium (Monoplex) pileare. – van den Hoek Ostende *et al.*, 2002, p. 36 (in part not *Murex pilearis* Linné, 1758).

Type material – *Tritonium gembacanum* Martin, holotype RGM 9790, from "Ngembak, Residency of Semarang", Java, Middle Miocene.

Distribution – Known only by the holotype.

Remarks – The holotype of *Cymatium gembacanum* is a small (H 21 mm), short, evenly oval shell resembling *C. vespaceum* (Lamarck) (Figs. 229, 230) in its fine, crisp sculpture, but much shorter and wider in shape. The sutural ramp is weakly concave and is defined clearly by the short axial folds commencing abruptly at the periphery, forming 7-8 nodules in each intervariceal interval where they cross the spiral cords. The six primary spiral cords on the last whorl, passing onto the varices, and all on the spire are deeply subdivided by a prominent median groove where they cross the varices, and the uppermost two cords, at and immediately below the periphery, are deeply subdivided over the entire teleoconch surface. With its prominent varices and strongly dentate aperture, this shell therefore closely resembles *Cymatium (Monoplex) exaratum* (Reeve, 1844a). Indeed, it seems quite likely that *C. gembacanum* is a synonym of *C. exaratum*. More material from Neogene rocks of Indonesia is required to be sure whether the smaller size and slightly finer, crisper sculpture remain constant characters distinguishing *C. gembacanum* from *C. exaratum*.

Cymatium exaratum is a well-known Recent species (commonly reaching more than 65 mm in height; maximum seen 78 mm) in eastern, western and southern Australia (particularly common in central and southern Queensland), the Kermadec Islands, New Caledonia (Beu, 1998, p. 89, figs. 23n, 27a-k) and in southern Japan to Taiwan. It also occurs moderately commonly in northern New Zealand. In South Africa it occurs syntopically with the similar, but smaller and more coarsely sculptured, species *C. durbanense* (E.A. Smith, 1899). I also know of other confirmed records of rare specimens from the Hawaiian Islands (Midway; one specimen in BP Bishop Museum, BPBM

62160), the Red Sea (Wellens & Wils, 1996, p. 77, fig. 21; examined AGB) and St Croix, Virgin Islands, western Atlantic (Clench & Turner, 1957, pl. 118, fig. 5; as *C. (Ranularia) sarcostoma* (Reeve, 1844a)). Pleistocene fossils are well-known in central and southern Japan, a Pleistocene fossil from South Africa is present in NMP and a single late Middle Pleistocene (oxygen isotope stage 7) fossil is known from Te Piki, near East Cape, New Zealand. This is, therefore, a classic "Pacific fringe" species, with a very similar range to that of *Charonia lampas* (Linné, 1758), and a record from Miocene rocks of Indonesia is unexpected and particularly interesting.

Cymatium (Monoplex) gemmatum **(Reeve, 1844)**
Figs. 203-208.

Triton gemmatus Reeve, 1844a, pl. 15, fig. 60a, b; Reeve, 1844c, p. 117.
Tritonium gemmatum. – Tapparone-Canefri, 1881, p. 26.
Aquillus gemmatus. – Schepman, 1907, p. 181.
Eutritonium bomasense Martin, 1916, p. 242, pl. 2, fig. 40; van der Vlerk, 1931, p. 239.
Eutritonium gemmatum. – van der Vlerk, 1931, p. 239.
Cymatium (Gutturnium) vespaceum var. *gracilis*. – Wissema, 1947, p. 152 (not *Triton gracilis* Reeve, 1844a).
Cymatium (Monoplex) gemmatum. – Beu, 1985, p. 58; Emerson, 1991, p. 63, figs. 1-8; Henning & Hemmen, 1993, p. 62, pl. 12, fig. 4; Beu, 1998, p. 103, figs. 23c, 31a-j (with further synonymy); Okutani, 2000, p. 287, pl. 142, fig. 14; Higo *et al.*, 2001, p. 47, fig. G1577.
Charonia bomasense. – Skwarko & Sufiati, 1994, p. m4.
Charonia gemmatus. – Skwarko & Sufiati, 1994, p. m5.
Charonia bomasensis. – van den Hoek Ostende *et al.*, 2002, p. 35.

Type material – *Triton gemmatus* Reeve, lectotype (of Emerson, 1991, p. 64, figs. 3, 4) BMNH 198055, with three paralectotypes, all labelled "Masbate", Philippines (although Reeve's (1844a, pl. 15) caption states "Island of Ticao"). *Eutritonium bomasense* Martin, holotype (Figs. 207, 208) RGM 9803, from Kembang Sokkoh (Kembangsoko), Residence of Jogjakarta, south-central Java, Miocene.

Other material examined – RGM 107 514, Kaju Ragi, Manado I., Sulawesi (1, recorded by Schepman, 1907; Figs. 203, 204); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 100 (1; Figs. 205, 206).

Distribution – The Recent distribution of *Cymatium gemmatum* is poorly known. Most material is from the Philippine Islands, but records range through the western Pacific archipelagos from the Amami Islands, southern Japan, to New Caledonia and the Capricorn Group, southern Great Barrier Reef, Australia. The fossils recorded here are the only ones I am aware of.

Remarks – One of the specimens from Nias Island, Sumatra, recorded by Wissema (1947, p. 152) with the phrase "the specimen from locality 100 belongs to the var. *gracilis* Reeve", is a small, narrow shell with narrow, undivided spiral cords and many fine axial ridgelets, and belongs in *Cymatium gemmatum* (Reeve), as identified by Emerson (1991) and Beu (1998, p. 103). The specimen from the Pleistocene locality of Kaju Ragi, Manado Island, northern Sulawesi, recorded by Schepman (1907, p. 181), also is a specimen of true *C. gemmatum*. The holotype of *Eutritonium bomasense* Martin is a small, incomplete shell, lacking the outer lip and anterior canal, but agreeing with *C. gemmatum* in size, shape and general sculptural details, and has a well-preserved protoconch closely resembling that of Recent specimens. However, it is an abraded specimen with all the fine teleoconch surface detail obliterated, so it is not possible to be certain of its identity. *Cymatium gemmatum* is easily recognised in the Recent fauna because of its small size, its narrow shape and the uniform cream to pale orange-brown exterior colour. The varices are slightly paler than the rest, except that each has two darker bands between the main spiral cords. I have seen Recent material of *C. gemmatum* only from the central western Pacific archipelagos, and particularly from the Philippine Islands; there seem to be no Indian Ocean records and none from as far east as Polynesia. In contrast, the much more common *C. mundum* (Gould), the larger, more crudely sculptured, white to cream species that usually has been known as *C. gemmatum*, occurs commonly throughout the Indo-West Pacific province, in its widest sense. However, both these species are rare as fossils; the three specimen of *C. gemmatum* recorded here apparently are the only recorded fossil specimens and there are no definitely identified specimens of *C. mundum* in the Indonesian Neogene fossil collections examined here. The one other Indonesian fossil specimen examined to date (Citalahab, West Java, Late Miocene; in collection of B. Dharma) is poorly preserved and relatively narrow, and it is uncertain whether it belongs in *C. gemmatum* or *C. mundum*.

***Cymatium (Monoplex) intermedium* (Pease, 1869)**

Figs. 209, 210.

Triton intermedium Pease, 1869, p. 74; Kobelt *in* Küster & Kobelt, 1878, p. 326, pl. 77, fig. 19.

?*Cymatium (Lampusia) alasaense* Wissema, 1947, p. 148, pl. 6, figs. 137, 138.

Cymatium (Septa) pileare. – Clench & Turner, 1957, p. 216, pl. 122, fig. 2 only (lectotype of *Triton intermedium* Pease) (in part not *Murex pileare* Linné, 1758).

Lampusia kikaiensis Shikama, 1970, p. 19, pl. 1, figs. 4, 5; Higo *et al.*, 2001, p. 48, fig. G1580s.

Cymatium (Septa) intermedium. – Wolfe, 1975, p. 6, figs. 4 (left), 5 (left); Kay, 1979, p. 220, figs. 76C, 77C.

Cymatium (Monoplex) intermedium. – Beu & Kay, 1988, p. 200, figs. 4, 5, 33-40 (with further synonymy); Henning & Hemmen, 1993, p. 63, pl. 14, fig. 4.

Type material – *Triton intermedius* Pease, lectotype (of Clench & Turner, 1957, p. 217) MCZ 191331, from Oahu, Hawaii, with eight paralectotypes, MCZ 191330. *Cymatium alasaense* Wissema, holotype (Figs. 209, 210) RGM 231 341, with 1 paratype, RGM 231 342 (a specimen of *C. aquatile*; Figs. 198, 199), both from Schroeder's locality 42, Pleistocene (?), Nias Island, Sumatra. *Lampusia kikaiensis* Shikama, holotype "stored in the writer's collection in the Geological Institute, Yokohama National University" (Shikama, 1970, pl. 1, fig. 4), from Kikai Island, Amami Islands, southern Japan.

Distribution – *Cymatium intermedium* is common in the eastern part of the western Pacific, in the Tuamotu Islands, Marquesas Islands and Hawaii. Although specimens occur further westward as far as Madagascar, they are very rare, and the species seems largely to be replaced by *C. aquatile* west of Hawaii. Fossils are quite common in Pleistocene or Holocene rocks of Hawaii, but the holotype of *C. alasaense* is the one possible fossil recorded from elsewhere.

Remarks – Beu & Kay (1988) suggested that the holotype of *Cymatium (Lampusia) alasaense* Wissema, 1947, is a specimen of *C. intermedium* (Pease). However, without the colour pattern that is so helpful in the identification of Recent specimens, it is difficult to be certain of this identification. *Cymatium intermedium* is closely similar to *C. aquatile* (Reeve), with a similar pale orange interior to the outer lip, but reaches a significantly smaller maximum size, has a smaller protoconch and has a dark brown to black inner lip with white transverse ridges (as in *C. pileare*), whereas the entire aperture of *C. aquatile* is a uniform pale orange. The paratype of *C. alasaense* (which I had not examined previously) has more prominent dorsal nodules than the holotype, suggesting that it is a specimen of *C. aquatile* rather than *C. intermedium*, but this evidence is equivocal, particularly as the specimen is severely abraded.

***Cymatium (Monoplex) pileare* (Linné, 1758)**

Figs. 211-221.

Murex pileare Linné, 1758, p. 749; Linné, 1767, p. 1217.
Tritonium olearium. – Röding, 1798, p. 126 (not *Murex olearium* Linné, 1758).
Triton pileare. – Lamarck, 1816, pl. 415, fig. 4a, b, "Liste des objets" p. 4; Lamarck, 1822, p. 182; Kiener, 1842, p. 15, pl. 7, fig. 1.
Lampusia pilearis Schumacher, 1817, p. 250.
Triton haemastoma Valenciennes, 1832, p. 304.
Triton pilearis. – Reeve, 1844a, pl. 7, fig. 23.
Tritonium (Simpulum) beccarii Tapparone-Canefri, 1875, p. 587, pl. 19, fig. 7; Mienis, 1990, p. 10, figure; Singer, 1990, p. 21, fig. 6a.
Tritonium (Simpulum) pilearis var. – Martin, 1899, p. 141, pl. 22, figs. 323, 323a, 324.
Aquillus pilearis. – Schepman, 1907, p. 180.
Triton (Simpulum) pilearis. – Tesch, 1915, p. 66, pl. 82, fig. 146a, b.
Eutritonium pileare. – Martin, 1919, pp. 87, 126, 128, 130, 131, 137; Martin, 1926, p. 10; Martin, 1928, p. 8; van der Vlerk, 1931, p. 239.
Cymatium vestitum insulare Pilsbry, 1921, p. 320.
Saginafusus pricei perficus Iredale, 1931, p. 227, pl. 23, fig. 1.
Cymatium andoi Nomura, 1935, p. 167, pl. 8, fig. 21.
Cymatium pileare. – Oostingh, 1935, p. 226; Cox, 1948, p. 39.
Cymatium (Lampusia) pileare. – Beets, 1941, p. 90 (with further synonymy); van Regteren Altena, 1942, p. 101 (with further synonymy); Schmid & Walther, 1962, p. 256, pl. 27, figs. 1, 2.
Cymatium (Septa) pileare. – Clench & Turner, 1957, p. 216, pl. 122, fig. 1 (in part only); Kay, 1979, p. 54, figs. 76D, 77A, B.
?*Cymatium (Lampusia)* cf. *C. pileare*. – MacNeil, 1961, p. 59.
Cymatium (Monoplex) pileare. – Beu, 1985, p. 58; Beu & Kay, 1988, p. 203, figs. 3, 17-20, 42-48; Henning & Hemmen, 1993, p. 67, pl. 14, fig. 1; Wilson, 1993, p. 246, pl. 41, fig. 4; Beu, 1998, p. 114, figs. 33d, e, 34c; Beu, 1999, p. 32, figs. 62, 63 (with further synonymy); Okutani, 2000, p. 287, pl. 142, fig. 13.
Cymatium (Monoplex) pileare orientalis Garcia-Talavera, 1987, p. 245, fig. 2.
Lampusia pilearis. – Skwarko & Sufiati, 1994, p. m18.

Type material – *Murex pileare* Linné, lectotype (of Beu & Kay, 1988; Beu, 1998, fig. 33d, e), in Gualtieri Collection, Museo di Storia Naturale e del Territorio, Università di Pisa, Certosa di Calci, Pisa. Beu (1998) designated the type locality as Ambon Island, Indonesia. *Triton haemastoma* Valenciennes, holotype in MNHN, from "Acapulco" (spurious). *Tritonium beccarii* Tapparone-Canefri, holotype (Mienis, 1990; Singer, 1990, fig. 6a) in Museo Civico de Storia Naturale "Giacomo Doria", in Genoa; from Massawa, Ethiopia, Red Sea. *Cymatium vestitum insulare* Pilsbry, lectotype (of Emerson & Old, 1963, p. 22) ANSP 35279, from the "Sandwich Islands", with one paralectotype, ANSP 139220, from Honolulu Harbour, Oahu, Hawaii. *Cymatium andoi* Nomura, Institute of Geology and Paleontology, Tohoku University, Sendai, Japan, IGPS 53973, from the Pliocene Byoritsu Formation of Taiwan. *Saginafusus pricei perficus* Iredale, holotype AMS C.57800, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia. *Cymatium pileare orientalis* Garcia-Talavera, holotype in Natural Science Museum of Tenerife, Canary Islands, no. TF.MCM.T24 (Garcia-Talavera, 1987, p. 249, fig. 2 left).

Other material examined – RGM 9781, Selatjau [Selacau], Java, Late Miocene (1, Figs. 220, 221); RGM 9784, Tji Angsana [Ciangsana], Java, Preanger [Priangan] (2, with one *C. gembacanum*); RGM 9785, Tji Talahab [Citalahab], Java, Preanger [Priangan] (2, with one *C. aquatile*); RGM 9787, Kambang Sokkoh (Kembangsoko), Res. Djogjakarta (one); RGM 9779, Lodan, Java, Rembang Formation, Middle Miocene (1 small, identified as *Sassia (Cymatiella) fennemai*); "Kendeng beds" material in Mijnwezen Collection: locality M126 (RGM 456 277, 1, large, incomplete; Figs. 218, 219); M142 (RGM 456 276, 1, good; Figs. 216, 217), M167 (1), M281 (1); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 565 (1 poor); locality L391, Mangkalihat Peninsula, Borneo, Miocene? (1, incomplete, spiral cords unusually prominent); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 275, 1, Figs. 214, 215, with 3 *C. aquatile*), locality 42 (RGM 456 274, 3; Figs. 212, 213), locality 153 (RGM 456 273, 1 spire; Fig. 211); Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (3 small); Pasir Ipis, Cirebon, Java, Pliocene (1, in collection of B. Dharma); Sangiran, central Java, Late Pliocene, presented by B. Dharma (GNS WM174722, 2); Koperberg's (1931) material from the Pliocene of Timor, received in RGM from MGMD: "Neke-niki-niki, Amanoetan, Timor", Koperberg's thesis "pl. 32, fig. 146" (1, good); material from IAUU, received in RGM: Pleistocene, Kaju Ragi, Manado I., Sulawesi, coll. Wichman (1, spire); Timmena, near Sentana Lake, New Guinea, coll. Wichman, Pleistocene? (1 good).

Distribution – *Cymatium pileare* occurs widely throughout the Indo-West Pacific region, from Natal, South Africa, east Africa and the Red Sea eastwards to Hawaii, and from southern Honshu, Japan (Beu, 1999) south to Sydney Harbour, in eastern Australia. There are few records of fossils other than those from Indonesia and Okinawa.

Remarks – *Cymatium pileare* is distinguished above from the rather similar *C. aquatile*. Most fossil specimens are small, thin-shelled and finely sculptured, probably indicating that they lived near the lower limit of the depth range of the species. The sculpture is dominantly of low, narrow spiral cords, quite different in appearance from the coarser, wider and more nodulous cords of *C. aquatile*.

In a range of papers over many years, Beets and other authors on Indonesian fossils have misidentified a range of other species as *Cymatium pileare* (e.g., *C. tenuiliratum* in the Mangkalihat fauna; *C. gembacanum* Martin). On the other hand, some authors have misidentified *C. pileare* as a distinct species (e.g., *C. andoi* Nomura). Well-preserved specimens are readily recognised by the tall narrow form, the low spiral sculpture and the long ridges passing into the aperture inside the outer lip, but, of course, not all fossils are well enough preserved for these characters to be discernible.

Cymatiym (Monoplex) rembangense (Wanner & Hahn, 1935)

Figs. 201, 202.

Triton (Simpulum) pilearis var. – Martin, 1899, p. 141, pl. 22, fig. 323, 323a.

Eutritonium rembanense Wanner & Hahn, 1935, p. 255, pl. 19, figs. 14, 15; Pannekoek, 1936, p. 42.

Cymatium pileare. – Beets, 1950c, p. 333; Skwarko & Sufiati, 1994, p. m18 (in part not *Murex pilearis* Linné, 1758).

Cymatium (Monoplex) pileare. – van den Hoek Ostende *et al.*, 2002, p. 36 (in part not *Murex pileare* Linné, 1758).

Type material – I am not aware of the location of any type material of Wanner & Hahn (1935) and enquiries about its location have all had negative results. As the type material may still exist, a neotype is not designated here. However, the excellent illustrations by Wanner & Hahn (1935, pl. 19, figs. 14, 15) leave no doubt that *Eutritonium rembanense* is the common Indonesian Miocene and Pliocene species that was illustrated by Martin (1899, pl. 22, figs. 323, 323a) as a variety of *Cymatium pileare*.

Other material examined – RGM 9782, Tji Talahab (Citalahab), Njalindoenglagen (Nyalindung Formation), Priangen, Java, Middle Miocene (tall-spired specimen, illustrated by Martin, 1899, pl. 22, fig. 323, 323a, as "*Triton (Simpulum) pilearis* var."; Figs. 201, 202); RGM 9795, Menengteng Gorge, Waled, Cheribon [Cirebon], Java, Pliocene (2 paralectotypes of *Triton pseudopyrum* Martin, 1 illustrated by Martin; 1 is a spire of *C. sinense*, 1 a specimen of *C. rembangense*); RGM 9783, Tjilindung (Cilindung), Prianger, Java, Middle Miocene (2); RGM 9784, Tji Angsana (Ciangsana), Java, Miocene (1 *C. rembangense,* with 2 *C. pileare*); RGM 9786, Tji Boerial (Ciburial), Prianger, Java, Middle Miocene (1, small spire apex, identity uncertain); RGM 9788, Mount Spolong, Res. Djogjakarta, Java (3); RGM 9789, Ngampel, Rembang, Java, Middle Miocene (1); RGM 47 030, Ngampel, Rembang, Java, Middle Miocene (1); RGM 47 070, Bandoeng (Bandung), Tji Lanang (Cilanang), Java (1); Citalahab, West Java, Late Miocene, presented by B. Dharma (GNS WM 17246, 3, + 1 in collection of B. Dharma); Nyalindung, West Java, Middle Miocene, presented by B. Dharma (GNS WM17483, 1); Robba's Nyalindung Formation localities NJ (1), NJR (1), Tjimerang, western Java, Preangerian, Middle Miocene (both in Università di Milano-Bicocca); Cijarian, West Java, Miocene (1, in collection of B. Dharma); Pasir Ipis, Cirebon, Java, Pliocene (1, in collection of B. Dharma).

Distribution – *Cymatium rembangense* is recorded only from Miocene and Pliocene rocks of Java.

Remarks – *Cymatium rembangense* has not been distinguished from similar species by most previous authors, but seems to be an endemic, restricted Indonesian Miocene and Pliocene species. It is similar in most characters to both *C. aquatile* and *C. mundum*. The specimens I have examined are 35-70 mm high, smaller than large adult specimens of *C. aquatile* and larger than all but the very largest *C. mundum*. The uppermost three or four spiral cords on the last two whorls are subdivided by a weak median groove where they cross the varices, but not over the intervariceal intervals, and the surface is crossed by many fine, close, sharp axial ridgelets, as in *C. mundum*. *Cymatium rembangense* differs from both similar species in its markedly taller and wider, consistently more obviously concave sutural ramp, in its fewer, more prominent peripheral nodules forming a consistently prominent shoulder angle, and in its markedly larger nodules inside the outer lip.

***Cymatium (Monoplex) tjaringinense* (Martin, 1899)**
Figs. 224-226.

Triton (Simpulum) tjaringinensis Martin, 1899, p. 142, pl. 22, fig. 325.
Eutritonium tjaringinensis. – van der Vlerk, 1931, p. 239.
Eutritonium (Simpulum) tjaringinense. – Wanner & Hahn, 1935, p. 256.
Charonia (Simpulum) tjaringinensis. – Skwarko & Sufiati, 1994, p. m7; van den Hoek Ostende *et al.,* 2002, p. 35.

Type material – *Triton tjaringinensis* Martin, holotype (Figs. 224, 225) RGM 9793, from Jjikeusik [Cikeusik], Java, Pliocene.

Other material examined – Cimanceurih, Bayah, West Java, Late Pliocene (1, in collection of B. Dharma; Fig. 226).

Distribution – *Cymatium tjaringinense* is recorded only from Pliocene rocks of Java.

Remarks – *Cymatium tjaringinense* has a low spire, a relatively wide, but rounded (evenly inflated), sutural ramp, a moderately long anterior siphonal canal and a sculpture of low, wide, closely spaced, rather irregularly nodulous spiral cords. Its aperture is highly distinctive, with prominent ridges on both lips, and inside the outer lip the ridges are unusually prominent, closely spaced, and each subdivided into a pair of short nodules. *Cymatium tjaringinense* closely resembles the West African living species *C. trigonum* (Gmelin, 1791) and seems likely to be related phylogenetically to it. The aperture, the external sculpture and the shape are very similar, but the aperture is even more strongly armed than in *C. trigonum*. This, therefore, seems to be an Atlantic relationship in the Indo-West Pacific fauna that has not been suspected previously. Certainly, *C. tjaringinense* is an extinct, highly distinctive species that formerly inhabited the Indo-West Pacific province. Only two specimens have been examined during this review, so it apparently was a rare species.

***Cymatium (Monoplex) vespaceum* (Lamarck, 1822)**
Figs. 227-230.

Triton vespaceum Lamarck, 1822, p. 185; Kiener, 1842, p. 18, pl. 3, fig. 2; Reeve, 1844a, pl. 15, fig. 61a, b.
Triton elongatus Reeve, 1844a, pl. 15, fig. 59; Reeve, 1844c, p. 117.
?*Aquillus thersites.* – Schepman, 1907, p. 181 (?not *Triton thersites* Reeve, 1844a).
Triton (Simpulum) vespaceum. – Tesch, 1915, p. 67, pl. 82, fig. 147a, b.
Eutritonium vespaceum. – van der Vlerk, 1931, p. 239.
?*Eutritonium thersites.* – van der Vlerk, 1931, p. 239.
Cymatium (Gutturnium) vespaceum. – Wissema, 1947, p. 151.
Cymatium (Lampusia) pileare var. *borneana* Cox, 1948, p. 39, pl. 4, fig. 1a, b.
?*Cymatium (Lampusia) vespaceum.* – Beets, 1950a, p. 246.
Cymatium (Turritriton) vespaceum. – Beu, 1985, p. 60; Henning & Hemmen, 1993, p. 105, pl. 21, fig. 4.

?*Cymatium (Lampusia) pileare*. – Beets, 1986a, p. 26 ("var. *borneana*").
Cymatium (Monoplex) vespaceum. – Wilson, 1993, p. 246 (not pl. 42, fig. 3a, b = *C. thersites* (Reeve, 1844)); Beu, 1998, p. 97, figs. 23k, 29a-i, 30a-k (with further synonymy); Okutani, 2000, p. 287, pl. 142, fig. 16.
Cymatium (Monoplex) thersites. – Okutani, 2000, p. 287, pl. 142, fig. 12 (not *Triton thersites* Reeve, 1844a).

Type material – *Triton vespaceum* Lamarck, lectotype (Kiener, 1842, pl. 3, fig. 2 lower; Beu, 1998, fig. 29c, d) MHNG 1100/5/4, with one paralectotype MHNG 1100/5/2. Beu (1998) designated the type locality as Bohol, Philippine Islands. *Triton elongatus* Reeve, holotype BMNH 1967635, from "Philippine Islands". *Cymatium pileare* var. *borneana* Cox, holotype NMB H. 14421, with two paratypes, NMB H. 14422/1-2, from Togopi Formation (Pliocene-Pleistocene?), Dent Peninsula, North Borneo.

Other material examined – Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (RGM 456 279, 1, small, incomplete but well preserved; Figs. 229, 230); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Fatoekan-Lahoeroes", Koperberg's thesis "pl. 82, fig. 147" (1 good, small); Nyalindung, West Java, Late Miocene, collected by B. Dharma (GNS WM17436, 2; GNS WM17484, 2).

Distribution – *Cymatium vespaceum* occurs widely throughout the Indo-West Pacific region, from eastern South Africa and East Africa (but not recorded from the Gulf of Arabia or Red Sea) eastwards to Tonga, Fiji and Vanuatu, but not recorded from as far east as Hawaii; and from southern Japan to southern Western Australia and to Moreton Bay in southern Queensland, Australia. The first few authentic specimens from the western Atlantic were reported by Piech (1993). Fossils are reported only from the Philippines and Indonesia.

Remarks – *Cymatium vespaceum* is a small species (to *c.* 60 mm high, but few specimens exceed 40 mm) of elongate shape, most specimens having a moderately long anterior canal. Paler and darker colour bands on the varices of Recent specimens presumably led to the species name (wasp-like). It is largely limited to the Indo-West Pacific province, although there are a few authentic records from the western Atlantic (Piech, 1993). The sculpture is of narrow, crisp spiral cords, the uppermost two lightly subdivided by a median groove over the varices or, on a few large specimens, quite obviously subdivided over the whole surface of the last few teleoconch whorls. The cords are crossed by many close, narrow, crisp axial ridgelets. The protoconch is small and narrow, the smallest of those of all closely related species. The similar species *Cymatium comptum* (A. Adams, 1855) is still smaller and more finely sculptured, with completely undivided spiral cords, with narrower and more prominent ridges in the aperture, and with a more uniform coloration on Recent specimens. *Cymatium comptum* is common in the Atlantic as well as the Indo-West Pacific and is the species that usually has been known as *C. gracilis* in the Atlantic (the syntypes of *Triton gracilis* Reeve, 1844a, are small specimens of *C. pfeifferianum* Reeve).

Three specimens from locality L114, Miocene of Mangkalihat Peninsula, Kalimantan, identified by Beets on labels as "*Cymatium clavator*", but included in his Mangkalihat monograph (Beets, 1941, p. 91) under *Cymatium (Lampusia) pileare*, "drei kleinere Schalen", are a species I have not seen elsewhere (RGM 312 446; Figs. 227, 228). It is most similar to *Cymatium vespaceum* in its small size (although the specimens are only *c.* 15-18 mm high and so possibly juvenile), in having all primary spiral cords subdivided by a median groove, and in its generally fusiform-oval shape. Certainly, it has nothing to do with *Cymatium (Ranularia) "clavator"*, i.e., *C. gutturnium* (Röding), which has a shorter last whorl and a much longer canal. However, the Kalimantan specimens differ from *C. vespaceum* in their more evenly fusiform shape and in their much sparser and more prominent axial ridges. The Kalimantan shells also differ from *C. gembacanum* Martin in their much less prominent varices and nodules, and their much lower and narrower spiral cords. This appears to be an unnamed species, but better material is required for detailed comparison.

The holotype of *Cymatium (Lampusia) pileare* var. *borneana* Cox (1948) has been examined in NMB and is a large specimen of *C. vespaceum*, with the uppermost two primary spiral cords, at the periphery and immediately below, subdivided by a narrow groove where they cross the varices on the last two whorls, but not across the intervariceal surface.

Subgenus *Ranularia* Schumacher, 1817

Ranularia Schumacher, 1817, p. 253 (misspelled *Ranula* on p. 77). Type species (by subsequent designation, Gray, 1847, p. 133): "*Murex clavator* Chemnitz, 1795" (non-binominal) (= *Ranularia longirostra* Schumacher, 1817; *M. clavator* cited in its synonymy = *Tudicla gutturnium* Röding, 1798), Miocene to Recent, Indo-West Pacific.

Retusum Jousseaume, 1892, p. 344. Type species (by monotypy): *Triton retusum* Lamarck, 1822 (= *Monoplex oboesus* Perry, 1811), Recent, northern Indian Ocean.

Tritonocauda Dall, 1904, p. 133. Type species (by original designation): *Murex caudatus* Gmelin, 1791, Recent, Indo-West Pacific.

Remarks – The species of *Cymatium (Ranularia)* inhabit offshore environments, mostly in more than about 30 m, and are collected today by dredging or trawling on the continental shelf on soft substrates. They also are rather uncommon in the present fauna, and so their moderate commonness and diversity in the Indonesian Neogene fauna presumably reflects the offshore deposition sites of Indonesian Neogene rocks.

Cymatium (Ranularia) gutturnium (Röding, 1798)
Figs. 233, 234.

Tudicla gutturnium Röding, 1798, p. 145.

Triton macrourum Link, 1807, p. 122.

Monoplex formosus Perry, 1811, pl. 3, fig. 5.

Ranularia longirostra Schumacher, 1817, p. 253.

Ranularia labiata Schumacher, 1817, p. 253.

Murex clavator Dillwyn, 1817, p. 701.

Triton clavator. – Lamarck, 1822, p. 185; Kiener, 1842, p. 4, pl. 10, fig. 2; Reeve, 1844a, pl. 3, fig. 7.

Triton pyrum. – Martin, 1883a, p. 207, pl. 9, fig. 8 (not *Murex pyrum* Linné, 1758).

Triton (Ranularia) pseudopyrum Martin, 1899, p. 143, pl. 22, figs. 326-328; Tesch, 1915, p. 67, pl. 82, fig. 148a, b; Fischer, 1927, p. 63 (in part).

Eutritonium pseudopyrum. – Martin, 1919, pp. 87, 128, 132, 141; van der Vlerk, 1931, p. 239; van der Vlerk, 1932, p. 111 (in part).

Cymatium (Ranularia) clavator. – van Regteren Altena, 1942, p. 102; Wissema, 1947, p. 150; Skwarko & Sufiati, 1994, p. m11 (in part); van den Hoek Ostende *et al.*, 2002, p. 35.

Cymatium (Ranularia) gutturnium. – Beu, 1987, p. 291, figs. 64-68; Henning & Hemmen, 1993, p. 72, pl. 15, fig. 1; Wilson, 1993, p. 247, pl. 42, fig. 9a, b; Beu, 1998, p. 124, figs. 34g, 37c-i (with further synonymy); Okutani, 2000, p. 289, pl. 143, fig. 29.

Type material – Neotype (of Beu, 1987, pp. 292-293) of *Tudicla gutturnium* Röding, *Tritonium macrourum* Link, *Monoplex formosus* Perry, *Ranularia longirostra* Schumacher, *Ranularia labiata* Schumacher and *Murex clavator* Dillwyn, USNM 849016, Recent, from Visayan Sea, Philippine Islands.

Other material examined – RGM 9798, Sonde, Residence of Madiun, Java (1, paralectotype of *T. pseudopyrum* Martin, with 2 other paralectotypes); "Kendeng beds" in Mijnwezen Collection: locality M125 (RGM 456 280, 1 good, Figs. 233, 234), M257 (1, fragmentary), M260 (1), M269 (1), M278 (1, with 2 *C. pfeifferianum*), M281 (1), M346 (2 poor); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 564 (1, incomplete); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (25 good), locality 100 (1, fragmentary); Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma); Koperberg's material from the Pliocene of Timor, received in RGM from the Mineralogisch-Geologisch Museum, Delft: "Lahoeroes", Koperberg's thesis "pl. 82, fig. 148", identified as "*Triton pseudopyrum* Martin" (1, good, canal incomplete); material from IAUU, received in RGM: calcareous tuff and sandstone near Wahai in northern Sulawesi, coll. Rutten, Pleistocene? (1).

Distribution – *Cymatium gutturnium* seems to be limited almost entirely to the western Pacific, from Taiwan to northeastern Australia and New Caledonia, and as far eastward as Hawaii, although a single specimen from Réunion Island in the Indian Ocean is present in MNHN. The Indonesian fossils are the only ones I am aware of.

Remarks – Several species have been misidentified as "*Cymatium clavator*" in the Indonesian Neogene fauna. In particular, *Triton pseudopyrum* Martin is a conglomeration of at least three species, as pointed out by Beu (1987). Most of the Indonesian specimens belong in the most common and widespread of the present-day species, *Cymatium gutturnium*. This species is recognisable by its low spire and very long anterior canal, by its sculpture of prominent, narrow, rather widely spaced spiral cords lacking any median grooves and lacking particularly prominent cords on the anterior canal, its low, rounded axial folds producing nodules on the spiral cords, its low, narrow varices and in many specimens not producing a varix before the terminal one, and its smoothly callused aperture with a smooth, obviously, but narrowly, reflected inner lip, and a narrowly flared outer lip bearing seven obvious, narrow transverse ridges. In Recent specimens, the aperture is pale orange to deep orange-red and the exterior of the last whorl bears several bright red-brown axial flames on a pale background. The narrow, prominent, simple spiral cords and the lack of any unusually prominent cords on the canal make fossil specimens easily recognisable.

Cymatium (Ranularia) pyrulum **(A. Adams & Reeve, 1850)**
Figs. 235-240.

Triton pyrulum A. Adams & Reeve, 1850, p. 37, pl. 10, fig. 17.
Triton (Gutturnium) pyrulum; Tryon, 1880, p. 23, pl. 13, fig. 109.
Triton (Ranularia) pseudopyrum Martin, 1899, p. 143, pl. 22, fig. 326a, b (in part).
Cymatium (Ranularia) pyrulum. – Beu, 1987, p. 302, figs. 94-104.
Cymatium (Ranularia) fortespirale Parth, 1993, p. 76, figs. 3, 4 (right), 5 (left), 6 (left), 7.

Type material – *Triton pyrulum* A. Adams & Reeve, neotype (of Beu, 1987, p. 303) USNM 849015, from fishermen's tangle nets, off Punta Engaño, Mactan Island, Cebu, Philippine Islands. *Triton pseudopyrum* Martin, lectotype (of Beu, 1987, p. 303; Figs. 237, 238), RGM 9797, from Sonde, Residence of Madiun, Java, Pliocene, with one paralectotype removed to *C. sarcostoma* (Fig. 241); three paralectotypes RGM 9798 (Figs. 239, 240), all data as for lectotype; four further paralectotypes are listed below under material of *C. sarcostoma* (Reeve). *Cymatium (Ranularia) fortespirale* Parth**,** holotype Zoologische Staatsammlung München no. 1874, from Mactan Island, Cebu, Philippines; two paratypes in collection of M. Parth, from Mactan Island and from Phuket, Thailand.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M255 (2, 1 good); Pasir Ipis, Cirebon, Java, Pliocene (1, in collection of B. Dharma); Sangiran, central Java, Late Pliocene, presented by B. Dharma (WM17480, 12, + many in collection of B. Dharma).

Distribution – *Cymatium pyrulum* is recorded in the Recent fauna only from the central western Pacific and northwestern Indian Ocean, from the Philippine Islands to Indonesia, and from the Andaman Islands and eastern Thailand. The Indonesian fossils (if correctly referred here) are the only ones I am aware of.

Remarks – Beu (1987) considered that the most complete illustrated syntype of *Triton pseudopyrum* Martin is a specimen of *C. pyrulum* (A. Adams & Reeve) and designated this specimen the lectotype. This species differs from *C. gutturnium* in having a prominent groove (an axial depression, of roughly semicircular cross-section) behind each varix. It also differs from *C. gutturnium* in having slightly wider and more prominent spiral cords, a slightly taller spire, consistently forming one varix before the terminal one, and the spiral cords considerably lower over the varices than in *C. gutturnium*. Many specimens also have a more deeply excavated columella and a straighter anterior canal than in *C. gutturnium*.

Parth (1993) considered that the original *Cymatium pyrulum* of A. Adams & Reeve (1850) was likely to be the slightly narrower and more finely sculptured species (named *C. parthi* by Arthur, 1991) illustrated as a possible syntype of *C. pyrulum* by Beu (1987, figs. 99, 100). Although this may well be correct, my selection of a neotype (Beu, 1987, p. 303) cannot be set aside because of taxonomic (rather than nomenclatural) differences under the *International Code of Zoological Nomenclature*, as the original neotype is "consistent with what is known of the original name-bearing type", and Arthur (1991) was correct to rename the smaller, narrower species. In any case, despite Parth's (1993) claim to the contrary, the lectotype of *Cymatium pseudopyrum* (Martin) selected by Beu (1987,

p. 303; Parth, 1993, fig. 7) is probably a specimen of the species identified by Beu (1987) as *C. pyrulum*, so *C. pseudopyrum* (Martin, 1899) is an earlier name for *C. fortespirale* Parth, 1993, if this were the name to be used for this species.

The identity of Indonesian fossil specimens with the Recent species *Cymatium pyrulum* has always been a little dubious, as the lectotype of *C. pseudopyrum* and similar (small, apparently immature) specimens clearly have a shallower groove behind the terminal varix than Recent specimens. The collection of many specimens at Sangiran, central Java (Late Pliocene) by Bunjamin Dharma recently has indicated reasonably conclusively that this is a species distinct from *C. pyrulum*. Besides almost completely lacking the groove behind the varix in adults, the Indonesian fossils have more numerous, more prominent transverse ridges on the inner lip than do Recent specimens. However, the whole question of species determinations of Indonesian fossil *C. (Ranularia)* species needs reconsideration, as further, apparently distinct species are brought to light by B. Dharma's collecting and they will be treated elsewhere.

***Cymatium (Ranularia) sarcostoma* (Reeve, 1844)**
Figs. 241-243.

Triton sarcostoma Reeve, 1844a, pl. 7, fig. 21; Reeve, 1844c, p. 113.
Triton (Ranularia) pseudopyrum Martin, 1899, p. 143, pl. 22, figs. 326-328 (in part).
Eutritonium pseudopyrum. – Martin, 1919, pp. 87, 128, 132, 141; van der Vlerk, 1931, p. 239 (in part).
Cymatium (Gutturnium) gallinago. – Cox, 1948, p. 38, pl. 3, fig. 9a, b (not *Triton gallinago* Reeve, 1844).
Cymatium (Ranularia) sarcostoma. – Beu, 1985, p. 59; Henning & Hemmen, 1993, p. 83, pl. 17, fig. 3; Wilson, 1993, p. 247, pl. 42, fig. 5 (not fig. 7a, b); Beu, 1998, p. 126, fig. 34i (with further synonymy); Higo *et al.*, 2001, p. 48, fig. G1598.
Cymatium (Ranularia) clavator. – Skwarko & Sufiati, 1994, p. m11 (in part).

Type material – *Triton sarcostoma* Reeve, lectotype (of Beu, 1998, p. 127) BMNH 1967600/1, with two paralectotypes, from "Island of Ticao", Philippines.

Other material examined – RGM 9797, largest (incomplete) paralectotype (Fig. 241) of *Triton pseudopyrum* Martin, separated from lectotype (= *C. pyrulum* A. Adams & Reeve; see above); RGM 9796, Padas Malang [Padasmalang], Residence of Madiun, Java, Pliocene (1, small, paralectotype of *T. pseudopyrum* Martin; Figs. 242, 243); RGM 9798, Sonde, Residence of Madiun, Java (1, paralectotype of *T. pseudopyrum* Martin); RGM 9799, illustrated paralectotype of *Triton pseudopyrum* Martin, Mount Sela, Java, Late Miocene; RGM 47 031, Tji Talahab [Citalahab], Java (1, identified as "*T. clavator* var."); Nyalindung, West Java, Late Miocene, collected by B. Dharma (GNS WM17437, 1); Citalahab, Java, Miocene (1, narrow, in collection of B. Dharma). The specimen (NMB H.14420/1) from the Togopi Formation (Pliocene-Pleistocene?), Dent Peninsular, North Borneo, illustrated by Cox (1948, pl. 3, fig. 9a, b), has been examined and is a specimen of *C. sarcostoma*.

Distribution – *Cymatium sarcostoma* occurs throughout the western Pacific region and the northern Indian Ocean. Specimens have been seen from localities ranging from southern India and from Taiwan to northern Australia and New Caledonia, and eastwards throughout Polynesia to Hawaii. The Indonesian fossils are the only ones I am aware of.

Remarks – *Cymatium sarcostoma* is one of the least common of the Indo-West Pacific *C. (Ranularia)* species. It is similar to *Cymatium cynocephalum* (Lamarck), but lacks the red colour area on the parietal lip of *C. cynocephalum. Cymatium cynocephalum* (= *Triton moritinctus* Reeve, 1844a) does not occur in the western Pacific, but is limited to the Indian and Atlantic Oceans, whereas most Recent material I have seen of *C. sarcostoma* is from the central western Pacific (Philippine Islands to New Caledonia). *Cymatium sarcostoma* also is a little smaller than *C. cynocephalum*, and has a uniform yellow to pale orange-brown exterior and a uniform flesh-pink aperture (hence the species name). The spire is moderately tall and the two or three prominent varices have undercut margins. Most distinctive of all is the microsculpture; the spiral cords are finely subdivided by a median groove, particularly on early spire whorls, and the entire teleoconch surface is crossed by very fine, narrow, crisp axial ridgelets. Therefore, juvenile specimens are very distinctive, unlike those of most other *C. (Ranularia)* species. However, the fossils from Java differ a little from Recent specimens in being a little narrower and having much less complex microsculpture; more, better-preserved material is required to be certain they are conspecific with Recent specimens.

Cymatium (Ranularia) sinense (Reeve, 1844)
Figs. 244, 245.

Triton sinensis Reeve, 1844a, pl. 6, fig. 18: Reeve, 1844c, p. 113.
Ranularia sinensis defranata Iredale, 1936, p. 308, pl. 23, fig. 2.
Cymatium sinense. – Yen, 1942, p. 215, pl. 17, fig. 107.
Ranularia sinensis. – Habe, 1961, p. 45, pl. 22, fig. 14; Habe, 1964, p. 71, pl. 22, fig. 14.
Cymatium (Ranularia) sinense. – Ladd, 1982, p. 41, pl. 7, figs. 7, 8; Wilson, 1993, p. 247, pl. 42, fig. 10; Beu, 1998, p. 127, fig. 39h (with further synonymy); Beu, 1999, p. 41, figs. 76-78 (with further synonymy); Higo *et al.*, 2001, p. 48, fig. G1599.
Cymatium (Ranularia) sinense sinense. – Beu, 1987, p. 306, figs. 113-116; Henning & Hemmen, 1993, p. 84, pl. 16, fig. 2.

Type material – *Triton sinensis* Reeve, lectotype (of Beu, 1998, p. 127) BMNH 1967598/1, with two paralectotypes, from "China". *Ranularia sinensis defranata* Iredale, holotype AMS C.60661, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia.

Other material examined – RGM 9795, Menengteng Gorge, Waled, Cheribon [Cirebon], Java, Pliocene (2 paralectotypes of *Triton pseudopyrum* Martin, one illustrated by Martin; 1 is a spire of *C. sinense* (Figs. 244, 245), 1 a specimen of *C. gembacanum* Martin); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 563 (1, incomplete);.

Distribution – *Cymatium sinense* occurs throughout the western Pacific archipelagos, from southern Japan (as far north as Kii Peninsula) south to Sydney Harbour, Australia, and New Caledonia. Fossils are reported from Indonesia and from southern Japan.

Remarks – *Cymatium sinense* is easily recognised by its relatively tall spire for a *Cymatium (Ranularia)* species, its long, narrow anterior canal, its prominent, narrow transverse ridges on both apertural lips and by having all spiral cords deeply subdivided by a median groove. Most specimens have only very small nodules, unlike the similar

C. testudinarium, which has large, prominent nodules. The exterior of the teleoconch of *C. sinense* is uniform white to cream and the strongly ridged aperture is plain white. This contrasts further with *C. testudinarium*, which has a bright red-brown exterior and a large, dark brown to black parietal area in the aperture. One of the Indonesian fossil specimens of *C. sinense* I have seen, from the upper "Kendeng beds" of Java, was identified by van Regteren Altena (1942) as "*Cymatium (Ranularia)* spec.", whereas another is among the several species included in "*Triton pseudopyrum*" by Martin (1899). The third specimen, an incomplete one from Pasir Ipis, has a most unusually short spire, so that it resembles a specimen of *C. (Ranularia) caudatum* (Gmelin, 1791) lacking the characteristic, deeply channelled suture. This possibly represents yet another undescribed Indonesian fossil species, but again more material is required to be sure its characters are constant.

Some specimens collected recently (2003-2004) by Bunjamin Dharma are similar to *Cymatium sinense* and at first were identified as this species (Pasir Ipis, West Java, mid-Pliocene, GNS WM17438, 1; Citalahab, West Java, Late Miocene, 1 in collection of B. Dharma). Their relatively tall spires and details of external sculpture are in agreement with *C. sinense*, but both specimens have a much more strongly sculptured inner lip with relatively few, prominent, long, widely spaced transverse ridges that are not present on any Recent specimens of *C. sinense*. They, therefore, probably represent yet another unnamed endemic Indonesian species, but again must await the collection of more material before they can be be named and were acquired too recently to be illustrated.

Cymatium (Ranularia) springsteeni **Beu, 1987**

Figs. 246, 247.

Cymatium (Ranularia) clavator. – van Regteren Altena, 1942, p. 102 (in part not *Murex clavator* Dillwyn, 1817).

Cymatium (Ranularia) springsteeni Beu, 1987, p. 303, figs. 105-112; Henning & Hemmen, 1993, p. 85, pl. 15, fig. 2; Beu, 1998, p. 128, fig. 34d (with further synonymy).

Cymatium (Ranularia) sprigsteeni (sic). – Okutani, 2000, p. 289, pl. 143, fig. 30.

Type material – *Cymatium springsteeni* Beu, holotype USNM 849008, from Panglao Peninsula, Bohol, Philippines; 25 paratypes from the Philippine Islands in GNS (Beu, 1987, p. 306).

Material examined – "Kendeng beds" material in Mijnwezen Collection: locality M177 (1), M274 (RGM 456 282, 2 good; Figs. 246, 247), M281 (1, good).

Distribution – *Cymatium springsteeni* occurs throughout the Indo-West Pacific region, including the Red Sea, from Madagascar and southern Japan to New Caledonia and Hawaii. As most specimens have been confused with *C. gutturnium*, its distribution is poorly defined. The Indonesian specimens are the only fossils I am aware of.

Remarks – Beu (1987) pointed out that specimens previously identified as *Cymatium gutturnium* actually fall into two species. The previously unrecognised *C. springsteeni* differs from *C. gutturnium* in its lower and wider spiral cords, in its varices "clasping" the previous whorl more tightly at the posterior (adapical) end of each varix than in *C. gutturnium* (separated from the previous whorl only by a deep, narrow groove, rather than the wide groove of *C. gutturnium*), in its more thickened aperture with more narrowly flared lips and markedly more deeply excavated columella, in the aperture being white to pale cream rather than orange-red, and in bearing several unusually prominent, dark brown spiral cords on the anterior canal that are not present on *C. gutturnium*.

Several specimens in the Mijnwezen Collection (from the "Kendeng beds") have prominent spiral cords on the siphonal canal that are not present in *Cymatium gutturnium* (Röding) and these specimens are referred to *C. springsteeni.* Not all specimens are well enough preserved to be sure of the identification, however, and those in which critical characters are not visible have been listed under *C. gutturnium* (as this is the more common species in the Recent fauna).

Cymatium (Ranularia) testudinarium **(A. Adams & Reeve, 1850)**

Figs. 248-251.

Triton testudinarius A. Adams & Reeve, 1850, p. 37, pl. 8, fig. 3a, b.

Cymatium testudinarium. – Yen, 1942, p. 215, pl. 18, fig. 108.

Cymatium (Ranularia) clavator. – Wissema, 1947, p. 150 (in part).

Cymatium (Ranularia) testudinarium. – Beu, 1985, p. 59; Henning & Hemmen, 1993, p. 86, pl. 18, fig. 4; Beu, 1998, p. 129, figs. 34j, 39i, j (with further synonymy); Higo *et al.*, 2001, p. 48, fig. G1600.

Cymatium (Ranularia) sarcostoma. – Okutani, 2000, p. 291, pl. 144, fig. 36 (not *Triton sarcostoma* Reeve, 1844a).

Type material – *Triton testudinarius* A. Adams & Reeve, lectotype (of Beu, 1998, p. 129) and two paralectotypes, BMNH 1967686, from "China Seas".

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M257 (RGM 456 284, 1, spire only; Fig. 251); Nias Island, Sumatra, Pliocene-Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39a (RGM 456 283, 3 good, Figs. 248-250).

Distribution – *Cymatium testudinarium* occurs uncommonly throughout the Indo-West Pacific region, from Réunion, southern Japan and Taiwan to New Guinea, New Caledonia and Vanuatu. The Indonesian fossils are the only ones I am aware of.

Remarks – One incomplete specimen (Fig. 251) in the Mijnwezen Collection (from the "Kendeng beds") has an unusually tall spire for a *Cymatium (Ranularia)* species. It differs from the more common tall-spired species, *C. (Ranularia) sinense* (Reeve, 1844a), in having simple spiral cords, without the median groove along the crest of the cords that is present on all specimens of *C. sinense*. (Other differences between these species are discussed under *C. sinense.*) The fossil, therefore, is identified as *C. testudinarium*. However, without the colour pattern of Recent specimens, this identification is difficult to confirm. The three excellent Nias Island specimens (recorded from locality 39a by Wissema, 1947, p. 150) definitely are *C. testudinarium*, agreeing in all characters with Recent specimens.

Subgenus *Reticutriton* Habe & Kosuge, 1966

Reticutriton Habe & Kosuge, 1966, pp. 315, 330. Type species (by original designation): *Triton pfeifferianus* Reeve, 1844a, Miocene to Recent, Indo-West Pacific and Atlantic.

Cymatium (Reticutriton) pfeifferianum (Reeve, 1844a)
Figs. 252-257.

Triton pfeifferianus Reeve, 1844a, pl. 4, fig. 14; Reeve, 1844c, p. 112; Martin, 1932, p. 114.
Triton gracilis Reeve, 1844a, pl. 15, fig. 58 a, b; Reeve, 1844c, p. 117.
Lampusia gracile. – Dall, 1889, p. 227, pl. 29, fig. 2.
Cymatium (Gutturnium) pfeifferianum. – van Regteren Altena, 1942, p. 103; Wissema, 1947, p. 151; Skwarko & Sufiati, 1994, p. m10.
Cymatium (Gutturnium) bayeri van Regteren Altena, 1942, p. 104, fig. 2a, b.
Reticutriton pfeifferianum. – Habe & Kosuge, 1966, p. 43, pl. 15, fig. 14.
Cymatium gracile? – Poppenoe & Kleinpell, 1978, pl. 5, figs. 60, 63.
Cymatium (Reticutriton) pfeifferianum. – Beu, 1985, p. 59; Piech, 1993, p. 90, figs. 7-10; Henning & Hemmen, 1993, p. 88, pl. 20, fig. 12; Wilson, 1993, p. 248, pl. 42, fig. 2; Beu, 1998, p. 130, figs. 23h, 42a-g (with further synonymy); Higo *et al.*, 2001, p. 48, fig. G1590.

Type material – *Triton pfeifferianus* Reeve, lectotype (of Beu, 1998, p. 130) and two paralectotypes BMNH 1967596, without locality; type locality designated by Beu (1998) as Bohol Island, Philippines. *Triton gracilis* Reeve, lectotype (of Beu, 1998, p. 130) and one paralectotype BMNH 1966534, from "Philippines". *Cymatium (Gutturnium) bayeri* van Regteren Altena, holotype RGM 456 888, from Mijnwezen locality M128, map sheet 110A, Poetjangan layers, layer 2, a Pliocene fossil from the "Kendeng beds", mid-Java.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M90 (1), M178 (1), M260 (RGM 456 287, 1 incomplete, large; Figs. 256, 257), M278 (2, plus 1 *C. gutturnium*), M292 (1, identified by van Regteren Altena as "*Cymatium* sp."); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 561 (1 incomplete), RGM 46 562 (1 incomplete); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 39, Pleistocene? (RGM 456 285-6, 17 good, Figs. 252-255), locality 102, Pliocene-Pleistocene (1); Pasir Ipis, Cirebon, central Java, mid-Pliocene, collected and presented by B. Dharma (GNS WM17239, 1); Mount Butack, Rembang, central Java, Middle Miocene, in collection of B. Dharma (1); Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma).

Distribution – *Cymatium pfeifferianum* occurs at present throughout the Indo-West Pacific region, in the widest sense, and in the Atlantic. In the Indian Ocean, it occurs from Durban, eastern South Africa to East Africa and the Red Sea and to Kimberley in Western Australia. In the western Pacific, it occurs from Okinawa and Taiwan to Queensland, Australia and New Caledonia. In the Atlantic, it occurs from southern Florida to northern Brazil. Fossils are moderately common in Indonesia, but have not been reported from elsewhere.

Remarks – *Cymatium pfeifferianum* is easily recognised by its tall and narrow, evenly fusiform shape, its very deeply impressed suture, its many fine, close, cancellate axial ridges and spiral cords, and the unusually numerous, narrow transverse ridges inside the outer lip. The shape is rather variable, and the holotype of *Cymatium bayeri* van Regteren Altena merely is a rather short and wide specimen of *C. pfeifferianum*, as was pointed out by Beu (1998, p. 132). Several other fossils have been misidentified as *C. bayeri* since it was described (e.g., Kanno *et al.*, 1982, *C. vespaceum*; Poppenoe & Kleinpell, 1978, *C. aquatile*). Again, this is an offshore species, most commonly collected at present by dredging on the continental shelf on soft substrates in *c.* 30-200 m, and the occurrence of several specimens in the Indonesian Neogene reflects the offshore deposition site of these rocks.

Subgenus *Septa* Perry, 1810

Septa Perry, 1810, caption to plate 2. Type species (by monotypy) *Septa scarlatina* Perry, 1810 (= *Murex rubecula* Linné, 1758), Miocene-Recent, Indo-West Pacific.

Simpulum Mörch, 1853, p. 108. Type species (by subsequent designation, Clench & Turner, 1957, p. 214): *Murex rubecula* Linné, 1758 [not a homonym of *Simpulum* Fabricius, 1823, introduced in a work placed on the Official Index in International Commission on Zoological Nomenclature (1958, Opinion 521)].

Cymatium (Septa) dharmai sp. nov.

Figs. 264-266.

Type material – Holotype, RGM 456 290 (Figs. 264, 265), and 3 paratypes (GNS WM17362, 2 paratypes; 1 paratype in collection of B. Dharma; Fig. 266), from Citalahab, West Java, Late Miocene, collected and presented by Bunjamin Dharma.

Distribution – Known only by the type material.

Dimensions – Holotype, H 28.6, D 18.4 mm; paratypes WM 17362: H 25.6, D 16.8 mm; H 25.3, D 16.7 mm; paratype in collection of B. Dharma, H 26.7, D 18.3 mm.

Description – Shell small for subgenus (25-28 mm high, compared with *c.* 45-50 mm in *C. rubeculum*, and greater than 65 mm in *C. hepaticum*), short and inflated, with short, evenly rounded last whorl, short spire of slightly convex outlines, and short, wide anterior canal inclined weakly to right. Varices prominent, high and narrow, situated regularly each 0.66 whorls; three varices on holotype and four on figured paratypes. Spiral cords prominent, relatively wide, with strongly convex crests, 7 evenly spaced primary cords on last whorl (entering onto terminal varix) and 3 on spire whorls, with one weak cord on sutural ramp and 10-12 weak cords on base and canal. Axial (collabral) sculpture of very few narrow, widely spaced, sharply defined, high and narrow ridges, with interspaces each 3-4 times width of one ridge; 17-21 on each intervariceal interval. Spiral interspaces each with 3-5 very fine, weak spiral threads; a few faint axial threads in some interspaces and moderately prominent on varices. Aperture relatively large, oval; interior of outer lip with 8 short, narrowly rounded nodules. Inner lip with 10-12 prominent, narrow, widely spaced transverse ridges, weakly anastomosing over central columella, continuing down anterior canal as 4-5 further, short ridges. Protoconch not seen.

Discrimination – Five specimens of *Cymatium (Septa)* collected at Citalahab by Bunjamin Dharma seem to fall into two distinct species. A single small specimen (H 23.5 mm) has very fine, closely spaced, thin, sharp axial ridges (31 and 33 ridges in the last two intervariceal intervals), whereas the other four slightly larger, short, wide specimens have very prominent, wide, sharply defined, well raised, widely spaced axial ridges (21 and 19 ridges on the last two intervariceal intervals on the holotype of *B. dharmai*, 19 and 17 on the largest paratype). However, all five specimens are very unusual for *C. (Septa)* species in their short, wide shape, with only seven (rather than the more usual eight) primary spiral cords on the last whorl, entering onto the terminal varix. Beu (1987, pp. 274-291) described the characters of most of the Recent *C. (Septa)* species (to which Arthur & Garcia-Talavera (1990) added *C. mixtum*), differentiating them not only by the most obvious character of exterior teleoconch colour, but also by their numbers and spacing of axial ridges and primary spiral cords. Almost all the previously known species have eight primary spiral cords on the last whorl, entering onto the terminal varix, whereas *C. peasei* Beu, 1987, and *C. marerubrum* Garcia-Talavera, 1985, have only seven primary spiral cords, and *C. flaveolum* (Röding, 1798) has nine primary spiral cords. The fourth cord below the periphery, pale to white in most specimens, is lacking in *C. peasei*, apparently "deleted" from the cord numbers to allow the last whorl to be shorter than in other species. In contrast, the relatively great width of the flat-topped cords in *C. marerubrum* seems to have led to suppression of the lowest primary cord, the fourth, pale cord is still present and the whorl shape is relatively elongate as in most other *C. (Septa)* species.

Numbers of axial ridges per intervariceal interval in the previously recognised species are: *Cymatium bibbeyi* Beu, 1987 (Philippine Islands), 10-19 very coarse, wide, but rounded, not sharply defined ridges, forming large, rounded nodules on the primary spiral cords; *C. closeli* Beu, 1987 (Indian Ocean), 20-25 moderately narrow, rounded axial ridges; *C. flaveolum* (Röding, 1798) (Indo-West Pacific), 26-28 fine, close, rounded axial ridges; *C. hepaticum* (Röding, 1798) (Indo-West Pacific), 18-20 moderately narrow, rounded axial ridges; *C. marerubrum* Garcia-Talavera, 1985 (Red Sea), 12-16 very coarse, wide, widely spaced axial ridges, forming (as in *C. bibbeyi*) large, rounded nodules on the spiral cords; *C. occidentale* (Mörch, 1853) (Indo-West Pacific and Atlantic), 33-46 very fine, closely spaced, rounded axial ridges; *C. peasei* (Polynesia), 10-19 low, narrow, rounded axial ridges; *C. rubeculum* (Linné, 1758) (Indo-West Pacific), 19-25 low, rounded axial ridges; and *C. mixtum* Arthur & Garcia-Talavera, 1990 (Indo-West Pacific), *c.* 40-50 very fine, weakly defined, closely spaced, rounded (not sharply defined) axial ridges.

Addition of fossils to this picture introduces a wider range of variation in some characters. *Cymatium dharmai* sp. nov. has only seven primary spiral cords and 17-21 axial ridges, but the ridges are sharply defined, narrow, and widely spaced, unlike the wider and more weakly defined ridges of almost all Recent species. A further new species from the Miocene of the Dominican Republic, to be named by me (research in progress), is similar to *C. dharmai* sp. nov. in its short, wide last whorl, in having only seven primary cords on the last whorl and in having numerous, fine axial ridges, but this species is unusual in having *c.* 47 exceedingly fine, close axial ridges on the penultimate intervariceal interval. Although they commence at the same size and spacing on the last intervariceal interval, they increase greatly in spacing and coarseness over the last interval to have only 17 ridges on the later half of the interval. This Dominican Republic species also is larger and still shorter and wider than *C. dharmai* sp. nov., with a strongly inflated, subspherical last whorl. These fossil species, then, offer a shorter, wider shape and a greater range of axial ridges than do the Recent species. The very narrow, sharply defined, widely spaced axial ridges of *C. dharmai* sp. nov.

are unique to this species and the combination with only seven primary spiral cords is very distinctive.

The single specimen (see below) of a second species from Citalahab is identified tentatively here as *C. occidentale*, but has only seven primary spiral cords, a character discordant with *C. occidentale*. I have seen a single Recent specimen that agrees with the Citalahab specimen in all characters (WM 13854, Mauritius, *ex* Closel Collection), and these probably represent yet another, unnamed species. Further specimens are needed to be sure of the identity of these fossil and Recent specimens.

Etymology – The species name honours the collector of the holotype, Bunjamin Dharma, of Jakarta, who provided a large amount of very helpful information and material for this paper.

***Cymatium (Septa) hepaticum* (Röding, 1798)**

Figs. 258, 259.

Tritonium hepaticum Röding, 1798, p. 126.
Triton rubecula var. γ Reeve, 1844a, pl. 9, fig. 29d.
Cymatium (Lampusia) rubeculum. – Wissema, 1947, p. 148 (in part).
Cymatium (Septa) hepaticum. – Beu, 1985, p. 59; Beu, 1987, p. 282, figs. 29-36; Henning & Hemmen, 1993, p. 92, pl. 19, fig. 9; Wilson, 1993, p. 247, pl. 42, fig. 16a, b; Beu, 1998, p. 132, fig. 23p (with further synonymy); Okutani, 2000, p. 289, pl. 1433, fig. 21.

Type material – *Tritonium hepaticum* Röding, neotype (of Beu, 1987, p. 282) USNM 124168, from Mauritius, Indian Ocean.

Other material examined – Nias Island, Sumatra, Pliocene-Pleistocene, Schroeder's collection described by Wissema (1947): locality 77 (RGM 456 288, 1 good; Figs. 258, 259).

Distribution – *Cymatium hepaticum* occurs throughout the Indo-West Pacific region, from East Africa to the Marquesas Islands and from the Ryukyu Islands, southern Japan, to the southern Great Barrier Reef, Australia and New Caledonia. It is moderately common in the western Pacific archipelagos, in shallow water around coral reefs, but is much less common than the sympatric *C. closeli* Beu, 1987, in the Indian Ocean. The only fossil I am aware of is that recorded here.

Remarks – One of the specimens from Nias Island, Sumatra, recorded by Wissema (1947) as *Cymatium rubeculum*, is larger than most specimens of *C. rubeculum* and is a little more ovate in outline, although it has the same prominent, coarse axial ridgelets as in the uniformly red species *C. rubeculum*. This seems likely to be a specimen of *C. hepaticum*, although it is difficult to be certain of this identification without the brightly banded brown and yellow colour pattern that is so distinctive in Recent specimens.

***Cymatium (Septa)* aff. *C. occidentale* (Mörch, 1877)**

Fig. 269.

Triton (Lampusia) rubecula occidentale Mörch, 1877, p. 29.
Septa? *blacketi* Iredale, 1936, p. 307, pl. 23, fig. 3.

Cymatium (Septa) rubeculum occidentale. – Clench & Turner, 1957, p. 214, pl. 110, fig. 3; pl. 113, fig. 5; pl. 121, figs. 1-3.
Cymatium (Septa) occidentale. – Beu, 1985, p. 59; Beu, 1987, p. 386, figs. 37-45; Henning & Hemmen, 1993, p. 94, pl. 19, fig. 4; Beu, 1998, p. 134, fig. 23l.
Cymatium (Septa) beui Garcia-Talavera, 1985, p. 28, figs. 1, 2, 5.

Type material – *Triton rubecula occidentale* Mörch, holotype ANSP 36874, from St Thomas, Virgin Islands, Caribbean Sea. *Septa? blacketi* Iredale, holotype AMS C.60662, from Nielsen Park, Watson's Bay, Sydney Harbour, New South Wales, Australia. *Cymatium beui* Garcia-Talavera, holotype in Museu Insular de Ciencias Naturales de Tenerife, Canary Islands (Garcia-Talavera, 1985), from Oahu, Hawaii.

Other material examined – Citalahab, West Java, Late Miocene (1, in collection of B. Dharma; Fig. 269).

Distribution – *Cymatium occidentale* occurs at present in both the Indo-West Pacific region and the Atlantic, the only species of *Cymatium (Septa)* to occur in the Atlantic. It is moderately common in Hawaii sympatrically with *C. rubeculum* and widespread, but uncommon, in the western Atlantic from Florida to Brazil, but is rare further east in the Indo-West Pacific (as far east as Mauritius), and specimens have been recorded from the Canary Islands in the eastern Atlantic (Garcia-Talavera, 1985). The possible specimen recorded here is the only fossil I am aware of.

Remarks – *Cymatium occidentale* is similar to *C. rubeculum* in most characters, but is shorter and wider, and has much finer, more numerous and more closely spaced axial ridgelets. Recent specimens also are pale yellow-brown, rather than crimson as in *C. rubeculum*. One of the specimens collected by Bunjamin Dharma at Citalahab, West Java, is similar to the material of *C. dharmai* sp. nov., but as noted above it has markedly finer and more closely spaced axial ridgelets, and possibly belongs in *C. occidentale* (see discussion under *C. dharmai*).

***Cymatium (Septa) rubeculum* (Linné, 1758)**

Figs. 260-263.

Murex rubecula Linné, 1758, p. 749; Linné, 1767, p. 1218.
Septa scarlatina Perry, 1810, pl. 2, fig. 2; Perry, 1811, pl. 14, fig. 2.
Tritonium rubecula. – Röding, 1798, p. 127.
Triton nubecula (sic). – Lamarck, 1816, pl. 413, fig. 2a, b, "Liste des objets" p. 4.
Triton rubecula. – Lamarck, 1822, p. 188; Reeve, 1844a, pl. 9, fig. 29a.
Aquillus rubecula. – Schepman, 1907, p. 181.
Eutritonium rubeculum. – van der Vlerk, 1931, p. 239.
Cymatium (Lampusia) rubeculum. – Wissema, 1947, p. 148 (in part).
Cymatium (Lampusia) rubecula. – Schmid & Walther, 1962, p. 257, pl. 27, figs. 3, 4.
Cymatium (Septa) rubecula. – Ladd, 1977, p. 34, pl. 11, fig. 8.
Cymatium (Septa) rubeculum rubeculum. – Beu, 1987, p. 288, figs. 1, 2, 4, 5, 52-57.
Cymatium (Septa) rubeculum. – Kay, 1979, p. 223, fig. 79D; Henning & Hemmen, 1993, p. 90, pl. 19, fig. 1; Wilson, 1993, p. 248, pl. 42, fig. 15a, b; Beu, 1998, p. 134, fig. 23q (with further synonymy); Okutani, 2000, p. 289, pl. 143, fig. 22.
Charonia rubeculum. – Skwarko & Sufiati, 1994, p. m5.

Type material – *Murex rubecula* Linné, lectotype (of Beu, 1987, p. 290) the smallest of five syntypes in Linné's collection housed by the Linnean Society of London, and the smaller of two syntypes that are the red species *Cymatium rubeculum*. Beu (1998, p. 135) designated the lectotype as the neotype of *Septa scarlatina* Perry and the type locality as the Philippine Islands.

Other material examined – Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 42, Pleistocene? (1, abraded), locality 78, Pliocene-Pleistocene (RGM 456 289, 1 good; Figs. 262, 263); RGM 107 515, Kaju Ragi, Manado Island, Sulawesi, Pleistocene (1 small, good; Figs. 260, 261).

Distribution – *Cymatium rubeculum* occurs at present throughout the Indo-West Pacific region, from eastern South Africa and East Africa to Hawaii, and from southern Japan to the southern Great Barrier Reef in Australia. It is the most common species of the subgenus *Cymatium (Septa)* throughout this region, but is replaced in the Red Sea by the more coarsely sculptured species *C. marerubrum* Garcia-Talavera, 1985. The fossils recorded here are the only ones I am aware of.

Remarks – Of the specimens recorded as *Cymatium rubeculum* from Nias Island, off the southwest coast of Sumatra, by Wissema (1947), two relatively small specimens have the narrow, parallel-sided outlines and coarse axial ridgelets characteristic of *C. rubeculum*. Therefore, these seem likely to be correctly identified, despite the lack of a colour pattern. The only other fossil record from Indonesia is that of Schepman (1907), from the Pleistocene of Sulawesi and, of course, it is uncertain which species this refers to.

Subgenus *Turritriton* Dall, 1904

Turritriton Dall, 1904, p. 134. Type species (by original designation): *Triton gibbosus* Broderip, 1833, Pleistocene and Recent, eastern Pacific.

Tritoniscus Dall, 1904, p. 134. Type species (by original designation): *Triton loroisii* Petit de la Saussaye, 1852 (= *Murex labiosus* Wood, 1828), Pliocene to Recent, Indo-West Pacific and Atlantic.

Particymatium Iredale, 1936, p. 307. Type species (by original designation): *Triton strangei* A. Adams & Angas, 1864 (= *Murex labiosus* Wood, 1828).

Remarks – The species of *Cymatium (Turritriton)* were reviewed by Beu & Knudsen (1987), although I conclude here that *C. tenuiliratum* (Lischke) and similar species (*C. pharcidum* (Dall, 1889), Atlantic; *C. fittkaui* Parth, 1991, western Pacific) also belong in this subgenus. Another species that obviously belongs here is *C. grundense* (Hoernes & Auinger, 1879), Middle Miocene, Europe. The distinctive character of the subgenus is the fine spiral sculpture of narrow, sharply defined spiral cords grouped in threes, each primary cord consisting of a central, raised cord with a lower one on each side – a fasciculate pattern. Another character that seems likely to be diagnostic is the tall, "waisted" central tooth demonstrated for *C. (Turritriton) labiosum* by Bandel (1984, fig. 158; pl. 10, fig. 2), but the radula has not been reported for any of the other species assigned here.

Cymatium (Turritriton) labiosum (Wood, 1828)

Figs. 267, 268.

Murex labiosus Wood, 1828, p. 15, pl. 5, fig. 18.
Tritonium rutilum Menke, 1843, p. 25.
Triton labiosus. – Reeve, 1844a, pl. 14, fig. 52.
Triton loroisii Petit de la Saussaye, 1852, p. 53, pl. 2, fig. 8.
Triton strangei A. Adams & Angas, 1864, p. 35.
Triton loebbeckei Lischke, 1870, p. 23; Lischke, 1871, p. 36, pl. 4, figs. 13, 14; Higo *et al.*, 2001, p. 48, fig. G1589s.
Triton (Gutturnium) orientalis Nevill & Nevill, 1874, p. 29.
Cymatium spec. – van Regteren Altena, 1942, p. 105; Skwarko & Sufiati, 1994, p. m10 (in part).
Cymatium (Cabestana) labiosum. – Clench & Turner, 1957, p. 201, pl. 111, figs. 9, 10; pl. 116, fig. 1.
Cymatium (Turritriton) labiosum. – Beu, 1985, p. 60, fig. 23; Beu & Knudsen, 1987, p. 74, figs. 3, 6-14; Henning & Hemmen, 1993, p. 102, pl. 22, figs. 4, 5; Wilson, 1993, p. 248, pl. 42, fig. 4a, b; Beu, 1998, p. 135, figs. 33c, 42m-o (with further synonymy); Beu, 1999, p. 42, figs. 80-83 (with further synonymy); Okutani, 2000, p. 289, pl. 143, fig. 26 (upper fig. only).
Cymatium (Cymatriton) nicobaricum. – Noda, 2002, p. 106, fig. 18-3a, b (not *Tritonium nicobaricum* Röding, 1798).

Type material – *Triton strangei* A. Adams & Angas, holotype BMNH 1870.10.26.99, from Moreton Bay, Queensland, Australia. This specimen was designated by Beu (1998, p. 136) as the neotype of both *Murex labiosus* Wood and *Tritonium rutilum* Menke. *Triton loroisii* Petit de la Saussaye, five syntypes in MNHN, from Guadeloupe, western Atlantic. *Triton loebbeckei* Lischke, holotype (Beu, 1998, fig. 33c) in Löbbecke Museum und Aquazoo, Düsseldorf, from "Nagasaki", Japan. *Triton orientalis* Nevill & Nevill, types in the Indian Museum, Calcutta, not seen; from the Andaman Islands.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M123 (1, incomplete, identified by van Regteren Altena as "*Cymatium* spec."), M347 (RGM 456 291, 1 complete, identified by van Regteren Altena as "*Cymatium* spec."; Figs. 267, 268); Sangiran, mid-Java, Late Pliocene (2, in collection of B. Dharma).

Distribution – *Cymatium labiosum* is one of the most widely distributed of all benthic molluscs, occurring throughout both the Indo-West Pacific and Atlantic regions. It ranges from Natal, South Africa, East Africa and the Red Sea to Hawaii and the Marquesas Islands and, rarely, to the eastern Pacific; from central Honshu, Japan, to northern New Zealand (as far south as Auckland); and from Cape Hatteras, North Carolina to Bahia, northern Brazil, and at the Canary and Cape Verde Islands. Fossils are recorded only from Late Miocene and Pliocene rocks of Okinawa and Java, but their small size has made the identity of specimens of *C. labiosum* obscure and many occurrences are probably unrecorded.

Remarks – *Cymatium labiosum* is easily recognised by its small size (few specimens exceed 25 mm in height), relatively short, wide shape, simple, unsculptured aperture and the dominantly spiral sculpture with the cords arranged in a fasciculate pattern, i.e., with three narrow secondary cords on each primary cord, the central one of the three protruding slightly above the others. Fine axial ridgelets cross the spiral sculpture, and form a very finely beaded surface. Two of the unidentified specimens from the Kendeng beds recorded by van Regteren Altena (1942, p. 105) are specimens of *C. labiosum* and others have now been collected by Bunjamin Dharma from Sangiran, central Java.

Cymatium (Turritriton) tenuiliratum **(Lischke, 1873)**

Figs. 222, 223.

Triton tenuiliratus Lischke, 1873, p. 20; Lischke, 1874, p. 30, pl. 2, figs. 18, 19.
Turritriton tenuiliratum. – Habe, 1961, p. 45, pl. 22, fig. 7; Habe, 1964, p. 72, pl. 22, fig. 8.
Reticutriton tenuiliratus. – Kuroda *et al.*, 1971, p. 127, pl. 29, fig. 1.
Cymatium (Turritriton) tenuiliratum. – Beu, 1985, p. 60, fig. 22; Henning & Hemmen, 1993, p. 104, pl. 22, figs. 1, 2.
Cymatium (Monoplex) tenuiliratum. – Beu, 1998, p. 101, figs. 23g, 33a (with further synonymy); Beu, 1999, p. 33, figs. 65-67 (with further synonymy); Okutani, 2000, p. 287, pl. 142, fig. 15.

Type material – *Triton tenuiliratus* Lischke, holotype (Beu, 1998, fig. 33a) in Löbbecke Museum und Aquazoo, Düsseldorf, from “Süd-Japan”.

Other material examined – RGM 312 444, Mangkalihat Peninsula, Borneo, locality L114, Miocene? (1 good, complete specimen, unusually short; presumably the specimen identified by Beets (1941, p. 91) as *Cymatium (Lampusia) pileare*, “ein fast ganz erhaltenes Exemplar”); RGM 456 278, Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene? (3 good, incomplete; Figs. 222, 223); Nyalindung, West Java, Late Miocene, collected by B. Dharma (GNS WM17435, 1; 1 specimen in collection of B. Dharma).

Distribution – *Cymatium tenuiliratum* occurs widely, but uncommonly, throughout the Indo-West Pacific region, from Boso Peninsula, Honshu, central Japan, south to Indonesia and New Caledonia, but not recorded from further eastwards; Beu (1998, p. 101) recorded a single specimen from Somalia, in the Indian Ocean. Fossils are moderately common in southern Japan in Pliocene and Pleistocene rocks (nine references listed by Beu, 1998, p. 101), but the Indonesian specimens recorded here are the only other fossils I am aware of.

Remarks – Specimens in the RGM collection from the Mangkalihat Peninsula, Borneo, and Pendopo, Sumatra, are fairly typical, though relatively short, specimens of *Cymatium tenuiliratum*. This species was named from the Japanese Recent fauna, but is now recognised as occurring throughout the Indo-West Pacific (Beu, 1998, p. 101). Important characters are the tall, narrow shape, the fasciculate pattern of spiral cords, with each primary cord consisting of a group of three narrow spiral ridges, the central one higher than the one on each side, and the relatively heavy, prominent, but thin varices.

The Pliocene specimens from the “Kendeng beds” and Sangiran, Java, reported above are typical, short specimens of *Cymatium labiosum*, closely resembling Indo-West Pacific and Atlantic Recent specimens. Two Late Miocene specimens seen from Indonesia, collected recently by Bunjamin Dharma from Nyalindung, West Java, resemble *C. labiosum* in sculpture, but are much taller and narrower than any Recent specimens seen, with a tall spire and a long, straight anterior siphonal canal. They are, therefore, very similar indeed to *Cymatium (Turritriton) domingense* (Gabb, 1873) from Miocene and Early Pliocene rocks of the Dominican Republic, Caribbean. However, comparison with the much larger Mangkalihat Peninsula specimens of *C. tenuiliratum* demonstrated clearly that the Nyalindung specimens are small specimens of the shallow-water form of *C. tenuiliratum*. The prominent spiral sculpture arranged in obvious fasciculate groups of three narrow cords, crisply reticulated by the prominent, but very narrow, axial ridgelets, is identical in all specimens. This sculpture becomes weaker down the shell on the larger Mangkalihat specimens, so that the last whorl bears lower, but still clearly fasciculate, cords as in Recent Japanese shallow-water material of *C. tenuiliratum*.

Until now I have referred *Cymatium tenuiliratum* to the subgenus *Cymatium (Monoplex)*, but the Indonesian material is important for demonstrating that it should actually be referred to *Cymatium (Turritriton)*. Comparison of radulae to determine whether or not *C. tenuiliratum* has the tall, "waisted" central tooth of *C. (Turritriton) labiosum* (Bandel, 1984, fig. 158; pl. 10, fig. 2) would help understand the relationships of this species, as well as the probable synonym *C. pharcidum* (Dall, 1889) (Atlantic), and the closely related western Pacific species *C. fittkaui* Parth, 1991. These all are quite similar in most characters to the southern European Neogene species *C. distortum* (Brocchi, 1814) and it seems plausible that the Recent species have descended from the European fossil. The occurrence of Late Miocene or Early Pliocene specimens in Indonesia then provides a complex scenario for the evolution of this species group.

Genus *Sassia* Bellardi, 1873

Sassia Bellardi, 1873, p. 219. Type species (by subsequent designation, Cossmann, 1903a, p. 93): *Triton apenninicum* Sassi, 1827, Miocene and Pliocene, Europe.

Cymatona Iredale, 1929, p. 177. Type species (by original designation, Iredale, 1929, p. 189): *Nassaria kampyla* Watson, 1886, Pliocene to Recent, circum-Southern Ocean.

Charoniella Powell & Bartrum, 1929, p. 426. Type species (by original designation): *Charonia (Charoniella) arthritica* Powell & Bartrum, 1929, Early Miocene, New Zealand (junior homonym of *Charoniella* Thiele, 1929 = *Austrotriton* Cossmann, 1903a).

Austrosassia Finlay, 1931, p. 7. Type species (by original designation): *Septa parkinsonia* Perry, 1811, Pleistocene and Recent, New Zealand and southeastern Australia.

Phanozesta Iredale, 1936, p. 309. Type species (by original designation, Iredale, 1936, p. 336): *Phanozesta remensa* Iredale, 1936, Recent, southwest Pacific (= *Triton apenninicum* Sassi, 1827?).

Proxicharonia Powell, 1938, p. 373. Replacement name for *Charoniella* Powell & Bartrum, 1929, preoccupied.

Remarks – I previously have listed *Monocirsus* Cossmann, 1889, as a further synonym of *Sassia* (e.g., Beu, 1998, p. 139), but examination of the excellent Paris Basin Eocene material in the collection of Jacques le Renard (MNHN) has demonstrated that *Monocirsus* is a very strongly distinct genus of tiny, thin-shelled tonnoideans, probably referable to Family Laubierinidae rather than Ranellidae.

Subgenus *Cymatiella* Iredale, 1924

Cymatiella Iredale, 1924, p. 253. Type species (by original designation): *Triton quoyi* Reeve, 1844a (= *Triton verrucosus* Reeve, 1844a), Pliocene to Recent, southern and eastern Australia.

Vernotriton Iredale, 1936, p. 308. Type species (by original designation, Iredale, 1936, p. 336): *Charonia pumilio* Hedley, 1903, Recent, southern Queensland and northern New South Wales, Australia.

Remarks – Species of the subgenus *Sassia (Cymatiella)* are characterised by their small size and correspondingly small, turbiniform protoconch, the relatively tall spire and very short anterior siphonal canal, the weakly concave sutural ramp, and (in most species, at least) the subdued sculpture of low spiral cords and axial costae. The relatively small aperture is weakly armed in most species. This is a well-defined group of small *Sassia* species that occurs in the Paris Basin Eocene, in the Miocene (and Early Pliocene?) of the Central American area (Dominican Republic and Jamaica; Beu, research in progress), in the Miocene and Pliocene of Indonesia, and in the Miocene to Recent of southern Australia. This, therefore, seems to be a classic example of a group that has managed to avoid extinction in its area of origin, the Tethys Ocean, by being transported (as planktotrophic larvae in ocean currents) to the opposite side of the world. Details of the content and range of the subgenus are still coming to light.

Sassia (Cymatiella) fennemai **(Martin, 1899)**

Figs. 270-280.

Triton (Colubraria) fennemai Martin, 1899, p. 141, pl. 22, fig. 322; Martin, 1914a, p. 330.
Eutritonium (Sassia) fennemai. – Martin, 1916, p. 242; Wanner & Hahn, 1935, p. 256.
Eutritonium fennemai. – Martin, 1919, pp. 87, 126, 130; van der Vlerk, 1931, p. 239; Pannekoek, 1936, p. 6.
Charonia (Sassia?) fennemai. – Beets, 1941, p. 91.
Charonia (Sassia) fennemai. – Beets, 1983, p. 29; Beets, 1986a, p. 28; Skwarko & Sufiati, 1994, p. m7; van den Hoek Ostende *et al.*, 2002, p. 35.

Type material – Triton (Colubraria) fennemai Martin, illustrated syntype RGM 9775, Selatjau [Selacau], Java, Late Miocene (Martin's (1899) fig. 322, 322 a-c; Figs. 272, 273); 1 syntype RGM 9776, Njaliendoeng [Nyalindung], Java, Preanger [Priangan] (Figs. 276, 277); 1 syntype RGM 9777, Tjadasngampar [Cadasngampar], Java, Preanger [Priangan]; 1 syntype RGM 9778, Kembang Sokkoh [Kembangsokoh], Residence of Jogjakarta, Java, Miocene; 1 syntype RGM 46 962, Ngampel, Rembang, Java, Middle Miocene (Figs. 274, 275).

Other material examined – RGM 9780, Ngampel, Java, Rembang beds, Middle Miocene (1); Citalahab, West Java, Late Miocene, presented by B. Dharma (GNS WM17245, 2, Figs. 279, 280; plus one in collection of B. Dharma, Fig. 278); Robba's Middle Miocene Rembang locality RMG2, mid-Java (2, in Università di Milano-Bicocca); RGM 312 447, Mangkalihat Peninsula, Kalimantan Timur (East Borneo), Miocene (1 small, immature; Figs. 270, 271).

Distribution – Sassia (Cymatiella) fennemai occurs only in Middle and Late Miocene rocks of Java.

Remarks – Sassia (Cymatiella) fennemai is one of the largest species of the subgenus, reaching *c.* 30 mm in height, whereas few specimens of the typical southern Australian living species exceed 20 mm in height. Large specimens are rather heavy, more solid in appearance than usual for *S. (Cymatiella)* species, with a strongly concave, narrow sutural ramp, but immature and half-grown specimens closely resemble *S. verrucosa* (Reeve) in all characters. The interior of the outer lip has the second nodule from the top (i.e., from the posterior end) enlarged above its neighbours, giving the aperture an appearance resembling that of *Sassia (Personella)* species as much as that of *S. (Cymatiella).*

Sassia (Cymatiella) menkrawitensis **(Beets, 1941)**

Figs. 281, 282.

Charonia (Sassia?) menkrawitensis Beets, 1941, p. 92, pl. 5, figs. 194-198; Beets, 1986a, p. 28; Skwarko & Sufiati, 1994, p. m7.

Type material – I have not seen the holotype of *Charonia (Sassia?) menkrawitensis*, stated by Skwarko & Sufiati (1994, p. m7) to be in IAUU, and so presumably now in RGM (but not unpacked as yet), from loc. 144, Kali Orang, Kalimantan Timur (East Borneo) (presumably the locality recorded by Beets (1986a) as the Sangkulirang area, Kalimantan Timur, Gelingseh Formation); 1 paratype RGM 312 449, from Mangkalihat Peninsula, Kalimantan Timur (Figs. 281, 282).

Distribution – Known only by the type material.

Remarks – It seems possible that *Sassia menkrawitensis* is based on specimens of two distinct species. The holotype (Beets, 1941, figs. 194, 195), from the Gelingseh formation of Kari Orang, East Borneo (Kalimantan), seems to be a small specimen of a species closely resembling *S. fennemai* (Martin), with a well-callused aperture similar to that of *S. fennemai*, but with larger and more obviously triangular peripheral nodules. The paratype illustrated by Beets (1941, figs. 197, 198), from the Mangkalihat Peninsula, is more strongly biconic, with a much more gradually tapered base, with larger, more conical peripheral nodules and with a much more weakly callused and more widely open aperture than the holotype. However, it is possible that the paratype is simply an immature specimen and comparison of a larger number of adult specimens is desirable.

Sassia (Cymatiella) **sp. nov.**

Material examined. – Citalahab, West Java, Late Miocene (1, in collection of B. Dharma).

Remarks. – A single specimen in the collection of B. Dharma is an interesting addition to Pacific *Sassia (Cymatiella)* diversity, as it is small, moderately tall-spired, relatively finely sculptured and close in general appearance to the southern Australian living species, particularly *S. (Cymatiella) verrucosa* (Reeve, 1844a). Again, this new species requires more material before it can be named and was brought to light too late in the project to be illustrated.

Family Tonnidae Suter, 1913 (1825)
Genus *Eudolium* Dall, 1889

Doliopsis Monterosato, 1872, p. 49. Type species (by monotypy): *Dolium crosseanum* Monterosato, 1869, Recent, Mediterranean and Atlantic (junior homonym of *Doliopsis* Vogt, 1852, and *Doliopsis* Conrad, 1865).

Eudolium Dall, 1889, pp. 20, 232. Replacement name for *Doliopsis* Monterosato, 1872, preoccupied.

Galeodolium Sacco, 1891, p. 228. Type species (by subsequent designation, Vokes, 1986, p. 178): *Cassidaria mutica* Michelotti, 1861, Oligocene, Italy.

Tuberculodolium Sacco, 1891, p. 233. Type species (by subsequent designation, Vokes, 1986, p. 178): *Eudolium antiquum* Sacco, 1891, Oligocene, Italy. (The holotype of *E. antiquum* was illustrated by Ferrero-Mortara *et al.* (1984, pl. 3, fig. 5). It was said to be "taller and narrower than *Eudolium* species" by Bouchet & Warén (1993, p. 797), but in my opinion it is a poorly preserved *Eudolium* specimen with the outer lip broken back).

Remarks – Some authors have considered *Simplicidolium* Sacco, 1891, to be a further synonym of *Eudolium* Dall, 1889, but Bouchet and Warén (1993, p. 797) considered that it is a synonym of *Tonna;* see under *Tonna,* below. Marshall (1992, p. 25) pointed out that the type designations for *Galeodolium* and *Tuberculodolium* of Sacco, 1891, by Cossmann (1903a) are invalid, and the designations were first made validly by Vokes (1986).

The attempt to classify the Indonesian fossils has shone light on the distinction between shells of the Cassidae (particularly *Galeodea*) and Tonnidae (particularly *Eudolium*). There is little problem distinguishing these genera in the Recent fauna, because of the larger, much thinner, more brightly coloured shells of *Eudolium* than of *Galeodea* species. The exteriors of the teleoconchs of *Galeodea* species all are white or cream to pale red-brown, whereas those of *Eudolium* species are pale to quite bright red-brown, maculated in various ways with paler and/or darker colour and, in *E. bairdii* (Verrill & Smith *in* Verrill, 1881), the spiral cords are darker than their background, forming a spirally banded colour pattern. In the absence of these characters in fossils, though, what characters remain as reliable guides to family position? Perhaps the most distinctive character of all Tonnidae is the very large (4-6 mm in diameter), multiwhorled, low-turbiniform, superficially smooth protoconch, very much larger than the small (1-1.5 mm in diameter) protoconch of one whorl in *Galeodea*. This distinction falls down with *Cypraecassis*, though, as *Cypraecassis* species have huge protoconchs similar to those of Tonnidae, to 8.5 mm high and 6.5 mm diameter in *C. rufa* (Linné, 1758). The other distinctive tonnid character is the long, straight anterior canal, passing into the columella with little or no bend or obvious distinction of any kind, quite different from the weakly to strongly twisted canal of cassids, distinguished from the columella in virtually all species by a marked bend or inflection. The combination of an almost completely straight anterior canal, confluent with the straight lower part of the columella, and the very large, obvious, superficially smooth protoconch allows the unambiguous recognition of species of Tonnidae. It has allowed the recognition that several species assigned to *Galeodea* by Martin in several papers, by Beets (1943b) and by Pannekoek (1936) actually belong in *Eudolium*. The diversity of the Tonnidae is increased significantly in the present report.

The distinction between *Eudolium* and *Tonna* is subtle. Species assigned to *Eudolium* have narrow, relatively widely spaced spiral cords with a range of narrow, widely spaced secondary and tertiary spiral threads, crossed by low, narrow, but crisp and well raised axial ridgelets (Marshall, 1992). Species assigned to *Tonna* mostly are larger than those assigned to *Eudolium*, most have a shorter and less obvious columellar base and anterior canal, and they supposedly have wider spiral cords and narrower spiral interspaces than *Eudolium* species. However, SEM examination of juvenile specimens of *Tonna galea* (type species of *Tonna* Brunnich, 1772) showed that it has narrow, widely spaced spiral cords, elaborate secondary and tertiary spiral threads in the wide, gently concave spiral interspaces and much fine, sharp axial sculpture early in its ontogeny, and at this stage closely resembles *Eudolium* species in all characters. There is some evidence that *Tonna* has been applied to the more robust, large-shelled species that live in relatively shallow water, whereas *Eudolium* has been applied to the more thin-shelled, finely sculptured, offshore species; the two seem to intergrade. If this is one intergrading genus, it would help explain the anomalous fossil record of *Tonna*, which seems to appear abruptly in the fossil record early in the Neogene (Miocene of Indonesia and the Dominican Republic), whereas species assigned to *Eudolium* are known from at least Eocene time onwards. They include a number of other species, from localities other than in Indonesia, usually placed in *Galeodea*, such as "*Galeodaria*" *shubutensis* (Aldrich, 1885) and "*G.*" *tricarinata* (Conrad, 1860) (MacNeil & Dockery, 1984, pp. 107-108, pl. 4, figs. 1, 2; pl. 17, figs. 1-4; pl. 29, figs. 20-22; pl. 49, figs. 9-13); MacNeil & Dockery (1984, p. 107) described the "very fine raised axial microsculpture" of *G. shubutensis*. (The type species of *Galeodaria* Conrad, 1865, *Morio petersoni* Conrad, 1854, is a species of *Galeodea* (Schenck, 1926, pl. 14, figs. 3, 4), so *Galeodaria* is yet another synonym of *Galeodea* rather than an earlier name for *Eudolium*.) The progressively better representation of near-shore taxa in younger and younger rocks then might well explain the "appearance" of *Tonna* relatively late in the history of the Tonnidae. It also is feasible that tonnids have invaded the shallow-water, near-shore habitat relatively recently, i.e., only in Miocene time. Rather than a separate clade, *Eudolium* might then represent a "background grade" from which a variety of *Tonna* species have evolved as they entered shallower water. In either case, the species of these "genera" seem likely to be polyphyletic, and the continued separation of *Eudolium* from *Tonna* is probably not tenable in the long run.

***Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881)**

Figs. 283, 284.

Dolium bairdii Verrill & Smith *in* Verrill, 1881, p. 299; Verrill, 1882, p. 515; Verrill, 1884, p. 253, pl. 29, fig. 2a, b.

Dolium (Eudolium) crosseanum. – Dall, 1889, p. 134, pl. 15, fig. 5, pl. 44, fig. 2, pl. 62, figs. 83, 83a; Dautzenberg & Fischer, 1906, p. 38 (not *D. crosseanum* Monterosato, 1869).

Dolium biornatum Tate, 1894, p. 173, pl. 10, fig. 5 (new synonym).

Dolium (Eudolium) crosseanum var. *solidior* Dautzenberg & Fischer, 1906, p. 38, pl. 3, fig. 1.

Morio lineata Schepman, 1909, p. 124, pl. 10, fig. 5.

Dolium (Eudolium) bituminatum Martin, 1933, p. 29, pl. 4, fig. 29; Martin, 1935, p. 117, pl. 2, fig. 10 (new synonym).

Eudolium lineatum. – Osima, 1943, p. 133, pl. 5, fig. 1; Okutani, 2000, p. 281, pl. 139, fig. 2.

Eudolium inflatum Kuroda & Habe, 1952, p. 56 ("replacement name" for *Eudolium lineatum* Osima, 1943, supposedly not conspecific with *Morio lineata* Schepman, 1909); Kira, 1962, p. 59, pl. 23, fig. 4.

Eudolium kuroharai Azuma, 1960, p. 98, pl. 1, fig. 8, text-fig. 1; Higo *et al.*, 2001, p. 46, fig. G1523s.

Eudolium bairdii. – Marshall, 1992, p. 33, figs. 10-19, 22, 31-36, 38 (with further synonymy); Wilson, 1993, p. 252, pl. 39, fig. 3.

Tonna (Eudolium) bituminatum. – Skwarko & Sufiati, 1994, p. k13.

Type material – Marshall (1992, p. 34) listed the type material of *Dolium bairdii* and its Recent synonyms. *Dolium biornatum* Tate, 1894, holotype in South Australian Museum, Adelaide, Tate Type Collection no. T.854, from Fyansford, near Melbourne, Victoria, Balcombian Stage (Middle Miocene). *Dolium bituminatum* Martin, 1933, holotype (Figs. 283, 284) RGM 15 224, from Waisiu, Buton Island, in bituminous sandstone (Late Miocene).

Distribution – *Eudolium bairdii* occurs at present throughout the Indo-West Pacific and Atlantic-Mediterranean regions. The type locality is off Barnegat, New Jersey; specimens are recorded from there south to off French Guiana. In the eastern Atlantic, specimens are recorded from the Azores, the Canary Islands and off Morocco, with a single record from off Sicily in the Mediterranean Sea. In the Indian Ocean, specimens are recorded from Natal, South Africa to Madagascar and Réunion, as well as off north-western Australia. In the western Pacific, specimens are recorded from southern Japan (at least as far north as Tosa Bay, Shikoku) south to eastern Australia and northern New Zealand (as far south as Mayor Island, Bay of Plenty) (Marshall, 1992, fig. 38). Although there have not been any previous records from east of New Caledonia and the Loyalty Islands, seven specimens in MNHN are from the Marquesas Islands, so *E. bairdii* probably occurs very widely throughout the Indo-West Pacific region. The fossils reported here from Indonesia and southern Australia are the only ones I am aware of, although it seems likely that *E. bairdii* has been reported as a fossil from southern Japan and Taiwan under other names.

Remarks – The holotype of *Eudolium bituminatum* is a typical species of *Eudolium*, indistinguishable from Recent specimens of *E. bairdii*. The sculpture of the holotype of *E. bituminatum* is of widely spaced, well-raised, sharply defined spiral cords, with one secondary cord and several fine tertiary threads in each spiral interspace, and with small, prominent nodules on the primary peripheral cords, all crossed by many fine, close, sharply defined axial ridgelets. The aperture is widely open and weakly callused, with a narrowly reflected outer lip, as in *E. bairdii*. The sculpture of the holotype of *E. bituminatum* is a little coarser than on most specimens of *E. bairdii* seen, but is within the range of variation of *E. bairdii* illustrated by Marshall (1992, figs. 11-19). There is little doubt that *E. bituminatum* is simply another synonym of *E. bairdii.*

Eudolium bairdii differs from *E. javanum* (= *E. pyriforme* (G.B. Sowerby 3rd); see below) in its slightly coarser axial ridgelets, in having fine nodules on the spiral cords that are absent from *E. javanum*, in its thicker and, in some specimens, markedly wider terminal varix, and in having a distinctive spiral colour pattern of dark brown spiral cords on a paler ground, whereas *E. javanum* has an irregularly marbled and spotted colour pattern, in many specimens with alternating paler and darker spots on the spiral cords. Many specimens of *E. javanum* also are a little more elongate than those of *E. bairdii.*

Inclusion of *Dolium biornatum* Tate (1894) in the synonymy calls for comment, as this provides a Middle Miocene record of *E. bairdii* in the Indo-West Pacific, along the southern coastline of Australia. The holotype was examined at Museum Victoria. This cracked and rather distorted specimen is *c.* 50 mm high and bears remnants of a large tonnid protoconch. It has 10-12 primary spiral cords, 12-14 more closely spaced cords on the base and canal, and one secondary cord and several very fine tertiary threads in each spiral interspace. The surface bears many fine, low axial ridgelets and the spiral cords bear many closely spaced, low, rounded nodules. *Dolium biornatum,* therefore, also is indistinguishable from *E. bairdii*. One other complete specimen has been examined, in Museum Victoria (P.26520), from Muddy Creek, near Hamilton, western Victoria, also Balcombian. This is much less distorted than the holotype and is similar in shape to Recent specimens of *E. bairdii* (H 47.2, D 29.9 mm) with much more clearly defined axial ridgelets than the holotype of *D. biornatum*. It bears obvious small nodules on the uppermost peripheral spiral cord. An incomplete specimen in GNS (WM 11336), also from Muddy Creek, western Victoria, also is closely similar in shape, axial ridgelets, and small nodules on the spiral cords to Recent specimens of *E. bairdii*, although this specimen apparently had an unusually tall spire.

Eudolium erbi (Haanstra & Spiker, 1932)

Figs. 285-291.

Cassidaria erbi Haanstra & Spiker, 1932, p. 1321, figs. 16-18.
Galeodea erbi. – Beets, 1943b, p. 440; Skwarko & Sufiati, 1994, p. k6.

Type material – *Cassidaria erbi* Haanstra & Spiker, holotype in IAUU, from lower Palembang Formation (Late Miocene- Pliocene?), Palembang, southeastern Sumatra; not seen.

Other material examined – Pendopo Oilfield, 16 km east of Talang Akar, Sumatra, Late Miocene-Pliocene? (RGM 456 292-4, 47; Figs. 285-291).

Distribution – *Eudolium erbi* is recorded only from Neogene rocks of Sumatra.

Remarks – Although *Eudolium erbi* was classified in *Galeodea* by Beets (1943b) and has a general similarity to this genus, it is referred here to *Eudolium* because of its large, rather low, wide tonnid protoconch, its straight columella and anterior siphonal canal, and its axial sculpture of fine, low, sharply defined threads. I have not seen the original material, but the illustrations by Haanstra & Spiker (1932, figs. 16-18) show a relatively weakly sculptured shell, very similar to "*Galeodea*" *errabunda* Beets, but with a slightly wider shape and one or two extra rows of low nodules below the periphery. The type material is from southeastern Sumatra, from the Residences of Benkoelen [Bengkulu] and Palembang, probably Pliocene in age. Beets (1943b, pp. 440-41) differentiated *E. erbi* from *E. errabundum* by several minor characters, such as the shell having a "plumper" (more inflated) shape, the varix having a convex rather than flat outer surface, the peripheral nodules being more equidimensional (less spirally elongate) and in the presence of 1-2 extra rows of small, weakly defined nodules in *E. erbi* than in *E. errabundum*. All these characters might well be variable within one species and *E. errabundum* seems likely to be part of the variation of *E. erbi*, but more material is required to clarify the relationship of these nominal species.

The specimens referred to *Eudolium erbi* from the Pendopo Oilfield, Sumatra (RGM 456 292-RGM 456 294), are quite variable. The largest (Figs. 285-287) is still small for the genus (41 mm high), with prominent, wide, strap-like spiral cords and a prominent, spout-like posterior apertural canal. Some specimens have larger, more equidimensional nodules (Figs. 288-291) in a variable number of rows. Some of the medium-sized specimens greatly resemble the holotype of *E. erbi* in the original illustration (Haanstra & Spiker, 1932, figs. 16-18), while one of the smaller, complete specimens is amost identical to the holotype of *E. errabundum.* This material therefore reinforces the idea that *E. errabundum* is a synonym of *E. erbi*.

***Eudolium errabundum* (Beets, 1943b)**
Figs. 292-294.

Galeodea errabunda Beets, 1943b, p. 439, pl. 1, figs. 7-9; Skwarko & Sufiati, 1994, p. k6.

Type material – *Galeodea errabunda* Beets, holotype RGM 42 325, from “locality 1444, Madura, from a collection of the “Bataafsche Petroleum My.”, “equivalent to the Javanese Rembang fauna”, i.e., Middle Miocene (Figs. 292-294).

Distribution – Known only by the holotype.

Remarks – As with *Eudolium erbi*, the holotype of *E. errabundum* resembles *Galeodea* in many characters, but its large multiwhorled tonnid protoconch, and straight columella and siphonal canal demonstrate that it actually is a species of *Eudolium*. It is a small shell for *Eudolium* (H 25.1, D 17.4 mm), sculptured with prominent, narrow, well-raised, rather widely spaced spiral cords and two peripheral rows of small, sharp, spirally elongate nodules, as well as very fine, sharp axial ridgelets. The axial ridgelets are well preserved, obvious and widely spaced in a few places – particularly above the posterior end of the terminal varix and alongside some of the major spiral cords – but somewhat abraded elsewhere. They do not cross the spiral cords in most places, but do so above the varix, suggesting that they have been abraded off the cords elsewhere. The wide, flat spiral interspaces each bear a central secondary cord. The interior of the outer lip is strongly thickened, with many narrow transverse ridges, and stops abruptly at the anterior end to form a very obvious anterior channel that completely lacks any cassid twist towards the side or the dorsum. The posterior edge of the terminal varix is very sharply defined by a deep, narrow groove, an infolding of the shell surface, and the varix has a flat outer face, parallel to the whorl surface. The outer edge of the varix is weakly sinuous in lateral view, protruding a little over a wide central area to form a low sinus anteriorly and posteriorly. Most unusually, the inner area of the columella bears three very prominent, high, narrowly rounded transverse ridges spaced widely down the length of the lower half of the columella and an anteriorly decreasing series of three similarly prominent ridges is present on the inner edge of the columellar base, opposite the abrupt termination of the inner edge of the terminal varix. A closely similar anterior “spout” is present also in *E. erbi*, including the material from the Pendopo Oilfield.

Eudolium javanum (Martin, 1879)

Figs. 295-300.

Cassidaria javana Martin, 1879, p. 46, pl. 8, figs. 9, 10; Martin, 1919, p. 89; van der Vlerk, 1931, p. 241.

Dolium pyriforme. – G.B. Sowerby 3rd, 1914, p. 37, pl. 2, fig. 14 (new synonym).

Galeodea javana. – Beets, 1943b, p. 436; Skwarko & Sufiati, 1994, p. k6; van den Hoek Ostende *et al.*, 2002, p. 33.

Eudolium pyriforme. – Osima, 1943, p. 131, pl. 5, fig. 4; Kira, 1959, p. 55, pl. 22, fig. 5; Garrard, 1961, p. 17; Kira, 1962, p. 59, pl. 23, fig. 6; Habe & Kosuge, 1967, p. 66, pl. 25, fig. 12; Kuroda *et al.*, 1971, p. 135, pl. 37, fig. 4; Powell, 1974, p. 201; Cernohorsky, 1976, p. 1, fig. 1; Cernohorsky, 1978a, p. 61, pl. 16, fig. 7; Powell, 1979, p. 163; Kosuge, 1985, p. 59, pl. 22, fig. 6; Kilburn, 1986, p. 4, fig. 11; Okutani *et al.*,1988, p. 78, fig. 46; Marshall, 1992, p. 32, figs. 5-8, 21, 27-30, 37; Wilson, 1993, p. 252, pl. 39, fig. 6; Okutani, 2000, p. 281, pl. 139, fig. 1; Higo *et al.*, 2001, p. 46, fig. G1522.

Type material – *Cassidaria javana* Martin, illustrated syntype RGM 9990 (Figs. 297, 298), here designated the lectotype of *Cassidaria javana* Martin, 1879, from Junghuhn's locality K, southwestern Java, Late Miocene (spiral cords narrow); 1 paralectotype RGM 9991 (Figs. 295, 296), Junghuhn's locality K, southwestern Java, Late Miocene (incomplete, aperture and part dorsum only, with wide spiral cords); 1 paralectotype RGM 9992, Junghuhn's locality L, Java, Neogene; 1 paralectotype RGM 9992, Junghuhn's locality L, Java, Preanger [Priangan], Middle Miocene (a poorly preserved juvenile, spiral cords narrow; not certainly congeneric or conspecific with the lectotype; Figs. 299, 300). As the last-mentioned paralectotype is not certainly conspecific with the lectotype, it is necessary to designate Martin's illustrated syntype as the lectotype of *Cassidaria javana* Martin, 1879. *Dolium pyriforme* G.B. Sowerby 3rd, holotype BMNH 1915.1.6.148, from "Kii, Japan".

Distribution – *Eudolium javanum* is the species identified by Marshall (1992) as *E. pyriforme* (G.B. Sowerby 3rd). It is widespread in the Indo-West Pacific Recent fauna, from southern Japan (as far north as Tosa Bay, Shikoku) to northern New Zealand (as far south as Tokomaru Reef, Gisborne), and from Natal, South Africa and East Africa to Hawaii (Marshall, 1992, fig. 37). The type material of *E. javanum* from Java provides the only fossil record I am aware of although, as with *E. bairdii*, it would not be surprising if it has been recorded from Taiwan or southern Japan under other names.

Remarks – Marshall (1992) revised the Recent species of *Eudolium* and concluded that *Eudolium pyriforme* (G.B. Sowerby 3rd) is the more finely sculptured, elongate-oval species limited to the Indo-West Pacific. Differences from *E. bairdii* are described more fully above. *Cassidaria javana* was based on incomplete specimens of a typical *Eudolium* species with low, narrow, widely spaced spiral cords without the obvious small nodules on the cord crests that characterise *E. bairdii* and is indistinguishable from Recent specimens of *E. pyriforme*. *Cassidaria javana* clearly is an earlier name for *E. pyriforme*. This fossil record is, therefore, important for demonstrating that *E. javanum* was widespread in the Indo-West Pacific by Miocene time.

As the species name *Cassidaria* (or *Galeodea*) *javana* has been well known in the literature on Indonesian fossils and is included in the catalogues by van der Vlerk (1931), Skwarko & Sufiati (1994) and van den Hoek Ostende *et al.* (2002), as well as being used as a valid name in papers by Martin (1919) and Beets (1943b), it does not qualify as a *nomen oblitum* to be suppressed in favour of *E. pyriforme.*

Eudolium pamotanense **(Martin, 1899)**

Figs. 301, 302.

Morio (sensu stricto) pamotanensis Martin, 1899, p. 157, pl. 24, fig. 365.
Cassidaria pamotanensis. – Martin, 1919, p. 89; van der Vlerk, 1931, p. 241; Pannekoek, 1936, p. 7.
Galeodea pamotanensis. – Beets, 1943b, p. 436; Skwarko & Sufiati, 1994, p. k6; van den Hoek Ostende *et al.*, 2002, p. 33.

Type material – Morio pamotanensis Martin, holotype RGM 9993, Mount Butak, Pamotan district, Rembang, Java, Rembang Formation, Middle Miocene (Figs. 301, 302).

Distribution – Known only by the holotype.

Remarks – The holotype of *Morio pamotanensis* is a small shell (H 21 mm) with a typical large tonnid protoconch, and a straight columella and anterior canal, and clearly belongs in a species of *Eudolium*. However, it is very unusual in having only 7-8 very widely spaced, narrow, well raised spiral cords, with many fine interstitial cords in the extremely wide, concave spiral interspaces. If this proves to be a consistent form, *E. pamotanensis* is a very distinctive species of *Eudolium*, with many fewer, more widely spaced spiral cords than any of the Recent species described by Marshall (1992). However, it also resembles *E. javanum* closely in most characters and possibly represents an aberrant specimen with several of the primary spiral cords suppressed. If this proves to be the case, *E. pamotanensis* is a further synonym of *E. javanum.* Only further material can resolve the status of this form.

Genus *Malea* Valenciennes, 1832

Malea Valenciennes, 1832, p. 325. Type species (by subsequent designation, Herrmannsen, 1847, p. 13): *Malea latilabris* Valenciennes, 1832 (= *Cassis ringens* Swainson, 1822), Pliocene to Recent, eastern Pacific.
Quimalea Iredale, 1929, p. 345. Type species (by original designation): *Buccinum pomum* Linné, 1758, Pleistocene and Recent, Indo-West Pacific.

Malea papuana **(Beets, 1943b)**

Figs. 303, 304.

Galeodea papuana Beets, 1943b, p. 441, pl. 1, figs. 4-6; Beets, 1986b, p. 110, pl. 8, figs. 10-12; Skwarko & Sufiati, 1994, p. k7.

Type material – Galeodea papuana Beets, holotype RGM 42 280, from "locality R. 26" of Bataafsche Petroleum My., Irian Jaya, Late Miocene (Figs. 303, 304).

Distribution – Known only by the holotype.

Remarks – *"Galeodea" papuana* Beets has a sculpture of prominent, wide, well raised, smooth spiral cords, without the fine spiral threads characteristic of *Galeodea*; if it were a cassid, it would seem to belong in Subfamily Phaliinae rather than Cassinae. Unfortunately, the unique holotype lacks the anterior end, including the siphonal canal, so the critical character of the degree of twisting of the anterior canal cannot be determined. The thick, unusually wide (in the spiral plane of the shell wall) terminal varix (but absence of any earlier varices), the inner lip raised a little above the previous whorl along its outer edge and the prominent ridges in the aperture are distinctive species characters. Beets (1943b, fig. 5; 1986b, fig. 11) illustrated the extremely large (*c.* 6 mm diameter), multi-whorled, superficially smooth protoconch, which indicates a position in the Tonnidae. This specimen lacks the fine, sharp axial ridgelets characteristic of *Eudolium*. The outer part of the inner lip, extending across the previous whorl from the parietal area, is unusually strongly thickened and smooth. In contrast, the interior of the outer lip and the inner part of the inner lip, well within the aperture, bear many very prominent, widely spaced transverse ridges. This combination of characters is most like that seen in *Malea* and at present it seems best to interpret this as a *Malea* species in which the ridges on the inner lip are not noticeably grouped into high, ridged nodules. In fact, of named species *Malea papuana* seems most closely similar to *M. pomum* (Linné), differing only in its slightly narrower and more raised spiral cords. Comparison of better specimens is needed to confirm whether the slightly different arrangement of the inner lip ridges from those of other *Malea* species is consistent, and whether the terminal varix is perhaps an aberrant, irregularly grown ridge rather than a true varix. It would not be surprising if this name is based on a very aberrant specimen of *Malea pomum*.

Malea pomum (Linné, 1758)

Buccinum pomum Linné, 1758, p. 735; Linné, 1767, p. 1197; Gmelin, 1791, p. 3470.

Cadus pomum. – Röding, 1798, p. 151.

Dolium pomum. – Lamarck, 1816, pl. 403, fig. 2a, b, "Liste des objets" p. 3; Lamarck, 1822, p. 261; Kiener, 1835, p. 12, pl. 5, fig. 8a, b; Deshayes, 1844, p. 142; Reeve, 1848b, pl. 4, fig. 6a, b.

Cassis labrosa Gray, 1847, p. 137.

Dolium (Malea) pomum. – Boettger, 1908, p. 671; Schepman, 1909, p. 125.

Malea pomum. – Hedley, 1916, p. 196; van der Vlerk, 1931, p. 243; Kilburn, 1986, p. 4, fig. 10; Wilson, 1993, p. 252, pl. 39, fig. 12a-c.

Tonna (Malea) pomum. – Oostingh, 1925, p. 130 (with long synonymy); Kilias, 1962, p. 19, fig. 15a; Skwarko & Sufiati, 1994, p. k13.

Quimalea pomum. – Iredale, 1929, p. 345; Ladd, 1977, p. 36, pl. 12, fig. 11.

Quimalea pomum macgregori Iredale, 1931, p. 215, pl. 23, fig. 22.

Tonna (Malea) pomum macgregori. – Kilias, 1962, p. 20, fig. 15b.

Malea (Quimalea) pomum. – Habe, 1964, p. 96, pl. 24, fig. 7; Okutani, 2000, p. 281, pl. 139, fig. 3.

Malea noronhensis Kempf & Matthews, 1969, p. 57, figs. 1-5; Abbott & Dance, 1982, p. 119, top left fig.; Matthews *et al.*, 1987, p. 41, fig. 8; Rios, 1994, p. 84, pl. 28, fig. 328.

Type material – *Buccinum pomum* Linné, two syntypes in Linné's collection housed by the Linnean Society of London; the wider (H 43.9, D 33.5 mm) has the number "441" inscribed on the inner lip, whereas the narrower (H 45.3, D 30.3 mm) is unmarked (and so may not have been an original Linnean specimen). Acording to Wallin (1993, p. 53), 2 further syntypes identified as *Buccinum pomum* are present in Uppsala University Zoological Museum (UUZM 641, UUZM 1161). Wallin (1993) listed an identification of the first of these by the well-known malacologist Nils Odhner as *Tonna costata* (Menke, 1828) (i.e., *Tonna allium* Dillwyn, 1817), so at least one of these is not conspecific with *Buccinum pomum* Linné. Therefore, the wider syntype in Linné's collection in London, marked "441", is here designated the lectotype of *Buccinum pomum* Linné, 1758. The type locality is here designated as Ambon Island, Indonesia. *Cassis labrosa* Gray, no type material known; the lectotype of *Buccinum pomum* Linné is here designated the neotype of *Cassis labrosa* Gray, 1847. *Quimalea pomum macgregori* Iredale, holotype AMS C.57796, from Sydney Harbour "*Triton*" dredgings, New South Wales, Australia. *Malea noronhensis* Kempf & Matthews, holotype in Museu Nacional, Universidade Federal do Rio de Janeiro, Brazil, no. 3493, from Atol das Rocas, Brazil; with 7 paratypes (listed by Kempf & Matthews, 1969, and by Matthews *et al.*, 1987, p. 42); 1 paratype examined in MNHN.

The synonym *Cassis labrosa* was published originally by Martini (1773, pl. 36, figs. 370, 371); these are recognisable illustrations of *Malea pomum*, although of course this name is not available from this non-binominal work. Although Deshayes (1844, p. 143) listed it in the synonymy of *Dolium pomum*, the name was not made available until Gray (1847, p. 137) used it as the valid name, presumably regarding Martini's names as available. Martini's illustrated (and long-lost) specimen must be construed as the holotype of *Cassis labrosa* Gray. It is possible that this specimen remains in the collection purchased for Peter the Great, in the Zoological Institute, Russian Academy of Sciences, St Petersburg.

Other material examined. – Sangiran, central Java, Late Pliocene (1, in collection of B. Dharma).

Distribution – *Malea pomum* occurs rarely at islands off northeastern Brazil (Fernando de Noronha and Atol das Rocas, possibly Trindade Island) in the western Atlantic and very widely throughout the Indo-West Pacific region. Specimens have been seen from eastern South Africa and East Africa to the Marquesas Islands in eastern Polynesia, and from southern Japan to Sydney Harbour, New South Wales, Australia, with a single record from northern New Zealand (Powell, 1974, p. 204). Ladd (1977, p. 36, pl. 12, fig. 11) recorded a Pleistocene fossil from the Kere River, southern Espiritu Santo Island, Vanuatu. Other than that, the only fossil records I am aware of are the present one and the Pleistocene specimen recorded from West Timor by Boettger (1908), which I have not seen. However, it is also possible that the holotype of *M. papuana* (Beets) is a very aberrant specimen of *M. pomum.*

Remarks – *Malea pomum* is easily recognised by its small size (maximum height rarely more than about 60 mm), its thick, polished shell, its very low spire, its sculpture of low, wide, smooth spiral cords of evenly rounded section and evenly concave interspaces, its thick, strongly dentate outer lip, and the area of very prominent nodules and ridges on the lower columella that is characteristic of *Malea.* The Atlantic form named *Malea noronhensis* by Kempf & Matthews (1969) has no distinctive characters and, as with occurrences of Recent specimens of *Charonia lampas* (Linné, 1758) form *pustulata* Euthyme, *Cymatium (Ranularia) gallinago* (Reeve, 1844a) and *Ranella gemmifera* (Euthyme, 1889) in Brazil, seems likely to result from occasional dispersal of larvae to the Atlantic from South Africa.

As with many of the other taxa in this report, the entry on *Malea pomum* in Oostingh (1925, p. 130) includes a very long, full list of earlier references, admirably supported by his full bibliography.

Genus *Tonna* Brunnich, 1772

Tonna Brünnich, 1772, p. 248. Type species (by subsequent designation, Suter, 1913, p. 314): *Buccinum galea* Linné, 1758, Late Miocene to Recent, Mediterranean, Atlantic (and Indo-West Pacific?).

Cadus Röding, 1798, p. 150. Type species (by subsequent designation, Woodring, 1959, p. 310): *Buccinum perdix* Linné, 1758, Pleistocene and Recent, Indo-West Pacific.

Dolium Lamarck, 1801, p. 79. Type species (by monotypy): *Buccinum galea* Linné, 1758.

Cadium Link, 1807, p. 113. Type species (by subsequent designation, Woodring, 1959, p. 310): *Cadium perdix* Link, 1807 (= *Buccinum perdix* Linné, 1758).

Perdix Montfort, 1810, p. 447. Type species (by monotypy): *Perdix reticulatus* Montfort, 1810 (= *Buccinum perdix* Linné, 1758). Junior homonym of *Perdix* Brisson, 1760.

Macgillivrayia Forbes, 1852, p. 383. Type species (by monotypy): *Macgillivrayia pelagica* Forbes, 1852 (= *Tonna* sp., planktonic larval stage).

Simplicidolium Sacco, 1891, p. 237. Type species (by monotypy): *Pyrula fasciata* Borson, 1821, Miocene and Pliocene, Italy. [Lectotype of *P. fasciata* illustrated by Pavia (1976); a young *Tonna* according to Bouchet & Warén (1993, p. 797).]

Foratidolium Rovereto, 1899, p. 107. Replacement name for *Perdix* Montfort, 1810, not of Brisson, 1760.

Parvitonna Iredale, 1931, p. 216. Type species (by original designation, Iredale, 1931, p. 232): *Parvitonna perselecta* Iredale, 1931 (= *Tonna cumingii* Reeve, 1849, according to Winckworth & Tomlin, 1933, p. 211), Recent, western Pacific.

Remarks – The taxonomy and nomenclature of the Recent Indo-West Pacific *Tonna* species is very poorly known indeed. In the absence of a modern monograph I have largely followed the reviews of (a) world species, by Winckworth & Tomlin (1933) and Kilias (1962), and (b) South African species, by Kilburn (1986). My overview of the specimens in RGM that formed the basis of Martin's and van Regteren Altena's *Tonna* records also leads me to suggest that few (if any) of the apparently restricted Indonesian fossil species are distinct from the living Indo-Pacific ones, unless far more numerous, more narrowly defined species are to be recognised in the genus. *"Dolium" losariense* Martin is removed here to the Ranellidae (= *Cymatium (Linatella) cingulatum* (Lamarck)); this species was identified by Martin at various times as *Cymatium cingulatum*, *Cassis tegalensis*, *Purpura bantamensis, Dolium variegatum* and *Dolium losariense*.

Menke's collection is now housed in SMF (received in the Bronn collection; examined during July 2000) and will provide some basis for a firmer taxonomy (although not all Menke's *Tonna* species are represented in what remains of the collection). The greatest problem with the taxonomy of this genus is that few of Linné's type specimens of *Tonna* species (housed by the Linnean Society of London; examined during July 2000) agree with the usual interpretation of these names, although Linnean syntypes are present of *Buccinum dolium, Buccinum galea, Buccinum olearium, Buccinum perdix* and *Bulla canaliculata*. This whole complex will be difficult to resolve and a firmly based taxonomy is not attempted here.

Tonna allium (Dillwyn, 1817)

Figs. 307-310.

Buccinum allium Dillwyn, 1817, p. 585.

Dolium costatum Menke, 1828, p. 35; Menke, 1830, p. 63; Deshayes, 1844, p. 144; Reeve, 1849, pl. 5, fig. 8; Martin, 1879, p. 40, pl. 7, figs. 9, 10; Tryon, 1885, p. 263, pl. 4, figs. 21, 22 only (in part); Martin, 1899, p. 161, pl. 25, figs. 371, 371a, b, 372, 373; Schepman, 1907, p. 182; Schepman, 1909, p. 125; Zwierzycki, 1915, pp. 105, 109; Martin, 1919, pp. 89, 122, 123, 132, 141, 151; Fischer, 1927, p. 33; Martin, 1928, p. 8; van der Vlerk, 1931, p. 242; Haanstra & Spiker, 1932, p. 1313; van Regteren Altena, 1942, p. 115 (with further synonymy).

Dolium fasciatum. – Kiener, 1835, pl. 4, fig. 6 (in part not *Buccinum fasciatum* Bruguière, 1789).

Dolium latescens Mörch, 1853, p. 111.

Dolium latesulcatum and var. *picta* Hanley, 1860, p. 489.

Dolium hochstetteri Martin, 1879, p. 39, pl. 7, fig. 8 (in part); Martin, 1899, p. 162; Zwierzycki, 1915, p. 109; van der Vlerk, 1931, p. 243.

Dolium costatum var. *martini* Boettger, 1883, p. 84, pl. 6, figs. 4a, b, 5a, b.

Dolium fimbriatum var. *natalensis* E.A. Smith, 1906, p. 41, pl. 7, fig. 10 (Kilburn, 1986, fig. 1, right).

Dolium tessellatum. – Vredenburg, 1919, p. 156, pl. 7, figs. 8a-10d; pl. 8, figs. 11a-13c (not *Dolium tessellatum* Lamarck, 1822).

Tonna (Tonna) costata. – Oostingh, 1925, p. 123; van Regteren Altena & Beets, 1945, p. 40; Beets, 1950a, p. 246; Kilias, 1962, p. 28, fig. 23; Skwarko & Sufiati, 1994, p. k13.

Dolium costatum martini. – Van der Vlerk, 1931, p. 242.

Tonna allium. – Iredale, 1931, p. 215, pl. 23, fig. 23; Winckworth & Tomlin, 1933, p. 208; Wilson & Gillett, 1971, p. 74, pl. 51, fig. 2; Ladd, 1982, p. 42, pl. 8, fig. 8; Kilburn, 1986, p. 2, fig. 1; Wilson, 1993, p. 252, pl. 39, fig. 2; Okutani, 2000, p. 283, pl. 140, fig. 13.

Tonna (Tonna) hochstetteri. – van Regteren Altena & Beets, 1945, p. 40; Skwarko & Sufiati, 1994, p. k15; van den Hoek Ostende *et al.*, 2002, p. 32.

Tonna costata. – Shuto, 1969, p. 94, pl. 6, figs. 19-21, text-fig. 22.

Type material – *Dolium costatum* Menke, 2 syntypes SMF 314411/2, from (a) Cape of Good Hope, *ex* F. Krauss, 1840, and (b) Java, *ex* Winter, 1836. *Dolium hochstetteri* Martin, illustrated syntype RGM 10 028, Menengteng Gorge, Cheribon [Cirebon], Java, Pliocene (poor internal mould with short spire, but distorted; I can see no differences from *T. allium*; Figs. 309, 310). I do not know the location of type material of the other synonyms.

Other material examined – RGM 10 018, Bajah [Bayah], Residence of Bantam [Banten], Java, Pliocene? (fragments); RGM 10 013, Menengteng Gorge, Losari, Residence of Cheribon [Cirebon], Java, Pliocene (1); RGM 10 012, Menengteng Gorge, Residence of Cheribon [Cirebon], Pliocene (2, Martin's (1899) illustrated specimens, figs. 371, 372; Figs. 307, 308); RGM 10 015, Cheribon [Cirebon], Java, Pliocene (2 small); RGM 10 020, Junghuhn's locality L, Java, Preanger [Priangan] (1, specimen illustrated by Martin as *Dolium costatum*, dorsal and lateral view, lateral view shows mould of varix); RGM 10 014, Menengteng Gorge, Waled, Residence of Cheribon [Cirebon], Java, Pliocene (2, with widely spaced, simple cords, apparently *T. allium*); "Kendeng beds" material in Mijnwezen Collection: locality M67 (1, poor), M82a (1, poor), M110f (1, poor), M120 (1, poor), M129 (1, poor), M250 (1, poor mould), M260 (1, poor), M261 (1, excellent), M271 (1, fragment); Nias Island, Sumatra, Pleistocene?, Schroeder's collection described by Wissema (1947): locality 39 (2 good); Bojong, Pandeglang, West Java, Late Pliocene/

Early Pleistocene, presented by B. Dharma (GNS WM17244, 2 small, plus 1 in collection of B. Dharma); Cijarian, West Java, Middle Miocene (2, in collection of B. Dharma); Koperberg's material from the Pliocene of Timor, received in RGM from MGMD: "Noil-Besi", original of Koperberg's thesis "pl. 129, fig. 159" (1); material from IAUU, received in RGM: "Grindban ken der Mosso River zijriv der Tami" (1, small); Lubuq Hill, Benkulen, Sumatra (1, incomplete).

Distribution – *Tonna allium* occurs widely in the Indo-West Pacific region although, as with all other Recent *Tonna* species, its detailed distribution is poorly known. Kilias (1962, fig. 24) recorded specimens from East Africa to New Caledonia and from southern Honshu, Japan, south to Green Island, southern New South Wales, Australia. Ladd (1982, p. 42, pl. 8, fig. 8) illustrated a Pleistocene specimen from the Kere River, Espiritu Santo, Vanuatu, and Shuto (1969, p. 94, pl. 6, figs. 19-21) illustrated three specimens from the Late Miocene-Early Pliocene Ulian Formation and the Early? Pleistocene Santa Barbara Silt on Panay Island, Philippines; the only other fossils I have seen are those from Indonesia recorded here. However, Shuto (1969, p. 95) stated that this species occurs fossil also in Pliocene rocks of Taiwan and southwest Japan.

Remarks – Following Kilburn (1986), *Tonna allium* is interpreted as a small, very short species (few adults exceed 70 mm in height) with relatively few, wide, simple, widely spaced spiral cords and a prominently thickened outer lip. Menke's type specimens of *Tonna costata* are, as interpreted by Winckworth & Tomlin (1933), the species usually known as *Tonna allium* (Dillwyn). Indonesian specimens listed here belong in the species as interpreted by Kilburn (1986). However, a number of the specimens identified by this name by Martin and van Regteren Altena are a little taller and narrower than *T. allium* (as interpreted here), and are listed under *T. sulcosa.*

***Tonna canaliculata* (Linné, 1758)**
Figs. 311, 312.

Bulla canaliculata Linné, 1758, p. 727; Linné, 1767, p. 1185; Gmelin, 1791, p. 3427; Hanley, 1855, pp. 207, 503.
Dolium marmoreum Schröter, 1788, p. 30; Tryon, 1885, p. 293.
Buccinum olearium Bruguière, 1789, p. 243 (junior primary homonym of *Buccinum olearium* Linné, 1758).
Cadus cepa Röding, 1798, p. 150.
Dolium olearium. – Lamarck, 1816, pl. 403, fig. 1, "Liste des objets" p. 3; Lamarck, 1822, p. 259; Kiener, 1835, p. 6, pl. 1, fig. 1, 1a; Deshayes, 1844, p. 140 (in part); Reeve, 1849, pl. 8, fig. 14; Tryon, 1885, p. 262, pl. 2, fig. 8 only; Schepman, 1909, p. 125 (not *Buccinum olearium* Linné, 1758).
Dolium cepa. – Hanley, 1860, p. 489.
Tonna canaliculata. – Hedley, 1919, p. 335; Iredale, 1931, p. 215, pl. 23, fig. 25; Winckworth & Tomlin, 1933, p. 208; Yen, 1942, p. 217; Habe, 1964, p. 76, pl. 24, fig. 6; Wilson & Gillett, 1971, p. 74, pl. 51, fig. 6.
Tonna (Tonna) canaliculata. – Oostingh, 1925, p. 121.
Tonna (Tonna) cepa. – Beets, 1950a, p. 246; Kilias, 1962, p. 23, fig. 17; Skwarko & Sufiati, 1994, p. k13.
Tonna cepa. – Kay, 1979, p. 233; Kilburn, 1986, p. 4, fig. 7; Wilson, 1993, p. 252, pl. 39, fig. 7; Okutani, 2000, p. 281, pl. 139, fig. 5.

Type material – *Bulla canaliculata* Linné, two syntypes in Linné's collection, housed by the Linnean Society of London, both marked "339" (the number for this species in

Linné, 1758) inside the outer lip. Both are small (H 43.5, D 32.9 mm; H 40.1, D 29.8 mm), but clearly display the deeply channelled suture and the weak spiral sculpture for a short distance below the suture that characterise the species more usually known in recent times as *Tonna cepa* (Röding, 1798). The larger syntype of *Bulla canaliculata* Linné is here designated the neotype of both *Cadus cepa* Röding, 1798, and *Buccinum olearium* Bruguière, 1789.

Other material examined – Boenjoe (Bunyu) Island, East Kalimantan, Borneo (1 specimen, RGM 41 809; Beets, 1950a, p. 426; Figs. 311, 312), Pasir Ipis, Cirebon, West Java, Pliocene (1 large, in collection of B. Dharma, assigned tentatively).

Distribution – *Tonna canaliculata* occurs throughout the Indo-West Pacific region from eastern South Africa and the Red Sea to Tonga, and from the Philippine Islands to Sydney Harbour, New South Wales, Australia (Kilias, 1962, fig. 18). However, its range is poorly known in detail. The Indonesian fossils are the only ones I am aware of.

Remarks – Linné's syntypes of *Bulla canaliculata* clearly belong in the species more usually known as *Tonna cepa* (Röding) in current publications and this species should bear the name *Tonna canaliculata*. It is characterised by its very low, wide, closely spaced spiral cords, particularly weakly defined for a short interval below the suture, by its deeply and narrowly channelled suture, and by the consequently narrowly and strongly convex whorl profile below the suture.

Tonna chinensis **(Dillwyn, 1817)**

Buccinum chinense Dillwyn, 1817, p. 585; Wood, 1825, pl. 22, fig. 7.
Dolium variegatum. – Philippi, 1847, p. 36, *Dolium* pl. 1, figs. 1, 2; Martin, 1879, p. 39, pl. 7, fig. 7; Tryon, 1885, p. 262, pl. 3, fig. 13 (in part); Martin, 1899, p. 162, pl. 25, fig. 376; Martin, 1926, p. 10; van der Vlerk, 1931, p. 243 (not *Dolium variegatum* Lamarck, 1822).
Dolium chinense. – Reeve, 1849, pl. 6, fig. 10; Deshayes, 1844, p. 146; Hanley, 1860, p. 491; Martin, 1899, p. 163; Vredenburg, 1919, p. 185; van der Vlerk, 1931, p. 242.
Dolium australe Mörch, 1853, p. 111.
?*Dolium variegatum* var. *angusta* Hanley, 1860, p. 491.
Dolium variegatum var. *chinense*. – Tryon, 1885, p. 262, pl. 3, fig. 14.
Tonna chinensis. – Winckworth & Tomlin, 1933, p. 209; Yen, 1942, p. 217; Kilias, 1962, p. 27, fig. 21; Wilson & Gillett, 1971, p. 74, pl. 51, fig. 3; p. 72, fig. 15; Wilson, 1993, p. 252, pl. 39, figs. 4, 10.
Tonna chinensis angusta. – Yen, 1942, p. 217.
Tonna fasciata. – van Regteren Altena, 1942, p. 116 (in part; not *Buccinum fasciatum* Bruguière, 1789).
Tonna chinense. – Skwarko & Sufiati, 1994, p. k11.

Type material – Dillwyn's reference illustration for the name *Dolium chinense* was Chemnitz (1795, pl. 188, figs. 1804, 1805). Chemnitz's own collection has been thought long lost, but it is possible that the illustrated specimen remains in ZMC, among the specimens lent to Chemnitz for illustration, or in the Zoological Institute, Russian Academy of Sciences, St Petersburg, among Chemnitz Collection material purchased for Peter the Great (Martynov, 2002; Lamprell, 2003). Possible types are not considered further here. *Dolium variegatum* var. *angusta* Hanley, holotype BMNH 1968305, from "China Seas", *ex* Cuming collection; it is not clear whether this represents *T. chinensis* or a small, narrow specimen of *T. variegata* (Lamarck, 1816). I am not aware of the location of any type material of the other names in the synonymy.

Other material examined – RGM 10 035, Sangiran, central Java, Late Pliocene (1, poor incomplete specimen); RGM 10 032, Tji Boerial [Ciburial], Java, Preanger [Priangan], Miocene (3 poor moulds); RGM 10 030, Junghuhn's locality O, Java, Late Miocene (3, poor, 1 illustrated by Martin as *Dolium chinense,* 2 views; too poor for certain identification); RGM 47 067, near Tjandi [Candi], Semarang, Java, Pliocene? (1, spire severely distorted, identified by Martin as *Dolium fasciatum*, but clearly has simple, flat spiral sculpture as in *T. chinensis*); "Kendeng beds" material in Mijnwezen Collection: locality M143 (4 large fragments, no secondary sculpture), M217 (1, fragment, no secondary sculpture), M218 (1, poor fragment), M222 (1 large fragment, identified by van Regteren Altena (1942) as *T. zonata*, but lacks secondary sculpture).

Distribution – The distribution of *Tonna chinensis* is poorly known and it is one of the few well-known Recent species not reported from eastern South Africa to Mozambique by Kilburn (1986). Recent material has been reported from the western Pacific and eastern Indian Ocean archipelagos from southern Japan to Sydney, Australia. I am aware of fossils only from Java.

Remarks – Martin and van Regteren Altena seem to have used names such as "*Dolium chinense* Chemnitz" and *Tonna fasciata* (Bruguière) for a variety of simply sculptured *Tonna* species with moderately wide to quite narrow, strap-like spiral cords and narrow interspaces, lacking the interstitial spiral cords of *Tonna galea*. Most of the material is very poorly preserved and not identifiable with certainty. The name *T. chinensis* (Dillwyn) is used rather loosely for this group, recognising that Indo-West Pacific *Tonna* species are desperately in need of revision. Specimens with these simple, strap-like spiral cords are also closely similar to *Tonna variegata* (Lamarck, 1822), but *T. variegata* differs from Recent specimens of *T. chinensis* and from the present fossils in its much larger adult size, and its fewer, wider spiral cords. The synonymy listed above does not pretend to be an exhaustive one for *Tonna chinensis*.

***Tonna galea* (Linné, 1758)**

Figs. 313-318.

Buccinum galea Linné, 1758, p. 734; Linné, 1767, p. 1197; Dillwyn, 1817, p. 582.

Buccinum olearium Linné, 1758, p. 734; Linné, 1767, p. 1196; Wood, 1825, pl. 22, fig. 1.

Dolium galea. – Lamarck, 1822, p. 259; Kiener, 1835, pl. 2, fig. 2; Reeve, 1848b, pl. 1, fig. 1; Hanley, 1860, p. 487; Tryon, 1885, p. 261, pl. 1, fig. 3.

Dolium tenue Menke, 1830, p. 143.

Dolium zonatum Green, 1830, p. 131, pl. 4; Reeve, 1849, pl. 7, fig. 12a, b; Hanley, 1860, p. 488; Tryon, 1885, p. 263, pl. 3, fig. 17; Vredenburg, 1919, p. 187, pl. 3, fig. 6; Martin, 1926, p. 10; Fischer, 1927, p. 61; Koperberg, 1931, p. 123; van der Vlerk, 1931, p. 243; van der Vlerk, 1932, p. 111.

Dolium ampullaceum Philippi, 1846b, p. 147; Philippi, 1849, p. 11, *Dolium* pl. 2; Hanley, 1860, p. 491.

Dolium crenulatum Philippi, 1846b, p. 148; Philippi, 1849, *Dolium* pl. 1, fig.1; Martin, 1879, p. 41, pl. 14, fig. 6.

Dolium galea var. *tenebrosa* Hanley, 1860, p. 488.

Dolium antillarum Mörch, 1877, p. 41.

Dolium antillarum var. *brasiliana* Mörch, 1877, p. 42.

Dolium galea vars. *epidermata, spirintrorsum* and *tardina* Gregorio, 1884, pp. 144-115.

Dolium zonatum, var. – Martin, 1899, p. 159, pl. 25, figs. 368, 368a, b, 369, 369a; Martin, 1919, pp. 89, 132, 151.

Dolium modjokasriense Martin, 1899, p. 160, pl. 25, fig. 370; van der Vlerk, 1932, p. 111.

Tonna modjokasriensis. – Martin, 1919, pp. 89, 145; van der Vlerk, 1931, p. 243; van Regteren Altena, 1942, p. 117 (with further synonymy); Skwarko & Sufiati, 1994, p. k15.

Dolium zonatum, prior. – Martin, 1928, p. 8.

Tonna galea. – Winckworth & Tomlin, 1933, p. 210; Turner, 1948, p. 173, pl. 75, fig. 4; pl. 78, figs. 1, 2 (with further synonymy); Kilias, 1962, p. 36, fig. 31; Matthews *et al.,* 1987, p. 31, figs. 1-5.

Tonna zonata. – van Regteren Altena, 1942, p. 117 (with further synonymy); van Regteren Altena & Beets, 1945, p. 40; Wissema, 1947, p. 164; Kilias, 1962, p. 54, fig. 47 (copy of Green's illustration); Skwarko & Sufiati, 1994, p. k15.

Tonna ampullacea. – van Regteren Altena, 1942, p. 118 (with further synonymy).

Tonna cf. *zonata.* – Cox, 1948, p. 35, pl. 3, fig. 5.

Tonna galea brasiliana. – Turner, 1948, p. 176, pl. 79, figs. 1, 2.

Tonna olearium. – Powell, 1967, p. 192; Powell, 1979, p. 162, pl. 34, fig. 5; Okutani, 2000, p. 283, pl. 140, fig. 8.

Tonna galea tenebrosa. – Kilburn, 1986, p. 2, fig. 4.

Tonna (Tonna) modjokasriensis. – van den Hoek Ostende *et al.,* 2002, p. 32.

Type material – *Buccinum galea* Linné, 1758, "type figure" selected by Turner (1948, p. 174) as Gualtieri (1742, pl. 42, fig. A), in effect (although not formally) designating the illustrated specimen as the lectotype of *Buccinum galea*. This specimen is in the Museo di Storia Naturale e del Territorio, Università di Pisa, in the Certosa di Calci, outside Pisa, Gualtieri Colln. no. 6 (examined during January 2000). Turner (1948) also restricted the type locality to Naples, Italy. The existence of the Gualtieri Collection syntype is fortunate, as the one possible syntype remaining in Linné's collection housed by the Linnean Society of London is a specimen of *Tonna canaliculata* (Linné, 1758), with the name "*galea*" written inside the outer lip. A label accompanying this specimen states: "This shell is marked "Galea" but see Hanley's comments [Hanley, 1855, p. 239]. S.P.D. [Dance] 21.xi.62. ?non-Linnean". As this specimen (H 99.6, D 79.8 mm) is under suspicion as not being a specimen from Linné's collection, and is not conspecific with the usual concept of *Tonna galea*, and as Turner's (1948) "type figure"selection is not a formal designation of a lectotype, the specimen in Gualtieri's collection, no. 6, is here designated the lectotype of *Buccinum galea* Linné, 1758. *Buccinum olearium* Linné, 1758 (not *Buccinum olearium* Bruguière, 1789), two lots present in Linné's collection, housed by the Linnean Society of London; the first is one small (H 31.9, D 24.7 mm) specimen of the usual Mediterranean-Atlantic form of *Tonna galea* (Linné), marked "438" (the number for *Buccinum olearium* in Linné, 1767) inside the outer lip, although Hanley (1855, p. 238) suggested that this was a *lapsus* for "439", the number for *Buccinum galea* Linné; S.P. Dance has noted (on a manuscript label accompanying this specimen) "It is *galea* and not *olearium* in fact". The second lot consists of one medium-sized specimen (H 71.2, D 59.7 mm) of the species identified here as *Tonna canaliculata* (Linné) (see above), marked "376" faintly on the inner lip; this is the number for *Buccinum olearium* in Linné (1758). To prevent further confusion over the identities of both *Tonna galea* and *Tonna canaliculata*, the smaller syntype of *Buccinum olearium* Linné, marked "439" inside the outer lip, is here designated the lectotype of *Buccinum olearium* Linné, 1758. As first reviser, I select *Tonna galea* (Linné, 1758) as the name to be used for the species named both *Buccinum galea* and *Buccinum olearium* by Linné (1758). The well-known name *Tonna olearium* (Linné) thereby becomes a synonym of *T. galea* (Linné) and, if the Indo-West Pacific form usually known as *T. olearium* should prove to be a species distinct from *T. galea*, the earliest name for it is *T. zonata* (Green, 1830). *Dolium modjokasriense* Martin, illustrated syntype RGM 10 011, Tambak batoe [Tambakbatu], Java, Late Miocene (very incomplete, H 81 mm, with 2 orders of interstitial spiral cords; Fig. 318). No type material of *Dolium tenue* is present in Menke's collection, in SMF. Philippi's collection apparently is in the Department of Zoology, National Museum of Natural History, Santiago, Chile, but is not yet available for consultation. I am not aware of the location of the type material of the other listed synonyms.

Other material examined – RGM 10 004, Menengteng Gorge, Java, Pliocene (3, including specimen illustrated by Martin, 1899, figs. 368, 369, as *Dolium zonatum*; all 3 illustrated in Figs. 313-317); RGM 10 009, Menengteng Gorge, Waled, Residence of Cheribon [Cirebon] (2 more identified as *Dolium zonatum*); RGM 10 010, Padas Malang [Padasmalang], Residence of Madiun, Java, Miocene (1 small, good); RGM 47 303, Tji Boerial [Ciburial], Bandung, Java, Pliocene? (1, distorted, surface poor, identified by Martin as *Dolium chinense*, but clearly has interstitial spiral cords); RGM 10 043, Sonde, Residence of Madiun, Java, Pliocene (2 small fragments identified as "*Dolium* sp.", but clearly have the complex sculpture of *T. galea*); RGM 10 040, Mount Gombel, near Tjandi [Candi], Residence of Semarang, Pliocene? (1 large, identified by Martin as *Dolium fasciatum* Bruguière, i.e., *T. sulcosa*; surface poor but clearly has complex secondary and tertiary spiral sculpture); "Kendeng beds" material in Mijnwezen Collection (identified by van Regteren Altena (1942) as *T. zonata, T. modjokasriensis*, or (in a few cases, for very large specimens) *T. ampullacea* Philippi): locality M98 (1 small), M107 (1, spire, good), M122 (1, good), M125 (1, large fragment identified by van Regteren Altena (1942) as *T. ampullacea*), M153 (1, poor), M158 (1 fragment), M163 (several large fragments, identified by van Regteren Altena (1942) as *T. ampullacea*), M164 (1, large fragment identified by van Regteren Altena (1942) as *T. ampullacea*), M176 (1, poor), M189 (1, spire, good), M216 (3, poor), M219 (3, 2 good spires + 1 fragment), M251 (1, large fragment identified by van Regteren Altena (1942) as *T. ampullacea*), M257 (1, small, good), M261 (3 fragments), M266 (1, poor mould), M271 (1, large fragment, identified by van Regteren Altena (1942) as *T. ampullacea*), M272 (2 fragments), M273 (2 fragments, identified by van Regteren Altena (1942) as *T. ampullacea*), M291 (1, poor, + 2 large fragments identified by van Regteren Altena (1942) as *T. ampullacea*), M292 (1 poor mould), M298 (1, poor), M304 (1, good, incomplete), M311 (1, poor), M347 (1, fragment identified by van Regteren Altena (1942) as *T. ampullacea*); Cosijn Collection, upper Kendeng beds, Pleistocene: (a) specimens identified by van Regteren Altena (1942) as *T. zonata*: RGM 46 679 (2, 1 small (*T. allium*?) and 1 large), RGM 46 680 (1 poor), RGM 46 681 (1 small), RGM 46 682 (1 spire), RGM 46 683 (1 poor), RGM 46 684 (1 poor); (b) specimens identified by van Regteren Altena (1942) as *T. modjokasriensis* Martin: RGM 46 692 (1 small); RGM 46 693 (1 small), RGM 46 694 (1 good), RGM 46 695 (1 poor); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 43, Pliocene (7 poor, one clearly has the interstitial secondary and tertiary spiral threads of *T. galea*, the others are indeterminable); locality 107, Pliocene (4 poor, have interstitial cords, although identified by Wissema (1947) as *T.*

fasciata Bruguière, i.e., *T. sulcosa*); Pasir Ipis, Cirebon, West Java, Pliocene (3, in collection of B. Dharma); Togopi Formation (Pliocene-Pleistocene?), Dent Peninsular, North Borneo (NMB H. 14417, 1, illustrated by Cox, 1948, pl. 3, fig. 5).

Distribution – As construed here, *Tonna galea* occurs very widely throughout the Indo-West Pacific and Atlantic-Mediterranean regions. As well as occurring throughout the Mediterranean Sea, it occurs in the western Atlantic from Beaufort, North Carolina to northern Brazil, and sparsely in the eastern Atlantic. In the Indo-West Pacific, it occurs from eastern South Africa to the central western Pacific archipelagoes (not seen from east of Australia-New Caledonia) and from southern Japan to northeastern New Zealand. Fossils are recorded from Miocene and younger rocks of both the Dominican Republic (Caribbean) and Indonesia.

Remarks – The name *Tonna galea* is used here for the *Tonna* species with one to many intermediate secondary and tertiary cords between the primary spiral cords. I cannot see any major differences between Indo-West Pacific and Atlantic-Mediterranean specimens of this species, i.e., the form known in the Indo-West Pacific as *T. olearium* (Linné) (which, however, as noted above, actually is a synonym of *T. galea*) or *T. zonata* (Green) is considered to be part of the variation of *T. galea,* a name traditionally used only in the Mediterranean and Atlantic. This conclusion was also reached by Turner (1948). This, therefore, is a significant difference from names in the review by Kilburn (1986), who recognised a distinct South African form, *T. galea tenebrosa* (Hanley) (a form particularly close to Martin's *Dolium modjokasriense*). I also cannot see any clear distinctions between *T. galea*, *T. modjokasriensis* (Martin) and the large specimens identified by van Regteren Altena (1942) as *T. ampullacea* (Philippi). Martin (1899) and van Regteren Altena (1942) seem to have used the name *T. modjokasriensis* for specimens with a shorter spire, wider sutural ramp, wider primary spiral cords, and, in some cases, more numerous intermediate secondary and tertiary cords than the specimens they classified as *T. zonata*, but these forms intergrade completely, in both Recent and fossil collections. Interpretations of *T. ampullacea* (Philippi) have varied greatly, because Philippi (1846b, 1849) did not know the locality of the holotype, but this large, strongly inflated specimen with unusually wide spiral cords has usually been interpreted as a large specimen of *T. galea* (e.g., Turner, 1948) and I have seen identical large, coarsely sculptured, short-spired, dark brown Recent specimens from both the Atlantic and the western Pacific regions. This also seems to be the case for the few large, fragmentary specimens identified as *T. ampullacea* by van Regteren Altena (1942); they appear to me to be incomplete, large specimens of *T. galea*. The present interpretation, then, is that *Tonna galea* is an almost pan-tropical, rather variable species with one to several intermediate spiral cords between the primary ones, ranging at least from Miocene (in the Dominican Republic, as well as Indonesia) to Recent.

Turner (1948) maintained the short-spired form named *Dolium antillarum* var*. brasiliana* by Mörch (1877, p. 42) as a subspecies of *Tonna galea*, but Matthews *et al.* (1987, pp. 31-37, fig. 5) demonstrated that this form merely is based on normal large adult specimens of *T. galea*; the spire decreases in height as the shell grows. One character that might therefore be important for distinguishing Indo-Pacific specimens from Atlantic-Mediterranean ones is the apparent lack of development of an unusually short spire by large specimens in the Indo-Pacific population.

Tonna lischkeana (Küster, 1857)

Figs. 319, 320.

?*Dolium marginatum* Philippi, 1846b, p. 147 (identity unclear).

?*Dolium fimbriatum*. – Reeve, 1848b, pl. 3, fig. 3a (not 3b; not *Dolium fimbriatum* J. Sowerby & G.B. Sowerby 1st, 1826, *in* 1820-1834 = *T. tessellata* (Lamarck, 1822), see below).

Dolium lischkeanum Küster, 1857, p. 71, pl. 62, fig. 1.

Dolium reevii Hanley, 1860, p. 493.

Dolium hochstetteri Martin, 1879, p. 39, pl. 7, fig. 8 (in part).

Dolium costatum var. *fimbriatum*. – Tryon, 1885, p. 264, pl. 3, fig. 18 only (in part).

Dolium tessellatum. – Vredenburg, 1919, pl. 6, fig. 7a-c only (in part not *Dolium tessellatum* Lamarck, 1822).

Tonna (Tonna) costata. – van Regteren Altena, 1942, p. 114 (in part).

Tonna dolium. – Powell, 1952, p. 177 (not *Buccinum dolium* Linné, 1758).

Tonna lischkeana. – Kilias, 1962, p. 41, figs. 33, 34.

Tonna maculata. – Powell, 1964, p. 15; Powell, 1967, p. 192; Powell, 1979, p. 162, pl. 34, fig. 1 (not *Dolium maculatum* Lamarck, 1822).

Tonna marginata. – Kilburn, 1986, p. 3, fig. 5; Okutani, 2000, p. 283, pl. 140, fig. 11.

Type material – *Dolium hochstetteri* Martin, illustrated syntype RGM 10 027, from Junghuhn's locality L, Java, Pliocene (Figs. 319, 320). *Dolium reevii* Hanley, two syntypes BMNH 1968304, without locality. Recognition of Philippi's material (apparently in the National Museum of Natural History, Santiago, Chile, but not yet available for consultation) would clarify the application of the poorly understood name *Dolium marginatum* (not illustrated by Philippi), which might be the earliest name for this species. I am not aware of the location of any other type material.

Other material examined – "Kendeng beds" material in Mijnwezen Collection: locality M202 (1, large mould), M249 (1, poor, large). Two specimens in the collection of B. Dharma, from Pasir Ipis, West Java (Pliocene), are identified as *T. dolium* and seem to be specimens of *T. lischkeana*, although they are referred tentatively as I have seen only photographs.

Distribution – I am aware of Recent specimens of *Tonna lischkeana* only from the Indian Ocean, as far south as Algoa Bay, South Africa (Kilburn, 1986) and from the central western Pacific archipelagos, from southern Japan to northeastern New Zealand (where specimens have been recorded for many years under the name *T. dolium* Linné). The Indonesian specimens recorded here are the only fossils I am aware of.

Remarks – The illustrated syntype of *Dolium hochstetteri* Martin and some of the material from the "Kendeng beds" identified by van Regteren Altena (1942) as *Tonna costata* are either much too large or too wide to be either *T. allium* or *T. tessellata*. With their narrow, widely spaced spiral cords, few, very low, very narrow interstitial cords, unthickened outer lips and short shape, with a particularly short spire, these specimens seem nearer to *T. lischkeana* than to either *T. allium* or *T. tessellata*. However, they all are too poorly preserved for certain identification. The question of the relationship of this species to the form named *Buccinum dolium* by Linné (1758) is complex and beyond the scope of this paper. The name *Tonna maculata* Lamarck, 1822, seems to apply to the similar species with more numerous interstitial spiral cords and a markedly thickened outer lip, but larger and without the raised collar over the neck that characterises *T. tessellata* (Lamarck).

Tonna perdix (Linné, 1758)

Buccinum perdix Linné, 1758, p. 734; Linné, 1767, p. 1197; Bruguière, 1789, p. 245; Gmelin, 1791, p. 3470; Dillwyn, 1817, p. 583.
Cadus perdix. – Röding, 1798, p. 150.
Cadus meleagris Röding, 1798, p. 150.
Cadus coturnix Röding, 1798, p. 150.
Cadium perdix. – Link, 1807, p. 133.
Perdix reticulatus Montfort, 1810, p. 447, with fig.
Dolium perdix. – Schumacher, 1817, p. 209; Lamarck, 1822, p. 261; Kiener, 1835, p. 4, pl. 5, fig. 9a, b; Deshayes, 1844, p. 144; Reeve, 1849, pl. 6, fig. 9; Hanley, 1860, p. 492; Tryon, 1885, p. 264, pl. 3, fig. 15; Watson, 1886, p. 412; Schepman, 1909, p. 230.
Dolium plumatum Green, 1830, p. 132.
Dolium pennatum Mörch, 1853, p. 110; Hanley, 1860, p. 493.
Tonna perdix. – Hedley, 1916, p. 196; Hedley, 1919, p. 335; Winckworth & Tomlin, 1933, p. 211; Turner, 1948, p. 172, pl. 75, fig. 1; pl. 77, figs. 1, 2; Wilson & Gillett, 1971, p. 74, pl. 51, figs. 4, 4a; Kilias, 1962, p. 48, figs. 37a, c, 41; Kay, 1979, p. 233, fig. 81D; Kilburn, 1986, p. 3, fig. 6; Wilson, 1993, p. 253, pl. 39, fig. 13; Okutani, 2000, p. 281, pl. 139, fig. 4.
Tonna (Tonna) perdix. – Oostingh, 1925, p. 127 (with long synonymy).
Tonna spec. – van Regteren Altena, 1942, p. 119 (in part).
Tonna zonata. – Wissema, 1947, p. 164 (in part).

Type material – *Dolium perdix* Linné, two syntypes in Linné's collection housed by the Linnean Society of London. The larger (H 112.4, D 71.6 mm) is marked both "378" (the number for this species in Linné, 1758) and "perdix" inside the outer lip; it is a typical specimen of the Indo-West Pacific form usually regarded as *Tonna perdix*, with a tall spire and a very wide, shallow anterior siphonal notch. The smaller syntype (H 100.1, D 68.0 mm) is marked "440" (the number for this species in Linné, 1767) inside the outer lip; it is a little shorter and wider, and has a narrower anterior siphonal notch than the larger syntype, and so possibly is a specimen of the Atlantic form usually known as *Tonna maculosa* (Dillwyn, 1817) (but this is a junior homonym of *Buccinum maculosum* Gmelin, 1791); the earliest available name for this species is *T. sulphurea* (C. B. Adams, 1849)). Consequently, the larger syntype (H 112.4 mm) in Linné's collection, marked "378" and "perdix", is here designated the lectotype of *Buccinum perdix* Linné, 1758. This specimen is also here designated the neotype of *Cadus meleagris* and *Cadus coturnix* of Röding (1798), and of *Perdix reticulatus* Montfort (1810). I am not aware of the location of type material of any of the other synonyms.

Dolium pictum Schepman (1893, p. 276) (junior primary homonym of *Dolium latesulcatum* var. *pictum* Hanley, 1860 = *Tonna schepmani* Bayer (1937, p. 47), replacement name) has been considered a synonym of *Tonna perdix* by some authors, but examination of the holotype (Naturalis, Leiden, RMNH 97441) showed that it is a completely unrelated species, more inflated, with a very different, axially banded colour pattern and with a single narrow spiral cord in all the main spiral interspaces. It seems to be closely related to or a synonym of *Tonna deshayesiana* (Reeve, 1849).

Other material examined – Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 690 (1, poor, tall-spired, with low, close spiral cords; identified by van Regteren Altena (1942) as "*Tonna* spec."); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 108, Late Pliocene (3, very poor, distorted, tall-spired specimens identified by Wissema (1947) as *T. zonata*).

Distribution – *Tonna perdix* is the most common and widespread of the tropical Indo-West Pacific *Tonna* species, occurring in shallow water (including on coral reefs) throughout the region in its widest sense. It ranges from the Umkomaas area, Natal, South Africa, to East Africa and the Red Sea, eastwards to Hawaii and the Tuamotu Islands in eastern Polynesia, and from southern Japan to the southern Great Barrier Reef in Australia and, rarely, to northeastern New Zealand. The few specimens recorded here are the only fossils I am aware of.

Remarks – A few poor, fragmentary specimens in the Indonesian collections are tall and narrow, have an unusually tall, narrow, strongly conic spire with weakly convex outlines for a *Tonna* species, and have sculpture of low, wide, closely spaced, simple spiral cords. They seem to be specimens of *Tonna perdix*. As *T. perdix* is the most common *Tonna* species in shallow waters in the tropical western Pacific at present, its occurrence in Indonesian Neogene rocks is to be expected, but once again, the scarcity of *T. perdix* as a fossil probably results from its very shallow habitat.

***Tonna sulcosa* (Born, 1778)**

Figs. 321, 322.

Buccinum sulcosum Born, 1778, p. 230; Born, 1780, p. 241.
Buccinum fasciatum Bruguière, 1789, p. 247.
Dolium fasciatum. – Lamarck, 1822, p. 260; Kiener, 1835, p. 11, pl. 3, fig. 5 only; Reeve, 1848b, pl. 7, fig. 11a, b; Hanley, 1860, p. 489; Tryon, 1885, p. 263, pl. 3, fig. 16; Vredenburg, 1919, p. 145, pl. 2, figs. 1a-3c; pl. 3, figs. 4a-5c.
Dolium varicosum Preston, 1910, p. 34, fig. 6.
Tonna sulcosa. – Hedley, 1919, p. 335; Winckworth & Tomlin, 1933, p. 212; Ladd, 1977, p. 36, pl. 12, figs. 12, 13; Kilburn, 1986, p. 2, fig. 3; Wilson, 1993, p. 253, pl. 39, fig. 8; Okutani, 2000, p. 283, pl. 140, fig. 12.
?*Dolium costatum*. – Tesch, 1920, p. 45, pl. 129, fig. 159 (not *Dolium costatum* Menke, 1828).
Tonna fasciata. – van der Vlerk, 1931, p. 242; van Regteren Altena, 1942, p. 116; Skwarko & Sufiati, 1994, p. k14.
Tonna niasensis Wissema, 1947, p. 163, pl. 6, figs. 145-147.

Type material – *Buccinum sulcosum* Born, holotype in Naturhistorisches Museum Wien, marked "Born, sulcosum" and "f. 4" inside the outer lip, a moderately large (H. 99.1, D 78.7 mm) specimen of the species with four brown spiral bands on the last whorl, usually known as either *T. sulcosa* (Born) or *T. fasciata* (Bruguière). The holotype of *Dolium varicosum* Preston (an aberrant individual with a varix retained before the terminal one) is presumably in the Indian Museum, Calcutta; not seen. I am not aware of the location of type material of *Dolium fasciatum* Bruguière. *Tonna niasensis* Wissema, holotype RGM 456 296 (Figs. 321, 322), with 1 paratype, from Schroeder's locality 43, Nias Island, off the southwestern coast of Sumatra, Pliocene.

Other material examined – RGM 10 021, Junghuhn's locality K, southwestern Java, Miocene (1, compressed mould of *Tonna* identified as *Dolium costatum*, i.e., *T. allium*, but with very wide posterior spiral cords and interspaces, suggesting this is *T. sulcosum* rather than *T. costata*); "Kendeng beds" material in Mijnwezen Collection: locality M224 (1 small, poor, identified by van Regteren Altena (1942) as *T. fasciata* Bruguière, i.e., *T. sulcosa*); M226 (1, poor mould identified by van Regteren Altena (1942) as *T. costata*, i.e., *T. allium*, but is more elongate); Cosijn Collection, upper Kendeng beds, Pleistocene: RGM 46 685 (1 poor, no interstitial cords; identified by van Regteren Altena (1942) as *T. zonata*); Nias Island, Sumatra, Schroeder's collection described by Wissema (1947): locality 107, Pliocene (1 small); Pasir Ipis, Cirebon, West Java, Pliocene (3 good, in collection of B. Dharma).

Distribution – *Tonna sulcosa* occurs throughout the Indo-West Pacific region, from the Tugela River, Natal (Kilburn, 1986) and East Africa to the western Pacific archipelagoes, and from southern Japan south to southern Queensland in Australia. Ladd (1977, p. 36, pl. 12, figs. 12, 13) illustrated a possible Pleistocene specimen (with a few narrow interstitial threads and so not certainly *T. sulcosa*) from the Kere River, Espiritu Santo, Vanuatu, but I am not aware of any other fossil record apart from the specimens reported here.

Remarks – The name *Tonna sulcosa* is applied to specimens resembling *T. allium* in their sculpture of wide, low, flat-topped, relatively widely spaced spiral cords, with no interstitial spiral sculpture or only a few interstitial spiral threads in a few specimens, but differing in its slightly taller and narrower shape and in its still more widely spaced cords. A few unusually complete specimens have the thickened, dentate outer lip and long, prominently protruding columella and siphonal canal that characterise Recent specimens (Kilburn, 1986), such as the excellent, although finely sculptured, specimen in B. Dharma's collection. I cannot see any characters distinguishing the type material of *T. niasensis* Wissema (1947, p. 163, pl. 6, figs. 145-147) from *T. sulcosa.* The specimen from the Pliocene of Timor illustrated by Tesch (1920, pl. 129, fig. 159) also is quite elongate and appears to represent *T. sulcosa* rather than *T. costata*.

Tonna tessellata **(Lamarck, 1816)**

Figs. 305, 306, 323, 324.

Dolium tessellata Lamarck, 1816, pl. 403, fig. 3a, b, "Liste des objets", p. 2.

Dolium fimbriatum J. Sowerby & G.B. Sowerby 1st, 1826 *in* 1820-1834, pl. 242, fig. 2; Reeve, 1848b, pl. 3, fig. 3b; Hanley, 1860, p. 491.

Dolium minjac Deshayes, 1844, p. 145.

Dolium costatum var. *maculatum*. – Tryon, 1885, p. 264, pl. 4, figs. 21, 22 (not *Dolium maculatum* Lamarck, 1822).

Tonna (Tonna) tessellata. – Oostingh, 1925, p. 125.

Tonna tessellata. – Winckworth & Tomlin, 1933, p. 213; Wilson & Gillett, 1971, p. 74, pl. 51, figs. 5, 5a; Kilburn, 1986, p. 2, fig. 2; Wilson, 1993, p. 253, pl. 39, fig. 1a, b.

Tonna dolium. – Kilias, 1962, p. 32, figs. 27, 29 (not of Linné, 1758).

Type material – Lamarck's type material is presumably in MHNG; not seen. I am not aware of the location of any type material of *D. fimbriatum* or *D. minjac*.

Other material examined – RGM 10 019, Padas Malang [Padasmalang], Residence of Madiun, Java, Miocene? (3 good, 2 are small; the third is larger (height *c.* 60 mm) and clearly has the raised inner lip collar characteristic of *T. tessellata*; Figs. 305, 306); Bojong, West Java, Early Pleistocene, presented by B. Dharma (GNS WM17486, 1 complete, with raised collar; Figs. 323, 324).

Distribution – *Tonna tessellata* is another species that occurs widely throughout the Indo-West Pacific region, from Durban, Natal (Kilburn, 1986) and East Africa to the western Pacific archipelagoes, where it ranges from Taiwan and the Philippines to Sydney Harbour, New South Wales, Australia. The few confirmed fossil specimens recorded here are the only ones I am aware of, but the difficulty of identifying incomplete fossils makes its recognition even in Indonesia problematical and some of the records of *T. allium* are probably based on incomplete specimens of *T. tessellata*.

Remarks – *Tonna tessellata* is the small, very short-spired *Tonna* species with a prominently thickened outer lip and, uniquely, with a wide collar extending from the inner lip over the neck and umbilicus. A few Indonesian fossil specimens have the inner lip collar preserved, confirming an identification suggested by the short spire. The spiral cords are prominent and relatively narrow, similar to those of *T. allium*, but the spiral interspaces are narrower than in *T. allium*; Recent specimens have a tessellated colour pattern (with red-brown maculations on the spiral cords) that is absent from *T. allium.*

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Appendix

Taxa removed from Tonnoidea
Family Buccinidae Rafinesque, 1815

Remarks – For the many *Nassaria* species named by Martin in *Hindsia, Argobuccinum, etc.*, a position in Buccinidae automatically is assumed. These are not listed here, but were listed in *Argobuccinum* by Skwarko & Sufiati (1994, p. m4) [*A. bantamensis* Martin], in *Hindsia* by Skwarko & Sufiati (1994, pp. m15-m18), and in *Nassaria* by Cernohorsky (1981). Other Buccinidae were listed (within Ranellidae) in the invalid genus *Tritonidea* by Skwarko & Sufiati (1994, pp. m20-m21) and probably belong in *Cantharus*. Another buccinid (again, belonging in *Nassaria*?) that has been referred to the Ranellidae is *Eutritonium tubanense* Wanner & Hahn (1935, p. 254, pl. 19, figs. 16-18; Skwarko & Sufiati, 1994, p. m5, as *lubanense*). *Eutritonium njalindungense* Martin (1921, p. 467, pl. 59, fig. 55a, b; holotype examined, RGM 9805) is a fasciolariine buccinid with no varices and with a long, gently contracted base. Finally, Beu & Maxwell (1987) transferred *Plesiotriton* species, including *P. hillegondae* (Martin, 1914b), from the Eocene Nanggulan beds of Java, to Family Cancellariidae, Subfamily Plesiotrioninae.

Genus *Colubraria* Schumacher, 1817

Fusus Helbling, 1779, p. 116 (suppressed, ICZN Opinion 1765). Type species (by subsequent designation, Iredale, 1915, p. 466): *Murex (Fusus) intertextus* Helbling, 1779 [the species usually known as *Colubraria reticulata* (Blainville)], Pliocene-Recent, Mediterranean.

Colubraria Schumacher, 1817, p. 251. Type species (by subsequent designation, Harris, 1897, p. 194): *Colubraria granulata* Schumacher, 1817 (= *Murex maculosus* Lightfoot, 1786), Pleistocene and Recent, Indo-West Pacific.

Cumia Bivona-Bernardi, 1838, p. 322. Type species (by monotypy): *Cumia decussata* Bivona-Bernardi, 1838 (= *Murex (Fusus) intertextus* Helbling, 1779).

Epidromus "Klein" Mörch, 1853, p. 107. Type species (by subsequent designation, Cossmann, 1889, p. 117): *Triton distortus* "Shum." (*sic*) (= *Triton distortum* Schubert & Wagner, 1829, junior primary homonym of *Triton distortum* Lamarck, 1816 = *Triton tortuosus* Reeve, 1844b), Pliocene-Recent, Indo-West Pacific.

Obex Iredale, 1925, p. 259. Type species (by monotypy): *Obex mulveyana* Iredale, 1925, Recent, New South Wales, Australia.

Ratifusus Iredale, 1929, p. 128. Type species (by original designation, Iredale, 1929, p. 189): *Ratifusus adjunctus* Iredale, 1929, Recent, southern Australia and northern New Zealand.

Remarks – *Colubraria* is of interest here as a group formerly included in the Ranellidae, because of its prominent varices, but now known to belong in the Buccinidae (Beu & Maxwell, 1987). Beu & Maxwell (1987) distinguished *Fusus* Helbling, 1779 (since suppressed under ICZN Opinion 1765; *Cumia* Bivona-Bernardi, 1838, would replace it if this genus is to be used), from *Colubraria* by characters of the protoconch, but as noted above under *Cassis*, developmental characters are not now considered to be diagnostic generic characters and I agree with Parth (1992) that these species should all be included in *Colubraria*.

The Recent Indo-West Pacific species of *Colubraria* have been reviewed by Parth (1991, 1992, 1999) and, in particular, were listed by Parth (1992, p. 219). It should be pointed out, though, that Wilson (1994) illustrated several further, apparently unnamed species from

Australia. A point still needing consideration is the possibility that some of the species named as fossils in Indonesia could prove to be earlier names for the recently named Indo-West Pacific Recent species. A list (probably incomplete) is therefore provided here of the *Colubraria* species described on the basis of Indonesian Neogene fossils, along with one species named by Ladd (1982); more information on most of these species is provided by Skwarko & Sufiati (1994). A few other poorly known names based on Recent material are pointed out here also as a contribution to knowledge of *Colubraria* species in general. Other taxa that need to be considered in relation to a revision of *Colubraria* are the *Metula* species reviewed by van Regteren Altena (1949), including further Indonesian fossil species such as *M. boettgeri* Martin, 1899, and *M. jonkeri* Koperberg, 1931.

1. *Colubraria angsanana* (Martin, 1921, p. 467, pl. 59, fig. 54), Ciangsana, Java, Early Miocene [similar to *C. springsteeni* Parth, 1991, but with nodules on inner lip = *C. cumingii* (Dohrn, 1861)?; but taller than most material of *C. cumingii*].
2. *Colubraria*(?) *angusta* (E.A. Smith, 1899, p. 243 [*Pisania*]; Alcock & McArdle, 1901, pl. 11, fig. 1, 1a); Recent, deep water in the Bay of Bengal.
3. *Colubraria bataviana* (Martin, 1884, p. 134, pl. 7, fig. 135), Ngembak, Semarang, Java, Late Miocene.
4. *Colubraria bataviana timorensis* (Koperberg, 1931, p. 117), West Timor, Pliocene.
5. *Colubraria buitendijki* (Bayer, 1933, p. 77), Recent, Mnoekwari [Manokwari], Irian Jaya; reported in the Recent fauna also by Parth (1992).
6. *Colubraria ickei* Wissema, 1947 (p. 157, pl. 6, figs. 143, 144), Nias Island, Pliocene-Pleistocene [resembles *C. cumingii*, but more coarsely sculptured].
7. *Colubraria impressa* (Boettger, 1883, p. 38, pl. 2, fig. 1a, b), Sumatra, Miocene? [an apertural fragment only, with coarse sculpture; resembles *C. tenera* (Gray)].
8. *Colubraria losariensis* (Martin, 1899, p. 140, pl. 22, fig. 321), Menengteng Gorge, Cirebon, Java, Pliocene.
9. *Colubraria niasensis* Wissema, 1947 (p. 154, pl. 6, figs. 139, 140), Nias Island, Pliocene-Pleistocene.
10. *Colubraria rehderi* Ladd, 1982, p. 49, pl. 8, figs. 2, 3 (Pleistocene, Kere River, Espiritu Santo, New Hebrides, and Recent, 247 m, Philippines) [possibly an earlier name for *C. brinkae* Parth; also very similar to *C. buitendijki* (Bayer)].
11. *Colubraria schroederi* Wissema, 1947 (p. 155, pl. 6, figs. 141, 142), Nias Island, Pliocene-Pleistocene [possibly an earlier name for *C. springsteeni* Parth, 1991, p. 48].
12. *Colubraria tjilonganensis* (Martin, 1899, p. 139, pl. 22, fig. 319), Selacau, Cilongan, Java, Late Miocene; also Beets (1986a, p. 28), Sangkulirang area, Kalimantan ("Preangerian to Pliocene").

Family Conidae Fleming, 1822

Conus conica (Martin, 1881)

Cassis conica Martin, 1881, p. 121, pl. 8, fig. 2; van der Vlerk, 1931, p. 241; Skwarko & Sufiati, 1994, p. k4; van den Hoek Ostende *et al.*, 2002, p. 32.

Type material – Cassis conica Martin, illustrated syntype RGM 9950, Wirosari, Java, Neogene (mould in hard limestone); syntype RGM 9951, as above (very poor partial mould).

Distribution – Known only by the type material.

Remarks – Material referred to "*Cassis" conica* consists of poor moulds in hard limestone. The shells originally had a very low spire and a long, evenly tapered last whorl with straight outlines, and appear to belong in *Conus*.

Family Turbinellidae? Swainson, 1835
Genus *Turbinella*? Lamarck, 1801
Subgenus *Mangkalia* Beets, 1941

Mangkalia Beets, 1941, p. 86. Type species (by original designation): *Cassis*? *(Mangkalia) martini* Beets, 1941, Miocene, Borneo.

Turbinella? *(Mangkalia) martini* (Beets, 1941)
Figs. 325-327.

Cassis? *(Mangkalia) martini* Beets, 1941, p. 87, pl. 5, fig. 187-192.

Type material – *Cassis*? *(Mangkalia) martini*, holotype RGM 312 438, locality L114, Mangkalihat Peninsula, Borneo (spire only, D 180 mm; Figs. 325, 326); illustrated paratype RGM 312 440, locality L114 (as above) (huge fragment of whorl side, H 215 mm; Fig. 327); same locality, 4 other smaller fragments, all paratypes.

Distribution – Known only by the type material.

Remarks – Beets (1941) apparently thought the very low spire of "*Cassis*?" *(Mangkalia) martini*, with low, wide spiral cords on the sutural ramp, was evidence for a position close to *Cassis (sensu stricto)* or *Cypraecassis.* The type material is accompanied in the RGM collection by a sawn spire of *Cypraecassis rufa*, evidently indicating that Beets thought this the most similar cassid to his new species. However, "*Cassis" martini* has many characters that are foreign to all Cassidae. Firstly, it is very large; an incomplete fragment of the whorl side (below the very prominent, narrowly rounded shoulder angle) is 215 mm high, and lacks the anterior end; it ends part of the way down a very large, low (but obvious), wide, siphonal fasciole, much lower, wider and less strongly twisted than in Cassidae. The whole shell was probably more than 300 mm high. The spire certainly is extremely low over the later teleoconch whorls, but is tall and narrow initially, so it has a large, central, narrowly conical "spike" as in some *Conus* species, and strongly concave lower outlines that allow the sutural ramp to become horizontal and flat or even weakly concave on the last few whorls. The shell surface below the periphery is almost smooth, apart from irregular growth ridges, except that it bears several low, rounded, very wide, irregularly placed swellings (large, very low tubercles) around the periphery, probably originally only 4-6 per whorl. The shell is very thick (more than 10 mm thick near the shoulder) and solid. Finally, interior walls all have been resorbed, as in *Conus* and *Cypraea*. The overall appearance of a gigantic *Conus* species is, however, not borne out by the growth lines on the sutural ramp, as these are almost normal to the suture and lack the very deep retraction to the suture ("turrid sinus") that characterises all *Conus* species. The lack of sculpture below the periphery other than large, low, irregular swellings, the large, low siphonal fasciole and the very large size suggest that this is an extremely low-spired species of *Turbinella* Lamarck, 1801, but I have not been able to determine whether *Turbinella* species resorb the inner shell walls. Even if most species of *Turbinella* do not resorb the shell walls, it might well be a character unique to this species, made necessary by the very low spire. Certainly, *Mangkalia* is based on a buccinoidean *(sensu lato)*, rather than a tonnoidean. Apertural characters, such as the presence or absence of the columellar plaits characteristic of *Turbinella*, are required to determine the familial position with certainty. If this is a species of *Turbinella*, recognition of subgenus *T. (Mangkalia)* might prove desirable for it, because of its very short spire and, particularly, if the resorbed shell walls prove to provide a unique character.

Index of species names and synonyms

Remarks – As so many of the names for species recorded from Indonesia previously by Martin, Beets, van Regteren Altena and other authors have been changed, synonymised or reclassified in this report, a list is provided here of included species names, the main synonyms listed in synonymies, and the valid species and genera these are now classified in. Incorrect usages of names, and the species these actually refer to, are listed also, *for the Indonesian material only*. Names with no listed synonyms are regarded as valid.

acuta Perry, 1811, *Distorta* = *Distorsio reticularis* (Linné, 1758).

aculeata Schepman, 1909, *Gyrineum (Biplex) perca* var. = *Biplex pulchra* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).

affinis Broderip, 1833, *Ranella* = *Bursa granularis* (Röding, 1798).

affinis Tesch, 1920, *Ranella (Bursa)* [not of Broderip, 1833] = *Bufonaria crumena* (Lamarck, 1816).

agnitum Iredale, 1927, *Phalium* = *Phalium areola* (Linné, 1758).

alasaense Wissema, 1947, *Cymatium (Lampusia)* = ?*Cymatium (Monoplex) intermedium* (Pease, 1869).

albivaricosa Reeve, 1844b, *Ranella* = *Bufonaria rana* (Linné, 1758).

albocingulatus Deshayes, 1863, *Triton* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

alea Röding, 1798, *Cassis* = *Phalium areola* (Linné, 1758).

allium Dillwyn, 1817, *Buccinum* = *Tonna allium* (Dillwyn, 1817).

ampullaceum Philippi, 1846b, *Dolium* = *Tonna galea* (Linné, 1758).

andoi Nomura, 1935, *Cymatium* = *Cymatium (Monoplex) pileare* (Linné, 1758).

anjarensis Martin, 1884, *Ranella* = *Gyrineum bituberculare* (Lamarck, 1816).

antillarum Mörch, 1877, *Dolium* = *Tonna galea* (Linné, 1758).

antillarum Orbigny, 1842, *Triton* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

anus Linné, 1758, *Murex* = *Distorsio anus* (Linné, 1758).

aquatilis Reeve, 1844a, *Triton* = *Cymatium (Monoplex) aquatile* (Reeve, 1844a).

areola Linné, 1758, *Buccinum* = *Phalium areola* (Linné, 1758).

australe Mörch, 1853, *Dolium* = *Tonna chinensis* (Dillwyn, 1817).

bairdii Verrill & Smith *in* Verrill, 1881, *Dolium* = *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881).

bantamensis Martin, 1899, *Purpura* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

bayeri van Regteren Altena, 1942, *Cymatium (Gutturnium)* = *Cymatium (Reticutriton) pfeifferianum* (Reeve, 1844a).

bayeri Poppenoe & Kleinpell, 1978, *Cymatium* [not of van Regteren Altena, 1942] = *Cymatium (Monoplex) aquatile* (Reeve, 1844a).

beccarii Tapparone-Canefri, 1875, *Tritonium (Simpulum)* = *Cymatium (Monoplex) pileare* (Linné, 1758).

beckii Kiener, 1841, *Ranella* = *Bufonaria rana* (Linné, 1758).

beui Garcia-Talavera, 1987, *Cymatium (Septa)* = *Cymatium (Septa) occidentale* (Mörch, 1877).

bezoar Gray, 1839, *Cassis* = *Phalium glaucum* (Linné, 1758).

biornatum Tate, 1894, *Dolium* = *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881).

bisulcata Schubert & Wagner, 1829, *Cassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

bitubercularis Lamarck, 1816, *Ranella* = *Gyrineum bituberculare* (Lamarck, 1816).

bituminata Martin, 1933, *Cassidea (Semicassis)* = *Galeodea bituminata* (Martin, 1933) [earlier name for *Galeodea echinophorella* Habe, 1961].

bituminatum Martin, 1933, *Dolium (Eudolium)* = *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881).

blacketi Iredale, 1936, *Septa?* = *Cymatium (Septa) occidentale* (Mörch, 1877).

bomasense Martin, 1916, *Eutritonium* = *Cymatium (Monoplex) gemmatum* (Reeve, 1844a).

booleyi G.B. Sowerby 3rd, 1900, *Cassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

borneana Cox, 1948, *Cymatium (Lampusia) pileare* var. = *Cymatium (Monoplex) vespaceum* (Lamarck, 1822).

brasiliana Mörch, 1877, *Dolium antillarum* var. = *Tonna galea* (Linné, 1758).

bubo Linné, 1758, *Murex rana* = *Tutufa bubo* (Linné, 1758).

caledonensis Jousseaume, 1881, *Lampas* = *Tutufa (Tutufella) rubeta* (Linné, 1758).

canaliculata Linné, 1758, *Bulla* = *Tonna canaliculata* (Linné, 1758).

cancellata Röding, 1798, *Cassis* = *Phalium decussatum* (Linné, 1758).

cancellinus de Roissy, 1805, *Murex* [not of Lamarck, 1803] = *Distorsio reticularis* (Linné, 1758).

caput-equinum Röding, 1798, *Cassis* = *Cassis cornuta* (Linné, 1758).

carolimartini Beets, 1943, *Galeodea* = *Galeodea bituminata* (Martin, 1933).

caudatum Gmelin, 1791, *Buccinum* [not *Murex caudatum* Gmelin, 1791] = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

cepa Röding, 1798, *Cadus* = *Tonna canaliculata* (Linné, 1758).

chemnitzii Küster *in* Küster & Kobelt, 1871, *Ranella* = *Gyrineum lacunatum* (Mighels, 1845).

chinense Dillwyn, 1817, *Buccinum* = *Tonna chinensis* (Dillwyn, 1817).

cingulatum Lamarck, 1822, *Cassidaria* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

clandestinum Lamarck, 1816, *Triton* = *Cymatium (Gelagna) succinctum* (Linné, 1771).

clathratum Link, 1807, *Phalium* = *Phalium areola* (Linné, 1758).

clavator Dillwyn, 1817, *Murex* = *Cymatium (Ranularia) gutturnium* (Röding, 1798).

clavator van Regteren Altena, 1942, *Cymatium (Ranularia)* [in part not of Dillwyn, 1817] = *Cymatium (Ranularia) gutturnium* (Röding, 1798) in part = *C. springsteeni* Beu, 1987, in part.

clavator Wissema, 1947, *Cymatium (Ranularia)* [in part not of Dillwyn, 1817] = *Cymatium (Ranularia) gutturnium* (Röding, 1798) in part = *C. testudinarium* (A. Adams & Reeve, 1850) in part.

confinis Brancsik, 1896, *Triton* = *Cymatium (Gelagna) succinctum* (Linné, 1771).

conica Martin, 1881, *Cassis* = *Conus* sp.

cornutum Linné, 1758, *Buccinum* = *Cassis cornuta* (Linné, 1758).

corrugata van Regteren Altena, 1942, *Bursa (Colubrellina)* [not of Perry, 1811] = *Bursa granularis* (Röding, 1798).

costatum Menke, 1828, *Dolium* = *Tonna allium* (Dillwyn, 1817).

coturnix Röding, 1798, *Cadus* = *Tonna perdix* (Linné, 1758).

crenulatum Philippi, 1846b, *Dolium* = ?*Tonna galea* (Linné, 1758).

crispus Reeve, 1844a, *Triton* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

crumena Lamarck, 1816, *Ranella* = *Bufonaria crumena* (Lamarck, 1816).

crumenoides Valenciennes, 1832, *Ranella* = *Bufonaria crumena* (Lamarck, 1816).

cruzana Nowell-Usticke, 1959, *Cymatium pileare* var. = ?*Cymatium (Monoplex) aquatile* (Reeve, 1844a).

cubaniana Orbigny, 1842, *Ranella* = *Bursa granularis* (Röding, 1798).

cumingiana Dunker, 1862, *Bursa* = *Bursa granularis* (Röding, 1798).

cuspidata Reeve, 1844b, *Ranella* = *Gyrineum bituberculare* (Lamarck, 1816).

cuspidataeformis Kira, 1956, *Apollon pusillus* = *Gyrineum lacunatum* (Mighels, 1845).

cutaceus Lamarck, 1816, *Fusus* [not *Murex cutaceus* Linné, 1758] = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

dalrymplei Cox, 1948, *Phalium (Semicassis)* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

decipiens Reeve, 1844a, *Triton* = *Distorsio decipiens* (Reeve, 1844a).

decussatum Linné, 1758, *Buccinum* = *Phalium decussatum* (Linné, 1758).

defranata Iredale, 1936, *Ranularia sinensis* = *Cymatium (Ranularia) sinense* (Reeve, 1844a).

deliberatus Iredale, 1936, *Apollon* = *Gyrineum lacunatum* (Mighels, 1845).

denseplicata van Regteren Altena, 1942, *Distorsio cancellina* var. = *Distorsio denseplicata* van Regteren Altena, 1942.

denseplicata Martin, 1916, *Cassis (Semicassis)* = *Cypraecassis denseplicata* (Martin, 1916).

denticulata Röding, 1798, *Cassis* = *Casmaria erinacea* (Linné, 1758).

depressior Martin, 1879, *Cassis* = *Cassis depressior* Martin, 1879.

dharmai Beu, sp. nov., *Cymatium (Septa).*

diuturna Iredale, 1927, *Semicassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

djunggranganensis Martin, 1916, *Persona* = *Distorsio djunggranganensis* (Martin, 1916).

doliata Röding, 1798, *Neptunea* = *Cymatium (Gelagna) succinctum* (Linné, 1771).

echinatum Link, 1807, *Gyrineum* = *Bufonaria echinata* (Link, 1807).

echinophorella Habe, 1961, *Galeodea* = *Galeodea bituminata* (Martin, 1933).

edentulum Link, 1807, *Phalium* = *Casmaria erinacea* (Linné, 1758).

elegans Perry, 1811, *Biplex* = *Gyrineum natator* (Röding, 1798).

elegans G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, *Ranella* = *Bufonaria elegans* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).

elegans Martin, 1879, *Ranella* [not of G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841)] = *Bursina ignobilis* (Beu, 1987).

elongatus Reeve, 1844a, *Triton* = *Cymatium (Monoplex) vespaceum* (Lamarck, 1822).

erbi Haanstra & Spiker, 1932, *Cassidaria* = *Eudolium erbi* (Haanstra & Spiker, 1932).

erinaceus Linné, 1758, *Buccinum* = *Casmaria erinacea* (Linné, 1758).

errabunda Beets, 1943b, *Galeodea* = *Eudolium errabundum* (Beets, 1843b).

extinctum Link, 1807, *Phalium* = *Phalium areola* (Linné, 1758).

facetus Iredale, 1936, *Apollon* = *Gyrineum lacunatum* (Mighels, 1845).

fasciatum Bruguière, 1789, *Buccinum* = *Tonna sulcosa* (Born, 1778).

fasciata van Regteren Altena, 1942, *Tonna* [not of Bruguière, 1789] = *Tonna chinensis* (Dillwyn, 1817).

fennemai Martin, 1899, *Triton (Colubraria)* = *Sassia (Cymatiella) fennemai* (Martin, 1899).

fimbriatum J. Sowerby & G.B. Sowerby 1st, 1823, *Dolium* = *Tonna tessellata* (Lamarck, 1816).

flammeolum Röding, 1798, *Cassis* = *Phalium decussatum* (Linné, 1758).

floridanum Mansfield, 1930, *Cymatium (Linatella)* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

formosus Perry, 1811, *Monoplex* = *Cymatium (Ranularia) gutturnium* (Röding, 1798).

fortespirale Parth, 1993, *Cymatium (Ranularia)* = *Cymatium (Ranularia) pyrulum* (A. Adams & Reeve, 1850).

francesae Iredale, 1931, *Distorsio* = *Distorsio reticularis* (Linné, 1758).

fusco-costata Dunker, 1862, *Bursa* = *Gyrineum bituberculare* (Lamarck, 1816).

galea Linné, 1758, *Buccinum* = *Tonna galea* (Linné, 1758).

gallinago Cox, 1948, *Cymatium (Gutturnium)* [not of Reeve, 1844a] = *Cymatium (Ranularia) sarcostoma* (Reeve, 1844a).

gembacanum Martin, 1884, *Tritonium (Simpulum)* = *Cymatium (Monoplex) gembacanum* (Martin, 1884) (possibly a synonym of *C. (Monoplex) exaratum* (Reeve, 1844a)).

gemma Connolly, 1929, *Afrocanidea* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

gemmatus Reeve, 1844a, *Triton* = *Cymatium (Monoplex) gemmatum* (Reeve, 1844a).

gigantea E. A. Smith, 1914, *Bursa (Tutufa) rubeta* = *Tutufa bubo* (Linné, 1758).

glaucoides Martin, 1879, *Cassis* = *Phalium areola* (Linné, 1758).

glaucum Linné, 1758, *Buccinum* = *Phalium glaucum* (Linné, 1758).

gnorima Melvill, 1918, *Bursa* = *Bursina gnorima* (Melvill, 1918).

gracilis Reeve, 1844a, *Triton* = *Cymatium (Ranularia) pfeifferianum* (Reeve, 1844a).

granifera Lamarck, 1816, *Ranella* = *Bursa granularis* (Röding, 1798).

granosa Martin, 1884, *Ranella spinosa* var. = *Bufonaria granosa* (Martin, 1884) [?earlier name for *Bufonaria perelegans* Beu, 1987].

granulare Röding, 1798*, Tritonium = Bursa granularis* (Röding, 1798).
gutturnium Röding, 1798, *Tudicla = Cymatium (Ranularia) gutturnium* (Röding, 1798).
gyrina Martin, 1899, *Ranella (Apollo)* [not of Linné, 1758] = *Gyrineum lacunatum* (Mighels, 1845).
gyrinata Risso, 1826, *Ranella = Cymatium (Gutturnium) muricinum* (Röding, 1798).
gyrinus Linné, 1758, *Murex = Gyrineum gyrinum* (Linné, 1758).
gyrinus Wissema, 1947, *Apollon (Apollon)* [not of Linné, 1758] = *Gyrineum wilmerianum* Preston, 1908.
hamata Röding, 1798, *Cassis = Cassis cornuta* (Linné, 1758).
haemastoma Valenciennes, 1832, *Triton = Cymatium (Monoplex) pileare* (Linné, 1758).
hepaticum Röding, 1798, *Tritonium = Cymatium (Septa) hepaticum* (Röding, 1798).
herklotsi Martin, 1879, *Cassis = Semicassis bisulcata* (Schubert & Wagner, 1829).
hians Schumacher, 1817, *Lampas = Tutufa (Tutufella) rubeta* (Linné, 1758).
hochstetteri Martin, 1879, *Dolium = Tonna allium* (Dillwyn, 1817).
horrida Kuroda & Habe, 1961, *Distorsio (Rhysema) = Distorsio perdistorta* Fulton, 1938.
ignobilis Beu, 1987, *Bufonaria = Bursina ignobilis* (Beu, 1987).
imbricata W.H.D. Adams, 1868*, Triton = Charonia tritonis* (Linné, 1758).
inflatum Kuroda & Habe, 1952, *Eudolium = Eudolium javanum* (Martin, 1879).
insulare Pilsbry, 1921, *Cymatium vestitum = Cymatium (Monoplex) pileare* (Linné, 1758).
intermedium Pease, 1869, *Triton = Cymatium (Monoplex) intermedium* (Pease, 1869).
interrupta Martin, 1884, *Ranella = Bufonaria rana* (Linné, 1758).
jabick Röding, 1798, *Tritonium = Bursa granularis* (Röding, 1798).
japonica Reeve, 1848a, *Cassis = Semicassis bisulcata* (Schubert & Wagner, 1829).
javana Martin, 1879, *Cassidaria = Eudolium javanum* (Martin, 1879) [earlier name for *E. pyriforme* G.B. Sowerby 3rd, 1914].
junghuhni Martin, 1879, *Ranella (Apollo) = Gyrineum lacunatum* (Mighels, 1845).
karikalensis Cossmann, 1903b, *Ranella = Gyrineum bituberculare* (Lamarck, 1816).
keuneni Koperberg, 1931, *Persona (Distorsio) reticulata = Distorsio decipiens* (Reeve, 1844a).
kikaiensis Shikama, 1970, *Lampusia = Cymatium (Monoplex) intermedium* (Pease, 1869).
koperbergae van Regteren Altena, 1942, *Bursa (Bursa) = Bursina gnorima* (Melvill, 1918).
krenkeli Cox, 1930, *Cymatium (Linatella) = Cymatium (Linatella) cingulatum* (Lamarck, 1822).
kuroharai Azuma, 1960, *Eudolium = Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881).
labiata Perry, 1811, *Cassis = Cypraecassis rufa* (Linné, 1758) (not *Cassidea labiata* Perry, 1811 = *Semicassis labiata* (Perry, 1811)).
labiata Schumacher, 1817, *Ranularia = Cymatium (Ranularia) gutturnium* (Röding, 1798).
labiosus Wood, 1828, *Murex = Cymatium (Turritriton) labiosum* (Wood, 1828).
labrosa Gray, 1847, *Cassis = Malea pomum* (Linné, 1758).
lacunatum Mighels, 1845, *Triton = Gyrineum lacunatum* (Mighels, 1845).
lagenaeformis Boettger, 1883, *Cassis (Semicassis)* is unidentifiable.
lamonganana Martin, 1884, *Nassa = Distorsio reticularis* (Linné, 1758).
lampas Lamarck, 1816, *Triton* [not of Linné, 1758] = *Tutufa (Tutufella) rubeta* (Linné, 1758).
lampas Martin, 1899, Schepman, 1907, *etc.*, *Ranella (Lampas)* [not of Linné, 1758] = *Tutufa oyamai* Habe, 1973.
latescens Mörch, 1853, *Dolium = Tonna allium* (Dillwyn, 1817).
latesulcatum Hanley, 1860, *Dolium = Tonna allium* (Dillwyn, 1817).
latitudo Garrard, 1961, *Bursa = Bursa latitudo* Garrard, 1961.
latitudo wolfei Beu, 1987, *Bursa (Bufonariella) = Bursa latitudo* Garrard, 1961.
leucostoma Martin, 1879, *Ranella* [not of Lamarck, 1822] = *Bufonaria granosa* (Martin, 1884).
lineata Schepman, 1909*, Morio = Eudolium javanum* (Martin, 1879).
lischkeanum Küster, 1857, *Dolium = Tonna lischkeana* (Küster, 1857).
livida Reeve, 1844b, *Ranella = Bursa granularis* (Röding, 1798).
loebbeckei Lischke, 1870, *Triton = Cymatium (Turritriton) labiosum* (Wood, 1828).
longirostra Schumacher, 1817, *Ranularia = Cymatium (Ranularia) gutturnium* (Röding, 1798).
loroisii Petit de la Saussaye, 1852, *Triton = Cymatium (Turritriton) labiosum* (Wood, 1828).

losariense Martin, 1899, *Dolium* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).
macgregori Iredale, 1931, *Quimalea pomum* = *Malea pomum* (Linné, 1758).
macrourum Link, 1807, *Triton* = *Cymatium (Ranularia) gutturnium* (Röding, 1798).
magnifica Martin, 1879, *Ranella* = *Biplex magnifica* (Martin, 1879).
margaritula Deshayes, 1832, *Ranella* = *Bufonaria margaritula* (Deshayes, 1832).
marginalba Yamamoto & Sakurai, 1977, *Galeodea* = *Galeodea bituminata* (Martin, 1933).
marginatum Philippi, 1846b, *Dolium* is unidentifiable.
marmoratum Link, 1807, *Triton* = *Charonia tritonis* (Linné, 1758).
marmoreum Schröter, 1788, *Dolium* = *Tonna canaliculata* (Linné, 1758).
martini van Regteren Altena, 1942, *Sconsia*.
martini Boettger, 1883, *Dolium costatum* var. = *Tonna allium* (Dillwyn, 1817).
martini Beets, 1941, *Cassis (Mangkalia)* = *Turbinella? martini* (Beets, 1941).
meleagris Röding, 1798, *Cadus* = *Tonna perdix* (Linné, 1758).
menkrawitense Beets, 1941, *Phalium*.
menkrawitensis Beets, 1941, *Charonia (Sassia?)* = *Sassia (Cymatiella) mankrawitensis* (Beets, 1941).
metableta Cossmann, 1903b, *Persona* = *Distorsio reticularis* (Linné, 1758).
microstoma Fulton, 1930, *Bursa (Biplex)* = *Biplex pulchra* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).
minjac Deshayes, 1844, *Dolium* = *Tonna tessellata* (Lamarck, 1816).
minoense Itoigawa, 1960, *Apollon* = *Gyrineum bituberculare* (Lamarck, 1816).
modjokasriense Martin, 1899, *Dolium* = ?*Tonna galea* (Linné, 1758).
mulus Dillwyn, 1817, *Murex* = *Distorsio reticularis* (Linné, 1758).
muricina Röding, 1798, *Distorsio* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).
nanshaensis Zhang, 2004, *Gyrineum* = *Gyrineum lacunatum* (Mighels, 1845).
nashi Iredale, 1931, *Xenogalea* = *Semicassis bisulcata* (Schubert & Wagner, 1829).
natalensis E. A. Smith, 1906, *Dolium fimbriatum* var. = *Tonna allium* (Dillwyn, 1817).
natator Röding, 1798, *Tritonium* = *Gyrineum natator* (Röding, 1798).
neglecta G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, *Ranella* = *Bufonaria margaritula* (Deshayes, 1832).
neptunia Garrard, 1961, *Linatella* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).
niasensis Wissema, 1947, *Tonna* = *Tonna sulcosa* (Born, 1778).
nobilis Reeve, 1844b, *Ranella* = *Bursina nobilis* (Reeve, 1844b).
nobilis van Regteren Altena, 1942, *Ranella* [not of Reeve, 1844b] = *Bursina ignobilis* (Beu, 1987).
nobilis Tesch, 1920, *Ranella (Bursa)* [not of Reeve, 1844b] = *Bursina gnorima* (Melvill, 1918).
nodulus Link, 1807, *Tritonium* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).
nucleus Küster, 1857, *Cassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).
obesa C.B. Adams, 1850, *Litiopa* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).
occidentale Mörch, 1877, *Triton (Lampusia) rubecula* = *Cymatium (Septa) occidentale* (Mörch, 1877).
olearium Bruguière, 1789, *Buccinum* [not of Linné, 1758] = *Tonna canaliculata* (Linné, 1758).
olearium Linné, 1758, *Buccinum* = ?*Tonna galea* (Linné, 1758).
olearium Röding, 1798, *Tritonium* [not of Linné, 1758] = *Cymatium (Monoplex) pileare* (Linné, 1758).
olivator Mörch, 1853, *Ranella* = *Gyrineum natator* (Röding, 1798).
orientalis Garcia-Talavera, 1987, *Cymatium (Monoplex) pileare* = *Cymatium (Monoplex) pileare* (Linné, 1758).
orientalis G. & H. Nevill, 1874, *Triton (Gutturnium)* = *Cymatium (Turritriton) labiosum* (Wood, 1828).
osawanoensis Tsuda, 1959, *Apollon* = *Gyrineum bituberculare* (Lamarck, 1816).
oyamai Habe, 1973, *Tutufa* = *Tutufa (Tutufella) oyamai* Habe, 1973.
pacator Iredale, 1931, *Gyrineum* = *Bufonaria margaritula* (Deshayes, 1832).
pamotanensis Martin, 1899, *Morio* = *Eudolium pamotanense* (Martin, 1899).
pamotanensis Martin, 1899, *Ranella* = *Biplex pamotanensis* (Martin, 1899).
papuana Beets, 1943b, *Galeodea* = *Malea papuana* (Beets, 1943b).
paucinodosa Boettger, 1883, *Ranella crumena* = *Bufonaria crumena* (Lamarck, 1816).
peninsulum M. Smith, 1937, *Cymatium (Linatella) cingulatum* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

pennatum Gmelin, 1791, *Buccinum* = *Cypraecassis rufa* (Linné, 1758).

perca Perry, 1811, *Biplex*.

perdistorta Fulton, 1938, *Distorsio*.

perdix Linné, 1758, *Buccinum* = *Tonna perdix* (Linné, 1758).

perelegans Beu, 1987, *Bufonaria* = ?*Bufonaria granosa* (Martin, 1884).

perficus Iredale, 1931, *Saginafusus pricei* = *Cymatium (Monoplex) pileare* (Linné, 1758).

perliberalis Beets, 1984, *Apollon (Biplex)* = *Biplex perliberalis* (Beets, 1984).

persimilis Kira, 1955, *Semicassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

pfeifferi Hidalgo, 1871, *Cassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

pfeifferianus Reeve, 1844a, *Triton* = *Cymatium (Ranularia) pfeifferianum* (Reeve, 1844a).

pictum Schepman, 1893, *Dolium [nomen nudum]* = *Tonna perdix* (Linné, 1758).

pila Reeve, 1848a, *Cassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

pilearis Linné, 1758, *Murex* = *Cymatium (Monoplex) pilearis* (Linné, 1758).

plumatum Green, 1830, *Dolium* = *Tonna perdix* (Linné, 1758).

polychloros Tapparone-Canefri, 1875, *Ranella* = *Gyrineum lacunatum* (Mighels, 1845).

pomum Linné, 1758, *Buccinum* = *Malea pomum* (Linné, 1758).

poulsenii Mörch, 1877, *Triton (Linatella)* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

preangerensis Martin, 1899, *Cassis* [? = *Cassis cornuta* Linné, 1758].

productum Gould, 1852, *Triton* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

pseudopyrum Martin, 1899, *Triton (Ranularia)* = *Cymatium (Ranularia) gutturnium* (Röding, 1798) in part = ?*C. (Ranularia) pyrulum* (A. Adams & Reeve, 1850) in part = *C. (Ranularia) sarcostoma* (Reeve, 1844a) in part.

pulchra Pannekoek, 1936, *Sconsia*.

pulchra Reeve, 1844b, *Ranella* [not of G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841] = *Biplex perca* Perry, 1811.

pulchra G.B. Sowerby 2nd, 1836 in G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, *Ranella* = *Biplex pulchra* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841).

pullum Born, 1778, *Buccinum* = *Cypraecassis rufa* (Linné, 1758).

pusilla Reeve, 1844b, *Ranella* [not of Broderip, 1833] = *Gyrineum lacunatum* (Mighels, 1845).

pyriforme G.B. Sowerby 3rd, 1914, *Eudolium* = *Eudolium javanum* (Martin, 1879).

pyriformis Conrad, 1849, *Triton* = *Cymatium (Gutturnium) muricinum* (Röding, 1798).

pyrulum (A. Adams & Reeve, 1850), *Triton* = *Cymatium (Ranularia) pyrulum* (A. Adams & Reeve, 1850) [but note that the Indonesian fossil *C. pseudopyrum* (Martin, 1899) is probably a distinct species]

pyrum Martin, 1883a, *Triton* [not of Linné, 1758] = *Cymatium (Ranularia) gutturnium* (Röding, 1798).

quilonensis Dey, 1962, *Semicassis* = *Semicassis bisulcata* (Schubert & Wagner, 1829).

rana Linné, 1758, *Murex* = *Bufonaria rana* (Linné, 1758).

ranina Lamarck, 1816, *Ranella* = *Gyrineum gyrinum* (Linné, 1758).

raninoides Martin, 1883a, *Ranella* = *Gyrineum bituberculare* (Lamarck, 1816).

reevii Hanley, 1860, *Dolium* = *Tonna lischkeana* (Küster, 1857).

rembangense Wanner & Hahn, 1935, *Eutritonium* = *Cymatium (Monoplex) rembagnense* (Wanner & Hahn, 1935).

rembangensis Martin, 1899, *Cassis (Semicassis)* = *Phalium rembangense* (Martin, 1899).

rembangensis Pannekoek, 1936, *Sconsia* = *Sconsodolium rembangense* (Pannekoek, 1936), type species of *Sconsodolium* gen. nov.

reticularis Linné, 1758, *Murex* = *Distorsio reticularis* (Linné, 1758).

reticularis Tesch, 1915, *Persona (Distortrix)* [not of Linné, 1758] = *Distorsio decipiens* (Reeve, 1844a).

reticulata Röding, 1798, *Distorsio* = *Distorsio reticularis* (Linné, 1758).

reticulatus Montfort, 1810, *Perdix* = *Tonna perdix* (Linné, 1758).

robusta Fulton, 1936, *Gyrineum natator* var. = *Gyrineum natator* (Röding, 1798).

rosa Perry, 1811, *Biplex* = *Bursa rosa* (Perry, 1811).

rostratus Mörch, 1853, *Ranularia (Lagena)* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

rotunda Perry, 1811, *Distorta* = *Distorsio anus* (Linné, 1758).

rubecula Linné, 1758, *Murex* = *Cymatium (Septa) rubeculum* (Linné, 1758).

rubeculum Wissema, 1947, *Cymatium (Lampusia)* [in part not of Linné, 1758] = *Cymatium*

(Septa) hepaticum (Röding, 1798) in part.

rubeta Linné, 1758, *Murex rana* = *Tutufa (Tutufella) rubeta* (Linné, 1758)

rubeta van Regteren Altena, 1942, *Bursa (Ranella)* [not of Linné, 1758] = *Tutufa oyamai* Habe, 1973.

rubicola Perry, 1811, *Biplex* = *Bursa granularis* (Röding, 1798).

rufa Lamarck, 1822, *Cassis* = *Cypraecassis rufa* (Linné, 1758).

rufescens Röding, 1798, *Cassis* = *Cypraecassis rufa* (Linné, 1758).

rufum Linné, 1758, *Buccinum* = *Cypraecassis rufa* (Linné, 1758).

rugosa Schumacher, 1817, *Distorta* = *Distorsio anus* (Linné, 1758).

rutilum Menke, 1843, *Tritonium* = *Cymatium (Turritriton) labiosum* (Wood, 1828).

sagitta Küster *in* Küster & Kobelt, 1871, *Ranella* = *Gyrineum lacunatum* (Mighels, 1845).

sangirana sp. nov., *Bursa*.

sarcostoma Reeve, 1844a, *Triton* = *Cymatium (Ranularia) sarcostoma* (Reeve, 1844a).

scarlatina Perry, 1810, *Septa* = *Cymatium (Septa) rubeculum* (Linné, 1758).

scelestum Yokoyama, 1928, *Gyrineum* = *Bufonaria rana* (Linné, 1758).

schepmani Bayer, 1937, *Tonna* = *Tonna perdix* (Linné, 1758).

sinensis Reeve, 1844a, *Triton* = *Cymatium (Ranularia) sinense* (Reeve, 1844a).

siphonata Reeve, 1844b, *Ranella* = *Bursa rosa* (Perry, 1811).

solidior Dautzenberg & Fischer, 1906, *Dolium (Eudolium) crosseanum* var. = *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881).

spinosa Lamarck, 1816, *Ranella* = *Bufonaria echinata* (Link, 1807).

springsteeni Beu, 1987, *Cymatium (Ranularia)*.

strangei A. Adams & Angas, 1864, *Triton* = *Cymatium (Turritriton) labiosum* (Wood, 1828).

striata Martin, 1884, *Sconsia* [not of Lamarck, 1816] = *Sconsia martini* van Regteren Altena, 1942.

striata Wanner & Hahn, 1935, *Sconsia* [not of Lamarck, 1816] = *Sconsia pulchra* Pannekoek, 1936.

subgranosa Schepman, 1909, *Bursa* [not of G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841] = *Bursina gnorima* (Melvill, 1918).

subgranosa G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841, *Ranella* = *Bufonaria rana* (Linné, 1758).

subgranosa Tesch, 1915, *Ranella (Bursa)* [not of G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841] = *Bufonaroa granosa* (Martin, 1883)

subgranosa Wissema, 1947, *Gyrineum (Gyrineum)* [not of G.B. Sowerby 2nd, 1835 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841] = *Bufonaria elegans* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841)).

succinctus Linné, 1771, *Murex* = *Cymatium (Gelagna) succinctum* (Linné, 1758).

suensonii Mörch, 1853, *Bursa* = *Bufonaria echinata* (Link, 1807).

sulcatum Link, 1807, *Phalium* = *Phalium areola* (Linné, 1758).

sulcosa Born, 1778, *Buccinum* = *Tonna sulcosa* (Born, 1778).

suzumai Sakurai, 1984, *Galeodea echinophorella* = *Galeodea bituminata* (Martin, 1933).

szukouensis Hu & Tao, 1991, *Neptunea* = *Cymatium (Linatella) cingulatum* (Lamarck, 1822).

tegalensis Martin, 1899, *Cassis (Semicassis)* = ?*Cymatium (Linatella) cingulatum* (Lamarck, 1822).

tenebrosa Hanley, 1860, *Dolium galea* var. = *Tonna galea* (Linné, 1758).

tenue Menke, 1830, *Dolium* = *Tonna galea* (Linné, 1758).

tenuigranosa E. A. Smith, 1914, *Bursa (Tutufa) rubeta* var. = *Tutufa (Tutufa) tenuigranosa* (E. A. Smith, 1914)

tenuiliratus Lischke, 1873, *Triton* = *Cymatium (Turritriton) tenuiliratus* (Lischke, 1873).

tessellatum Lamarck, 1816, *Dolium* = *Tonna tessellata* (Lamarck, 1816).

testudinarius A. Adams & Reeve, 1850, *Triton* = *Cymatium (Ranularia) testudinarium* (A. Adams & Reeve, 1850).

thersites Redfield, 1846, *Ranella* = *Bufonaria thersites* (Redfield, 1846)

thersites Schepman, 1907, *Aquillus* [not of Reeve, 1844a] = *Cymatium (Monoplex) vespaceum* (Lamarck, 1822).

timorensis Koperberg, 1931, *Ranella (Apollon) nobilis* = *Bursina gnorima* (Melvill, 1918).

timorensis Koperberg, 1931, *Ranella (Biplex) pulchra* = *Biplex pulchra* (G.B. Sowerby 2nd,

Explanation of plates

Figures 1-13. All specimens figured in this paper are from Neogene rocks of Indonesia.
Figures 1-2. RGM 9875. *Bufonaria crumena* (Lamarck, 1816). Bajah, Java, Indonesia. Unnamed beds, Pliocene. H 71 mm.
Figures 3-4. RGM 9876. *Bufonaria crumena* (Lamarck, 1816). Palabuan Ratu, Java, Indonesia. Unnamed beds, Middle Miocene. H 29 mm.
Figure 5. SMF VIII/2880a. *Bufonaria crumena* (Lamarck, 1816). Seluma, Sumatra, Indonesia. *Eburna* marls, Middle Miocene. H 35 mm. Holotype of *R. crumena* var. *paucinodosa* Boettger, 1883.
Figures 6-7. RGM 9905. *Bufonaria echinata* (Link, 1807). Junghuhn locality O, Java, Indonesia. Unnamed beds, Late Miocene. H 56 mm.
Figures 8-9. RGM 9905. *Bufonaria echinata* (Link, 1807). Junghuhn locality O, Java, Indonesia. Unnamed beds, Late Miocene. H 43 mm.
Figures 10-11. RGM 456 222. *Bufonaria elegans* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 73 mm.
Figures 12-13. RGM 26 823. *Bufonaria elegans* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841). Tjibinong, Java, Indonesia. Unnamed beds, age unknown. H 57 mm.

Figures 14-30.
Figures 14-15. RGM 456 223. *Bufonaria elegans* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841). Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 59 mm.
Figures 16-17. RGM 9907. *Bufonaria granosa* (Martin, 1884). Gunung Sela, Java, Indonesia. Unnamed beds, Late Miocene. H 51 mm. Holotype of *Ranella granosa* Martin, 1884.
Figures 18-19. RGM 456 224. *Bufonaria margaritula* (Deshayes, 1832). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 34 mm.
Figure 20. RGM 9888. *Bufonaria margaritula* (Deshayes, 1832). Tjikensik, Java, Indonesia. Unnamed beds, Pliocene. H 38 mm.
Figures 21-22. RGM 456 225. *Bufonaria margaritula* (Deshayes, 1832). Mijnwezen locality M90, Java, Indonesia. Pucangang Formation, Pleistocene. H 33 mm.
Figures 23-24. RGM 456 226. *Bufonaria rana* (Linné, 1758). Mijnwezen locality M173, Java, Indonesia. Pucangang Formation, Pleistocene. H 51 mm.
Figures 25-26. RGM 456 227. *Bufonaria rana* (Linné, 1758). Mijnwezen locality M163, Java, Indonesia. Pucangang Formation, Pleistocene. H 46 mm.
Figures 27-28. RGM 456 228. *Bursa granularis* (Röding, 1798). Mijnwezen locality M126, Java, Indonesia. Pucangang Formation, Pleistocene. H 35 mm.
Figures 29-30. RGM 46 582. *Bursa latitudo* Garrard, 1961. Mijnwezen locality Cosijn 52, Java, Indonesia. Pucangang Formation, Pleistocene. H 41 mm.

Figures 31-51.
Figures 31-32. UU 371934/ RGM 456 229. *Bursa rosa* (Perry, 1811). Wahai, Ceram, Indonesia. Unnamed beds, Pleistocene? H 28 mm.
Figure 33. In B. Dharma collection. *Bursa rosa* (Perry, 1811). Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 41 mm.
Figures 34-35. RGM 107 524. *Bursa rosa* (Perry, 1811). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 14 mm.
Figure 36. In B. Dharma collection. *Bursa sangirana* sp. nov.. Sangiran, Java, Indonesia. Kalibeng Formation, Pliocene. H 38 mm. Paratype.
Figures 37-38. RGM 456 230. *Bursa sangirana* sp. nov.. Sangiran, Java, Indonesia. Kalibeng Formation, Pliocene. H 41 mm. Holotype.
Figures 39-40. RGM 456 231. *Bursina gnorima* (Melvill, 1918). Mijnwezen locality M112, Java, Indonesia. Pucangang Formation, Pleistocene. H 40 mm.
Figure 41. In B. Dharma collection. *Bursina gnorima* (Melvill, 1918). Sangiran, Java, Indonesia. Kalibeng Formation, Pliocene. H 37 mm.

Figures 42-43. RGM 456 232. *Bursina ignobilis* (Beu, 1987). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 38 mm.

Figures 44-45. RGM 456 233. *Bursina ignobilis* (Beu, 1987). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 46 mm.

Figures 46-47. RGM 456 234. *Bursina ignobilis* (Beu, 1987). Mijnwezen locality M260, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 41 mm.

Figures 48-49. RGM 456 235. *Bursina ignobilis* (Beu, 1987). Mijnwezen locality M257, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 59 mm.

Figures 50-51. RGM 9899. *Bursina ignobilis* (Beu, 1987). Tji Angsana, Java, Indonesia. Unnamed beds, Pleistocene. H 56 mm.

Figures 52-67.

Figures 52-53. RGM 456 236. *Bursina* cf. *ignobilis* (Beu, 1987). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 44 mm.

Figure 54. In B. Dharma collection. *Bursina* aff. *ignobilis* Beu, 1987. Sangiran, Java, Indonesia. Kalibeng Formation, Pliocene. H 49 mm.

Figures 55-56. RGM 9893. *Bursina nobilis* (Reeve, 1844b). Junghuhn locality O, Java, Indonesia. Unnamed beds, Late Miocene. H 48 mm.

Figures 57-58. RGM 456 237. *Tutufa (Tutufa) bubo* (Linné, 1758). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 22 mm.

Figures 59-60. RGM 456 237. *Tutufa (Tutufa) bubo* (Linné, 1758). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 26 mm.

Figures 61-62. RGM 107 519. *Tutufa (Tutufa) bubo* (Linné, 1758). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 31 mm.

Figure 63. RGM 456 238. *Tutufa (Tutufa) bubo* (Linné, 1758). Mijnwezen locality M149, Java, Indonesia. Pucangang Formation, Pleistocene. H 54 mm.

Figures 64-65. RGM 456 239. *Tutufa (Tutufella) oyamai* Habe, 1973. Mijnwezen locality M278, Java, Indonesia. Pucangang Formation, Pleistocene. H 50 mm.

Figures 66-67. RGM 9944. *Cassis cornuta* (Linné, 1758). Junghuhn locality O, Java, Indonesia. Unnamed beds, Late Miocene. H 59 mm.

Figures 68-76.

Figures 68-69. RGM 9947. *Cassis depressior* Martin, 1879. Junghuhn locality O, Java, Indonesia. Unnamed beds, Late Miocene. H 63 mm. Syntype.

Figures 70-71. RGM 9949. *Cassis depressior* Martin, 1879. Tji Boerial, Java, Indonesia. Unnamed beds, Late Miocene. H 51 mm. Syntype.

Figures 72-73. RGM 9946. *Cassis preangerensis* Martin, 1899. Preanger, Java, Indonesia. Unnamed beds, Late Miocene? H 62 mm. Holotype.

Figures 74-76. RGM 47 051. *Cypraecassis denseplicata* (Martin, 1916). Gunung Spolong & Kali Kemedjin, Java, Indonesia. Unnamed beds, Miocene. H 30 mm. Syntype of *Cassis (Semicassis) denseplicata* Martin, 1916.

Figures 77-97.

Figures 77-78. RGM 456 182. *Galeodea bituminata* (Martin, 1933). Waisiu, Buton, Indonesia. Asphalt Beds, Late Miocene. H 33 mm. Holotype of *Cassidaria bituminata* Martin, 1933.

Figures 79-80. RGM 456 183. *Galeodea bituminata* (Martin, 1933). Tji Guleh, Kalimantan, Indonesia. Unnamed beds, Late Miocene. H 33 mm. Holotype of *Galeodea carolimartini* Beets, 1943b.

Figures 81-82. RGM 10 002. *Sconsia martini* van Regteren Altena, 1942. Ngembak, Java, Indonesia. Kendeng Beds, Late Miocene – Pliocene. H 32 mm. Holotype.

Figures 83-84. RGM 9997. *Sconsia pulchra* Pannekoek, 1936. Rembang, Java, Indonesia. Rembang Formation, Middle Miocene. H 29 mm. Syntype.

Figures 85-88. RGM 9998. *Sconsodolium rembangense* (Pannekoek, 1936). Rembang, Java, Indonesia. Rembang Formation, Middle Miocene. H 36 mm. Syntype of *Sconsia rembangensis* Pannekoek, 1936.

Figures 89-90. RGM 107 525. *Casmaria erinaceus* (Linné, 1758). Kaju Ragi, Manado Island, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 33 mm.
Figures 91-92. RGM 456 240. *Casmaria erinaceus* (Linné, 1758). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 33 mm.
Figures 93-94. RGM 14 222. *Echinophoria vandervlerki* (Martin, 1933). Waisiu, Buton, Indonesia. Asphalt Beds, Late Miocene. H 63 mm. Holotype of *Cassidea vandervlerki* Martin, 1933.
Figure 95. RGM 9982. *Phalium areola* (Linné, 1758). Junghuhn locality R, Java, Indonesia. Unnamed beds, Late Miocene. H 26 mm. Holotype of *Cassis glaucoides* Martin, 1879.
Figures 96-97. RGM 9983. *Phalium decussatum* (Linné, 1758). Bajah, Java, Indonesia. Unnamed beds, Pliocene. H 45 mm.

Figures 98-121.
Figures 98-99. RGM 456 241. *Phalium glaucum* (Linné, 1758). Mijnwezen locality M125, Java, Indonesia. Pucangang Formation, Pleistocene. H 43 mm.
Figures 100-101. RGM 312 437. *Phalium menkrawitense* Beets, 1941. Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 45 mm. Paratype.
Figures 102-103. RGM 312 436. *Phalium menkrawitense* Beets, 1941. Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 33 mm. Holotype.
Figures 104-105. RGM 9976. *Phalium rembangense* (Martin, 1899). Ngampal, Java, Indonesia. Unnamed beds, Early Miocene. H 22 mm. Martin's figured syntype of *Cassis rembangensis* Martin, 1899.
Figures 106-107. RGM 107 526. *Semicassis bisulcata* (Schubert & Wagner, 1829). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 20 mm.
Figures 108-109. RGM 456 242. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 36 mm.
Figure 110. RGM 456 242. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 40 mm.
Figures 111-112. RGM 456 243. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 78, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 20 mm.
Figures 113-114. RGM 456 244. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 107, Nias, Indonesia. Unnamed beds, Pliocene. H 38 mm.
Figures 115-116. RGM 456 245. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 107, Nias, Indonesia. Unnamed beds, Pliocene. H 23 mm.
Figures 117-118. RGM 456 246. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 32 mm.
Figure 119. RGM 456 246. *Semicassis bisulcata* (Schubert & Wagner, 1829). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 42 mm.
Figures 120-121. RGM 456 247. *Semicassis bisulcata* (Schubert & Wagner, 1829). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 23 mm.

Figures 122-142.
Figures 122-123. RGM 456 248. *Semicassis bisulcata* (Schubert & Wagner, 1829). Mijnwezen locality M281, Java, Indonesia. Pucangang Formation, Pleistocene. H 30 mm.
Figure 124. RGM 456 249. *Semicassis bisulcata* (Schubert & Wagner, 1829). Mijnwezen locality M216, Java, Indonesia. Pucangang Formation, Pleistocene. H 31 mm.
Figures 125-126. RGM 456 250. *Semicassis bisulcata* (Schubert & Wagner, 1829). Mijnwezen locality M255, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 22 mm.
Figures 127-128. RGM 456 251. *Semicassis bisulcata* (Schubert & Wagner, 1829). Mijnwezen locality M252, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 21 mm.
Figures 129-130. RGM 9970. *Semicassis bisulcata* (Schubert & Wagner, 1829). Sonde, Java, Indonesia. Unnamed beds, Pliocene. H 22 mm. Syntype of *Cassis herklotsi* Martin, 1879
Figures 131-132. RGM 9972. *Semicassis bisulcata* (Schubert & Wagner, 1829). Junghuhn locality R, Java, Indonesia. Unnamed beds, Late Miocene. H 26 mm. Syntype of *Cassis herklotsi* Martin, 1879.
Figures 133-134. RGM 9968. *Semicassis bisulcata* (Schubert & Wagner, 1829). Sonde, Java, Indonesia.

Unnamed beds, Pliocene. H 28 mm. Syntype of *Cassis herklotsi* Martin, 1879

Figures 135-136. RGM 456 252. *Distorsio anus* (Linné, 1758). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 57 mm.

Figures 137-138. RGM 456 253. *Distorsio decipiens* (Reeve, 1844a). Wissema locality 102, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 30 mm.

Figures 139-140. RGM 456 254. *Distorsio decipiens* (Reeve, 1844a). Mijnwezen locality M212, Java, Indonesia. Pucangang Formation, Pleistocene. H 43 mm.

Figures 141-142. TUD 13834/ RGM 456 255. *Distorsio decipiens* (Reeve, 1844). Noil Boenoe, Timur, Indonesia. Unnamed beds, Early Pliocene. H 54 mm. Syntype(?) of *Persona reticulata* Linné, 1758 subsp. *kueneni* Koperberg, 1931.

Figures 143-163.

Figures 143-144. RGM 456 256. *Distorsio denseplicata* van Regteren Altena, 1942. Mijnwezen locality M251, Java, Indonesia. Kalibeng Formation, Late Pliocene. LH38 mm. Holotype of *Distorsio cancellina* var. *denseplicata* van Regteren Altena, 1942.

Figure 145. In B. Dharma collection. *Distorsio djunggranganensis* (Martin, 1916). Karas, Java, Indonesia. Rembang Formation, Early Miocene. H 25 mm.

Figures 146-147. RGM 456 257. *Distorsio reticularis* (Linné, 1758). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 50 mm.

Figures 148-149. RGM 456 258. *Distorsio reticularis* (Linné, 1758). Mijnwezen locality M260, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 49 mm.

Figures 150-151. RGM 9813. *Distorsio reticularis* (Linné, 1758). Sonde, Java, Indonesia. Unnamed beds, Pliocene. H 46 mm.

Figures 152-153. RGM 456 259. *Biplex perca* Perry, 1811. Wissema locality 108, Nias, Indonesia. Unnamed beds, Late Pliocene. H 58 mm.

Figures 154-155. RGM 456 260. *Biplex pulchra* (G.B. Sowerby 2nd, 1836 *in* G.B. Sowerby 1st & G.B. Sowerby 2nd, 1832-1841). Wissema locality 94, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 27 mm.

Figures 156-157. RGM 456 261. *Biplex pamotanensis* (Martin, 1899). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 20 mm.

Figures 158-159. RGM 456 262. *Biplex pamotanensis* (Martin, 1899). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 22 mm.

Figures 160-161. RGM 456 262. *Biplex pamotanensis* (Martin, 1899). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 24 mm.

Figures 162-163. RGM 456 262. *Biplex pamotanensis* (Martin, 1899). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 19 mm.

Figures 164-186.

Figures 164-165. RGM 456 263. *Gyrineum bituberculare* (Lamarck, 1816). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 35 mm.

Figures 166-167. RGM 456 264. *Gyrineum bituberculare* (Lamarck, 1816). Mijnwezen locality M125, Java, Indonesia. Pucangang Formation, Pleistocene. H 37 mm.

Figures 168-169. RGM 107 521. *Gyrineum gyrinum* (Linné, 1758). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Quaternary. H 24 mm.

Figures 170-171. RGM 456 265. *Gyrineum gyrinum* (Linné, 1758). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pleistocene? H 28 mm.

Figures 172-173. RGM 456 266. *Gyrineum wilmerianum* Preston, 1908. Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 35 mm.

Figures 174-175. RGM 456 266. *Gyrineum wilmerianum* Preston, 1908. Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 34 mm.

Figures 176-177. RGM 456 268. *Gyrineum lacunatum* (Mighels, 1845). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 13 mm.

Figures 178-179. RGM 456 269. *Gyrineum lacunatum* (Mighels, 1845). Wissema locality 153, Nias, Indonesia. Unnamed beds, Pleistocene? H 24 mm.

Figures 180-181. RGM 456 270. *Gyrineum natator* (Röding, 1798). Mijnwezen locality M176, Java, Indonesia. Pucangang Formation, Pleistocene. H 27 mm.
Figures 182-183. RGM 9915. *Gyrineum natator* (Röding, 1798). Kalang Anjar, Java, Indonesia. Unnamed beds, Pliocene. H 30 mm.
Figures 184-185. RGM 456 267. *Gyrineum wilmerianum* Preston, 1908. Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 31 mm.
Figure 186. RGM 9810. *Charonia tritonis* (Linné, 1758). Tji Burial, Java, Indonesia. Unnamed beds, Late Miocene. H 140 mm.

Figures 187-211.
Figure 187. In B. Dharma collection. *Cymatium (Gelagna) succinctum* (Linné, 1771). Sangiran, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 33 mm.
Figures 188-189. RGM 456 271. *Cymatium (Gutturnium) muricinum* (Röding, 1798). Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 40 mm.
Figures 190-191. RGM 9979. *Cymatium (Linatella) cingulatum* (Lamarck, 1822). Langka, Java, Indonesia. Unnamed beds, Pliocene. H 16 mm. Holotype of *Cassis tegalensis* Martin, 1899.
Figures 192-193. RGM 10 038. *Cymatium (Linatella) cingulatum* (Lamarck, 1822). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 20 mm. Syntype of *Dolium losariense* Martin, 1899.
Figures 194-195. SMF XII/2881a. *Cymatium (Linatella) cingulatum* (Lamarck, 1822). Seluma, Sumatra, Indonesia. *Eburna* marls, Early Miocene. H 42 mm. Holotype of *Tritonium (Cabestana) verbeeki* Boettger, 1882.
Figures 196-197. RGM 10 037. *Cymatium (Linatella) cingulatum* (Lamarck, 1822). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 36 mm. Syntype of *Dolium losariense* Martin, 1899.
Figures 198-199. RGM 231 342. *Cymatium (Monoplex) aquatile* (Reeve, 1844a). Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 28 mm. Paratype of *Cymatium (Lampusia) alasaense* Wissema, 1947.
Figure 200. RGM 9785. *Cymatium (Monoplex) aquatile* (Reeve, 1844a). Tji Talahab, Java, Indonesia. Unnamed beds, Late Miocene. H 45 mm.
Figures 201-202. RGM 9782. *Cymatium (Monoplex) rembangense* (Wanner & Hahn, 1935). Tji Talahab, Java, Indonesia. Njalindung Beds, Middle Miocene. H 36 mm. Martin's (1899, pl. 22, figs. 323, 323a) figured specimen of "*Triton (Simpulum) pilearis* var".
Figures 203-204. RGM 107 514. *Cymatium (Monoplex) gemmatum* (Reeve, 1844a). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 22 mm.
Figures 205-206. RGM 456 272. *Cymatium (Monoplex) gemmatum* (Reeve, 1844a). Wissema locality 100, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 17 mm.
Figures 207-208. RGM 9803. *Cymatium (Monoplex) gemmatum* (Reeve, 1844a). Kembang Sokkoh, Java, Indonesia. Unnamed beds, Miocene. H 13 mm. Holotype of *Eutritonium bomasaense* Martin, 1916.
Figures 209-210. RGM 231 341. *Cymatium (Monoplex) intermedium* (Pease, 1869). Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 32 mm. Holotype of *Cymatium (Lampusia) alasaense* Wissema, 1947.
Figure 211. RGM 456 273. *Cymatium (Monoplex) pileare* (Linné, 1758). Wissema locality 153, Nias, Indonesia. Unnamed beds, Pleistocene? H 18 mm.

Figures 212-232.
Figures 212-213. RGM 456 274. *Cymatium (Monoplex) pileare* (Linné, 1758). Wissema locality 42, Nias, Indonesia. Unnamed beds, Pleistocene? H 60 mm.
Figures 214-215. RGM 456 275. *Cymatium (Monoplex) pileare* (Linné, 1758). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 47 mm.
Figures 216-217. RGM 456 276. *Cymatium (Monoplex) pileare* (Linné, 1758). Mijnwezen locality M142, Java, Indonesia. Pucangang Formation, Pleistocene. H 27 mm.
Figures 218-219. RGM 456 277. *Cymatium (Monoplex) pileare* (Linné, 1758). Mijnwezen locality M126, Java, Indonesia. Pucangang Formation, Pleistocene. H 72 mm.
Figures 220-221. RGM 9781. *Cymatium (Monoplex) pileare* (Linné, 1758). Selatjau, Java, Indonesia.

Unnamed beds, Late Miocene. H 25 mm.
Figures 222-223. RGM 456 278. *Cymatium (Turritriton) tenuiliratum* (Lischke, 1873). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 26 mm.
Figures 224-225. RGM 9793. *Cymatium (Monoplex) tjaringinense* (Martin, 1899). Tjikeusik, Java, Indonesia. Unnamed beds, Pliocene. H 26 mm. Holotype of *Triton (Simpulum) tjaringinensis* Martin, 1899.
Figure 226. In B. Dharma collection. *Cymatium (Monoplex) tjaringinense* (Martin, 1899). Cimanceurih, Java, Indonesia. Unnamed beds, Late Pliocene. H 23 mm.
Figures 227-228. RGM 312 446. *Cymatium (Monoplex)* cf. *vespaceum* (Lamarck, 1822). Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 18 mm.
Figures 229-230. RGM 456 279. *Cymatium (Monoplex) vespaceum* (Lamarck, 1822). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 21 mm.
Figures 231-232. RGM 9790. *Cymatium (Monoplex) gembacanum* (Martin, 1884). Ngembak, Java, Indonesia. Unnamed beds, Miocene? H 21 mm. Holotype of *Tritonium (Simpulum) gembacanum* Martin, 1884.

Figures 233-251.
Figures 233-234. RGM 456 280. *Cymatium (Ranularia) gutturnium* (Röding, 1798). Mijnwezen locality M125, Java, Indonesia. Pucangang Formation, Pleistocene. H 49 mm.
Figures 235-236. RGM 456 281. *Cymatium (Ranularia) pyrulum* (A. Adams & Reeve, 1850). Mijnwezen locality M255, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 25 mm.
Figures 237-238. RGM 9797. *Cymatium (Ranularia) pyrulum* (A. Adams & Reeve, 1850). Sonde, Java, Indonesia. Unnamed beds, Pliocene. H 26 mm. Lectotype of *Triton (Ranularia) pseudopyrum* Martin, 1899.
Figures 239-240. RGM 9798. *Cymatium (Ranularia) pyrulum* (A. Adams & Reeve, 1850). Sonde, Java, Indonesia. Unnamed beds, Pliocene. H 28 mm. Paralectotype of *Triton (Ranularia) pseudopyrum* Martin, 1899
Figure 241. RGM 9797. *Cymatium (Ranularia) sarcostoma* (Reeve, 1844a). Sonde, Java, Indonesia. Unnamed beds, Pliocene. H 36 mm. Paralectotype of *Triton (Ranularia) pseudopyrum* Martin, 1899.
Figures 242-243. RGM 9796. *Cymatium (Ranularia) sarcostoma* (Reeve, 1844a). Padas Malang, Java, Indonesia. Unnamed beds, Pliocene. H 35 mm. Paralectotype of *Triton (Ranularia) pseudopyrum* Martin, 1899.
Figures 244-245. RGM 9795. *Cymatium (Ranularia) sinense* (Reeve, 1844a). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 46 mm. Paralectotype of *Triton (Ranularia) pseudopyrum* Martin, 1899.
Figures 246-247. RGM 456 282. *Cymatium (Ranularia) springsteeni* Beu, 1987. Mijnwezen locality M274, Java, Indonesia. Pucangang Formation, Pleistocene. H 43 mm.
Figure 248. RGM 456 283. *Cymatium (Ranularia) testudinarium* (A. Adams & Reeve, 1850). Wissema locality 39a, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 40 mm.
Figures 249-250. RGM 456 283. *Cymatium (Ranularia) testudinarium* (A. Adams & Reeve, 1850). Wissema locality 39a, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 34 mm.
Figure 251. RGM 456 284. *Cymatium (Ranularia) testudinarium* (A. Adams & Reeve, 1850). Mijnwezen locality M257, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 29 mm.

Figures 252-282.
Figures 252-253. RGM 456 285. *Cymatium (Reticutriton) pfeifferianum* (Reeve, 1844a). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 19 mm.
Figures 254-255. RGM 456 286. *Cymatium (Reticutriton) pfeifferianum* (Reeve, 1844a). Wissema locality 39, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 40 mm.
Figures 256-257. RGM 456 287. *Cymatium (Reticutriton) pfeifferianum* (Reeve, 1844a). Mijnwezen locality M260, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 40 mm.
Figures 258-259. RGM 456 288. *Cymatium (Septa) hepaticum* (Röding, 1798). Wissema locality 77, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 41 mm.
Figures 260-261. RGM 107 515. *Cymatium (Septa) rubeculum* (Linné, 1758). Kaju Ragi, Sulawesi, Indonesia. Unnamed beds, Pleistocene. H 15 mm.

Figures 262-263. RGM 456 289. *Cymatium (Septa) rubeculum* (Linné, 1758). Wissema locality 78, Nias, Indonesia. Unnamed beds, Pliocene-Pleistocene. H 32 mm.
Figures 264-265. RGM 456 290. *Cymatium (Septa) dharmai* sp. nov. Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 29 mm. Holotype.
Figure 266. In B. Dharma collection. *Cymatium (Septa) dharmai* sp. nov.. Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 27 mm. Paratype.
Figures 267-268. RGM 456 291. *Cymatium (Turritriton) labiosum* (Wood, 1828). Mijnwezen locality M347, Java, Indonesia. Pucangang Formation, Pleistocene. H 15 mm.
Figure 269. In B. Dharma collection. *Cymatium (Septa)* sp. aff. *occidentale* (Mörch, 1877). Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 23 mm.
Figures 270-271. RGM 312 447. *Sassia (Cymatiella) fennemai* (Martin, 1899). Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 10 mm.
Figures 272-273. RGM 9775. *Sassia (Cymatiella) fennemai* (Martin, 1899). Selatjau, Java, Indonesia. Unnamed beds, Late Miocene. H 21 mm. Syntype of *Triton (Colubraria) fennemai* Martin, 1899.
Figures 274-275. RGM 46 962. *Sassia (Cymatiella) fennemai* (Martin, 1899). Ngampel, Java, Indonesia. Rembang Formation, Miocene. H 17 mm. Syntype of *Triton (Colubraria) fennemai* Martin, 1899.
Figures 276-277. RGM 9776. *Sassia (Cymatiella) fennemai* (Martin, 1899). Njalindung, Java, Indonesia. Unnamed beds, Miocene. H 20 mm. Syntype of *Triton (Colubraria) fennemai* Martin, 1899.
Figure 278. In B. Dharma collection. *Sassia (Cymatiella) fennemai* (Martin, 1899). Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 18 mm.
Figure 279. WM 17245. *Sassia (Cymatiella) fennemai* (Martin, 1899). Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 28 mm.
Figure 280. WM 17245. *Sassia (Cymatiella) fennemai* (Martin, 1899). Citalahab, Java, Indonesia. Unnamed beds, Late Miocene. H 24 mm.
Figures 281-282. RGM 312 449. *Sassia (Cymatiella) menkrawitensis* (Beets, 1941). Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 11 mm. Paratype of *Charonia (Sassia) menkrawitensis* Beets, 1941.

Figures 283-304.
Figures 283-284. RGM 15 224. *Eudolium bairdii* (Verrill & Smith *in* Verrill, 1881). Waisiu, Buton, Indonesia. Asphalt Beds, Late Miocene. H 38 mm. Holotype of *Dolium (Eudolium) bituminatum* Martin, 1933.
Figures 285-287. RGM 456 292. *Eudolium erbi* (Haanstra & Spiker, 1932). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 41 mm.
Figures 288-289. RGM 456 293. *Eudolium erbi* (Haanstra & Spiker, 1932). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 27 mm.
Figures 290-291. RGM 456 294. *Eudolium erbi* (Haanstra & Spiker, 1932). Pendopo, Sumatra, Indonesia. Unnamed beds, Pliocene? H 28 mm.
Figures 292-294. RGM 42 325. *Eudolium errabundum* (Beets, 1943b). locality BPM 1444, Madura, Indonesia. Unnamed beds, Early Miocene. H 25 mm. Holotype of *Galeodea errabunda* Beets, 1943b.
Figures 295-296. RGM 9991. *Eudolium javanum* (Martin, 1879). Junghuhn locality R, Java, Indonesia. Unnamed beds, Late Miocene. H 41 mm. Lectotype of *Cassidaria javana* Martin, 1879.
Figures 297-298. RGM 9990. *Eudolium javanum* (Martin, 1879). Junghuhn locality K, Java, Indonesia. Unnamed beds, Miocene. H 40 mm. Paralectotype of *Cassidaria javana* Martin, 1879.
Figures 299-300. RGM 9992. ?*Eudolium javanum* (Martin, 1879) (not certainly identified). Junghuhn locality L, Java, Indonesia. Unnamed beds, Miocene. H 12 mm. Paralectotype of *Cassidaria javana* Martin, 1879.
Figures 301-302. RGM 9993. *Eudolium pamotanense* (Martin, 1899). Pamotan, Java, Indonesia. Rembang Formation, Miocene. H 21 mm. Holotype of *Cassidaria pamotanensis* Martin, 1899.
Figures 303-304. RGM 42 280. *Malea papuana* (Beets, 1943b). locality BPM R26, Irian Jaya, Indonesia. Unnamed beds, Late Miocene. H 30 mm. Holotype of *Galeodea papuana* Beets, 1943b.

Figures 305-318.
Figures 305-306. RGM 10 019. *Tonna tessellata* (Lamarck, 1816). Padas Malang, Java, Indonesia. Unnamed beds, Miocene? H 55 mm.

Figures 307-308. RGM 10 012. *Tonna allium* (Dillwyn, 1817). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 48 mm.

Figures 309-310. RGM 10 028. *Tonna allium* (Dillwyn, 1817). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 44 mm. Martin's (1879) figured syntype of *Dolium hochstetteri* Martin, 1879.

Figures 311-312. RGM 41 809. *Tonna canaliculata* (Linné, 1758). Boenjoe Island, Kalimantan, Indonesia. Unnamed beds, Pleistocene? H 32 mm.

Figures 313-314. RGM 456 295. *Tonna galea* (Linné, 1758). Mijnwezen locality M122, Java, Indonesia. Pucangang Formation, Pleistocene. H 43 mm.

Figure 315. RGM 10 004. *Tonna galea* (Linné, 1758). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 69 mm.

Figures 316-317. RGM 10 004. *Tonna galea* (Linné, 1758). Menengteng Gorge, Java, Indonesia. Unnamed beds, Pliocene. H 69 mm.

Figure 318. RGM 10 011. *Tonna galea* (Linné, 1758). Tambakbatu, Java, Indonesia. Unnamed beds, Miocene. H 81 mm. Syntype of *Dolium modjakasriense* Martin, 1899.

Figures 319-327.

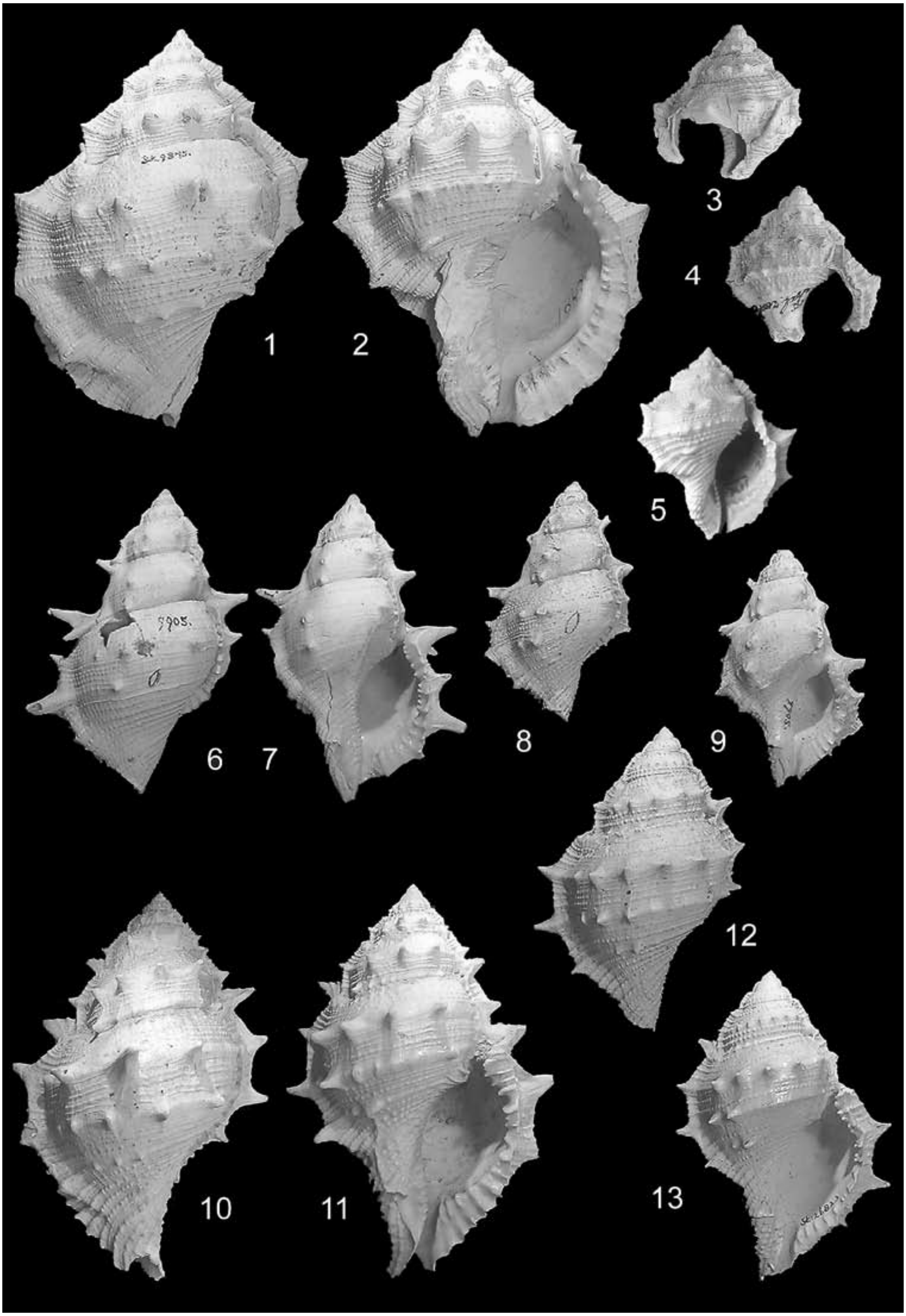
Figures 319-320. RGM 10 027. *Tonna lischkeana* (Küster, 1857). Junghuhn locality Z, Java, Indonesia. Unnamed beds, Pliocene. H 59 mm. Syntype of *Dolium hochstetteri* Martin, 1879.

Figures 321-322. RGM 456 296. *Tonna sulcosa* (Born, 1778). Wissema locality 43, Nias, Indonesia. Unnamed beds, Pliocene. H 43 mm. Holotype of *Tonna niasensis* Wissema, 1947.

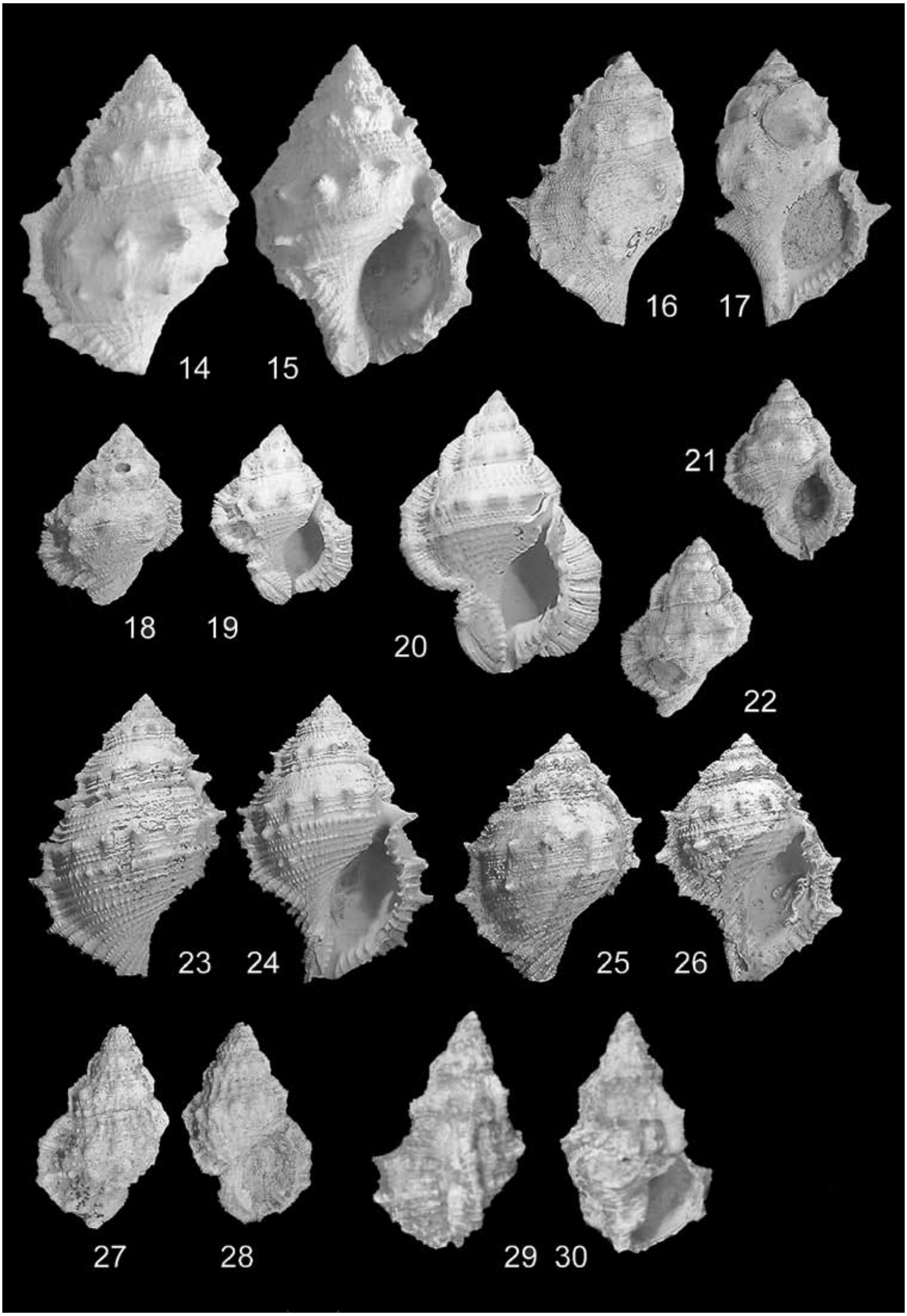
Figures 323-324. RGM 456 297. *Tonna tessellata* (Lamarck, 1816). Mijnwezen locality M261, Java, Indonesia. Kalibeng Formation, Late Pliocene. H 49 mm.

Figures 325-326. RGM 312 438. *Turbinella*? *martini* (Beets, 1941). Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. D 180 mm. Holotype of *Cassis? (Mangkalia) martini* Beets, 1941.

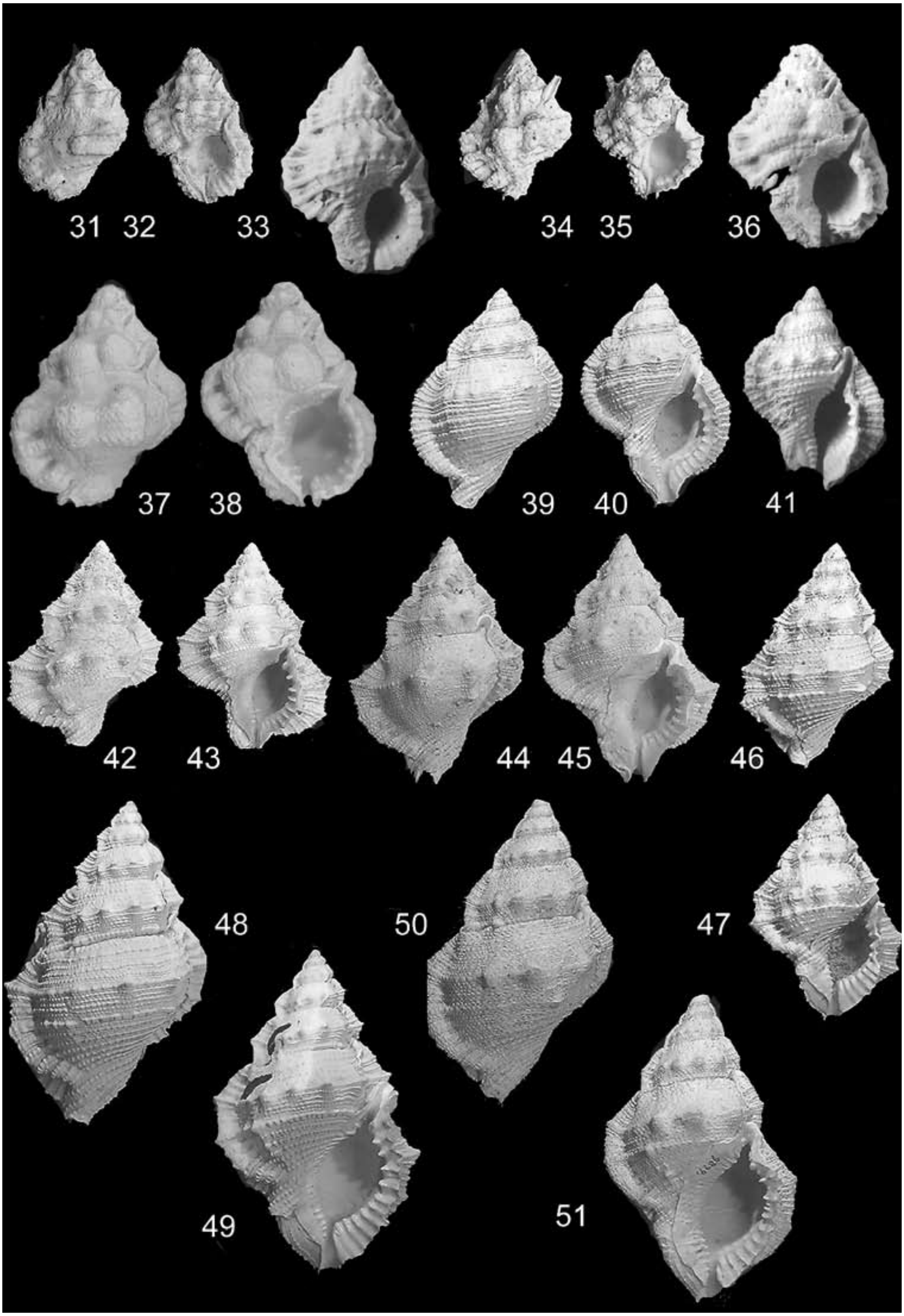
Figure 327. RGM 312 440. *Turbinella*? *martini* (Beets, 1941). Mangkalihat, Kalimantan, Indonesia. Unnamed beds, Miocene. H 215 mm. Paratype of *Cassis? (Mangkalia) martini* Beets, 1941.



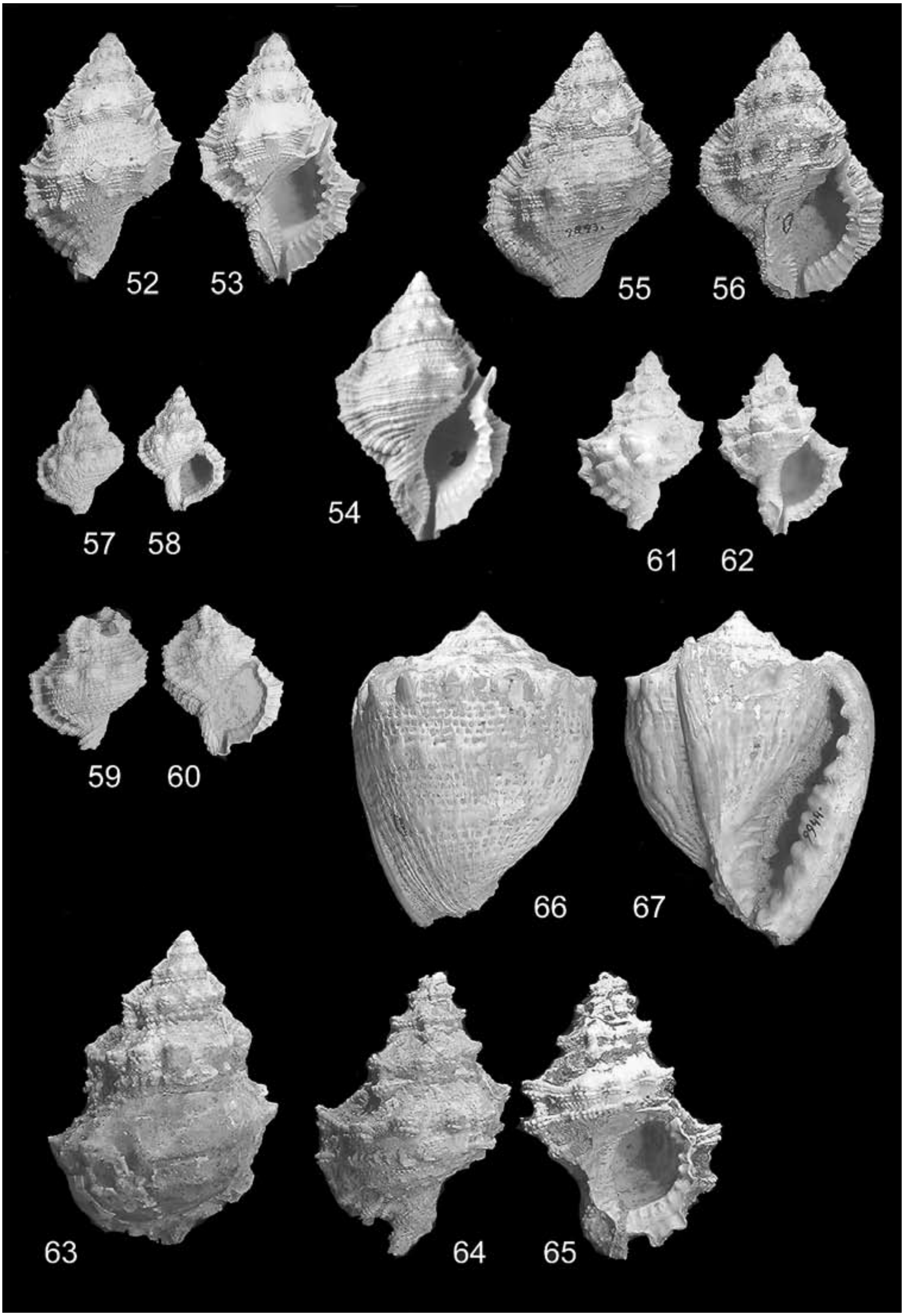
Figures 1-13



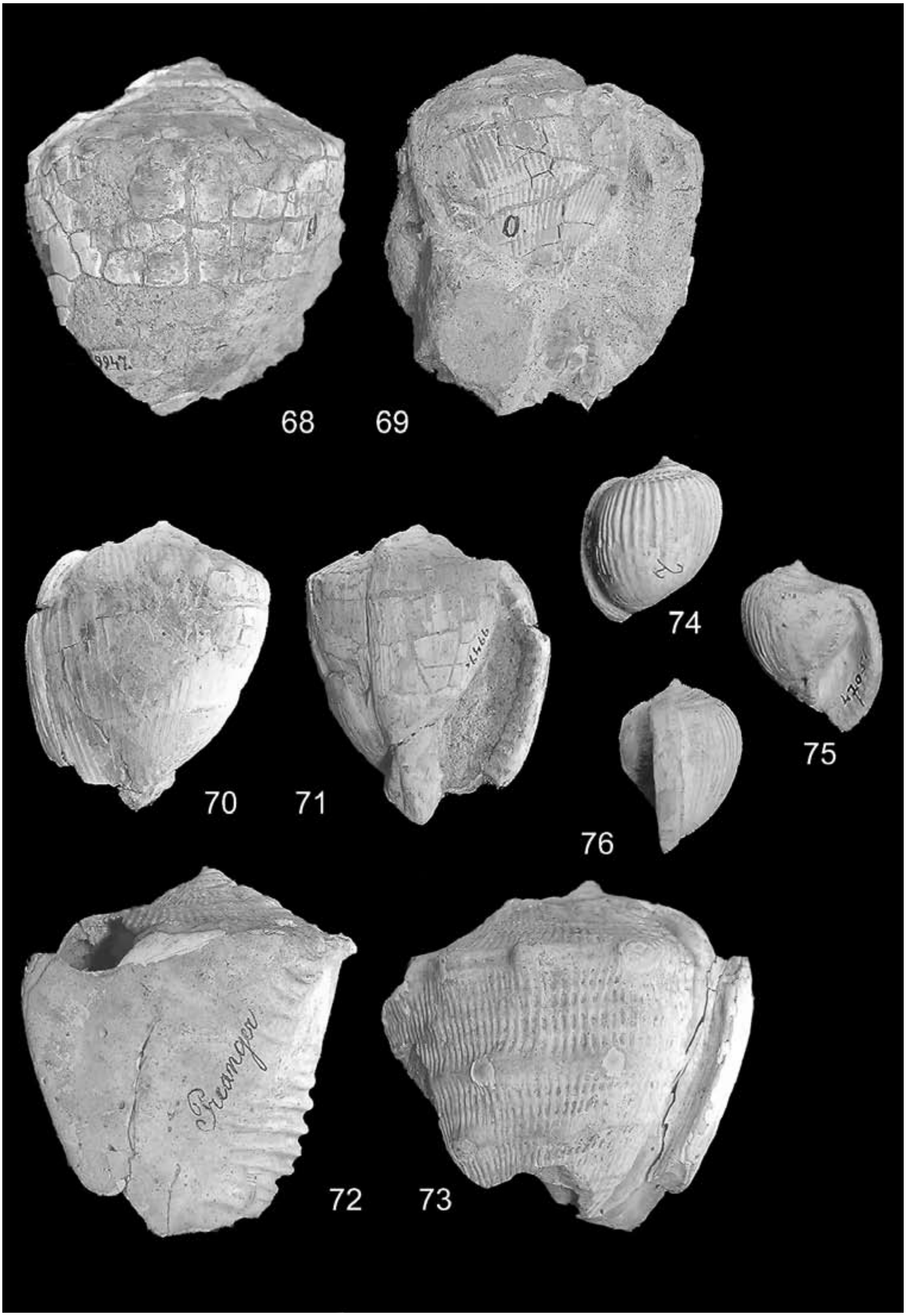
Figures 14-30



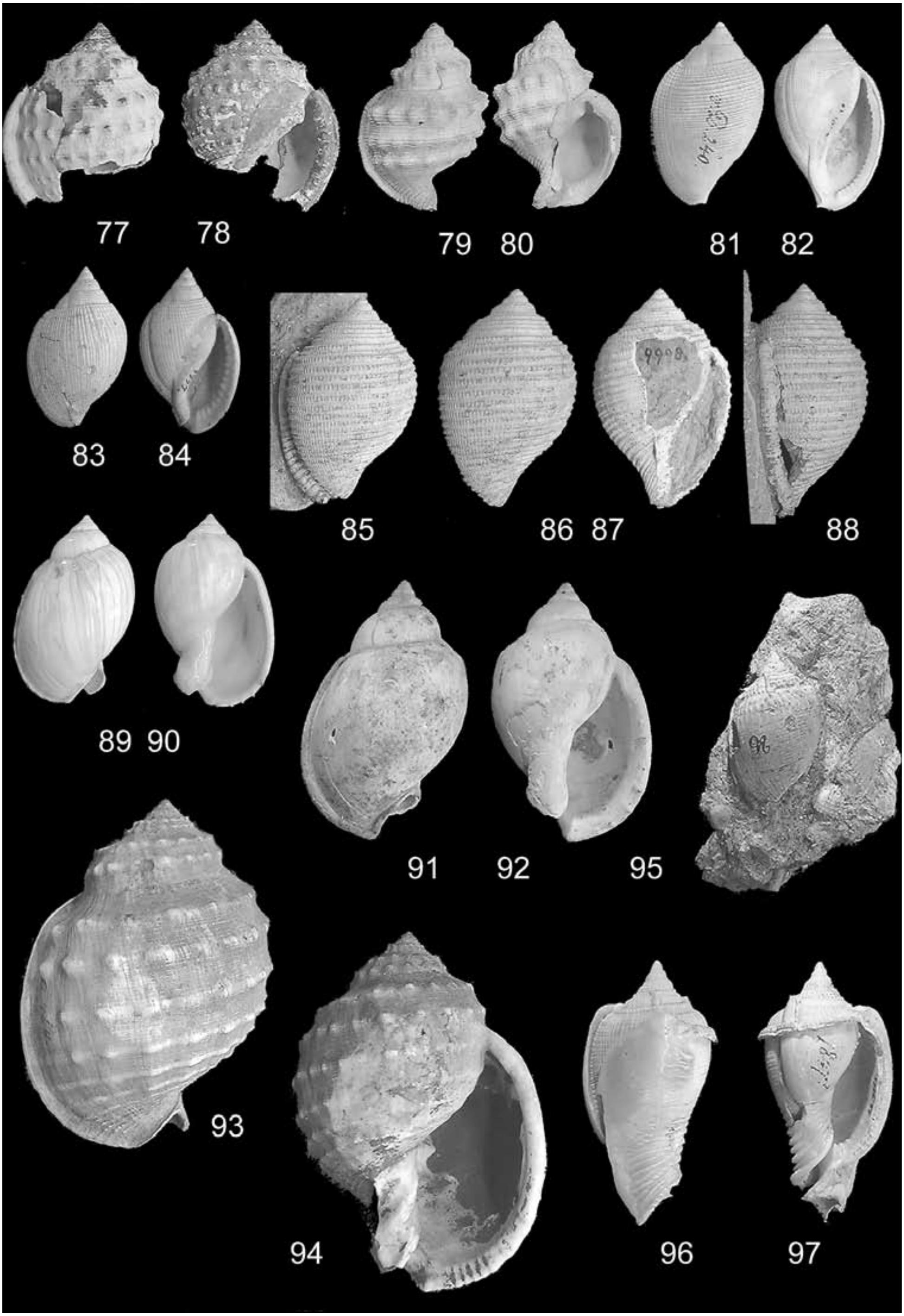
Figures 31-51



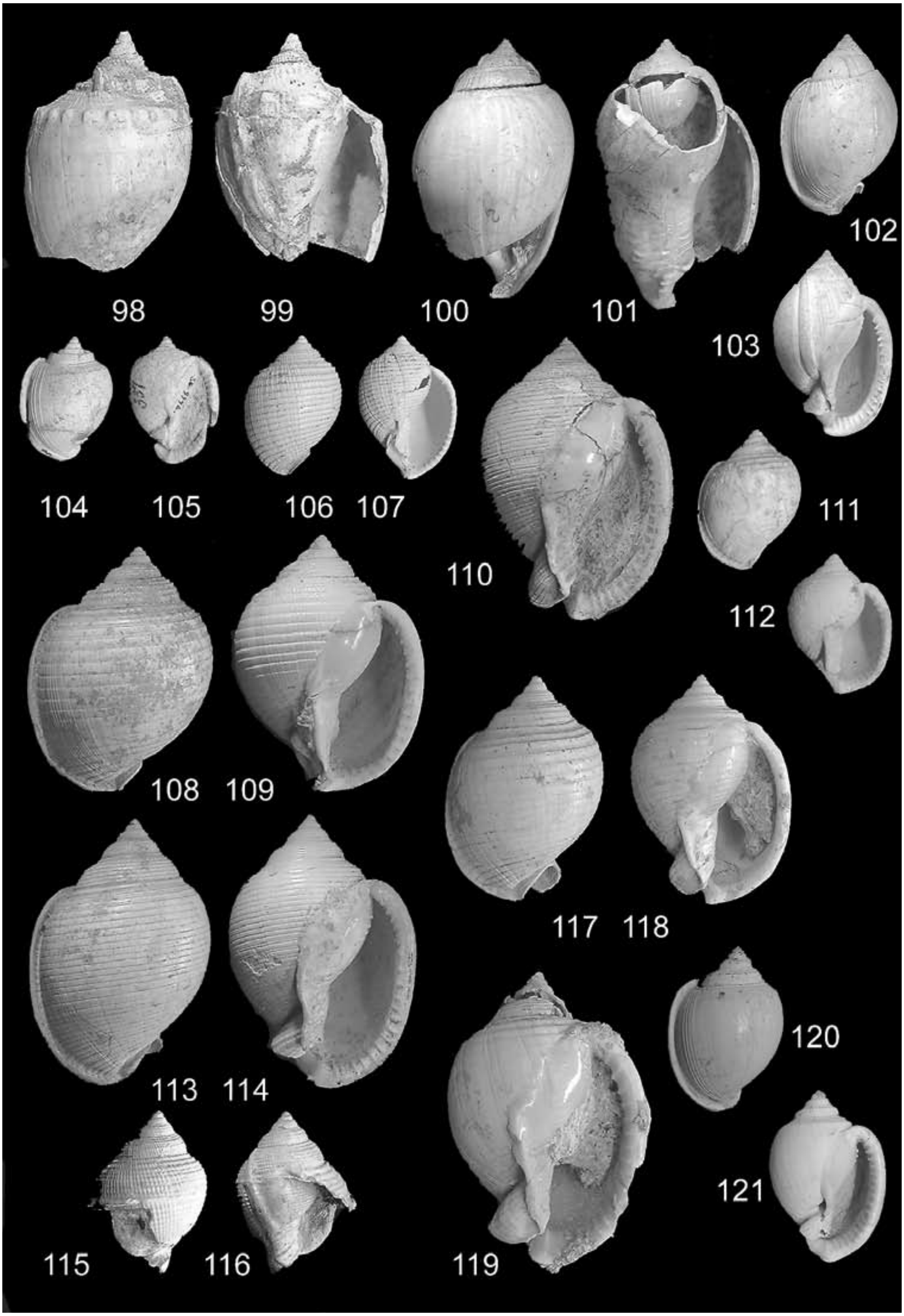
Figures 52-67



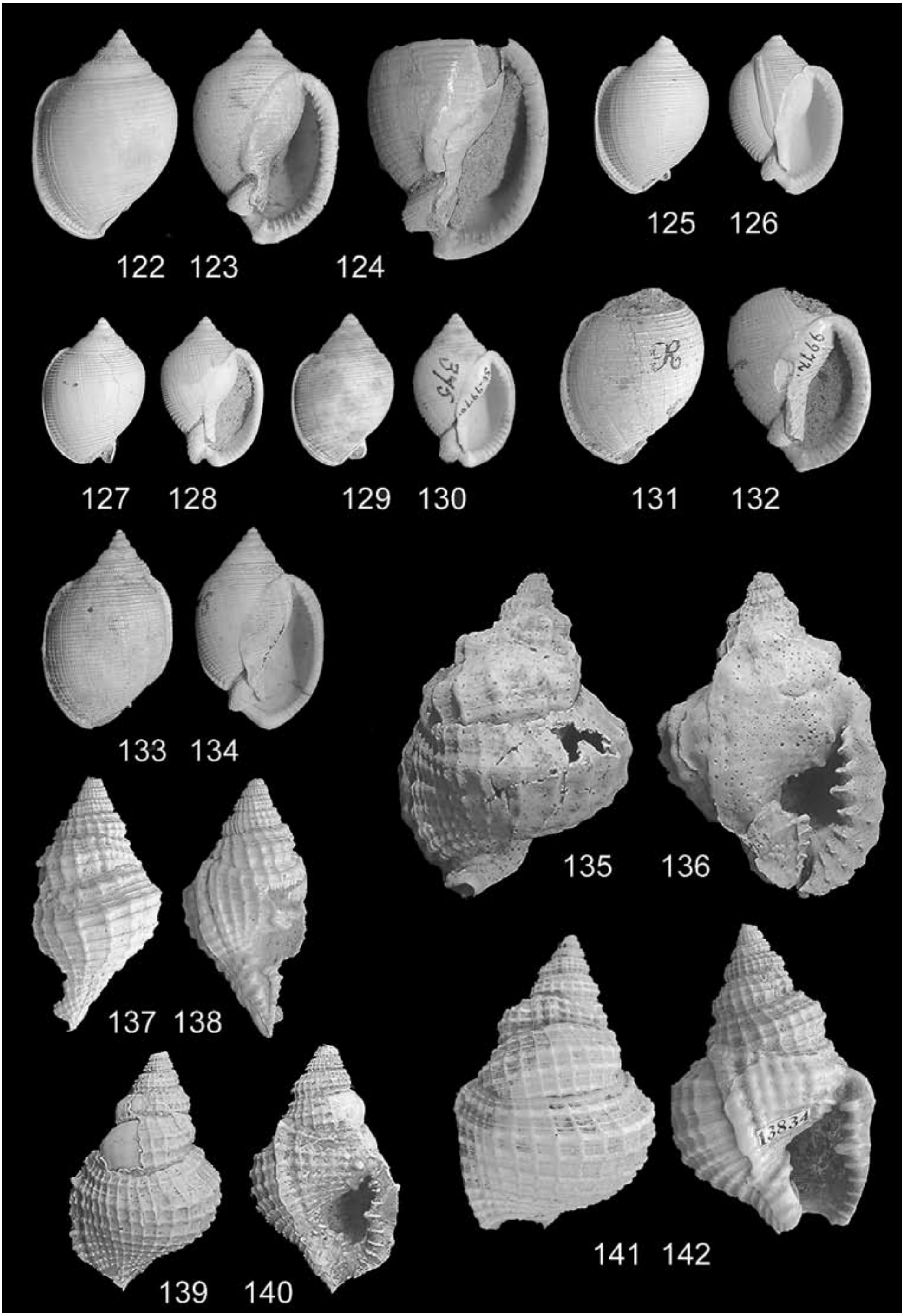
Figures 68-76



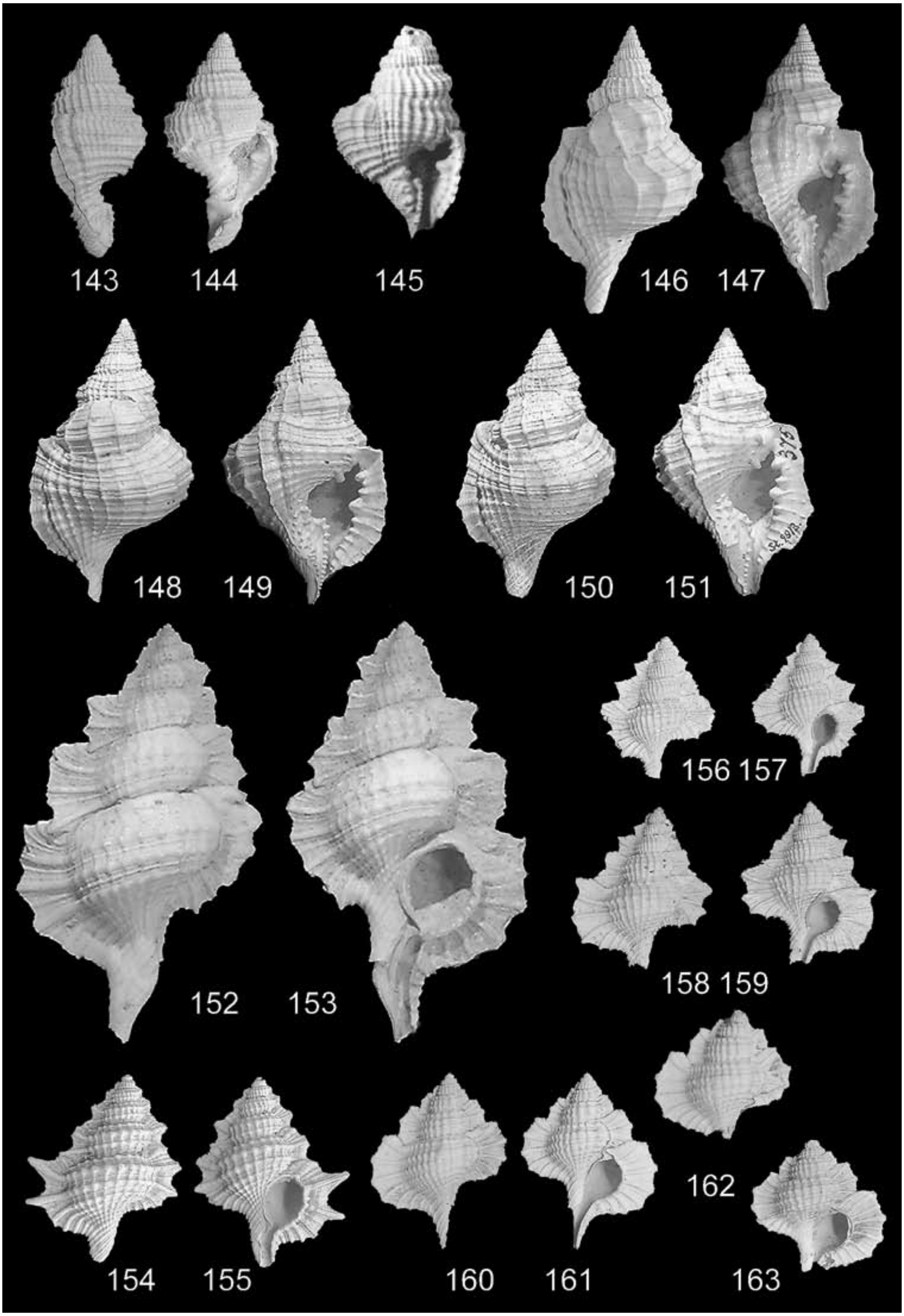
Figures 77-97



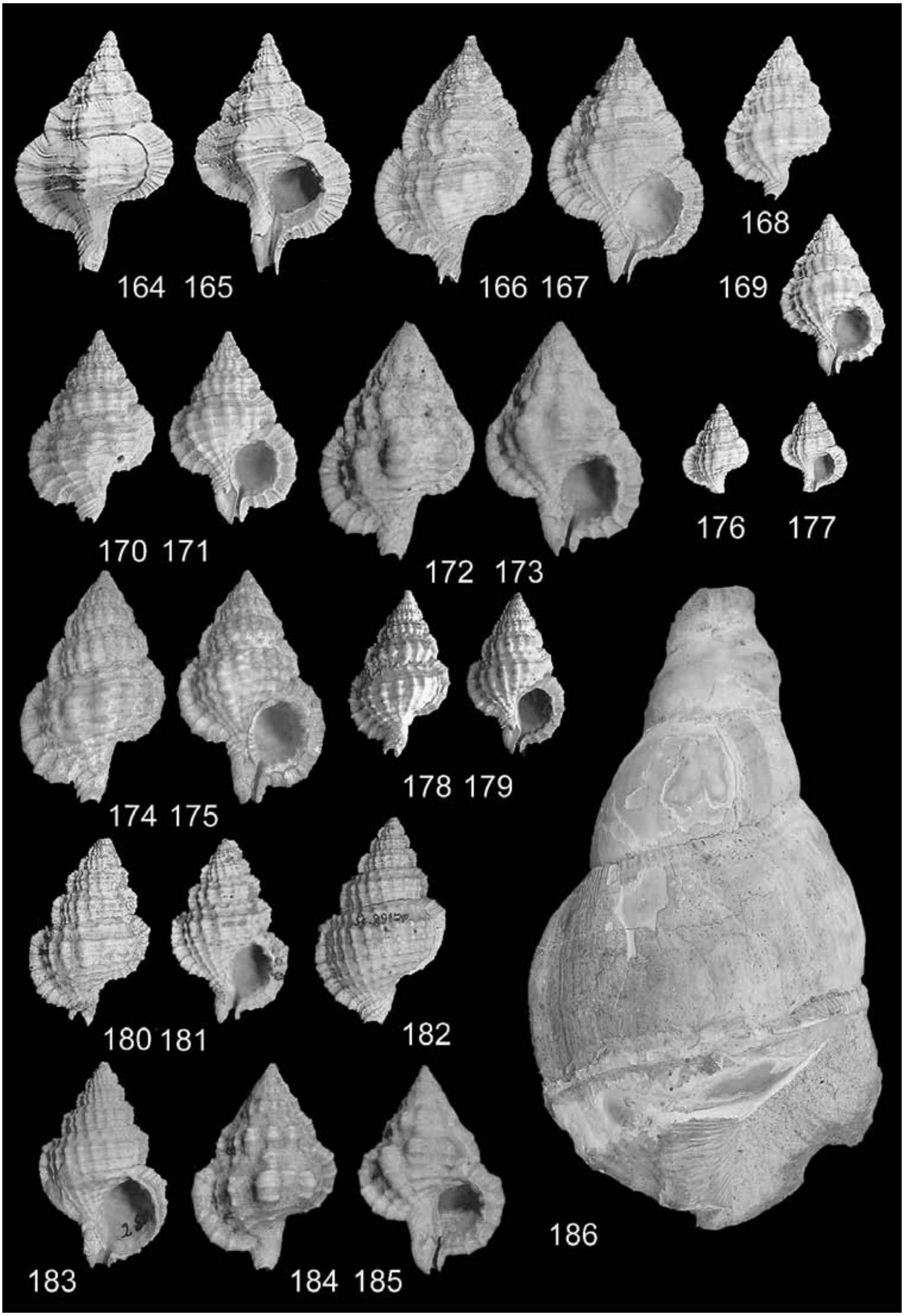
Figures 98-121



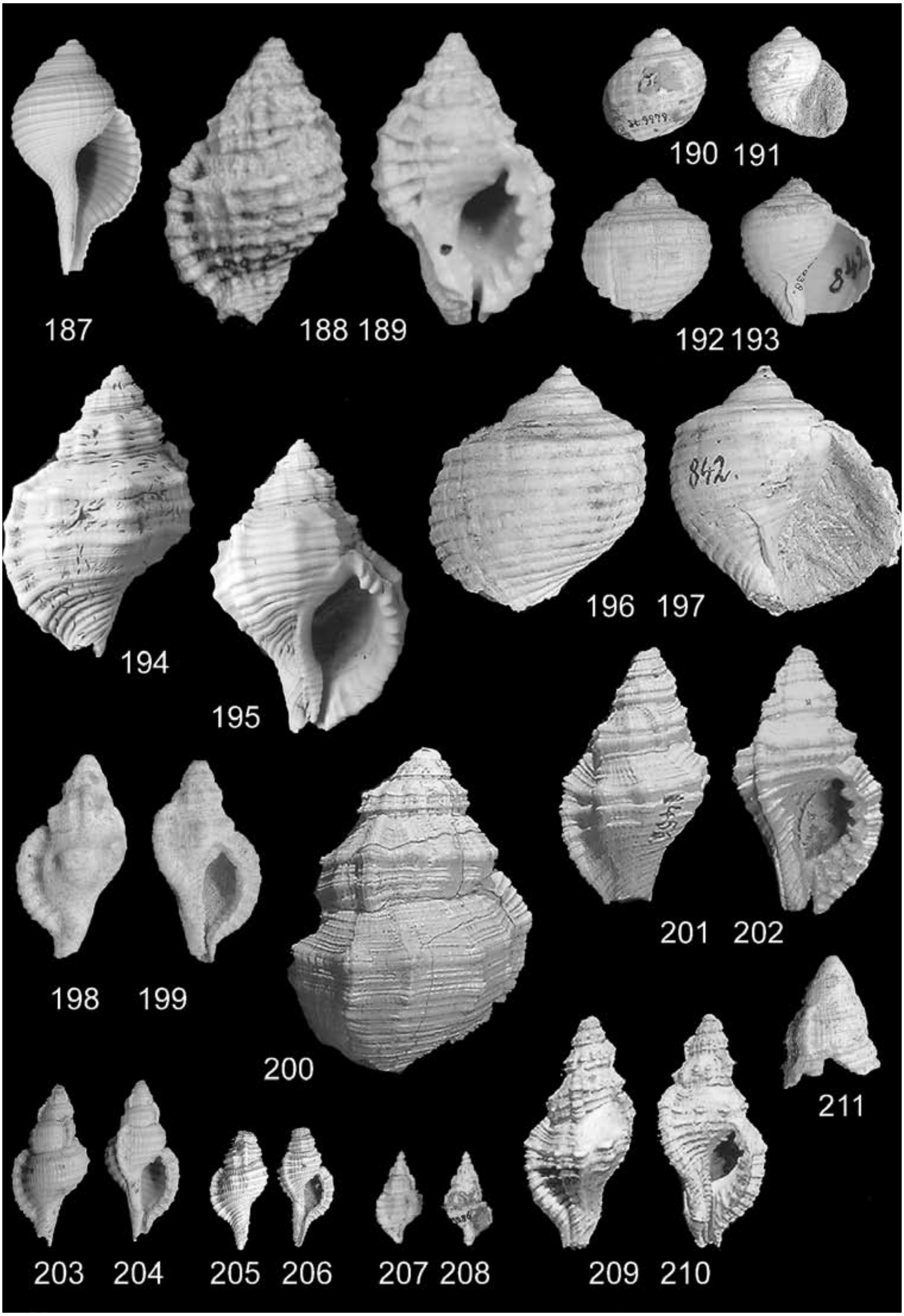
Figures 122-142



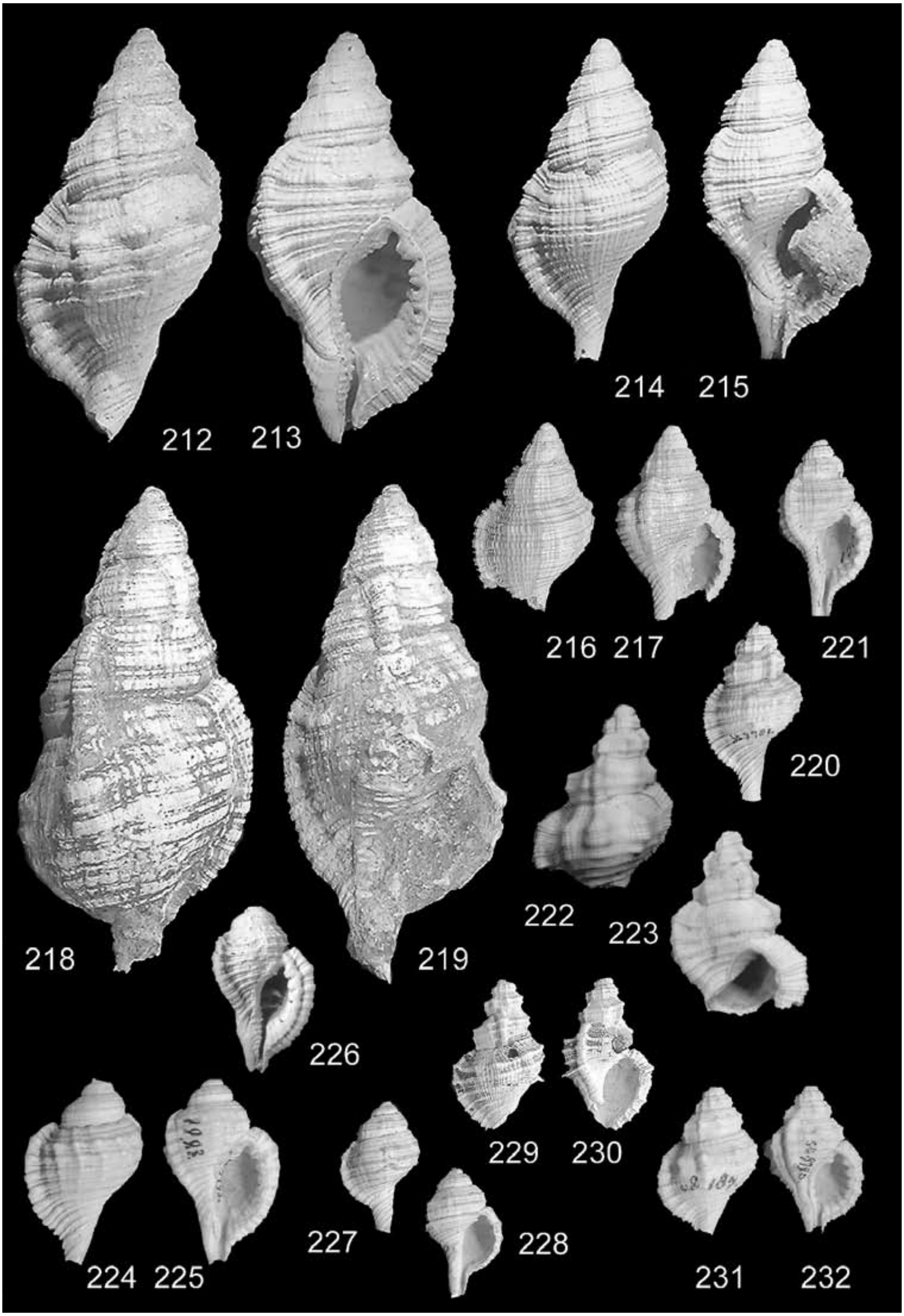
Figures 143-163



Figures 164-186



Figures 187-211



Figures 212-232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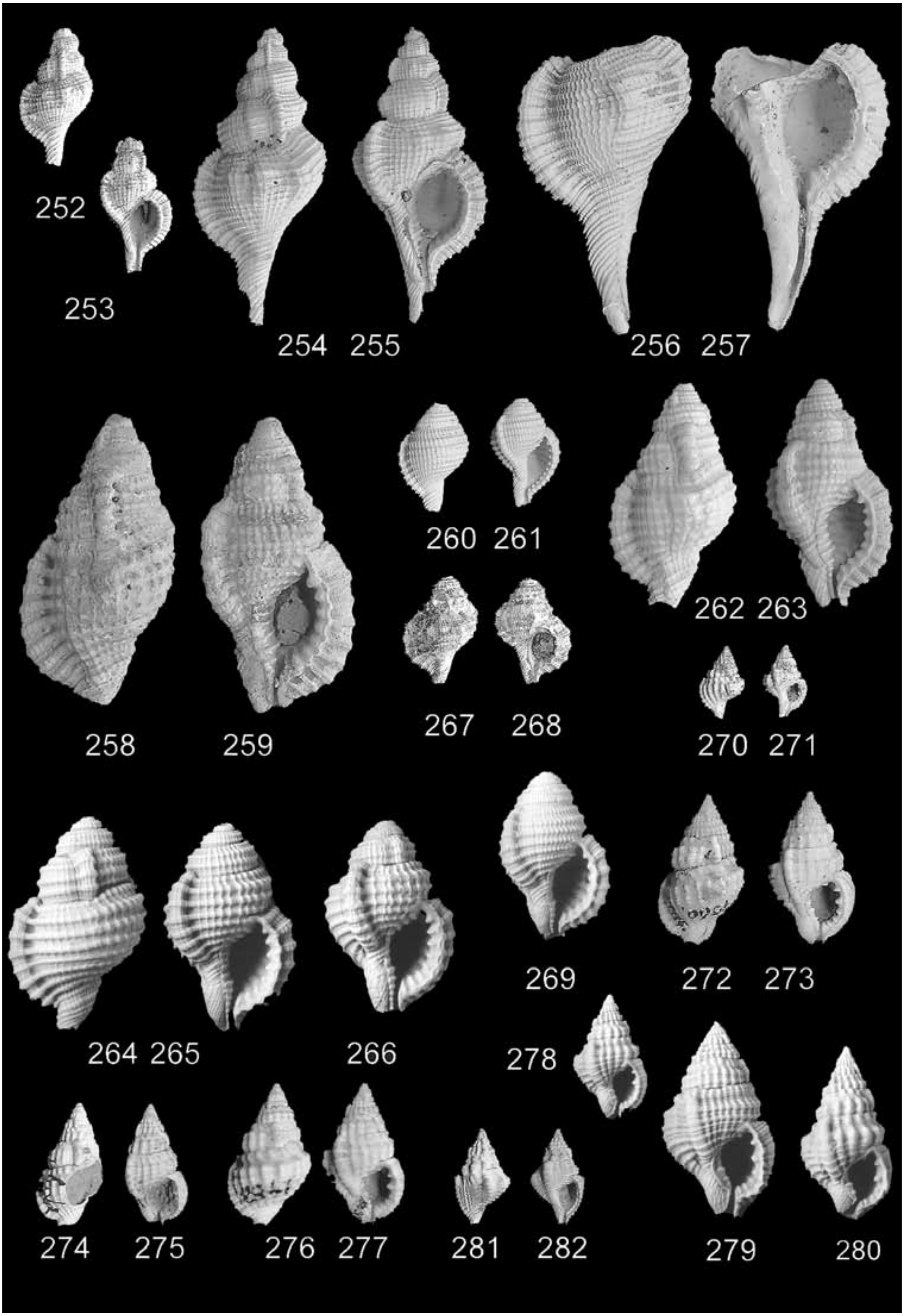
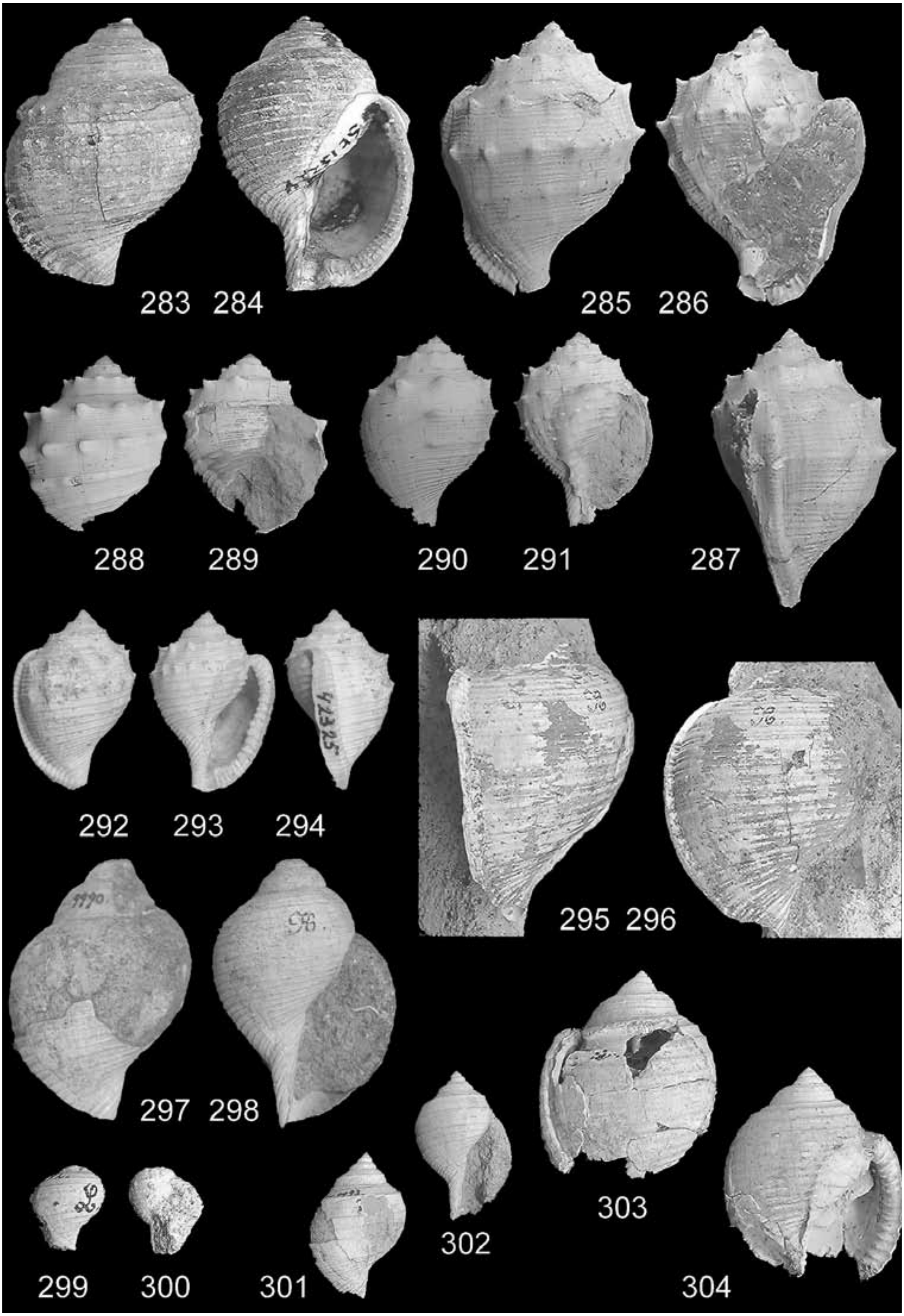
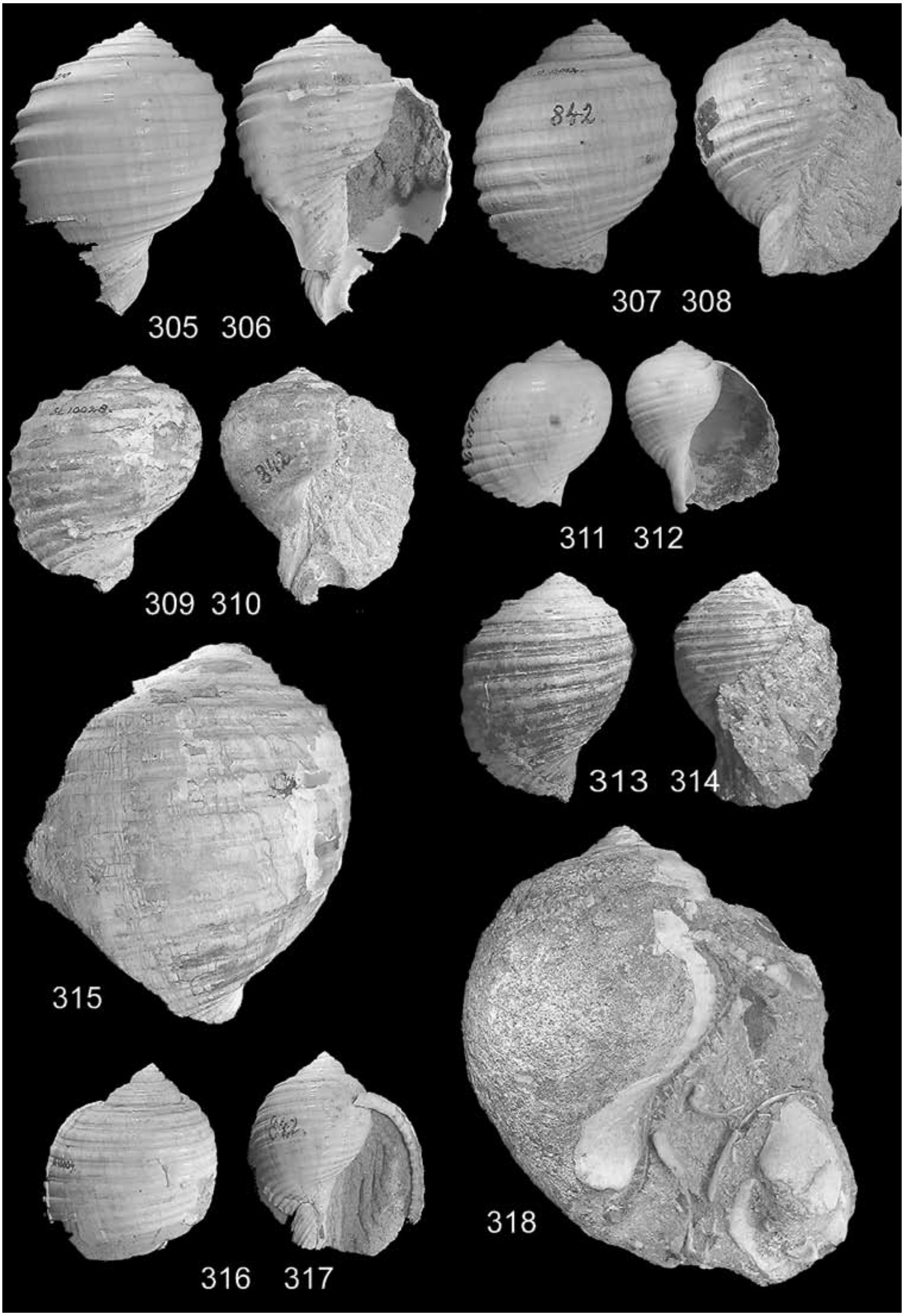
Figures 233-251



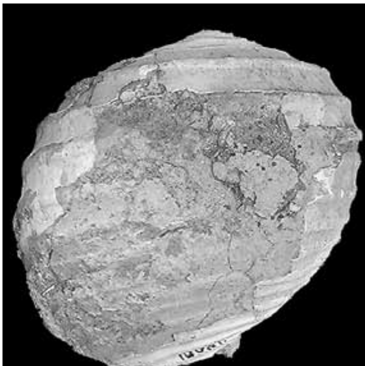
Figures 252-282



Figures 283-304



Figures 305-318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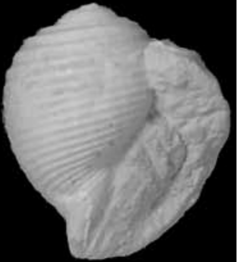
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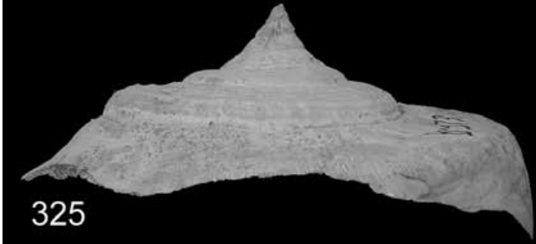
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Figures 319-327