

Late Miocene Mollusca from Tapian Langsat and Gunung Batuta, Sungai Bungalun area, Kalimantan (E. Borneo)

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Two rather small mollusc faunas, collected nearly seventy years ago by L. M. R. Rutten, have been examined. Though fairly close together and presumably not much different in age (Preangerian: Tf3), they show no relationship to one another.

Tapian Langsat: this locality yielded 11 species all of which occur in Preangerian deposits, particularly in the basal Menkrawit and Gelingsch Beds of the Sangkulirang/Mangkalihat area much farther to the North, there being but a solitary species in common with the classical Javanese Preangerian.

Gunung Batuta: consisting of 13 species, this assemblage has, like the corals from the same locality but unlike Tapian Langsat, a number of species (in this case 8) in common with the classical Preangerian, while the relationships with the fauna of the Gelingsch and basal Menkrawit Beds are less noticeable.

In both cases the relationships with a number of other Preangerian faunas from East Borneo are weak to non-existent, stressing the individual nature of the various sedimentary basins of East Borneo. Generally similar features in this respect have been emphasized by H. Gerth and J. H. F. Umbgrove concerning the corals, ties with distant assemblages often being much stronger than with nearby faunas.

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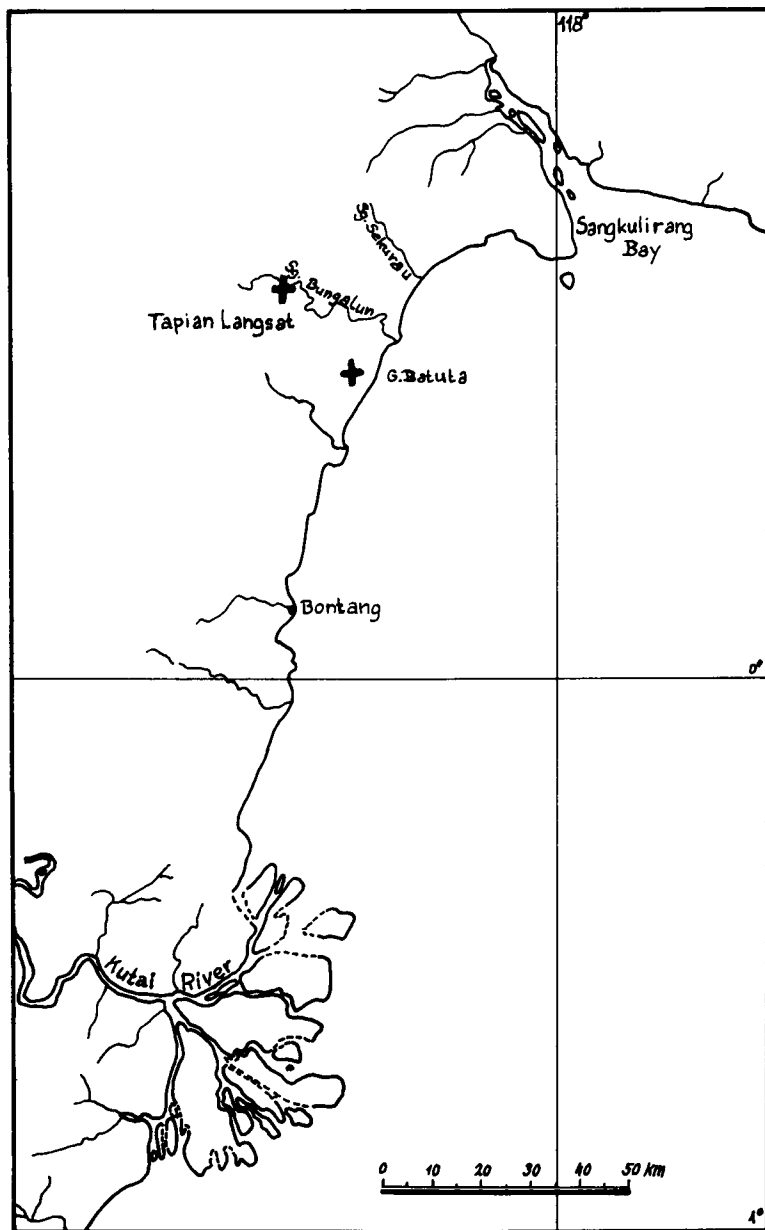


Fig. 1. Sketch map of the Sungai Bungal area, North of the Kutai River.

Introductory remarks

The present paper, like the foregoing (this volume), is one of a series intended to describe Neogene molluscs from a number of localities in the coastal and near-coastal area of East Borneo facing the Macassar Strait.

Tapian Langsat — This locality was first mentioned by Rutten (1913, pp. 283, 287) who described the Larger Foraminifera and determined its age as Late Miocene, that is, younger than the Javanese Njalindung Beds. Subsequently, van der Vlerk (1925, table facing p. 31) placed the locality in the lower part of the Gelingsseh Beds (= Upper Balikpapan Beds). It was referred to again by Rutten (1927, p. 222) and finally, Krijnen (1931, p. 534, Nr. 264). The locality is near the mouth of a small tributary running into Sungai Bungalun some 3 km roughly S.E. from Kampung Tapian Langsat (Fig. 1), the outcropping formation consisting of marly clays with Foraminifera and small molluscs, corals apparently being absent.

Gunung Batuta — This is a hill in the coastal area to the South of Sungai Bungalun, far out on the East flank of the Bungalun domal anticline (Rutten, 1927, p. 508, fig. 147): see Fig. 1. According to letters from Rutten to the writer, dated 27-3-1940 and 6-11-1940, he considered the age of the locality as definitely younger than the Gelingsseh Beds. Gerth (1923, Loc. Nr. 17, pp. 41 (misprint, G. Batoe), 44, 126), who described the coral fauna collected by Rutten, considered its age as Late Miocene, pointing out that some of the species are known from the Javanese Njalindung and Tjilanang Beds, at that time, when a twofold subdivision of the Miocene prevailed, generally considered the top of Early Miocene and the basal part of Late Miocene respectively. This he considered rather exceptional when taking into account the generally endemic character of the Borneo coral faunas (another exception is the coral assemblage from Leupold's locality L.114, described by Umbgrove (see: Beets, 1941, p. 187)). Krijnen (1931, p. 534, Nr. 264) evidently placed the locality in the Gelingsseh Beds, Tapian Langsat then being known as "Young Miocene" and the locality "Anticline S. from S. Boengaloen" as "Old Miocene" (Pulubalang Beds). Preliminary identifications of the molluscs were made by the present writer (Beets, 1941, pp. 194 - 195, 196) but their age not considered in particular, Late Miocene being accepted as concluded by Rutten and Gerth.

Brief comments on the identifications

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The material is kept in the Rijksmuseum van Geologie en Mineralogie, the registration numbers being prefixed by RGM. For stratigraphical data compare the next chapter.

Gibbula (Colliculus) leupoldi Beets, 1941

Material — RGM 312 003; two fragmentary specimens available.

Range — Preangerian: NT (basal and Lower Menkrawit Beds: L.114 and L.386; Gelingsseh Beds: Sg. Gelingsseh, "layer 2" and Loc. 149, Rutten; Gunung Madupar, Rutten and Wanner).

Cyclostremiscus (Ponocyclus) novemcarinatus (Melvill, 1906)

Material — RGM 312 009; a single damaged specimen.

Range — Early Miocene?, Preangerian to Recent: NT (basal Menkrawit Beds: L.114; Gelingsseh Beds: Sg. Gelingsseh, “layer 2”; Gunung Madupar, Rutten and Wanner) - M (“Early Miocene, Tf”, Eniwetok) - Q - Re.

Turritella (Haustator) talarensis Eames, 1950

Material — RGM 312 012 (f. typica) and 312 013 (f. sedanensis), one specimen each. Better known as *T. subulata* Martin, 1884 and *T. sedanensis* Martin, 1905.

Range — Early Miocene to Pliocene, Quaternary?: Ba - W - R - Rr (Rm) - UG - NT (basal, Lower and Upper Menkrawit Beds: L.114, L.386/391 and L.745; Gelingsseh Beds: Sg. Gelingsseh, “layer 1” and Loc. 144/149, Rutten; Sekurau; Lower Palembang Beds) - UM (Antjam Beds: L.963; Talar Beds) - P - ?Q (presumed lapse).

Rhinoclavis (Proclava) leupoldi (Beets, 1941)

Material — RGM 312 024; four more or less damaged but well identifiable specimens and a fragment.

Range — Early Miocene to Preangerian, Neogene: R - Rr (Ra) - NT (basal Menkrawit Beds: L.114; Gelingsseh Beds: Sg. Gelingsseh, “layer 2”; Mentawir Beds s. str.) - N (Mandul, mixed collection of fossils).

Cerithium bayeri Beets, 1941

Material — RGM 312 027; ten specimens available, most of them damaged.

Range — Preangerian: NT (basal and Lower Menkrawit Beds: L.114 and L.386/391; Mentawir Beds s. str.).

Triphora (Inella) javana berauensis subspec. nov.

Holotype — RGM 312 147 (see Beets, 1941, pl. 3, fig. 116).

Paratypes — RGM 312 148 (L.747, paratype 1: see Beets, 1941, pl. 3, fig. 117).

RGM 312 145 (L.114, paratype 2: see Beets, 1941, pl. 3, fig. 118).

Type-locality — Leupold's loc. L.386, Sungai Menkrawit, Berau, East Kalimantan.

Type-horizon — Lower Menkrawit Beds, exact horizon unknown.

Name — The subspecies is named for its type area.

Material — RGM 312 150; two specimens available.

Range — Early Miocene to Late Miocene: Rr (Rl) - NT (Mandul; basal and Lower Menkrawit Beds: L.114 and L.386; Gelingsseh Beds: Sg. Gelingsseh, “layer 2”; Gunung Madupar, Rutten and Wanner) - UM (Antjam Beds: L.747).

Comments — This is a subspecies from Borneo which both Martin (1914, p. 331) and the writer considered synonymous with *T. javana* (Martin, 1899) (Beets, 1941, pp. 61 (excl. syn.), 169, (non: 186), 190 (pars: excl. L.391 which is another species), 192, 196, 199 (excl. Nj), pl. 3, figs. 116 - 118). Although the resemblance between the type of *T. javana* and the subspecies is indeed striking, the latter is much smaller (up to about 6 mm long), while it remains to be seen what the apical and early post-apical whorls of *T. javana* look like. The description given in 1941 by the writer may suffice to characterise the subspecies.

The new subspecies is apparently related to *T. auberti* Abrard, 1946 from the Late Miocene of the New Hebrides (Abrard, 1946, p. 57, pl. 4, figs. 21, 21a) which however seems a little larger while its ornamentation is less ribbed and its aperture depressed whereas it is long in *T. javana berauensis*; also, its anterior canal is strongly turned backward almost perpendicular to the axis of its teleoconch. Finally, no additional spirals on the base are mentioned by Abrard.

Miralda (Oscilla) aff. M. (O.) faceta (Melvill, 1904)

Material — RGM 312 031.

Range — Preangerian: NT (Mandul).

Comments — A minute specimen is available, 2.6 mm long. Protoconch heterostrophic, with $2\frac{3}{4}$ smooth whorls, the last $\frac{3}{4}$ whorl normally wound. Post-apical whorls bearing three smooth spirals while a fourth becomes partly visible in the abapical suture. Between the spirals fine growthlines. Bodywhorl with a few more spirals on the base, the hindmost close to the sutural spiral. A well developed columellar plait is present. There are four to five spiral lirae on the inside of the outer lip.

The species is remarkably like *M. faceta* from Oman (Melvill, 1904, p. 82, pl. 8, fig. 10), which however has 2 apical whorls while Melvill figured a smooth inside of the outer lip. Mr C. P. Nuttall (British Museum Natural History) kindly compared the syntypes of *M. faceta* in the British Museum, confirming that the inside of the outer lip lacks spiral lirae while the columella in addition to a strong terminal plait bears two very weak ones behind it.

M. sumatrana (Thiele, 1925) also looks alike (Thiele, 1925, p. 131, pl. 17, fig. 10) but its protoconch is not described as heterostrophic and is not perpendicular to the axis of the teleoconch. Lirae on the inside of the outer lip are neither mentioned nor figured. Wissema (1947, p. 79, pl. 3, fig. 94) recorded *M. sumatrana* from Nias. His specimen likewise does not bear lirae on the inside of the outer lip.

Nucula (Nucula) njalindungensis Martin, 1919

Material — RGM 312 078.

Range — Preangerian: Nj - NT (basal Menkrawit Beds: L.114; Gelingseh Beds: Source area of Sg. Gelingseh and Sg. Gelingseh, "layer 2"; Gunung Madupar, Rutten and Wanner; Mentawir Beds s. str.).

Comments — Rather juvenile material, yet readily identifiable as the ornamentation is very characteristic. In sculpture, the species might be considered nearer to *Gibbonucula* Eames, 1951 or *Lamellinucula* Schenck, 1944, but *Nucula* s. str. in the sense accepted by Thiele in his Handbuch still seems the best choice in the case of *N. njalindungensis*.

Arcopsis (Arcopsis) sculptilis (Reeve, 1844)

Material — RGM 312 084; a damaged specimen represents this characteristic species.

Range — Early Miocene to Recent: UG (Quilon) - NT (Mandul; basal and Lower Menkrawit Beds: L.114 and L.386; Gelingsih Beds: Sg. Gelingsih, "layer 2" and Loc. 149, Rutten; Gunung Madupar, Wanner) - PQ (Togopi) - Q? - Re.

Trachycardium cf. *T. denticostulatum* (Beets, 1941)

Material — RGM 312 092.

Range — Preangerian to Pliocene/Quaternary: NT (basal Menkrawit Beds: L.114; Gelingsih Beds: Sg. Gelingsih, "layer 2" and Loc. 150, Rutten) - PQ (Togopi).

Comment — A number of fragments is available which, though probably correctly identified since the species has a very characteristic sculpture, have to be recorded with some doubt. The classification of the species is somewhat doubtful too; perhaps it should be called a *Vepricardium* or, as did Nuttall (1965, p. 179), a *Vasticardium*.

Corbula solidula Hinds, 1843

Material — RGM 312 101; four valves represent this small species.

Range — Early Miocene to Recent: Rr (Rl) - NT (Mandul; basal Menkrawit Beds: L.114; Gelingsih Beds: Source area of Sg. Gelingsih and Sg. Gelingsih, "layer 2"; Gunung Mendong; Sekurau; Gunung Madupar, Rutten and Wanner; Mentawir Beds s. str.) - P - N - Re.

GUNUNG BATUTA

The material is kept in the Instituut voor Aardwetenschappen, Utrecht. For stratigraphical data see the next chapter.

Turbo (Marmarostoma) rutteni Beets, 1942

Material — Holotype and paratype.

Range — Preangerian: NT (Sekurau).

Comment — Like *T. argyrostomus* Linné, 1758, the species has an open umbilicus and there is, the writer believes, no relationship between it and *Cirsochilus* Cossmann, 1888 (cf. MacNeil, 1960, p. 31).

Trochus (Trochus) maculatus Linné, 1758

Material — A single specimen is available.

Range — Preangerian to Recent: NT (basal Menkrawit Beds: L.114 (f. typica); Gelingseh Beds: Sg. Gelingseh, "layer 1" (var. granosus) and Loc. 150, Rutten (var. granosus)) - UM (Antjam Beds: L.747 (f. typica)) - P - N (Guam) - Q - Re.

Comment — The Batuta specimen belongs to the variety granosus Lamarck, 1822.

Tectus (Tectus) pyramis tjilonganensis (Martin, 1905)

Material — A single fairly well preserved specimen.

Range — Preangerian to Pliocene/Quaternary: Nj - Ta - PQ.

Comments — *T. tjilonganensis* would appear to be a subspecies of *T. pyramis* (Born, 1778) (range: Quaternary to Recent: Newton, 1900, p. 202; Wissema, 1947, p. 15; Ladd, 1966, p. 39).

A comparable case is presented by *T. bomasensis* (Martin, 1916) (Martin, 1916 - 1917, p. 261, pl. 3, figs. 90, 90a - b) which, the writer believes, is to be considered a Miocene subspecies of *T. fastigiatus* Adams, 1851, a living species also recorded from the Quaternary of Kaju Ragi, N. Celebes (Schepman, 1907, p. 195).

Vicarya (Vicarya) callosa Jenkins, 1864

Material — Part of a single specimen.

Range — Preangerian, Miocene: Bo - Nj - Tj (also Loc. O and Loc. P, Jung-huhn) - NT (basal Menkrawit Beds: L.114; Gelingseh Beds: Sg. Gelingseh, "layer 1" and Loc. 144, Rutten; Sungai Klindjau; Sandakan Formation, N. E. Borneo; Lower Buluan Formation, Philippines) - M.

Cerithium (Ptychocerithium) progoense (Martin, 1916)

Material — A single specimen is available.

Range — Early Miocene to Preangerian: W - UG (Quilon) - NT (basal Menkrawit Beds: L.114).

Comments — The specimen matches the less mature of the shells from Mangkalihat, L.114, beautifully. A specimen recorded from the Gelingseh Beds (Loc. 144, Rutten) with some doubt (Beets, 1941, pp. 195, 196) actually appears to represent *C. rude* Sowerby, 1840.

Cerithium (Thericium) traillii Sowerby, 1855

Material — One specimen.

Range — Preangerian to Recent: NT (Gelingsseh Beds: Sg. Gelingsseh, "layer 1", and Loc. 141, Rutten) - P - PQ (Togopi) - Q - Re.

Comments — The Gunung Batuta shell and the other three Miocene specimens available, from Rutten's Loc. 141 (1 specimen) and the Gelingsseh Beds, are considered unusual in being smaller and more obese than normally is the case and could conceivably be a variety of subspecific rank. However, they agree almost entirely with the smallest and more obese of the Recent specimens compared (Rijksmuseum van Natuurlijke Historie, Leiden), while one, from the Gelingsseh Beds, seems "normal", almost matching a small shell from Tarakan Island (RGM 41 746) (see: Beets, 1950a, pp. 254, 261; 1950b, p. 307; Nuttall, 1965, pp. 161, 169).

Strombus (Strombus) preoccupatus Finlay, 1927

Comment — The specimen previously recorded by the writer (Beets, 1941, p. 194) must be presumed lost.

Cypraea (Lyncina) lynx Linné, 1758

Material — A single fine specimen.

Range — Early Miocene?, Pliocene to Recent: M ("Early Miocene, Tf", Fiji) - P - PQ - Q - Re.

Comments — The Gunung Batuta specimen was successively recorded as *C. vitellus* Linné and *C. aff. C. lynx* by the writer (Beets, 1941, p. 194; 1950c, p. 332). It has recently been compared most carefully with a large suite of representatives of *C. lynx* in the Rijksmuseum van Natuurlijke Historie, Leiden and appeared to agree very well with some of the specimens collected by M. Vianney from Larantuka, East Flores Island, either in shape which is somewhat variable, or particularly the irregular dentition of the fossula. It was precisely this last point which in the past caused the writer's hesitation to refer the Batuta specimen to *C. lynx* outright; at that time, no identical living or fossil material was available.

In recent years Ladd recorded *C. lynx* from various localities on Western Pacific islands (Ladd, 1977, p. 19, pl. 2, figs. 6 - 7). It may be added that the fossils previously recorded from Indonesia as *C. lynx* (see: van der Vlerk, 1931, p. 245) have all been referred to other species by Schilder (1941, pp. 86 - 87).

Apollon (Apollon) bitubercularis (Lamarck, 1816)

Material — A single well preserved specimen is available.

Range — Early Miocene to Recent: R - Rr (Rm, Rl) - UG (Assam) - Ta -

Pa - NT (Mandul; basal Menkrawit Beds: L.114; Gunung Madupar, Wanner; Lower Palembang Beds; Tjilintung/Tjiangsana) - UM (Talar Beds) - P - N - PQ (Togopi) - Q - Re.

Drupa (Morula) angsanana (Martin, 1921)

Material — This rarely observed species is represented by a single well preserved specimen which matches the type splendidly.

Range — Preangerian: Nj.

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

Material — Two specimens are at hand.

Range — Early Miocene to Pliocene, Neogene: R - Rr (Rl) - K - UG (Sind, Katch) - Nj - Tj - Ta - Pa - NT (Mandul; Gelingsch Beds: Sg. Gelingsch, "layer 1" and Loc. 144, Rutten) - UM (Miyazaki Group, Japan) - P - N.

Comments — The specimens, particularly the biggest (fragmentary) one, agree well with Javanese shells from Tjadasngampar (RGM 9184).

Vredenburg, Oostingh and van Regeteren Altena (see: Altena, 1950, p. 233) have commented upon the very close relationships between *C. bucklandi*, presumed extinct, and the living *C. erythrostoma* (Reeve, 1846) (range: Pliocene to Recent). The fossil material available to the writer is not good enough to decide the point but Oostingh's at least is in part so like Recent specimens of *C. erythrostoma* that one can hardly doubt that *C. bucklandi* is indeed conspecific (Oostingh, 1938 - 1940, part 8, p. 118, pl. 14, figs. 245 - 248).

Clavilithes (Clavilithes) fennemai (Martin, 1906)

Material — One specimen is available.

Range — Preangerian to Pliocene: NJ - NT (Mandul; Gelingsch Beds: Loc. 144, Rutten) - P.

Comments — The specimen from Gunung Batuta, like the material from Mandul and the Gelingsch Beds, shows better developed spiral and rib ornamentation than some of the Javanese shells, or at least, it is longer present. Also, the ribs are not as pointed posteriorly as in the Javanese material. The posterior depression of the whorls is rather deep, but agrees perfectly with some of the Javanese specimens.

Gemmula (Gemmula) karangensis (Martin, 1895)

Material — Two specimens are available.

Range — Preangerian to Pliocene: Nj - NT (Gelingsch Beds: Sg. Gelingsch, "layer 1"; Gunung Madupar, Wanner; Tjilintung/Tjiangsana) - P.

Comment — The specimens show clearly separate spirals over the median keel.

Anadara (Anadara) antiquata (Linné, 1758)

Material — One left valve and four damaged right valves are present.

Range — Early Miocene to Recent: Rr (Rl) - Nj - Tj - NT (basal Menkrawit Beds: L.114; Sekurau; West Borneo) - M (Persia) - P - N (Tji Gugur, Java) - PQ (Togopi) - Q - Re.

Faunal lists and geologic ranges

The abbreviations listed below correspond with the stratigraphical records of the species examined (preceding chapter). Their number has been restricted in the faunal lists.

Re — Recent
 Q — Quaternary
 PQ — Pliocene/Quaternary
 N — Neogene, unclassified
 P — Pliocene (Th approximately)
 M — Miocene, unclassified
 UM — Late Miocene, in part (largely Tg, Odengian; including Antjam Beds, E. Borneo; Talar Beds, Pakistan; Upper Dingle Formation, Philippines)
 Preangerian (Tf3): Pr in the heading of the faunal lists:
 Bo — Bodjongmanik Beds s. str., Java
 Nj — Njalindung Beds, Java
 Tj — Tjilanang Beds, Java
 Ta — Tjadasngampar, Java
 Pa — Parungponteng (= Selatjau), Java
 NT — Preangerian, unspecified, including:

East Borneo:

Mandul I., coll., W. van Holst Pellekaan (Shell), unpublished
 Menkrawit Beds, coll. W. Leupold (Beets, 1941)
 Gelingsseh Beds, partly published (Martin, 1914; Beets, 1941)
 Kari Orang, coll. H. Witkamp (Shell), partly published (Beets, 1941)
 Loc. 141, Rutten, Kari Orang, partly published (Beets, 1941)
 Gunung Mendong, coll. M. Schmidt (Shell), unpublished
 Sekurau, coll. M. Schmidt (Shell), unpublished

Gunung Madupar, coll. L. M. R. Rutten and J. Wanner (Shell), unpublished
 Mentawir Beds s. str., coll. L. M. R. Rutten (Beets, 1981)
 Sungai Klindjau, coll. H. Witkamp (Shell) (Albrecht, 1946)
 Northeast Borneo:
 Sandakan Formation (Shuto, 1975, preliminary results)
 West Borneo:
 Coll. Shell, unpublished
 Sumatra:
 Lower Palembang Beds
 Java:
 Tjilintung/Tjiangsana

pre-Preangerian (Tf1 - 2): pPr in the heading of the faunal lists:

UG — Upper Gaj and equivalents (apparently Rembang going upward into Preangerian (in part))
 K — Kama (in disuse), perhaps correlating with UG
 Rr — Rembang equivalents:
 Ra — Api Api, Pasir, E. Borneo; coll. K. Goldschmid (Shell), unpublished
 Rm — Madura, coll. R. Gsell (Shell), unpublished
 Rl — Langkang, Sumatra, coll. W. van Holst Pellekaan (Shell), unpublished
 R — Rembang Beds (apparently in part correlating with Nj), Java
 W — Westprogo Beds, Java
 Ba — Badui Beds (= W + R), Java

Table 1. Stratigraphical records of the molluscs from Tapian Langsat.

	pPr					Pr									Q	Re
	Ba	W	R	Rr	UG	Nj	NT	UN	M	P	N	PQ				
<i>Gibbula leupoldi</i>	-	-	-	-	-	-	NT	-	-	-	-	-	-	-		
<i>Cyclostremiscus novemcarinatus</i>	-	-	-	-	-	-	NT	-	M	-	-	-	Q	Re		
<i>Turritella talarensis</i>	Ba	W	R	Rr	UG	-	NT	UM	-	P	-	-	Q?	-		
<i>Rhinoclavis leupoldi</i>	-	-	R	Rr	-	-	NT	-	-	-	N	-	-	-		
<i>Cerithium bayeri</i>	-	-	-	-	-	-	NT	-	-	-	-	-	-	-		
<i>Triphora javana berauensis</i>	-	-	-	Rr	-	-	NT	UM	-	-	-	-	-	-		
<i>Miralda</i> aff. <i>M. faceta</i>	-	-	-	-	-	-	NT	-	-	-	-	-	-	-		
<i>Nucula njalindungensis</i>	-	-	-	-	-	Nj	NT	-	-	-	-	-	-	-		
<i>Arcopsis sculptilis</i>	-	-	-	-	UG	-	NT	-	-	-	-	PQ	Q?	Re		
<i>Trachycardium</i> cf. <i>T. denticostulatum</i>	-	-	-	-	-	-	NT	-	-	-	-	PQ	-	-		
<i>Corbula solidula</i>	-	-	-	Rr	-	-	NT	-	-	P	N	-	-	Re		
Number of species recorded in each zone:	Ba				UG		NJ-NT	UM		P			Q	Re		
				5			11	2		2			1	3		

Table 2. Stratigraphical records of the molluscs from Gunung Batuta.

	pPr					Pr										Q	Re
	W	R	Rr	K	UG	Bo	Nj	Tj	Ta	Pa	NT	UM	M	P	N	PQ	
<i>Turbo ruttnei</i>	-	-	-	-	-	-	-	-	-	-	NT	-	-	-	-	-	-
<i>Trochus maculatus</i>	-	-	-	-	-	-	-	-	-	-	NT	UM	-	P	N	-	Q Re
<i>Tectus pyramis tjilonganensis</i>	-	-	-	-	-	-	Nj	-	Ta	-	-	-	-	-	-	PQ	-
<i>Vicarya callosa</i>	-	-	-	-	-	Bo	Nj	Tj	-	-	NT	-	-	-	-	-	-
<i>Cerithium progoense</i>	W	-	-	-	UG	-	-	-	-	-	NT	-	-	-	-	-	-
<i>Cerithium traillii</i>	-	-	-	-	-	-	-	-	-	-	NT	-	-	P	-	PQ	Q Re
(<i>Strombus preoccupatus</i> omitted)																	
<i>Cypraea lynx</i>	-	-	-	-	-	-	-	-	-	-	-	-	M	P	-	PQ	Q Re
<i>Apollon bitubercularis</i>	-	R	Rr	-	UG	-	-	-	Ta	Pa	NT	UM	-	P	N	PQ	Q Re
<i>Drupa anganana</i>	-	-	-	-	-	-	Nj	-	-	-	-	-	-	-	-	-	-
<i>Cantharus bucklandi</i>	-	R	Rr	K	UG	-	Nj	Tj	Ta	Pa	NT	UM	-	P	N	-	-
(<i>C. erythrostoma</i> *)														?(P	-	-	Q Re)
<i>Clavilithes fennemai</i>	-	-	-	-	-	-	Nj	-	-	-	NT	-	-	P	-	-	-
<i>Gemmula karangensis</i>	-	-	-	-	-	-	Nj	-	-	-	NT	-	-	P	-	-	-
<i>Anadara antiquata</i>	-	-	Rr	-	-	-	Nj	Tj	-	-	NT	-	M	P	N	PQ	Q Re
Number of species recorded in each zone:	W				UG	Bo					NT	UM		P		Q	Re
		4						12				3		8		5	5

*) See comments on *C. bucklandi*

Age determination

TAPIAN LANGSAT

Out of 11 species, 3 (or 27.3%) are still living, thus seemingly indicating a Pre-angerian age, were it not that the fauna is much too small to allow application of the percentage method for age determination.

If one considers the actual records of the species, the following distribution is obtained:

Recent:	: 3
Quaternary	: 1 (3?)
Pliocene	: 2
Late Miocene	: 2
(Pr) Preangerian	: 11
(pPr) Pre-Preangerian	: 5 (or 6: see <i>Cyclostremiscus novemcarinatus</i>)

The combined actual time ranges of the species are given in Table 3.

Table 3. Time range of the molluscs from Tapian Langsat.

	pPr	Pr	UM	P	PQ	Q	Re	
								2
								.1 (<i>Cyclostremiscus</i>)
								.1
								.1
								.1
								4
								1
(a)	5(6?)	11	6	5	4	3	3	(11 species considered)
(b)	3(4?)	9	4	3	2	1	1	(9 species considered)

(a) Number of species recorded in each zone.

(b) Ditto, when omitting the 2 longest ranging species.

All the species concerned occur in Preangerian deposits which, although there are no more than 11 species altogether, may be taken as a strong indication that the Tapian Langsat fauna indeed belongs to Tf3. Four species even seem confined to Tf3 but only one of these, *Nucula njalindungensis*, may have particular significance in this respect.

As the time ranges of the species are to a large extent made up of the recorded occurrences in fossil assemblages outside the classical Javanese realm,

Table 4. Preangerian records of the Tapian Langsat molluscs.

Tapian Langsat	a	b	c	d	gb	h	i	l	n	pr	lop
<i>Gibbula leupoldi</i>	—	b	c	—	gb	—	—	l	—	—	—
<i>Cyclostremiscus novemcarinatus</i>	—	b	—	—	gb	—	—	l	—	—	—
<i>Turritella talarensis</i>	—	b	c	d	gb	—	i	—	—	—	lop
<i>Rhinoclavis leupoldi</i>	—	b	—	—	gb	—	—	—	n	—	—
<i>Cerithium bayeri</i>	—	b	c	—	—	—	—	—	n	—	—
<i>Triphora javana berauensis</i>	a	b	c	—	gb	—	—	l	—	—	—
<i>Miralda</i> aff. <i>M. faceta</i>	a	—	—	—	—	—	—	—	—	—	—
<i>Nucula njalindungensis</i>	—	b	—	—	gb	—	—	l	n	pr	—
<i>Arcopsis sculptilis</i>	a	b	c	—	gb	—	—	l	—	—	—
<i>Trachycardium</i> cf. <i>T. denticostulatum</i>	—	b	—	—	gb	—	—	—	—	—	—
<i>Corbula solidula</i>	a	b	—	—	gb	h	i	l	n	—	—

The number of species in common with: a: 4 (36.4%); b: 10 (90.9%); c: 5 (45.5%); d: 1 (9%); gb: 9 (81.8%); h: 1 (9%); i: 2 (18.1%); l: 6 (54.5%); n: 4 (36.2%); pr: 1 (9%); lop: 1 (9%).

a - Mandul

b - basal Menkrawit Beds, L.114

c - Lower Menkrawit Beds

d - Upper Menkrawit Beds

gb - Gelingsch Beds

h - Gunung Mendong

i - Sekurau

l - Gunung Madupar

n - Mentawir Beds s. str.

pr - classical Preangerian, Java
(Nj, Tj, Ta, Pa)

lop - Lower Palembang Beds, Sumatra

that is, in Borneo in the main, it seems appropriate to add a few observations on the relationships between Tapian Langsat and the other Preangerian faunas examined to date.

The overall picture stresses the interesting point that merely one species, *Nucula njalindungensis*, is known from the classical Preangerian. On the other hand there is the remarkable fact that no less than 10 of the 11 species occur in the basal Menkrawit Beds and 9 in the Gelingseh Beds, with other assemblages of roughly the same age lagging more or less behind. With some of the other Borneo faunas, Gunung Batuta, Kari Orang, Batu Panggal, and Muara Kobun, there seem to be no ties at all. The overall picture may illustrate the individual character of the various Neogene basins of East Borneo.

As age determinations invariably imply the danger of arguing in a circle, it should be stated clearly that in this case the determining factor, i.e., the strong relationships between the Tapian Langsat fauna and the assemblages of the basal Menkrawit Beds and Gelingseh Beds, rests on solid ground: the Preangerian status of both the latter. Consequently, the writer does not doubt the correctness of the conclusion that Tapian Langsat is of Tf3 age, a conclusion not jeopardized by the apparent lack of relationships with the classical Preangerian.

GUNUNG BATUTA

The fauna consisting of no more than 13 species, the percentage of living species (5 or 6), viz., 38.4% - 46.1%, which would correspond with an Odengian age, cannot be considered of any real value.

The actual records of the species, however, give some useful pointers:

Recent	: 5 (or 6: see <i>Cantharus bucklandi</i>)
Quaternary	: 5 (or 6: see <i>Cantharus bucklandi</i>)
Pliocene	: 8
Late Miocene	: 3
(Pr) Preangerian	: 12
(pPr) pre-Preangerian	: 4 (or 5: see <i>Cypraea lynx</i>)

The above distribution obviously suggests a Preangerian rather than an Odengian age. So do the inferred occurrences of the 13 species concerned in the various time zones (see Table 5).

Table 5. Time range of the molluscs from Gunung Batuta.

	pPr	Pr	UM	P	PQ	Q	Re	
								2
								1 (<i>Cypraea lynx</i>)
								1 (<i>Cantharus bucklandi</i>)
								1
								3
								2
								1
								2
(a)	4(?)	12(13?)	8(9?)	9	6(?)	5(6?)	5(6?)	(13 species considered)
(b)	2(3?)	10(11?)	6(7?)	7	4(5?)	3(4?)	3(4?)	(10 species considered)

(a) Number of species recorded in each zone.

(b) Ditto, when disregarding the 2 longest ranging species.

It is certainly noteworthy that 12 out of 13 species have been recorded from Preangerian sequences. In addition, 3 species are perhaps of particular interest in having so far been observed in deposits of that age exclusively, were it not that two of them, *Turbo rutteni* and *Drupa angsanana*, have been but rarely recorded. *Vicarya callosa*, however, an often collected and widespread species, is usually considered a reliable index fossil for Preangerian. It at least enhances the chances that we are indeed dealing with a fauna of that age, the one the writer wishes to adhere to, in the hope however that more fossils from this locality and Tapian Langsat may in time be forthcoming.

As in the case of the Tapian Langsat fauna, it seems advisable to delve into the matter of the Preangerian relationships a little deeper (see Table 6).

Table 6. Preangerian records of the Gunung Batuta molluscs

Gunung Batuta	a	b	gb	i	l	o	p	pr	prx	lop
<i>Turbo rutteni</i>	—	—	—	i	—	—	—	—	—	—
<i>Trochus maculatus</i>	—	b	gb	—	—	—	—	—	—	—
<i>Tectus pyramis tjilonganensis</i>	—	—	—	—	—	—	—	pr	—	—
<i>Vicarya callosa</i>	—	b	gb	—	—	o	—	pr	prx	—
<i>Cerithium progoense</i>	—	b	—	—	—	—	—	—	—	—
<i>Cerithium traillii</i>	—	—	gb	—	—	—	—	—	—	—
<i>Apollon bitubercularis</i>	a	b	—	—	l	—	—	pr	prx	lop
<i>Drupa angsanana</i>	—	—	—	—	—	—	—	pr	—	—
<i>Cantharus bucklandi</i>	a	—	gb	—	—	—	—	pr	—	—
<i>Clavilithes fennemai</i>	a	—	gb	—	—	—	—	pr	—	—
<i>Gemmula karangensis</i>	—	—	gb	—	l	—	—	pr	prx	—
<i>Anadara antiquata</i>	—	b	—	i	—	—	p	pr	—	—

The number of species in common with: a: 3 (25%); b: 5 (41.7%); gb: 6 (50%); i: 2 (16.6%); l: 2 (16.6%); o: 1 (8.3%); p: 1 (8.3%); pr: 8 (66.6%); prx: 3 (25%); lop: 1 (8.3%).

a - Mandul
b - basal Menkrawit Beds, L. 114
gb - Gelingsih Beds
i - Sekurau
l - Gunung Madupar
o - Sungai Klindjau

p - West Borneo
pr - classical Preangerian, Java
(Nj, Tj, Ta, Pa)
prx - other Preangerian deposits, Java
lop - Lower Palembang Beds, Sumatra

In this case, unlike Tapian Langsat, good relationships exist with the classical Javanese Preangerian. Next best are the ties with the faunas of the Gelingsih and Menkrawit Beds, while those with other assemblages are weak. It is interesting to note that no relationships are apparent with the Lower and Upper Menkrawit Beds, Muara Kobun, Pulu Senumpah (Loc. 156, Rutten), Kari Orang, Gunung Mendong, Tapian Langsat, Batu Panggal, and the Men-tawir Beds s. str.

Taking all in all, the writer feels that the conclusion is justified that the Gunung Batuta assemblage is to be assigned a Preangerian age, Tf3, in harmony with the various distributions probed and taken in conjunction with the presence of *Vicarya callosa*.

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