Neogene Mollusca from the Vogelkop (Bird's Head Peninsula), West Irian, New Guinea

C. Beets

Beets, C. Neogene Mollusca from the Vogelkop (Bird's Head Peninsula), West Irian, New Guinea. — Scripta Geol., 82: 101-134, 2 figs., pls 8-11, Leiden, January 1987.

During a reconnaissance of the Tertiary formations in the western Vogelkop in 1929/1930 for the Bataafsche Petroleum Maatschappij, The Hague, the geologists J.P. Roothaan and J.B. Woolley collected a number of fossil molluscs in the outcrop area of the Klasaman Formation, later to be dated as 'Late Miocene and Plio-Pleistocene' on the basis of foraminiferal studies carried out in the course of a 25 years' search for oil (1935-1960), by the Nederlandsche Nieuw Guinea Petroleum Maatschappij. In 1930, Dr K. Martin made a preliminary examination of the fossils, which in recent years were restudied by the present writer, the number of species identified thereby being raised from 16 to 35. Unfortunately, an attempt to determine the ages of at least the two largest faunules (numbering merely 20 and 16 species respectively, both deriving from the upper part of the Klasaman Formation), more precisely than in Martin's time, failed to give satisfactory results, making it abundantly clear that much more material is needed before one can say more about the ages of these assemblages than that they are 'Miocene/Pliocene', and 'possibly Pliocene'. Palaeontologically however, the fauna is quite interesting.
Seven new forms are described, viz., *Zoila caputavisensis, Volutoconus hargreavesi aridus, 'Barbatia' sorongensis, Arcopsis caputavisensis, Glycymeris caputavisensis, Carditella caputavisensis,* and *Cardiocardita oostinghi*, an eighth, *Galeodea papuana*, having been described as far back as 1943. Finally, the new *Arcopsis altenai*, related to *A. caputavisensis* from Vogelkop, is described from Java on the basis of specimens selected from Martin's syntypes of *A. bataviana*. Some of the species are of particular interest as they belong to genera whose living species are restricted to Australian waters: these are the new representatives, presumed extinct, of *Zoila* and *Volutoconus*, while *Amoria canaliculata* is still living. There is also a sprinkling of rarely recorded species, *Strombus triangulatus* and *Nemocardium parvulum*, and a comparatively large number of small species; also four living species occur not previously recorded fossil.

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Introduction

The collection of Mollusca described in the present paper was made by J.P. Roothaan and J.B. Woolley, during a reconnaissance carried out in 1929/1930 for Bataafsche Petroleum Maatschappij N.V. (B.P.M.), now Shell Internationale Petroleum Maatschappij (S.I.P.M.), of the Tertiary of western Vogelkop (Bird's Head) area, West Irian (former Netherlands New Guinea; Fig. 1), their report to B.P.M. being dated July, 1930.

An account of less than half of the fossils was given by K. Martin, in two unpublished reports to B.P.M., dated August and November, 1930.

Subsequently, extensive explorations in the larger part of West Irian were carried out by a combine, the Nederlandsche Nieuw Guinea Petroleum Maatschappij (N.N.G.P.M.), in the course of a 25 years' search for oil, under B.P.M. management (1935-1960). The results were finally compiled and published in 1962 (Visser & Hermes, 1962), but Martin's preliminary results were not incorporated.

Meanwhile (period 1940-1945), the writer had obtained permission to study these and other molluscan collections made by B.P.M. geologists throughout Indonesia, the results of the long overdue final examination of the Vogelkop collection being given in the present paper. The writer wishes to express his indebtedness to Shell Internationale Petroleum Maatschappij, The Hague, for giving permission to publish the following account of the interesting faunules obtained so long ago. To his former B.P.M. colleague J.J. Hermes, the writer owes the diagram (Fig. 2), giving the latest information regarding the occurrences of the fossils, as imparted prior to the publication of Hermes' stratigraphical compilation, in tandem with Visser's compilation of other data referred to above.

Brief stratigraphic notes

The fossils discussed in the following pages derive from the localities:

J.P. Roothaan: R.11 (Klarainau)
R.15 (Kladai)
R.26 (Klagumuk)

J.B. Woolley: W. 4 (Klaguom)
W.15 (middle course of northern Klamalu)
W.18 (Kladuwis)
W.19 (Klamesin)
W.50 (Klagulu)
W.55 (Klawiri)

For location of the above samples see Fig. 1.

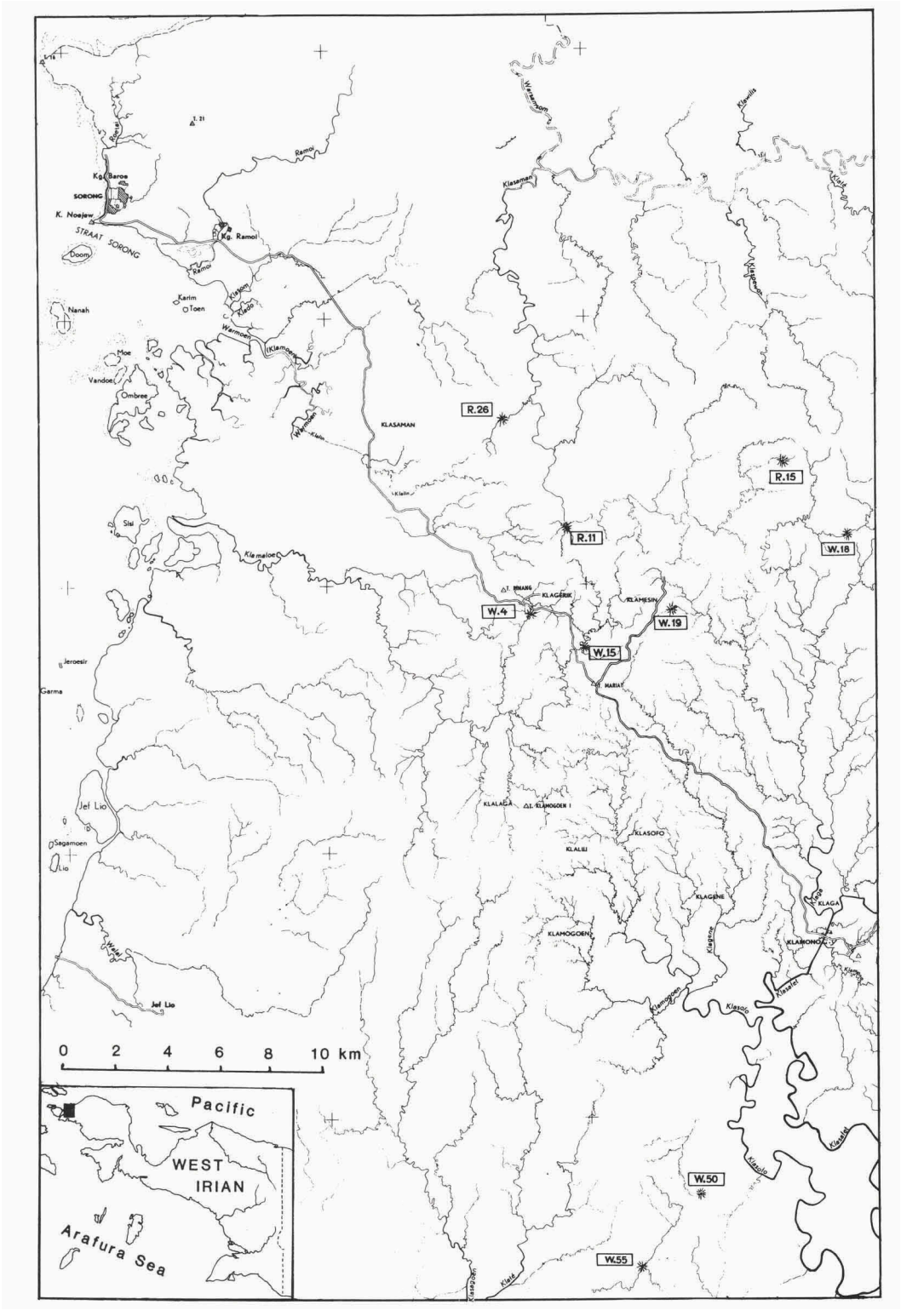


Fig. 1. Map showing Klasaman Formation fossil localities, Vogelkop area, West-Irian.

All the localities fall within the area of the type and reference sections of the Klasaman Formation in the Salawati basin: see Visser & Hermes, 1962, pp. 89-91, 130-132, 139, 199-200, encl. 1.I (rock unit Klm), encl. 2 (rock unit 16), encl. 8 (B-sections, rock unit Klm), encl. 10 (map VIII), and encl. 11 (N.W.Vogelkop).

The Klasaman Formation (see Fig. 2) – overlying the likewise marine Klasafet Formation of consistently fine-grained sediments which were laid down in a peri-orogenic belt in gradually shallower water (thought no more than 50 m deep, finally) was formed under shallow marine (neritic to littoral) conditions. It consists in the main of slightly sandy to sandy clays, marly in the lower part, with frequent intercalations of clayey and calcareous sands and, in the upper more sandy part, intercalated conglomerates and coal seams denoting paralic conditions. Mollusca are recorded as quite common in the upper part of this formation (compare localities R.26, W.55, also R.15, W.18, W.19), locally even forming coquinas. From the base of the formation upwards, the foraminiferal faunas, both benthonic and pelagic, become richer. The formation reaches a thickness of 1300 m in the Klasaman river type section, increasing to 2000 m near the coast west of Klamono and particularly, towards Salawati Island (3000 m) to the west of Vogelkop.

The dating of the Klasaman Formation (T.35-T.42), considered as Tertiary g-h, poses a problem: the Miocene/Pliocene boundary has always been placed by N.N.G.P.M. at the top of Tertiary f2-3, viz., at the top of the *Lepidocyclina/Miogypsina* range, probably not correctly so, as was fully realized (Visser & Hermes, 1962, pp. 61, 199). In passing, it may be remarked that T.g may be roughly equivalent with Odengian, upper Late Miocene, so far however, without the benefit of coordinated molluscan and foraminiferal evidence.

Summary of K. Martin's results

At the time, it was assumed on the basis of the reconnaissance field work, that the fossiliferous samples derived from two stratigraphical units with, from bottom to top, localities R.15, R.26 and R.11 in the lower succession, and W.19, W.18, W.50, W.55, W.15, and W.4 in the upper one. Photogeological interpretation has since created havoc with most of the original positioning of the samples, but if one disregards the least fossiliferous samples, we still have at present locality R. 26 occupying a lower position than W.55.

Martin's identifications listed 16 species (compare also Table 1):

Turritella cingulifera Sow.
Strombus triangulatus Mart.
Persona reticulata Linn. (= *Distorsio reticulata* Roeding)
Tritonidea ventriosa Mart. (= *Cantharus bucklandi* (d'Archiac))
Melongena gigas Mart.
Clavilithes Verbeeki Mart.
Conus socialis Mart. (= *C. mucronatus socialis* Martin)
Arca Fennemai Mart. (= *Anadara antiquata* (Linné))
Arca multiformis Mart. (= *Scapharca multiformis* (Martin))
Limopsis ovata Mart. (= *L. multistriata* (Bruguière))
Chlamys senatorius Gmel.
Diplodonta Everwijni Mart. (= *Cycladicama oblonga* (Hanley))
Cardium parvulum Mart. (= *Nemocardium parvulum* (Martin))
Venus chlorotica Phil. (= *Placamen tiara* (Dillwyn))
Corbula acuticosta Mart. (= *C. taitensis acuticosta* Martin)
Corbula cf. *scaphoides* Hinds.

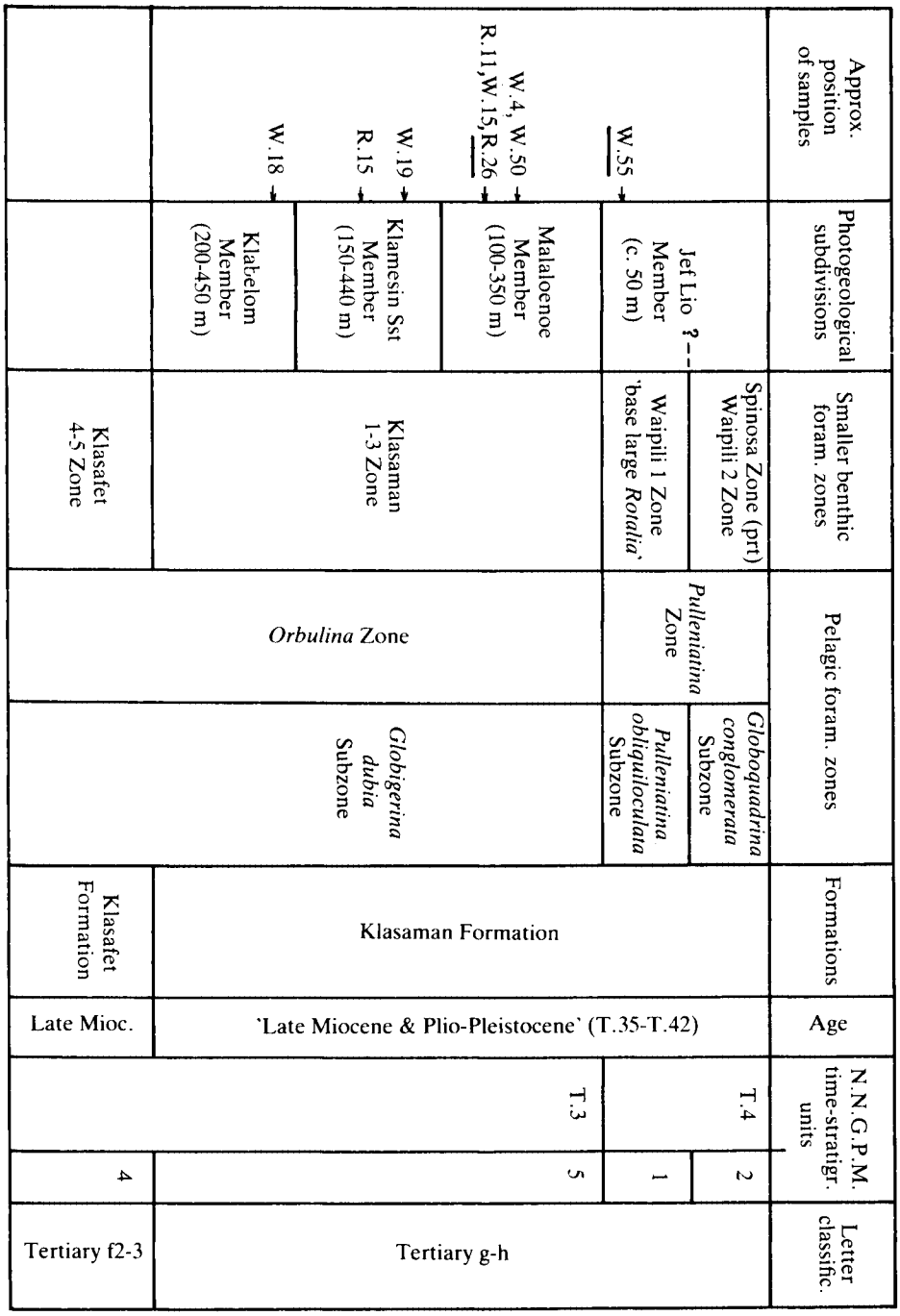


Fig. 2. Time-stratigraphic units, foraminiferal zonation and approximate location of Mollusca-bearing samples as based on detailed photogeological studies. Underlined: largest molluscan assemblages. Compare Visser & Hermes, 1962, text and encl. 7.

Note: *Arca fennemai, Limopsis ovata* and *Diplodonta everwijni*, considered extinct by Martin, are now treated as being conspecific with living species.

On the basis of the species listed above Martin concluded that the age of sample R.26 was most probably Mio-Pliocene, possibly Late Miocene because of the presence of *Strombus triangulatus*, the 'typically Miocene' form of *Melongena gigas* (which however since 1913 is known to occur in Pliocene formations of the Philippines), and finally, a coral species, *Heterocyathus sandalinus* Gerth, 1922.

As to the age of sample W.55, Martin concluded briefly that Late Miocene was its most probable age. As will be seen, the re-examination of the fauna, although comprising more than double the number of species taken into account by Martin, still does not offer better than a vague age determination, due evidently to the paucity of species whose geological range is sufficiently restricted to be of stratigraphic use when considering such small assemblages as are availabe to date.

Description of the molluscs

The following abbreviations are used to designate institutional collections:
RGM – Rijksmuseum van Geologie en Mineralogie, Leiden;
RNH – Rijksmuseum van Natuurlijke Historie, Leiden;
ZMA – Zoölogisch Museum, Amsterdam.

As to the stratigraphic ranges of the species, reference is made to the lists in recent papers (Beets, 1984a, b) in which the various symbols and abbreviations used have been set out in full.

Turritella cingulifera Sowerby, 1825

Material — Loc. R.26 (RGM 315 140: 2 fragments); loc. W.15 (RGM 42 305: a large number of specimens); loc. W.55 (RGM 42 311: several specimens).

Range — Pre-Preangerian to Recent: R - NT (Mandul; Lower Menkrawit Beds; Sekurau; Mentawir Beds s. str.; West Borneo) - P - N - PQ (Togopi) - Q - Re.

References — Altena, 1938, p. 304 (refs); Beets, 1985a, p. 10; Beets, 1985b, p. 53.

Comments — Martin recorded the species also from loc. W.29, a specimen never seen by the writer. On the other hand, the fragments from loc. R.26 were recently extracted from sediment.

Miralda (Oscilla) aff. *M. (O.) sumatrana* (Thiele, 1925)

Material — Loc. W.55 (RGM 315 136).

Range — No previous records.

Comments — A 4.6 mm long specimen is available which comes close to *M. sumatrana* (Thiele, 1925, p. 131, pl. 17, fig. 10). However, in each interval between the main spiral keels appears a secondary lira: in the whorl behind the penultimate whorl. On the base of the body-whorl there follow first six spirals (the most adapical one only a little stronger than the others), a seventh elevated broad lira and finally, four faint ones. The aperture is higher and the strong columellar fold situated more abapically than in Thiele's figure. Furthermore, the base of the columella bears a very oblique and weak but unmistakable second fold. Interior of the labrum smooth. Wissema's fossil *M. sumatrana* (Wissema, 1947, p. 79, pl. 3, fig. 94) from Nias is even more different. The shell from loc. W.55 evidently represents an as yet undescribed species. It was omitted from the faunal list (next chapter).

Strombus (Labiostrombus) triangulatus Martin, 1879
Pl. 9, figs. 1-8.

Material — Loc. R.26 (RGM 42 268: Pl.9, figs. 1-4; RGM 315 110: figs. 5-6; RGM 315 111: fig. 7; RGM 315 112: fig. 8; RGM 315 113: a fragment).

Range — Preangerian: Nj - Tj (and loc. O, Junghuhn).

References — Martin, 1879-1880, p. 49, pl. 9, fig. 5; Martin, 1891-1922, p. 186, pl. 30, fig. 431; Martin, 1911-1912, pp. 41, 46; Martin, 1919, pp. 91, 128; Martin, 1928, pp. 111, 115, 125; Abbott, 1960, p. 115, pl. 91.

Comments — Three fairly well preserved specimens, their apical whorls missing, and two damaged shells are available, agreeing well with Martin's type specimens. Axial riblets as described by Martin (1928) are not present and on the inner lip there are well developed parietal ridges, usually also some ridges near the basal end of the columella but not on all of the lip. The species occurs also in a collection from Tjilanang in the Geological Institute, Amsterdam.

Pratt & Smith (1913, p. 375, pl. 4, fig. 11) gave a poor figure of a doubtful specimen from either Pliocene or Miocene deposits of the Philippines, whose plump spire suggests that some other species is involved.

Zoila caputavisensis sp. nov.
Pl. 8, figs. 1-9.

Holotype — RGM 42 262: Pl. 8, figs. 1-5; length 38.5 mm, height 21.5 mm, maximum width 27.6 mm.
Paratype — RGM 315 114: Pl. 8, figs. 6-9; length 48.3 mm, height 25.8+ mm, width 29.5+ mm; loc. R.26.

Type-locality — Loc. R.26 (Klagumuk), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the upper Klasaman Formation.

Name — Derived from the Bird's Head (Vogelkop): Latin: caput = head, avis = bird.

Range — No previous records.

Description — The shell is subpyriform, with humped smooth dorsum, maximum height adapically to the centre; the base flattened, the lateral margins with a distinct tendency to angulation adapically to the hump, the sides covered by callous glaze except for an irregularly shaped area on the hump; the spire does not project. Adapical extremity projecting, lammelliform, recurved and distinctly edged and elevated around the deeply notched outlet. Basal extremity projecting narrowly, its edge is slightly upturned, notch shallow. Aperture narrow, curved. Labial and columellar teeth not extended on to the base: labial teeth short and strong, numbering 15 in the holotype, and 16 in the paratype, lying at regular intervals. Holotype with 12 columellar teeth, a weak thirteenth between the ninth and tenth tooth from the adapical end of the row, and an obsolete fourteenth at the abapical end. Paratype with 15 columellar teeth and abapically a very obsolete sixteenth. Fossula well developed, narrow.

Comments — *Z. gendinganensis gendinganensis* (Martin, 1899) (see Schilder, 1941, p. 173) and *Z. kendengensis* Schilder (op.cit., p. 174, figs. 1a-d), both show similarity to *Z. caputavisensis* but are readily distinguished by different shapes, particularly as their base is ovate instead of angular.

Z. caputavisensis is an interesting species as it is, to-date, the most easterly link between the Zoilas from south to southeast Asian Neogene/Pleistocene, and the Neogene Australian group, its Recent representatives being confined to southern Australian waters, as relics of a once widely distributed group of Zoilas.

Polinices (Polinices) mammilla (Linné, 1758)

Material — Loc. R.26 (RGM 42 279).

Range — Preangerian to Recent: Tj (and Loc. O, Junghuhn) - NT (basal Menkrawit Beds) - M - P - N - PQ - Q - Re.

References — Altena, 1941, p. 61 (syn.); Beets, 1941, pp. 73, 169, 175, 188, 201; Wissema, 1947, p. 124; Ladd, 1977, p. 28, pl. 8, fig. 3.

Comments — One specimen is at hand, with damaged columellar area but so nicely matching some, likewise more juvenile, Recent specimens in the RNH that the identification is made without hesitation.

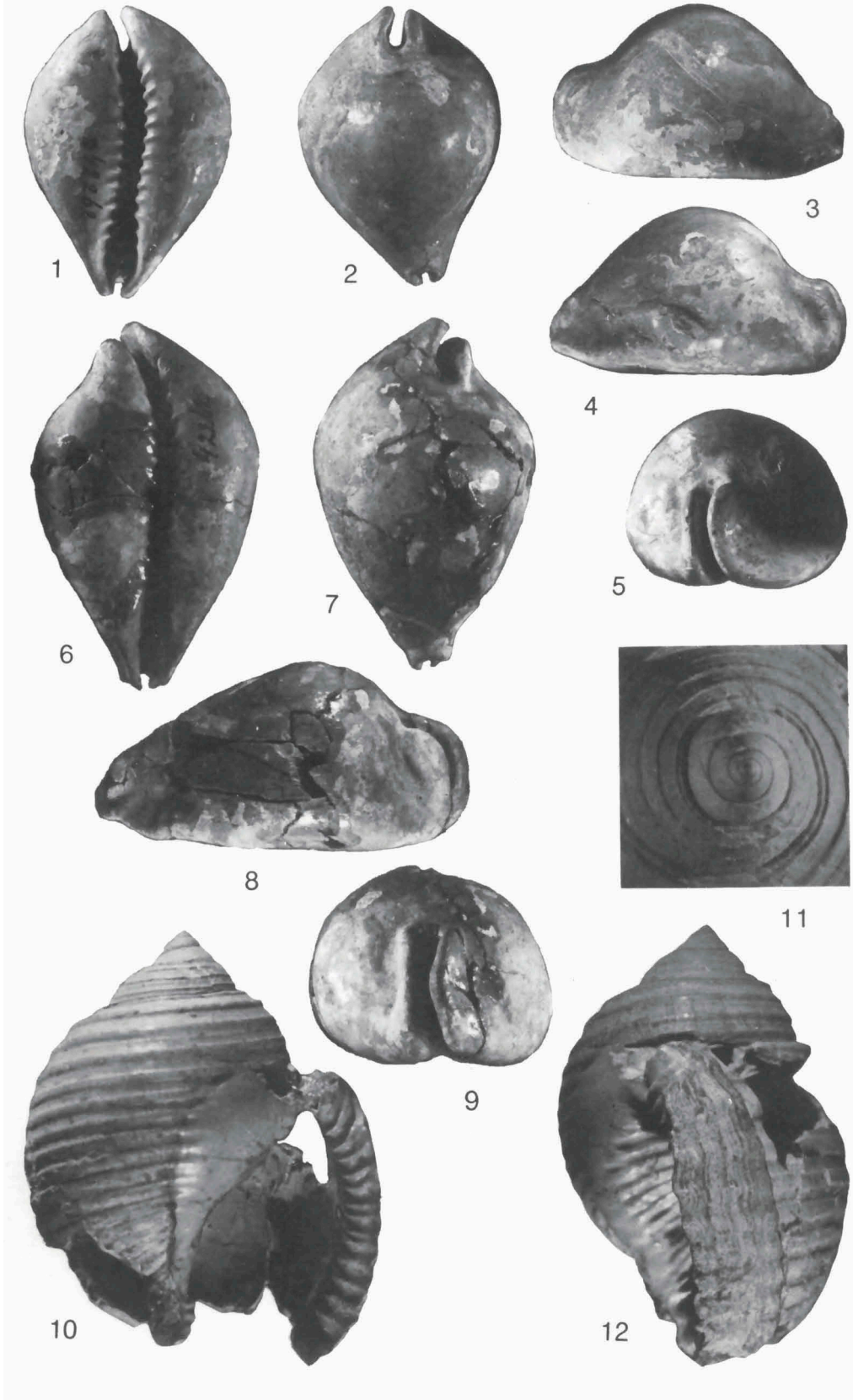
Plate 8

Figs. 1-5. *Zoila caputavisensis* sp. nov. Holotype, RGM 42 262; length 38.5 mm, height 21.5 mm, maximum width 27.6 mm; loc. R.26.

Figs. 6-9. *Zoila caputavisensis* sp. nov. Paratype, RGM 315 114; length 48.3 mm, height 25.8+ mm, width 29.5+ mm; loc. R.26.

Figs. 10-12. *Galeodea papuana* Beets, 1943. Holotype, RGM 42 280; height 32.5+ mm, width 27.5 mm. Original photographs (Beets, 1943, pl., figs. 4-6), refigured.

Plate 8



Galeodea papuana Beets, 1943
Pl. 8, figs. 10-12.

Material — Loc. R. 26 (RGM 42 280: holotype, refigured: Pl. 8, figs. 10-12); height 32.5+ mm, width 27.5 mm.

Range — No previous records.

Reference — Beets, 1943, pp. 436, 437, 441, pl., figs. 4-6.

Comment — The type is refigured in order to enable a preliminary comparison with similar looking material.

Distorsio reticulata Roeding, 1798

Material — Loc. R.26 (RGM 42 276).

Range — Pre-Preangerian to Recent: O (Nari; Singu) - UG (Kachh; Quilon) - Nj - Tj - Ta - Pa - NT (Tjitarum; Kali Merawa; West Borneo) - M - P- N - PQ - Q - Re.

References — *D. cancellina:* Altena, 1942, p. 105 (refs); Wissema, 1947, p. 152; Dey, 1962, p. 74; *D. reticulata:* Shuto, 1969, p. 90, pl. 4, fig. 8; Ladd, 1977, p. 35, pl. 11, fig. 14.

Comments — A damaged specimen at hand which yet could be safely identified by means of a careful comparison with a large number of other fossil and Recent shells. The species occurs also in Preangerian deposits of West Borneo (B.P.M. collection, RGM).

Cantharus (Pollia) bucklandi (d'Archiac, 1850)

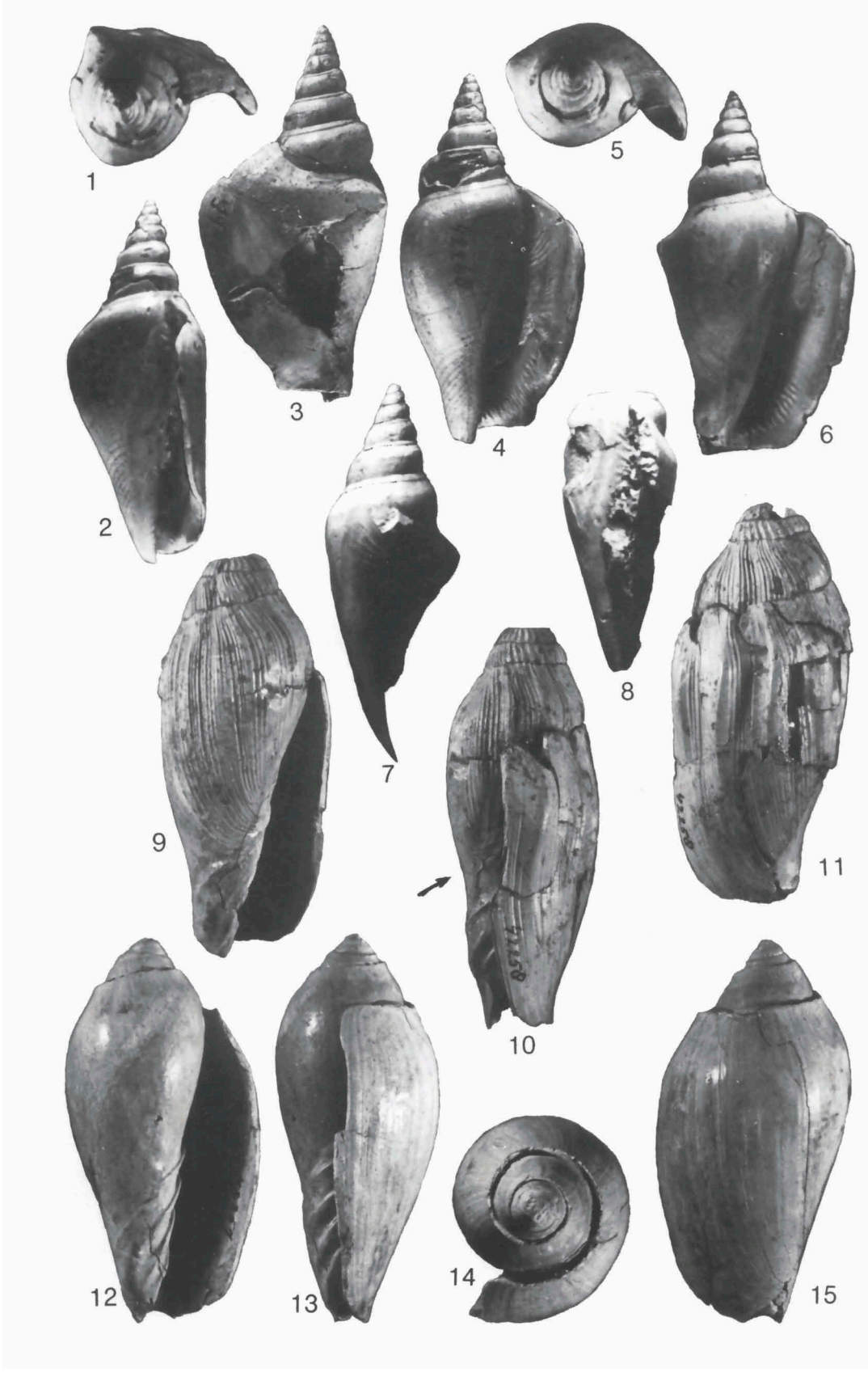
Material — Loc. R.26 (RGM 42 272).

Range — Pre-Preangerian to Pliocene, Neogene (to Recent?): R - Rr (Rl) - K - UG (Sind; Kachh) - Nj - Tj - Ta - Pa - NT (Mandul; Gelingseh Beds; Gunung Batuta) - UM (Japan) - P - N. If indeed conspecific with *C. erythrostoma* (Reeve, 1846), its range would include: P - Q - Re.

Plate 9

Figs. 1-4. *Strombus (Labiostrombus) triangulatus* Martin, 1879. RGM 42 268; height 54.5 mm; loc. R.26.
Figs. 5-6. *Strombus (Labiostrombus) triangulatus* Martin, 1879. RGM 315110; height 52.5 mm; loc. R.26.
Fig. 7. *Strombus (Labiostrombus) triangulatus* Martin, 1879. RGM 315 111; height 53.5 mm; loc. R.26.
Fig. 8. *Strombus (Labiostrombus) triangulatus* Martin, 1879. RGM 315 112; height 41+ mm; loc. R.26.
Figs. 9-11. *Volutoconus hargreavesi aridus* subsp. nov. Holotype, RGM 42 258; length 61+ mm; loc. R.26.
Figs. 12-15. *Amoria (Amoria) canaliculata* (McCoy, 1869). RGM 42 257; height 53 mm; loc. R.26.

Plate 9



Reference — Beets, this volume, pp. 32, 59, 65, 71.

Comments — The specimen at hand, 42 mm long, is damaged but otherwise well preserved, its whorls bearing 9-10 ribs. It likens particularly Oostingh's figs. 245 and 246 (Oostingh, 1938-1940, prt 8 (1939), p. 118, pl. 14, figs. 245-248). Originally, one part of the specimen was considered to be a *Murex* sp. indet. by Martin, but it proves actually to be the top part of the damaged shell identified by Martin as *Tritonidea ventriosa* Mart.

Melongena gigas Martin, 1883

Material — Loc. R.26 (RGM 42 282).

Range — Preangerian to Pliocene: Nj - Tj - Pa - UM (Tjiodeng) - P.

Reference — Beets, 1941, pp. 99 (refs), 170, 201, pl. 5, figs. 212-216.

Comment — A damaged large specimen is available, at least 190 mm long, which belongs to the typical form of the species and agrees very well with Javanese shells in the RGM collections.

Clavilithes (Clavilithes) verbeeki (Martin, 1895)

Material — Loc. R.26 (RGM 42 266; 315 138).

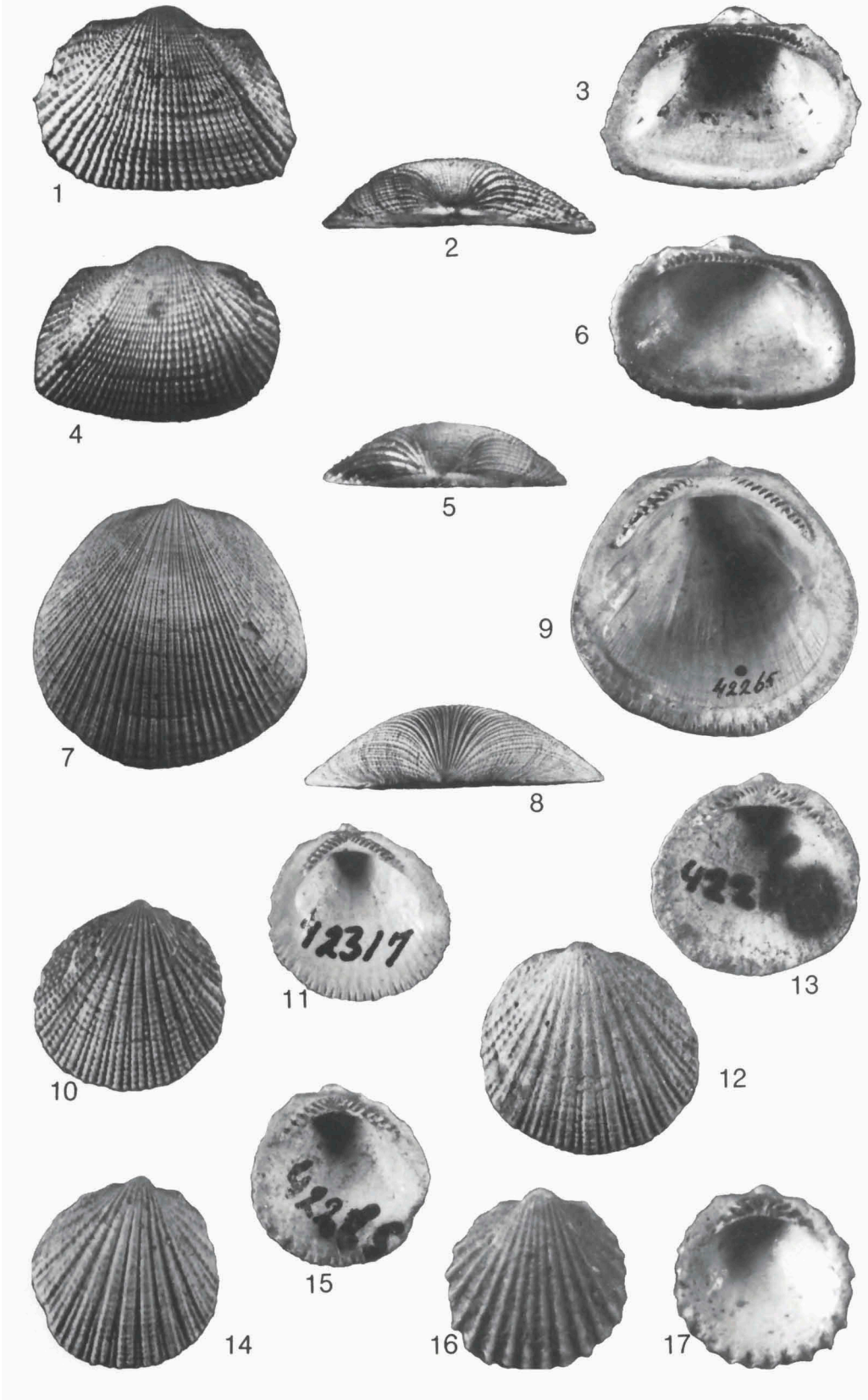
Range — Pre-Preangerian to Pliocene: R - Rr (Rm; Rl) - Nj - Tj - NT (Tjikao; Lower Palembang Beds; West Borneo) - UM (Tjiodeng; Palabuanratu; Talar Beds) - M - P.

References — Van Es, 1931, pp. 51, 94; van der Vlerk, 1932, p. 110; Martin, 1932, pp. 149, 151; Oostingh, 1935, pp. 88 (refs), 211, 217; Oostingh, 1938-1940, pt 8 (1939), p. 105, pl. 12, figs. 217-218; Beets, 1950c, p. 334 (no. 59).

Plate 10

Figs. 1-3. *Arcopsis (Arcopsis) caputavisensis* sp. nov. Holotype, RGM 315 123; left valve, length 7 mm, height 5 mm, inflation 1.9 mm; loc. R.26.
Figs. 4-6. *Arcopsis (Arcopsis) caputavisensis* sp. nov. Paratype, RGM 315 124; right valve, length 6.3 mm, height 4.5 mm, inflation 1.6 mm; loc. W.55.
Figs. 7-9. *Glycymeris (Glycymeris) caputavisensis* sp. nov. Holotype, RGM 42 265; left valve, length 38.9 mm. height 37.8 mm, inflation 10 mm; loc. R.26.
Figs. 10-11. *Glycymeris (Glycymeris) caputavisensis* sp. nov. Paratype, RGM 42 317; length 9.9 mm, height 9.8 mm, inflation 2.3 mm; loc. W.55.
Figs. 12-13. *Glycymeris (Glycymeris) caputavisensis* sp. nov. Paratype, RGM 315 129; length 11.2 mm, height 10.9 mm, inflation 2.6 mm; loc. R.26.
Figs. 14-15. *Glycymeris (Glycymeris) caputavisensis* sp. nov. Paratype, RGM 315 130; length 9.7 mm, height 9.6 mm, inflation 2.5 mm; loc. R.26.
Figs. 16-17. *Glycymeris (Glycymeris) caputavisensis* sp. nov. Paratype, RGM 315 131; lenght 3.4 mm; loc. W.55.

Plate 10



Comments — Four specimens at hand, one rather badly damaged. Three specimens are quite characteristic, agreeing very well with Javanese shells from Tjiburial and Tjiodeng, and others in the RGM collection. The comparatively smooth, damaged shell has a deep subsutural spiral depression, but a specimen from Tjiodeng comes quite close. Specimens from West Borneo (B.P.M. collection, RGM) are exactly alike, and all shells bearing a comparatively strong depression are without hesitation included in the species. A specimen from Ngembak, Java (RGM 9004), referred to *C. tjidamarensis* (Martin, 1879) by Martin (1883-1887, p. 100), would actually appear to be *C. verbeeki*, being very close to a small specimen from Palabuanratu (RGM 8989).

The writer agrees with Oostingh that the variety acutangula Wanner & Hahn, 1935 can hardly be separated from typical *C. verbeeki*. Shuto (1969, p. 154) included both the variety and Oostingh's shells of *C. verbeeki* from Bantam in *C. tjidamarensis*, but the writer does not share Shuto's opinion, a thorough reexamination of the Javanese material in the RGM having convinced him that the two are genuine species; also, that only well preserved material can be identified with certainty. It should be added that, unlike Shuto's contention, *C. verbeeki* may also show a double subsutural spiral (specimens from Bajah, Tjikeusik, Tjibining, Tjiburial) which may be quite appreciably stronger than indicated by Shuto.

Volutoconus hargreavesi aridus subsp. nov.
Pl. 9, figs. 9-11.

Holotype — RGM 42 258: pl. 9, figs. 9-11; length 61+ mm.

Type-locality — Loc. R. 26 (Klagumuk), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the upper Klasaman Formation.

Name — Derived from Latin: aridus = dry, in the sense of shrivelled, referring to its being wrinkled all over.

Range — No previous records.

Description — The holotype is damaged, the first surviving 1¼ whorl presumably belonging to the protoconch and concave subsuturally (first ¾ whorl preserved), with distant riblets and several fine spiral striae (three or four of which, abapically to the adapical depression are stronger than the others). On the last two (post-embryonal) whorls the riblets quite abruptly stand at short intervals and the striae disappear, the riblets also being much more clearly sigmoidal than on the protoconch. Towards the end of the penultimate whorl, axial costae-like swellings (bearing riblets) come in, which are most conspicuous in the last half of the body whorl.

Comments — *V. hargreavesi* (Angas, 1872) from Western Australia (Dampier Archipelago to Houtman Abrolhos Islands) is clearly related, particularly the variety daisyae Weaver, 1967 (Weaver & du Pont, 1970, p. 138, pl. 61, fig. G) which likewise has ribbing on protoconch and teleoconch but not so delicate as in *aridus*, while lacking the latter's conspicuous costae. Also it has five columellar plaits, one more than *aridus* and typical *hargreavesi*. It should be added that between the second and third plait of *aridus*, a fold is present (of plait-like appearance in Pl. 9, fig. 10) which corresponds to the abapical side of the siphonal notch, the sharp plait adapically to it demarcating the adapical side of the

notch and extending towards the basal end of the shell. The position of the fourth (most adapical) plait more inside the aperture is indicated by an arrow in fig. 10 of Pl. 9.

The differences noted do not seem to warrant separate treatment of *aridus* on a species level. To its acceptance as a subspecies is perhaps lent more credence by the presence of another Australian element, *Amoria canaliculata* (McCoy) in the same faunule.

At present *Volutoconus,* also occurring in Australian Eocene, is restricted to eastern, western and northern Australian waters, as a relic of a once wider distribution testified to by the new subspecies described above, which provides the first record of the genus in the Indonesian realm.

Amoria (Amoria) canaliculata (McCoy, 1869)
Pl. 9, figs. 12-15.

Material — Loc. R. 26 (RGM 42 257: Pl. 9, figs. 12-15; RGM 315 115).

Range — Recent: Re.

Reference — Weaver & du Pont, 1970, p. 148, pl. 63, figs. E-G; pl.69.

Comments — Two 53 mm long and therefore adult specimens are available, well preserved but for the protoconch of the figured shell and the damaged labrum of the other. As no colouring is preserved there is no saying whether the shallow-water variant (2-15 fathoms) is at hand, or the deeper water form.

Amoria is known from the Miocene of Australia. Its Recent distribution is restricted to the continental shelf around Australia, that of *A. canaliculata* in particular, to the eastern Australian waters of Queensland (Coral Sea: 2-70 fathoms, coral and sand substrate). Its occurrence at the northwestern tip of New Guinea in Neogene times therefore serves as an indication that the Recent habitat is a relic of a once wider distribution.

Conus mucronatus socialis Martin, 1885

Material — Loc. R. 26 (RGM 42 273).

Range — Preangerian to Pliocene/Quaternary: Ta - M - P - N (Tjigugur: var.) - PQ.

References — *C. socialis*: van der Vlerk, 1931, p. 215 (refs); van Es, 1931, pp. 39, 94, 115; Haanstra & Spiker, 1932, p. 1313; van der Vlerk, 1932, p. 110,; Oostingh, 1938-1940, pt 1 (1938), p. 20; Altena & Beets, 1945, pp. 47, 60, pl., fig. 1 (var.); Beets, 1950c, p. 336.

Comments — Two well preserved specimens at hand, one matching Tesch's figs. 17-18 (Tesch, 1915, p. 19, pl. 20), the other, a specimen from Tjadasngampar, Java in the RGM. Shuto (1969, p. 220) has formulated the minor differences between *C. socialis* and *C. mucronatus* Reeve, 1843.

'Barbatia' sorongensis sp. nov.
Pl. 11, figs. 1-9.

Holotype — RGM 315 125: Pl. 11, figs. 1-3, left valve; length 3.6 mm, height 2.7 mm, inflation 1.4 mm.
Paratypes — RGM 315 126: Pl. 11, figs. 4-6, left valve; length 3.5 mm, height 2.4 mm, inflation 1.3 mm; loc. W.55. RGM 315 127: figs. 7-9, left valve; length 3.1 mm, height 2 mm, inflation 1.1 mm; loc. W.55.

Type-locality — Loc. W.55 (Klawiri), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the top part of the Klasaman Formation.

Name — Derived from the name of Sorong, once headquarters of N.N.G.P.M.

Range — No previous records.

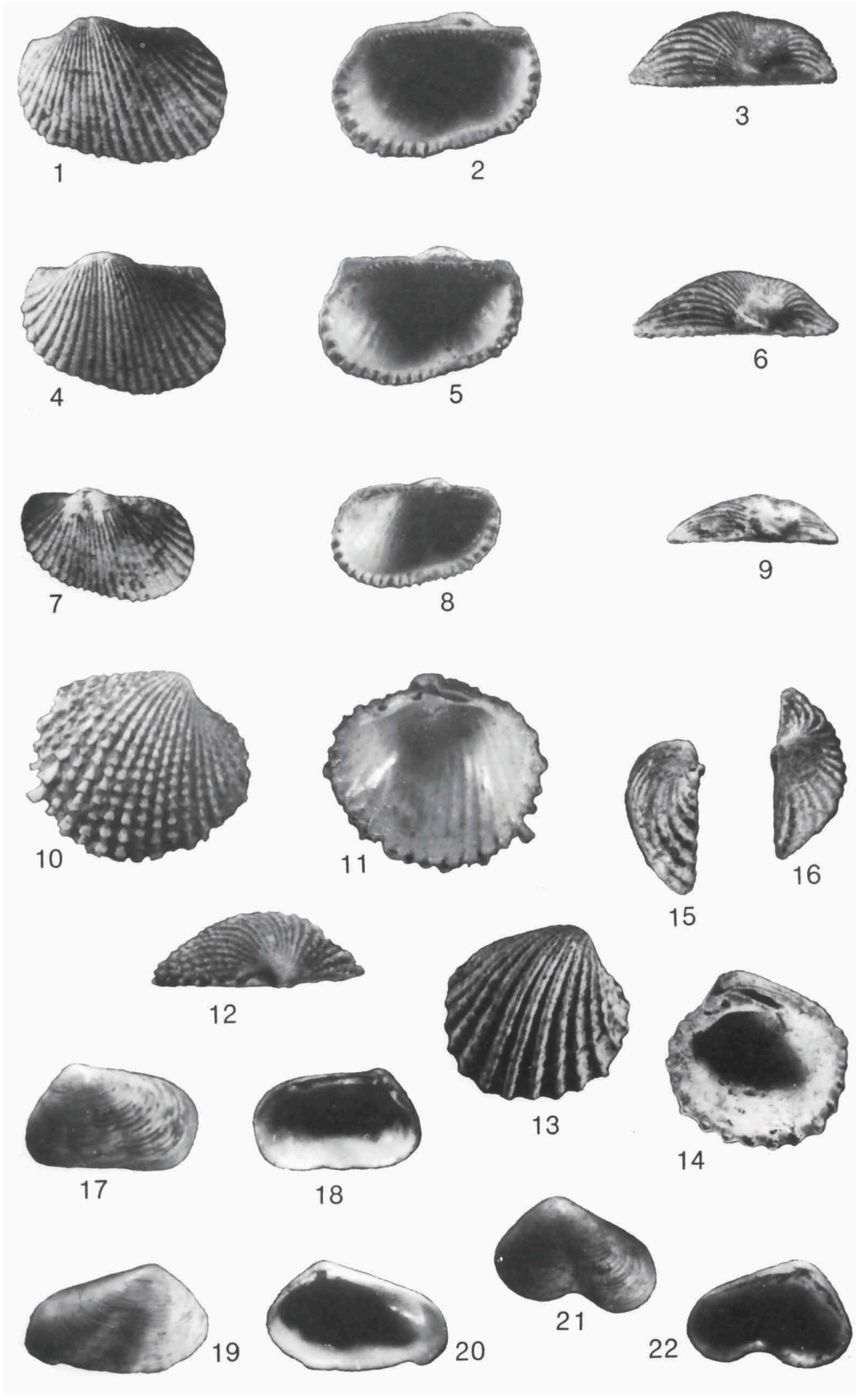
Description — This small species is represented by three valves, which are roughly ovoid. The transition between the dorsal and posterior margin is sometimes slightly wing-shaped. The largest inflation occurs behind a medial radial depression which is most clearly developed near the rather pronouncedly prosogyrate umbo. It is gradually weakening towards the ventral margin and finally almost disappearing. The ventral margin is therefore hardly sinuate.

The shell surface is covered with 27 (holotype), 26 (paratype 1) or 25 (paratype 2) flattened riblets bearing a rather pronounced ornament of ridge-like to nodule-like projections, formed by commarginal threads which are continuous, though weaker, in the interspaces of the riblets. The area is narrow behind the beak, shorter and broader in front of it. It is stepped, i.e., it has a posterior higher, narrow and smooth sliver radiating from the beak to the posterior end of the area. Its front is demarcated by a sharp flexure down to the comparatively large amphidetic ligamental area, which bears very fine striae parallel to the hinge line. Hinge slightly arched. The dental series has a short gap under the beak, the teeth radiating from a point below the beak. Shell margin crenulated; inside the pallial line, numerous striae and fine costae occur, a broad one corresponding with the medial depression. Anterior muscle scar rounded-triangular and smaller than the posterior scar which is squarish and deep.

Plate 11

Figs. 1-3. *'Barbatia' sorongensis* sp. nov. Holotype, RGM 315 125; left valve, length 3.6 mm, height 2.7 mm, inflation 1.4 mm; loc. W.55.
Figs. 4-6. *'Barbatia' sorongensis* sp. nov. Paratype, RGM 315 126; left valve, lenght 3.5 mm, height 2.4 mm, inflation 1.3 mm; loc. W.55.
Figs. 7-9. *'Barbatia' sorongensis* sp. nov. Paratype, RGM 315 127; left valve, length 3.1 mm, height 2 mm, inflation 1.1 mm; loc. W.55.
Figs. 10-12. *Carditella (Carditellona) caputavisensis* sp. nov. Holotype, RGM 42 315; right valve, length 3.9 mm, height 3.4 mm, inflation 1.3 mm; loc. W.55.
Figs. 13-16. *Cardiocardita (Cardiocardita) oostinghi* sp. nov. Holotype, RGM 42 269; right valve, length 6.1 mm, height 6 mm, inflation 2.5 mm; loc. R.26.
Figs. 17-18. *Erycina (Erycina) lineata* (Lynge, 1909). RGM 315 119, left valve, length 2.9 mm; loc. W.55.
Figs. 19-20. *Erycina (Erycina) lineata* (Lynge, 1909). RGM 315 120; right valve, length 3.1 mm (hinge damaged); loc. W.55.
Figs. 21-22. *Erycina (Erycina) lineata* (Lynge, 1909). RGM 315 121; left valve, length 2.8 mm; loc. W.55.

Plate 11



The writer is not aware of the existence of related species. *'B'. sorongensis* is a somewhat peculiar, *Barbatia*-like form whose systematic position poses a problem. Its denticulate border should preclude referring it to the Arcinae, although its hinge is that of *Barbatia (Cucullaearca)* and several *Barbatia* species also show a more or less fluted margin. On the whole, the species shows affinities to *Hawaiarca* Dall, Bartsch & Rehder, 1928 (the shell margin of which is fluted and scalloped) which may not be synonymous with *Barbatia*, but unlike the new species does not show a gap in its dental series. Further finds may clarify the situation, the new species reluctantly being referred to as a *'Barbatia'*.

Barbatia (Acar) tenella (Reeve, 1844)

Material — Loc. W.55 (RGM 315 134).

Range — Recent: Re.

References — *Arca tenella*: Lynge, 1909, p. 21, pl. 1, figs. 11-13; Prashad, 1932, p. 52 (syn.).

Comments — A left valve is at hand, 11 mm long, its ornament agreeing well with Recent material of this widespread species, its outlines in particular with Lynge's figures. This is apparently the first time that the species is recorded fossil.

B. tenella egenora Iredale (1939, p. 269, pl. 3, figs. 2, 2a) from Queensland is different in shape and has almost non-granulose ornament. It is the type of *Opularca* Iredale, 1939, a synonym of *Acar* Gray, 1857.

Trisidos tortuosa (Linné, 1758)

Material — Loc. W.55 (RGM 315 128).

Range — Pre-Preangerian to Recent: K - Tj - NT (West Borneo) - P - Q - Re.

References — *Arca tortuosa*: Vredenburg, 1925-1928, p. 418; Yokoyama, 1928, pp. 13, 15, 19, 105, pl. 16, fig. 2; Beets, 1941, pp. 5, 181; Beets, 1950c, p. 337 (syn.); *Trisidos semitorta*: Habe, 1964, p. 256, pl. 1, figs. 1-2.

Comments — Two juvenile left valves are at hand, beautifully preserved and agreeing perfectly with Recent material in the RNH collections.

Yokoyama's figured fossil specimen from Taiwan is typically *T. tortuosa* as redefined by Iredale (1939, p. 270, pl. 3, figs. 8, 8a), and not *T. semitorta* Lamarck, 1819, to which it was however assigned by Shuto (1971, p. 10), long after its being united with *T. kyonoi* (Kuroda, 1930) by Nomura (1933, p. 41). However, the writer considers Shuto's identification of a damaged valve from Panay as *T. semitorta* correct (op. cit., p. 9, pl. 4, fig. 17). On the other hand, the writer also ventured to unite *T. kyonoi* with *T. tortuosa* (Beets, 1950c, p. 337), failing to see any appreciable difference between the two. This was also done by Habe (1964), but Noda (1966, p. 77, pl. 3, figs. 1-3, 13) reinstated its alleged separate status.

The writer cannot see any difference between *T. tortuosa* and *Parallelipipedum prototortuosum* Noetling (1901, p. 152, pl. 7, figs. 10-11) from the Kama of Burma.

Anadara (Anadara) antiquata (Linné, 1758)

Material — Loc. R.11 (RGM 42 270); loc. R.26 (RGM 42 267).

Range — Pre-Preangerian to Recent: LM (Iran) - Rr (Rl) - Nj - Tj - NT (basal Menkrawit Beds; Sekurau; Gunung Batuta; West Borneo) - UM (Iran) - P - N (e.g., Tjigugur) - PQ (Togopi) - Q - Re.

References — *Arca antiquata*: Oostingh, 1935, p. 132 (syn.); Altena & Beets, 1945, pp. 51, 61; Beets, 1950b, pp. 310 , 314, 315; *Anadara antiquata*: Beets, 1985a, pp. 28, 29.

Comments — This species, of wide distribution both fossil and Recent, is represented by five specimens: two left and two right valves from loc. R.26 and the cast of a left valve from loc. R.11. It occurs also in undescribed collections from Ceram (Neogene = Pliocene?) and the Quaternary of New Guinea in the Instituut voor Aardwetenschappen, Utrecht.

Anadara (Andadara) sp. indet.

Material — Loc. W.55 (RGM 315 137).

Comments — A damaged, rather stout little left valve (6.4 mm long) at hand, is reminiscent in shape of *Scapharca pilula* (Reeve, 1844), but with a very narrow area which broadens in front of the beak.

Scapharca (Scapharca) multiformis (Martin, 1879)

Material — Loc. R.15 (RGM 42 263); Loc. W.19 (RGM 42 261).

Range — Pre-Preangerian to Pliocene, Neogene: UG (Sind; Assam) - Nj - Tj (and loc. O. Junghuhn) - Bo - NT (Wirosari; basal Menkrawit Beds, West Borneo) - UM (Cramatensis Beds = Odengian) - M (Pegu system) - P - N.

References — *Arca multiformis*: Beets, 1941, pp. 156 (syn.), 171, 173; Beets, 1950c, p. 337.

Comment — Several specimens are available which agree in particular with the Javanese Miocene shells.

Arcopsis (Arcopsis) caputavisensis sp. nov.
Pl. 10, figs. 1-6.

Holotype — RGM 315 123: Pl. 10 figs. 1-3, left valve; length 7 mm, height 5 mm, inflation 1.9 mm.
Paratype — RGM 315 124: Pl. 10 figs. 4-6, right valve; length 6.3 mm, height 4.5 mm, inflation 1.6 mm mm; loc. W.55.

Type-locality — Loc. R.26 (Klagumuk), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the upper Klasaman Formation.

Name — Derived from the Bird's Head (Vogelkop): Latin: caput = head, avis = bird.

Range — No previous records.

Description — Shell small, umbones submedian, hardly prosogyre, curvature rather strong. Ventral and dorsal margins almost straight and slightly diverging in anterior direction. Posterior diagonal angulation fairly sharp, curvature of posterior margin weak, anterior margin strongly curved and passing into ventral margin with rounded outline. The whole surface of the shell is covered with numerous radiating costae, the anterior ones more distant as are the riblets between the diagonal angulation and posterior margin; finer riblets are inserted at odd places. At rather regular intervals the growthlines are stronger, coinciding with small nodules on the costae. The nodules are lower and more rounded on the median part of the shell, getting more scale-like to spine-like towards the anterior margin, as well as on and behind the diagonal angulation. The hinge plate is lanciform, with fine longitudinal striae. The ligamental area is a small triangle under the umbo. Hinge line arcuate. Adductor scars trapezoid, anterior one slightly wider than the posterior scar, both demarcated against the median part of the shell interior by a fine sharp ridge.

Comments — Part of Martin's syntypes of *Arca bataviana* (cf. Martin, 1883-1887, p. 253, pl. 13, figs. 256-257) is rather closely related with *A. caputavisensis*. However, Martin described two quite different species as one and the same: one with a 'höchst undeutliche Radialkante' (his fig. 256) and a 'variety' characterised by a sharp diagonal angulation (his fig. 257). The first has a rather wide ligamental area, the other, a much narrower triangle, as in *A. caputavisensis*, and has to be renamed. The following are the particulars:

Arcopsis (Arcopsis) bataviana (Martin, 1885)

Lectotype — Designated here: RGM 4718; Martin, 1883-1887, p. 253 (pars), pl. 13, fig. 256 exclusively (length 7.2 mm, height 5.8 mm).
Lecto-paratypes — RGM 4720 (four valves): from Batavia, well 3, depth 81 mm (presumed Pliocene).

Type-locality — Ngembak, well B?

Type-horizon — Not known but presumed Pliocene.

Discussion — Cossman's *Fossularca bataviana* (Martin) (Cossmann, 1924, p. 101, pl. 4, figs. 7-9, pl. 5, fig. 41) from Karikal appears to be a genuine *bataviana*. However, Tesch's *Arca bataviana* Martin (Tesch, 1920, p. 98, pl. 20, fig. 260) is a more elongate form which should not be included in this species.

Martin's *Arca bataviana* from Kali Tjemoro (Martin, 1891-1922, p. 364, pl. 51, fig. 82: RGM 4117) is presently held to be *Striarca compressa* (Martin, 1885) (Martin, 1883-1887, p. 252, pl. 13, fig. 255) but *A. compressa* from Sondé (Martin, 1891-1922, p. 365, pl. 51, fig. 83) is a different species altogether. So is Tesch's *A. compressa* (Tesch, 1920, p. 98, pl. 20, fig. 261), which seems much closer to, and may well be conspecific with, *A. trapeziformis* Martin, 1879 (Martin, 1879-1880, p. 115, pl. 18, fig. 8), while Shuto figured specimens assigned to *A. bataviana* (Shuto, 1971, p. 22, pl. 1, figs. 10, 12, 18-21), which seem to be conspecific with Tesch's *A. compressa* (if not *A. trapeziformis*), being very different indeed from Martin's fig. 256 of *Arca bataviana* quoted by Shuto.

Chapman (e.g., 1918, p. 12) recorded *Arca* cf. *A. bataviana* Martin from Papua New Guinea, there being no saying which species is in fact involved without a revision of the Papuan material.

Arcopsis (Arcopsis) altenai sp. nov.

Holotype — RGM 4719, originally described by Martin as a 'variety' of *Arca bataviana* (Martin, 1883-1887, p. 254, pl. 13, fig. 257 exclusively); left valve, length 6.3 mm, height 4.6 mm, inflation 2 mm.
Paratypes — RGM 4721 (1 right and 1 left valve), loc. Batavia, well 2, depth 130 m; RGM 4722 (1 left valve and 2 right ones), loc. Batavia, well 3, depth 117 m.

Type-locality — Batavia, well 4, depth interval 130-134 m.

Type-horizon — Not ascertained, presumed Pliocene.

Name — The species is named for the late Dr C.O. van Regteren Altena.

Range — No record.

Discussion — Martin briefly described his 'variety' which, like *Arcopsis caputavisensis*, is perhaps related to *Arca harassowitzi* Oostingh (1935, p. 129, pl. 11, fig. 111) but is much smaller and less inflated, has denser and finer ribbing, several spine-like nodules, and different outlines, while the area behind the sharper diagonal angulation is wider.

Oostingh's fig. 108 of his *Arca djoereiensis* (Oostingh, 1935, p. 130, pl. 11, figs. 108-110) is not unlike *A. altenai* but nearly three times its size, has a wide-angle ligamental area and a more rounded posterior margin not so pointed at its transition with the ventral margin, while its riblets are more finely granulate.

Limopsis (Pectunculina) multistriata (Bruguière, 1789)

Material — Loc. W.15 (RGM 42 303); Loc. W.50 (RGM 42 306); loc. W.55 (RGM 42 309).

Range — Pliocene to Recent: P - N (e.g., Tjigugur) - PQ (Togopi) - Q - Re.

References — Cox, 1930, p. 151; Prashad, 1932, p. 58 (syn.); Weir, 1938, p. 66; Altena & Beets, 1945, pp. 54, 61; Beets, 1950c, p. 338 (syn.); Nuttall, 1965, p. 176.

Comments — Quite a number of specimens is available, particularly from loc. W.55. The species is variable to a large extent, as is most evident when considering, for instance, the Recent material in the RNH and ZMA (Siboga Exped.), the fossils from Tjigugur, Martin's material of *L. venusta* (Martin, 1885), and duplicates from Ceram in the RGM identified by Fischer (1927, p. 120), as well as the type material of *L. ovata* (Martin, 1885), all of which were carefully compared and found conspecific, the type of *L. ovata* matching the Siboga Expedition material from Station 99.

Glycymeris (Glycymeris) caputavisensis sp. nov.
Pl. 10, figs. 7-17.

Holotype — RGM 42 265: Pl. 10, figs. 7-9, left valve; length 38.9 mm, height 37.8 mm, inflation 10 mm.
Paratypes — RGM 42 317: Pl. 10 figs. 10-11; length 9.9 mm, height 9,8 mm, inflation 2.3 mm; loc.W.55. RGM 315 129: figs. 12-13; length 11.2 mm, height 10.9 mm, inflation 2.6 mm; loc. R.26. RGM 315 130: figs. 14-15; length 9.7 mm, height 9.6 mm, inflation 2.5 mm; loc. R.26. RGM 315 131: figs. 16-17; length 3.4 mm; loc. W.55. RGM 315 132 (mostly fragmentary material and 1 fairly well preserved juvenile valve); loc. R.26.

Type-locality — Loc. R.26 (Klagumuk), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the upper Klasaman Formation.

Name — Derived from the Bird's Head (Vogelkop): Latin: caput = head, avis = bird.

Range — No previous records.

Description — Shell medium-sized, rather compressed, sub-orbicular, costate, anterior and posterior margins flattened-convex, umbones near-orthogyrate, acute. Surface ornamented with a growing number of costae raying out from the beak. In juvenile valves (Pl. 3, fig. 16) there are about 21 costae. In slightly bigger specimens (Pl. 3, figs. 12, 14) their number has increased appreciably as some 14 costae have split into two equal parts while a little later, secondary riblets develop, one in each interval. All ribs tend to become nearly equally strong. The whole surface is covered with fine close-spaced concentric threads. Before the doubling of the costae, regularly spaced nodules are developed, this ornament covering all of the costae subsequently appearing towards the shell margin. Nearly all costae, whether inserted or the product of doubling, split up towards the shell margin, some of the posterior and anterior costae however failing to do so, thus creating differently ornamented fields radiating from the beak to near both ends of the posterior and anterior margins. Along the dorsal margin, finally, narrow zones on both sides of the beak do not bear costae.

The cardinal area is very small in juvenile specimens, in the holotype it has 6-7 chevron grooves. The hinge plate is broad, the dental series strongly arched (more v-shaped in juvenile shells and uninterrupted under the beak), in the type with 9-10 posterior teeth and 13-14 anterior ones, some, more or less clearly split, narrowly v-shaped, five of the posterior teeth most clearly so. The posterior set is broader than the anterior one and has stronger teeth. In the type, there is a wide medial hiatus with obsolescent teething between the two sets.

Adductor scars are well developed, each on a fairly sharply demarcated radial platform, the remainder of the inner shell surface is radially striate, ventral margin fluted.

G. uziniensis Cox (1927, p. 65, pl. 16, figs. 7-8) from the Pliocene of Zanzibar is probably related, but its costae, judging from the figures, do not double so clearly by far as in *G. caputavisensis*, which appears to be unrelated to any other fossil or Recent species described so far.

Glycymeris sp. 1

Material — Loc. W.55 (RGM 315 139).

Comment — Three small valves are at hand, the largest about 6.5 mm high and long, ornamented all over with simple radiating costae. Inner margin coarsely fluted.

Glycymeris sp. 2

Material — Loc. R.11 (RGM 315 109).

Comment — Two small valves are available, the largest nearly 5 mm high and 5.4 mm long, covered with fine costae exactly as in *Limopsis multistriata* (see above). Inner ventral margin very densely fluted.

Chlamys (Chlamys) senatoria (Gmelin, 1790)

Material — Loc. R.26 (RGM 42 256); loc. W.55 (RGM 42 310).

Range — Pre-Preangerian to Recent: O (Padaung) - LM (Lower Telisa; Iran; Pemba Island; Kenya) - W - R - Rr (Rm; Rl) - UG (Sind; Sri Lanka) - Nj - Tj - NT (Gelingseh Beds; Sekurau; West Borneo; basal and Lower Palembang Beds) - M (Middle and Upper Fars) - P - N (e.g., Tjigugur) - PQ (Togopi) - Q - Re.

References — Oostingh, 1935, pp. 151 (refs), 211, 218, 226; Beets, 1985 a, p.30 (refs); Beets, this volume pp. 48, 65, 78.

Comment — A few more or less damaged, yet well identifiable valves are at hand.

Spondylus (Spondylus) marisrubri Roeding, 1798

Material — Loc. R.26 (RGM 42 259).

Range — Pliocene to Recent: P - PQ - Q - Re.

References — *S. aculeatus*: van der Vlerk, 1931, p. 267; Abrard, 1942, p. 13, pl. 1, fig. 9; *S. marisrubri*: Cox 1931, p. 6; Nardini, 1937, p. 230, pl. 3, fig. 3.

Comments — A fragmentary valve is at hand, but for the damage beautifully preserved and so closely matching Recent Red Sea material in the RNH that the identification is considered quite safe. The species has been recorded by various authors from Pleistocene to Subrecent deposits of the Red Sea rim and the writer is familiar with Pliocene material from the Gulf of Suez area.

Linga (Bellucina) sp. indet.

Material — Loc. R.26 (RGM 315 135).

Range — No previous records.

Comment — A damaged and somewhat corroded left valve at hand is 4.2 mm long and 4.3 mm high, and reminiscent of *L. gonzalesi* Shuto (1971, p. 29, pl. 1, figs. 8, 11, 13-17) but, although likewise coarsely ribbed, has more ribs and its shape is nearly orbicular.

Cycladicama (Cycladicama) oblonga (Hanley, 1856)

Material — Loc. W.18 (RGM 42 260, 42 264).

Range — Preangerian to Recent: Nj - Tj - NT (Sekurau; Batu Panggal; West Borneo; Tjikao) - P - Q - Re.

Reference — Beets, 1985a, p. 31.

Comment — This well-known species is now represented by nineteen characteristic whole specimens.

Erycina (Erycina) lineata (Lynge, 1909)
Pl. 11, figs. 17-22.

Material — Loc. W.55 (RGM 315 119: Pl. 11, figs. 18-18; RGM 315 120: figs. 19-20; RGM 315 121: figs. 21-22; RGM 315 122: 2 fragments).

Range — Recent: Re.

Reference — Lynge, 1909, p. 80, pl. 3, figs. 16-18.

Comments — This is an interesting find of a minute yet characteristic living species now recorded fossil for the first time. The three valves at hand show variation in shape and depth of the median radial depression, as do Lynge's specimens. He gave the length as 4.5 mm, height 2.75 mm and inflation 2.5 mm.

Carditella (Carditellona) caputavisensis sp. nov.
Pl. 11, figs. 10-12.

Holotype — RGM 42 315: Pl. 11, figs. 10-12, right valve; length 3.9 mm, height 3.4 mm, inflation 1.3 mm.

Type-locality — Loc.W.55 (Klawiri), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the top part of the Klasaman Formation.

Name — Derived from the Bird's Head (Vogelkop): Latin: caput = head, avis = bird.

Range — No previous records.

Description — This and the next species belong to a group so far not recorded from Indonesian waters, but known from East Australia to the Western Pacific. The minute right valve seems related to *C. angasi* Smith, 1885 from New South Wales. It is quite inequilateral: anterior dorsal margin short, posterior margin and anterior part of ventral margin flattened convex, posterior dorsal margin almost straight. Shallow posterior radial depression present. Shell surface, but for the smooth, deeply impressed lunule, covered with 21 radiating costellae ornamented with fairly distant transverse tubercles nearer the beak, more and more prominently scaly towards the shell margins. Above the

posterodorsal radial depression occur two costellae, two finer ones in the depression, and on its anterior side a stronger, squamose rib, the remainder of the surface bearing 16 riblets: the first weaker than the strong rib along the radial depression, the others gradually finer towards the dorso-anterior margin. Beak prosogyrate. Cardinal tooth strong, triangular, almost horizontal; the posterior and anterior lateral teeth are weakly developed, the latter just below the pit for the anterior lateral of left valve. Shell margin fluted, inner shell surface correspondingly striate. Posterior adductor scar smooth, anterior one weakly striate and apparently not demarcated.

C. angasi (Smith, 1885, p. 217, pl. 15, figs. 9-9a) also has 21 riblets but these are not squamose. It is higher in shape and more inflated too.

Carditella (Carditellona) torresi Smith, 1885

Material — Loc. W.55 (RGM 315 116).

Range — Recent: Re.

Reference — Smith, 1885, p. 217, pl. 15, figs. 8a-b.

Comments — An interesting find, the species having been described from the Torres Straits and south of New Guinea. Twenty handsomely ornamented valves represent this small species which is here recorded for the first time fossil. The material matches Smith's description and figures beautifully. Smith mentioned a length of 5 mm, the largest fossil being 3.8 mm long. He also reported 15 radial costae but his figure 8a shows 17 riblets. The fossils bear 14-16 (possibly 17) riblets.

Cardiocardita (Cardiocardita) oostinghi sp. nov.
Pl. 11, figs. 13-16.

Holotype — RGM 42 269: Pl. 11, figs. 13-16, right valve; length 6.1 mm, height 6 mm, inflation 2.5 mm.

Type-locality — Loc. R.26 (Klagumuk), Vogelkop, West Irian.

Type-horizon — Not fully ascertained, some level in the upper Klasaman Formation.

Name — The species is named for the late Dr C.H. Oostingh.

Range — No previous records.

Description — The small but solid holotype is inequilateral, its ventral and anterior margins well rounded, the posterior and postero-dorsal margins flattened, the beak prosogyrate. The shell surface bears 18 radial costae, the most posterior one parallel to the dorsal margin and rather narrow and beaded, the next one stronger and also beaded; in the shallow radial depression another weak rib which is not beaded, the next rib being two-thirds smooth too, all other costae being rather distantly beaded. The interspaces of the ribs are ornamented with fine and densely scaly radial striae which are rarely visible in the earlier three-quarters of the shell and apparently grow rapidly in number nearer the margins, their scaly development being due to the fine concentric growth striae. This

ornament is continuous on the lowest part of the costae on either side of the interspaces. The lunule is small and fairly wide, smooth, delimited by an outer groove-like depression. Shell margin fluted, inside of shell smooth, anterior adductor scar small and well demarcated, not so the larger posterior scar. Hinge with strong triangular cardinal tooth, anterior lateral minute, pointed, situated just below the pit for the anterior lateral of the left valve; posterior lateral obsolete.

Comments — *C. bonnetti* (Cossmann, 1924, p. 112, pl. 5, figs. 37-40), with 15-16 costae, may be related but is comparatively much higher, more globose and it apparently lacks the elegant ornament of the costal interspaces; it is much nearer to *Cardita exporrecta* Martin, 1885 from Java.

Nemocardium (Discors) parvulum (Martin, 1879)

Material — Loc. W.4 (RGM 42 302).

Range — Preangerian: NT (Tjikarang, Loc. R., Junghuhn).

References — *Cardium parvulum*: Martin, 1879-1880, p. 107, pl. 18, figs. 3, 3a; Martin, 1919, pp. 63, 114 (no. 36), 153.

Comments — One right valve at hand, largely preserved as a cast but remarkably well identifiable at that and of about the same size as the Javanese type. The species is not unlike the living *N. simillimum* (Smith) (Smith, 1896, p. 372,; 1898, Illustr. 'Investigator', pl. 7, figs. 6, 6a) which is however larger and more coarsely ornamented, having a wider umbonal region and spines on some posterior radial riblets.

Circe (Circe) scripta (Linné, 1758)

Material — Loc. R.26 (RGM 42 271).

Range — Preangerian to Recent: NT (Gelingseh Beds; Sekurau) - P - N - PQ (e.g., Togopi) - Q - Re.

References — Oostingh, 1935, pp. 180 (syn.), 219; Beets, 1985a, p. 34, Beets, this volume p. 53.

Comment — At hand is a single well preserved right valve.

Dosinia (Austrodosinia) histrio (Gmeling, 1790)

Material — Loc. R.26 (RGM 315 117).

Range — Pliocene to Recent: P - PQ - Q - Re.

References — Koert & Tornau, 1910, p. 12; Dickerson, 1922, p. 213 (*D. variegata*); Cox, 1931, pp. 6, 8; Prashad, 1932, p. 244 (syn.); Nomura & Zinbô, 1936, p. 124; Weir, 1938, pp. 66, 78, pl. 7, fig. 12.

Comments — A damaged left valve is available, agreeing very well with Recent specimens in the RNH (from Ambon, Banda and particularly, the Philippines). The species occurs also in the Pliocene of Ceram, and Quaternary of Kaju Ragi, Celebes and New Guinea: (all in the Instituut voor Aardwetenschappen, Utrecht).

Placamen tiara (Dillwyn, 1817)

Material — Loc. W.55 (RGM 42 312).

Range — Uncertain, approximately Preangerian to Recent: Nj - P - N (Tjigugur) - PQ (Togopi?) - Q - Re.

References — *Venus tiara*: Altena & Beets, 1945, pp. 57, 61; Beets, 1950a, pp. 251, 259; compare Oostingh, 1935, p. 186 and Beets, 1985a, p. 35.

Comments — Four juvenile valves are at hand (two damaged), which, as far as can be said at present, appear to represent *P. tiara*. It seems quite certain that *P. isabellina* (Philippi, 1849) (= *P. chlorotica* (Philippi, 1849)) should be united with *P. tiara* (= *P. foliacea* (Philippi, 1848)), while *P. calophylla* (Philippi, 1836) would appear to be a separate species. Large series of Recent and fossil specimens are needed for a critical revision of these and related species.

Corbula monilis Hinds, 1843

Material — Loc. W.55 (RGM 315 133).

Range — Recent: Re.

References — Lynge, 1909, p. 270, pl. 5, figs. 27-30; *Aloidis monilis*: Prashad, 1932, p. 307 (refs).

Comments — This minute species is known in the Recent fauna from Siam, Singapore, Indonesia (Flores), the Philippines, and the Torres Straits to Mast Head Reef, Queensland. It is represented in the Vogelkop fauna by nine stray right valves, up to a little over 3 mm long.

Corbula cf. *C. scaphoides* Hinds, 1843

Material — Loc.W.55 (RGM 42 314).

Range — Pre-Preangerian to Recent: UG (Quilon) - NT (Gelingseh Beds; Kari Orang, Witkamp) - UM (Upper Dingle Formation, Panay) - M ('Upper Miocene', W. Sumatra) - P - N - Q - Re.

References — Beets, 1983, pp. 36, 38, 39; Beets, this volume, pp. 54, 60, 67, 73, 78.

Comment — A juvenile valve is available which agrees very well with, for instance, Pliocene material from Timor (Fatu Lulih) in the RGM.

Corbula solidula Hinds, 1843

Material — Loc. W.55 (RGM 315 118).

Range — Pre-Preangerian to Recent: Rr (Rl) - NT (Mandul; basal Menkrawit Beds; Gelingseh Beds; Gunung Mendong; Sekurau; Tapian Langsat; Gunung Madupar; Mentawir Beds s. str.) - P - N - Re.

References — Lynge, 1909, p. 270, pl. 5, figs. 31-34, 42-44; Beets, 1984a, pp. 36, 37; Beets, 1985b, p. 69; Beets, this volume, pp. 55, 58, 60, 73, 78.

Comments — The species occurs in the living fauna of Siam, Indonesia and the Philippines, to New Guinea. A large number of fossil specimens is available from Vogelkop, both complete ones and stray valves, agreeing very well with Recent specimens from Singapore in the RNH. Some of the shells, with comparatively fewer concentric riblets, match *C. taiwanensis* Nomura (1933, p. 106, pl. 3, figs. 10-11) which the writer considers a synonym of *C. solidula*.

Corbula taitensis acuticosta Martin, 1885

Material — Loc. W.55 (RGM 42 313).

Range — Preangerian to Pliocene, Neogene: Nj - Tj - NT (Kari Orang, Witkamp; Sekurau) - M (Tjidamar) - P - N.

References — Beets, 1983, pp. 36, 38, 39; Beets, 1985a, p. 37.

Comments — At hand is a left valve which agrees well with a likewise flat valve from Tjiburial, Java, in the RGM. It appears that in the typical *C. taitensis* Lamarck, 1818, of which the Siboga Expedition material in the ZMA was compared (Prashad, 1932, p. 308), a median radial depression is always present, rarely so in *acuticosta* and then, much weaker (specimen from Sekurau). In the latter, the ribs on the sharp posterior angulation are ventrally protruding, much more so than in *taitensis*, and sometimes fusing with neighbouring protrusions, a feature but rarely shown by *taitensis*. Both forms show from flat to more inflated valves, as does for instance *C. crassa* Hinds, 1843. Thiele & Jaeckel's (1931, p. 241, pl. 4, figs. 117) *C. valdiviae* from East Africa seems inseparable from *C. taitensis*, while apparently coming closer to *acuticosta* than *taitensis*. *C. taitensis taitensis* occurs in Red Sea Quaternary deposits.

Faunal list

For Table 1 reference is made to the lists of stratigraphic names, abbreviations and symbols preceding the faunal lists in recent papers by the writer such as Beets, 1985a, b.

Table 1. Faunal list and stratigraphical records.

	R(oothaan)			W(oolley)						Range:					
	11	15	26	4	15	18	19	50	55	pPr	Pr	UM	P	PQ	Q	Re
Turritella cingulifera	—	—	26	—	15	—	—	—	55	pPr	Pr	—	P	PQ	Q	Re
Strombus triangulatus	—	—	26	—	—	—	—	—	—	—	Pr	—	—	—	—	—
Zoila caputavisensis	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	—
Polinices mammilla	—	—	26	—	—	—	—	—	—	—	Pr	—	P	PQ	Q	Re
Galeodea papuana	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	—
Distorsio reticulata	—	—	26	—	—	—	—	—	—	pPr	Pr	—	P	PQ	Q	Re
Cantharus bucklandi	—	—	26	—	—	—	—	—	—	pPr	Pr	UM	P	—	—	—
(C. erythrostoma	—	—	—	—	—	—	—	—	—	—	—	—	P	—	Q	Re)
Melongena gigas	—	—	26	—	—	—	—	—	—	—	Pr	UM	P	—	—	—
Clavilithes verbeeki	—	—	26	—	—	—	—	—	—	pPr	Pr	UM	P	—	—	—
Volutoconus hargreavesi aridus	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	—
Amoria canaliculata	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	Re
Conus mucronatus socialis	—	—	26	—	—	—	—	—	—	—	Pr	—	P	PQ	—	—
'Barbatia' sorongensis	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	—
Barbatia tenella	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	Re
Trisidos tortuosa	—	—	—	—	—	—	—	—	55	pPr	Pr	—	P	—	Q	Re
Anadara antiquata	11	—	26	—	—	—	—	—	—	pPr	Pr	UM	P	PQ	Q	Re
Scapharca multiformis	—	15	—	—	—	—	19	—	—	pPr	Pr	UM	P	—	—	—
Arcopsis caputavisensis	—	—	26	—	—	—	—	—	55	—	—	—	—	—	—	—
Limopsis multistriata	—	—	—	—	15	—	—	50	55	—	—	—	P	PQ	Q	Re
Glycymeris caputavisensis	—	—	26	—	—	—	—	—	55	—	—	—	—	—	—	—
Chlamys senatoria	—	—	26	—	—	—	—	—	55	pPr	Pr	—	P	PQ	Q	Re
Spondylus marisrubri	—	—	26	—	—	—	—	—	—	—	—	—	P	PQ	Q	Re
Cycladicama oblonga	—	—	—	—	—	18	—	—	—	—	Pr	—	P	—	Q	Re
Erycina lineata	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	Re
Carditella caputavisensis	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	—
Carditella torresi	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	Re
Cardiocardita oostinghi	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	—
Nemocardium parvulum	—	—	—	4	—	—	—	—	—	—	Pr	—	—	—	—	—
Circe scripta	—	—	26	—	—	—	—	—	—	—	Pr	—	P	PQ	Q	Re
Dosinia histrio	—	—	26	—	—	—	—	—	—	—	—	—	P	PQ	Q	Re
Placamen tiara	—	—	—	—	—	—	—	—	55	—	Pr	—	P	PQ	Q	Re
Corbula monilis	—	—	—	—	—	—	—	--	55	—	—	—	—	—	—	Re
Corbula cf. *C. scaphoides*	—	—	—	—	—	—	—	—	55	pPr	Pr	UM	P	—	Q	Re
Corbula solidula	—	—	—	—	—	—	—	—	55	pPr	Pr	—	P	—	—	Re
Corbula taitensis acuticosta	—	—	—	—	—	—	—	—	55	—	Pr	—	P	—	—	—

Age determination

LOCALITY R.26

The number of species from this locality is only 20, with 9 (10?) of these or 45 % (50? %) still occurring in the Recent fauna. This percentage would place the assemblage within the highest reaches of Miocene time, or possibly even in very early Pliocene. On the other hand, there is a comparatively high proportion of bivalves, 40 % (8 species) which fact may well have raised the percentage figure of living forms as compared to many another fauna. In other words, the fauna may be older than seemingly indicated by the overall percentage figure. However, the assemblage is too small by far to take that figure

at its face value, as is clearly demonstrated by the fact that one species more or less has a considerable impact.

If the stratigraphical records of the various species are plotted, the following distribution is obtained, for 14 species, as 6 are as yet only known from this locality:
Recent – 9 (10?)
Quaternary – 8 (9?)
Pliocene/Quaternary – 9
Pliocene – 12
Late Miocene – 4
Preangerian – 11
pre-Prengerian – 6
As can be seen the distribution is slightly in favour of Pliocene, perhaps a little also by inference, that is, considering the comparatively strong showings of PQ and Q as opposed to Late Miocene (UM), a difference that is however obliterated by considering the combined inferred ranges of the species: Table 2.

Table 2. Inferred time ranges of the assemblage from loc. R.26.

	pPr	Pr	UM	P	PQ	Q	Re	
	pPr —	—	—	—	—	—	Re	: 4
	pPr —	—	—	P —	? —	? —	Re?	: 1
	pPr —	—	—	P				: 1
		Pr						: 1
		Pr —	—	P				: 1
		Pr —	—	—	PQ			: 1
		Pr —	—	—	—	—	Re	: 2
				P —	—	—	Re	: 2
							Re	: 1
(a)	6	11	10	12	9 (10?)	8 (9?)	9 (10?)	(14 species)
(b)	2	7	6	8	5 (6?)	4 (5?)	4 (5?)	(9 species)

(a) Number of species for each time (6 omitted).
(b) Ditto, disregarding the 4 longest lived forms and 1 not previously recorded fossil.

Although more logical than the distribution of the actual records, the situation has not really changed, the bias still being slightly towards Pliocene. This conclusion is hardly aided by the apparent confinement of two species to Pliocene or older deposits and by two other species being starters in Pliocene time, for there are no species 'confined' to Pliocene, while the range of one species seems 'restricted' to Preangerian (it has, however, not often been recorded). Four species are starters prior to Pliocene time (i.e., Preangerian) and four others are indifferent for our purpose anyway, by ranging from pre-Preangerian to the present day.

Obviously, a much larger fauna is needed to obtain a satisfactory age determination, the figure obtained for Pliocene not being too high for an Odengian (UM) or even Preangerian (Pr) age. Taking all in all, the age of the assemblage can but be called 'Miocene/Pliocene', for the time being.

LOCALITY W.55

There are even fewer species from this locality than from R.26, viz. 16, the percentage of living forms in this case being very high: 68.7 % (11 species). This could perhaps still be compatible with a Pliocene age, although Pleistocene would actually be the better choice, However, caution is indicated. In the first place, the faunule consists almost entirely of bivalves (nearly 94 %), which are on the whole longer lived than gastropods. Consequently, although the percentage figure is much too high for Miocene, the fauna could conceivably be older than say Late Pliocene. On the other hand one has to keep in mind that a restricted number of species is involved. In the second place, several small forms are present whose ranges are suspect anyway since they can easily have been overlooked in both the living fauna and/or Neogene deposits (small forms have generally been rarely recorded fossil).

Considering the stratigraphical records of the species, the following distribution is obtained, for 12 species only since 4 have no previous record:
Recent – 11
Quaternary – 6
Pliocene/Quaternary – 4
Pliocene – 8
Late Miocene – 1
Preangerian – 7
pre-Preangerian – 5
It is curious to note that but for the comparatively high Recent record, the above distribution comes quite close to the one obtained for R.26, Pliocene being slightly more favoured than Preangerian. The more logical picture is shown by Table 3.

Table 3. Inferred time ranges of the faunule from loc. W.55.

	pPr	Pr	UM	P	PQ	Q	Re	
	pPr	———	———	———	———	———	Re	: 5
		Pr	———	P				: 1
		Pr	———	———	———	———	Re	: 1
				P	———	———	Re	: 1
							Re	: 4
(a)	5	7	7	8	7	7	11	(12 species)
(b)	–	3	3	4	3	3	3	(4 species)

(a) Number of species for each time (4 omitted).
(b) Disregarding the 5 longest lived species as well as 3 not recorded fossil

All that one can say about the above distribution, which again is labouring under the pressure of a restricted number of species – many of which, moreover, are small ones – is that once more it does not differ much from the one for locality R.26 but for the percentage of living forms: Pliocene is only slightly favoured again as compared to pre-Pliocene or post-Pliocene. While however, 'Miocene/Pliocene' would seem to be indicated once more, the higher content of living species renders a Pliocene age more probable than in the case of locality R.26. Consequently, the age of this fauna is considered 'possibly Pliocene', for the time being.

In this context it is to be noted that no more than 4 species are common to the assemblages from the localities R.26 and W.55, while the overall composition of the

faunules is so different – W.55 being essentially an assemblage of bivalves – that facies differences must be involved, as well as a difference in age. Unfortunately, the bathymetric data on the Recent forms do not help to clarify this point. If one combines all that is known at present about depth ranges, it would seem that the faunule of R.26 may indicate a depositional depth of 10-35 m, while that of W.55 might have been from 10-55 m, results which are not really different from one another, and both, incidentally, confirming other evidence (Visser & Hermes, 1962). Or so it seems, for it must be kept in mind that the figures may well be spurious: much more material from both localities is needed, and further investigation of the living fauna, before one is justified in trusting the overall bathymetric picture sufficiently to postulate a probable depositional depth.

LOCALITIES R.11, R.15, W.4, W.15, W.18, W.19, W.50

All but one of these localities yielded but a single species, their stratigraphical records being meaningless for age determination (including the Preangerian record of *Nemocardium parvulum*), while only a few of the species occur also in the key faunules from R.26 and W.55.

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Manuscript received 21 May 1984.