Preangerian (Miocene) Mollusca from the Lower Sangkulirang Marl Formation, Kari Orang, Kalimantan (East Borneo)

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In the early part of the century L.M.R. Rutten collected a number of molluscs at his locality number 141, in Lower Sangkulirang Marls, long considered as Early Miocene (Tf2), near Sungai Kari Orang and not far from Witkamp's locality Kari Orang. But for their geologic age, these faunas have very little in common.

In the present paper some 20 molluscan species (among them very few bivalves) from loc. 141 are discussed, including 4 new ones (*Polinices? (Conuber?) orangensis, Nihonia witkampi, Conus kutaiensis*, and *Laevicardium (Discors) rutteni*), hence no more than 16 are used for age determination. Of these, 14 occur in Preangerian deposits. Equally close relationships appear to consist with the fauna of the Lower Gelingseh Beds and the classical Javanese Preangerian, a distribution also shown by Witkamp's Kari Orang fauna while curiously enough the ties between the latter and loc. 141 are almost non-existent. The overall evidence indicates that part of the Lower Sangkulirang Marl Formation, covering loc. 141 and overlying deposits, should be referred to the Preangerian, Tf3.

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Remarks on the locality

The present paper deals with a small collection of fossil molluscs from northern Kutai, East Borneo, made by L.M.R. Rutten in the early part of the century. The locality bears the number Rutten, 141: it is situated a few kilometers to the northwest of the mouth of Sungai Kari Orang – about 2.5 km up the river and again about 2.5 km west of that point – and the deposits exposed there were classified as 'Old Miocene in Globigerina-marl facies', subsequently called Lower Sangkulirang Marls (Tertiary f2). The locality is actually not far from the Gunung Mendong area (with a rich fauna of dwarf molluscs collected by M. Schmidt) and Witkamp's locality Kari Orang (see Beets, 1983b, fig. 1).

Description of the Mollusca

The fossils are kept in the Instituut voor Aardwetenschappen, Utrecht University. For stratigraphical data compare the faunal list.

Vermetus (Lemintina) javanus Martin, 1879

Material – A single fragmentary specimen.

Range – Pre-Preangerian to Quaternary: W - R - Rr (Rm; Rl) - K - UG (Assam(?)) - Pr (Nj; Tj; Ta) - NT (basal Menkrawit Beds: L.114; Gelingseh Beds: loc. 149, Rutten; West Borneo) - UM (Antjam Beds: L.747; Upper Dingle Formation, Panay) - M - P - N - PQ (Togopi) - Q.

References – Altena, 1938, p. 317 (syn.); Beets, 1941, pp. 33, 168, 188, 190, 194, 196; Nuttall, 1965, p. 169; Shuto, 1969, p. 60, pl. 4, figs. 10-12.

Paludomus (Paludomus) conicus (Gray, 1834)

Material – A single specimen is available.

Range – Preangerian to Recent: NT (basal Menkrawit Beds: L.114) - Re.

Comments – The specimen representing this freshwater species (India -Sri Lanka - Borneo) is unusual as it has more of an umbilical slit than other shells compared, but almost as in two specimens from L.114; also, the abapical part of the inner lip is more expanded than usual.

Reference – Beets, 1941, pp. 35, 168, 194, pl. 1, fig. 50.

Rhinoclavis (Rhinoclavis) erecta (Martin, 1884)

Material – A single fine shell is available.

Range – Pre-Preangerian to Pliocene: UG (Sind) - P.

References – *Cerithium (Vertagus) erectum* Martin: Martin, 1883-1887, pp. 149, 312, pl. 8, fig. 147; Martin, 1919, pp. 93, 125; Vredenburg, 1925-1928, p. 351; Martin, 1931, p. 2; van der Vlerk, 1931, p. 248; Beets, 1941, p. 194; non: Pannekoek, 1936, pp. 7, 52: compare Beets, 1950d, p. 330: *Cerithium leupoldi* Beets, 1941.

Cerithium (Thericium) traillii Sowerby, 1855

Material – A single specimen.

Range – Preangerian to Recent: NT (Gelingseh Beds: Sg. Gelingseh, 'layer 1'; Gunung Batuta) - P - PQ (Togopi) - Q - Re.

Comment – As reported before, the specimen belongs to a set of fossil shells from Borneo which are smaller than usual.

References – Beets, 1950a, pp. 254, 261; Beets, 1950c, pp. 307, 314, 315; Nuttall, 1965, pp. 161, 169; Beets, 1981b, pp. 20, 23, 26.

Strombus (Strombus) aff. *S. sedanensis* Martin, 1899

Material – A single shell.

Range – No previous records.

Comments – The outer lip of the specimen is lacking, hence it is impossible to decide which species is represented, *S. sedanensis* or its close relative, *S. daviesi* Dey, 1962, from Quilon, India.

Polinices (Polinices) callosior (Martin, 1879)

Material – One specimen.

Range – Preangerian to Pliocene: Pr (Tj) - NT (basal Menkrawit Beds: L.114; Gelingseh Beds: loc. 150, Rutten) - P.

Reference – Beets, 1941, pp. 71 (syn.), 169, 194, 196.

Polinices? (Conuber?) orangensis spec. nov.
Pl. 4, figs. 1-5.

Holotype – Pl. 4, figs. 1-3. Height 26+ mm.
Paratype – Pl. 4, figs. 4-5. Height 22+ mm.
Type-locality – Loc. 150, L.M.R. Rutten, Gelingseh Beds, Sungai Gelingseh area, N. Kutai, E. Borneo.
Type-horizon – Not ascertained, some level in the Lower Gelingseh Beds.
Name – Derived from Kari Orang.

Material – One specimen, the paratype, from Rutten's loc. 141.

Range – Preangerian: NT (Gelingseh Beds: loc. 150, Rutten).

Description – The apical part is missing, the spire high, its whorls convex though flattened to concave adapically, with a rather conspicuous spiral groove in the spiral concavity, to which a few additional less prominent grooves are added on the younger whorls, lying just in front of and behind the first groove. The whorls are covered with fine growth lines which are prosocline and straight, except in and behind the adapical concavity in which they are arched forwards.

The body whorl is comparatively large and the outer lip oblique. This whorl bears a few more inconspicuous spiral grooves lying at wide intervals. The aperture is ovoid, its adapical end pointed. The columella is slightly concave, the inner lip thickened though not expanded over the umbilicus. The latter is narrow and deep, with conspicuous growth lines, and encircled by a likewise conspicuous, though low, smooth ridge. No funicle is developed.

The type of *Conuber* Finlay & Marwick, 1937, *P. conicus* (Lamarck, 1822) is somewhat reminiscent of *P. orangensis*, but this Australian species (Tryon, 1879-1897, 8, p. 44, pl. 18, figs. 76-77) has a funicle and no ridge around its umbilicus.

Comment – The paratype of *P. orangensis* was previously thought to be *Paludomus conicus* (see above), until further preparation of this fossil proved its true identity (Beets, 1950d, p. 331).

Natica vitellus (Linné, 1758)

Material – Two specimens represent this species.

Range – Pre-Preangerian to Recent: R - Rr (Rl) - UG (Assam?) - Pr (Nj) - NT (Kari Orang; Lower Palembang Beds) - UM (Tjiodeng, Tjitarum) - M - P - N - PQ (Togopi) - Q - Re.

Reference – Beets, 1983b, p. 28.

Ancilla (Sparella) cinnamomea (Lamarck, 1810)

Material – Two specimens.

Range – Pre-Preangerian to Recent: Rr (Rm) - Pr (Nj; Tj) - NT (basal Menkrawit Beds: L.114; Lower Menkrawit Beds: L. 386, L. 391; Gelingseh Beds: Sg. Gelingseh, 'layer 1'; loc. 150, Rutten; Sekurau; Gunung Madupar, Rutten & Wanner) - P - Q - Re.

References – Oostingh, 1935, pp. 105, 217; Montanaro-Gallitelli, 1939, p. 255; Beets, 1941, pp. 105, 170, 175, 190, 192, 197.

Ancilla (Sparella) rembangensis (Martin, 1906)

Material – Several specimens are available.

Range – Pre-Preangerian to Preangerian: R - Rr (Ra; Tsk, Rm; Rl) - UG (Quilon) - NT (Lower Palembang Beds).

References – Martin, 1891-1922, p. 298, pl. 43, figs. 711-711a; Martin, 1907, p. 146; Martin, 1912, p. 159; Martin, 1919, pp. 77, 140; van der Vlerk, 1931, p. 222; Haanstra & Spiker, 1932a, p. 1096; Haanstra & Spiker, 1932b, p. 1314; Pannekoek, 1936, pp. 5, 13, 25; Dey, 1962, p. 89.

Oliva (Strephona) rufula djocdjocartae Martin, 1884

Material – A single fine shell.

Range – Pre-Preangerian to Pliocene: Rr (Rm) - Pr (Pa) - NT (Pulu Senumpah, Loc. 156, Rutten; Gelingseh Beds: Loc. 150, Rutten) - UM (Palabuanratu; Dingle Formation, Panay) - M (Tjidamar; W. Sumatra) - P.

Reference – Beets, 1983a, p. 11.

Mitra (Tiara) menkrawitensis Beets, 1941

Material – A single specimen.

Range – Preangerian: NT (basal Menkrawit Beds: L.114; Sekurau).

Reference – Beets, 1941, pp. 5, 116, 170, 194, pl. 6, figs. 239-240.

Mitra (Tiara?) spec. indet.

Material – One slender specimen.

Range – No previous records.

Comment – The apical part assigns this species to *Chrysame* H. & A. Adams, 1853, its overall shape and the ornamentation of the younger whorls to *Tiara* Swainson, 1831.

Nihonia witkampi spec. nov.
Pl. 4, figs. 6-7.

Holotype – Pl. 4, figs. 6-7. Length 31.5+ mm.
Type-locality – Loc. 141, Rutten, Sungai Kari Orang area, N. Kutai, E. Borneo.
Type-horizon – Not ascertained, some level in the Lower Sangkulirang Marl Formation.
Name – The species is named for H. Witkamp, one of the pioneers of geological exploration in northern Kutai.

Material – The holotype only.

Range – No previous records.

Description – Shell turreted, its apical and apertural parts damaged. About nine shouldered whorls are preserved, having a flat to gradually more concave spiral shelf sloping rather steeply up to the adapical suture. Along the latter a spiral cord, first single, soon double and finally even triple. These cords are indistinctly granulate due to the intersection of rather conspicuous growth lines. The median rounded shoulder of the whorls bears a couple of spiral cords, the abapical one being strongest. On the basal part of the whorls three rapidly developing spiral cords are added to the ornamentation, and soon these are about as strong as the shoulder cords. In each of the intervals between the primary cords a secondary one is formed. Also, a gradually increasing number of fine spiral threads is developed in the concave shelf, the most abapical one becoming quite strong finally. A fine cord is added along the adapical suture.

The numerous fine growth lines indicate that the outer lip is narrowly arched forward near the adapical suture, forming a deep rounded notch deepest just adapically of the middle of the spiral concavity, then swinging forward over the median shoulder.

The body whorl is badly damaged. It may have born some 16 additional spiral cords and a number of finer spirals.

The spiral cords are comparatively close-set, unlike those of all other known species of the genus, with the possible exception of *N. birmanica* (Vredenburg, 1921) (Vredenburg, 1921a, p. 90, pl. 12, fig. 4) from the Oligocene of Burma which appears to be related but seems to lack the deep adapical spiral concavity of the whorls so well developed in *N. witkampi*, while its shoulder is more rounded. Better Burmese material than figured by Vredenburg may reveal closer relationships between the Burmese species and *N. witkampi*.

Lophiotoma indica (Roeding, 1798)

Material – One specimen.

Range – Preangerian to Recent: Pr (Tj) - NT (Mandul; Muara Kobun; Pulu Senumpah, loc. 156, Rutten) - UM (Tjiodeng) - P - N - PQ (Togopi) - Q - Re.

Comments – Although its apical part is missing, the specimen appears to represent *L. indica*, which will be discussed in a forthcoming paper on molluscs from the Island of Mandul.

Reference – Beets, 1983a, p. 7

Conus decollatus Martin, 1884

Material – Two specimens.

Range – Pre-Preangerian to Preangerian: R - K - UG (Assam) - Pr (Nj; Ta) - NT (Gelingseh Beds: Sg. Gelingseh, 'layer 1'; Loc. 144, Rutten; West Borneo).

Comments – The spiral striation covers more of the body whorl than hitherto recorded and may even cover the whole whorl. The same ornamentation is shown by a specimen from Rutten's loc. 144.

References – Martin, 1883-1887, pp. 54, 353, pl. 4, fig. 55; Martin, 1891-1922, p. 23; Martin, 1912, p. 158; Martin, 1919, pp. 73, 130; Vredenburg, 1921b, p. 136; Vredenburg, 1925-1928, p. 91; Martin, 1928a, pp. 111, 120; Mukerjee, 1939, p. 83 (the occurrence quoted for this species in the Nanggulan Beds is erroneous). See also Beets, 1950d, p. 336, nrs 80 and 84.

Conus kutaiensis spec. nov.
Pl.4 , figs. 8-10.

Holotype – Pl. 4, figs. 8-10. Height 76 mm.
Type-locality – Loc. 141, Rutten, Sungai Kari Orang area, N. Kutai, E. Borneo.
Type-horizon – Not ascertained, some level in the Lower Sangkulirang Marl Formation.
Name – Derived from the district Kutai.

Material – The holotype only.

Range – No previous records.

Description – The shell has a moderately high spire. Ten post-nuclear whorls present, the shoulder rather prominent and bearing distinct though rounded tubercles. On the younger whorls the shoulder moves gradually down into the suture while the tubercles develop into undulations, becoming faint and finally disappearing on the early part of the penultimate whorl, the shoulder becoming smooth and rounded. Spiral ornamentation initially consisting of two spiral threads, one along the adapical suture. The number of spirals increases to about eight, the adapical one being doubled and finally tripled: the most abapical of the latter spirals and the couple of spirals abapically from it, are more prominent

than the other spirals. Secondary spiral threads are also developed, but both the three prominent spirals and secondary threads between them disappear quite unexpectedly and almost completely on the body whorl. According to the rather prominent growth lines, which produce a slight crenulation of the spirals, the anal sinus is fairly shallow, forming a broad curve deepest close to the adapical suture. The older whorls are flat, the younger ones gradually becoming moderately concave.

The last whorl is large, convex next to the shoulder, almost flat over much of its length, slightly concave along the rather prominent siphonal fasciole. Its surface is covered with numerous inconspicuous spiral threads of approximately equal strength while near the abapical concavity three comparatively broad and flat spiral bands occur, each faintly subdivided. The most abapical portion of the body whorl covered with conspicuous spirals and grooves. The aperture gradually tapering towards the shoulder, siphonal notch shallow. Outer lip, according to the growth lines, broadly arched forward.

The comparatively low-spired varieties of *C. terebra* Born, 1780 (Abrard, 1942, p. 84, pl. 8, fig. 26) resemble the new species but are somewhat more elongate and the spire whorls are flat instead of concave, except in some recent representatives from Ternate and Aden in the Rijksmuseum van Natuurlijke Historie, Leiden, but even then, they have the normal well developed spiral ornamentation covering all of the body whorl. *C. everwijni* Martin, 1883 (see van der Vlerk, 1931, p. 213) is perhaps related too, but much smaller, differently shaped, with pronouncedly stepped spire whorls and its shoulder not rounded as in *C. kutaiensis*.

Conus pamotanensis Martin, 1906

Material – A single specimen.

Range – Pre-Preangerian to Preangerian: W - R - K - NT (basal Menkrawit Beds: L.114).

Comment – Additional comparisons convinced the writer that the material doubtfully recorded as *C. pamotanensis* by Martin (1916-1917, pp. 226, 278, 294) and Haanstra & Spiker (1932a, pp. 1096, 1099) from the Westprogo and Rembang Beds respectively, can actually be safely included in this species.

References – Martin, 1907, p. 146; Beets, 1941, pp. 138 (syn.), 170, 186, 188, 194, 199.

Conus cf. *C. sinensis* Sowerby, 1833

Material – Three specimens.

Range – Not ascertained, generally Early Miocene to Recent: R - ? - Re.

Comments – The specimens agree well with the material from Muara Kobun (Beets, 1983a, p. 8), except that their shoulders are faintly tubercled, and with

Javanese specimens from Sondé, but they are rather immature, being up to 20 mm long. For reasons given by the writer in the paper on Muara Kobun fossils, the species is used in a restricted fashion for age determination.

Conus spec. indet.

Material – A single poorly preserved specimen.

Range – No previous records.

Laevicardium (Discors) rutteni spec. nov.
Pl. 4, figs. 11-12.

Holotype – Pl. 4, figs. 11-12. Left valve: length 25+ mm, height 29.4+ mm, inflation 8 mm.
Type-locality – Loc. 141, Rutten, Sungai Kari Orang area, N. Kutai, E. Borneo.
Type-horizon – Not ascertained, some level in the Lower Sangkulirang Marl Formation.
Name – The species is named for the late L.M.R. Rutten.

Material – The holotype only, which, though damaged, justifies description on account of its characteristics.

Range – No previous records.

Description – Shell elliptic-oblique, the greater part of its surface covered with radial riblets and grooves. The flank of the shell bears narrow and shallow grooves separating comparatively broad and flat riblets. The grooves are widest in the posterior area in which two approximately equal parts may be distinguished: the posterior one is a slightly concave radial zone bearing five narrow ridges separated by wide shallow grooves, the ridges deminishing in height towards the other, anterior part, which forms a concavo-convex transition between the former zone and the flank of the shell and bears flat riblets separated by narrower grooves, as on the adjoining posterior part of the flank. Posterior area and flank are separated by a conspicuous though not very deep diagonal groove. Escutcheon narrow, smooth but for fine growth lines, delimited by the first conspicuous rib of the posterior part of the corselet.

On the anterior third of the valve the radial riblets are inconspicuous, this part being strikingly ornamented with oblique riblets meeting the growth lines at a small angle as is typical for *Discors*. They lie at fairly close intervals and do not extend into the lunule. Hinge damaged, only the posterior cardinal preserved. The interior margin of the valve finely crenulated.

No definitely related species could be found, though perhaps *L. musperi* Oostingh, 1941 (Oostingh, 1941, pl. 2, figs. 41a-b) should be considered as such. However, judging from the figures, it is more inflated and not so strongly ornamented.

Dey (1962, p. 29, pl. 2, fig. 10) described a *Laevicardium (Discors)* sp. which is similar in shape (height apparently 14.5 instead of 11.5 mm; length 12.8 mm; inflation 7 mm), but again more inflated than *L. rutteni*. Its ornamentation may be similar.

Corbula socialis Martin, 1879

Material – A single valve which agrees well with one of the specimens from Junghuhn's locality O (Tjilanang) (RGM 6 885).

Range – Pre-Preangerian to Pliocene, Neogene: W - R - Rr (Rm) - K -UG (Assam; Quilon) - LM (Kenya; Pemba I.) - Pr (Tj) - NT (Gelingseh Beds: Source area Sg. Gelingseh; loc. 149, Rutten; West Borneo; Lower Palembang Beds) - UM (Dingle Formation, Panay) - M - P - N.

References – Oostingh, 1935, p. 202 (syn.); Eames, 1950, p. 146; Shuto, 1971, p. 67, pl. 10, figs. 7-9, textfig. 14. Compare Beets, 1950a, p. 252, under *Aloidis crassa* (Hinds).

Geological age of the fossils

The abbreviations and symbols listed below conform to the stratigraphical records of the fossils described in the previous chapter. It may be added that Early Miocene as used in the present writer's papers ranges upward to the interval between the Rembang Beds and the Preangerian (= Late Miocene, extending upward so as to include the Odengian). The writer thus adheres to Martin's usage of a twofold subdivision of the Indonesian Miocene without however letting this opinion interfere with the age determinations which are based on the comparison between faunal assemblages first and foremost.

Re – Recent
Q – Quaternary
PQ – Pliocene/Quaternary (e.g. Togopi Formation, N.E. Borneo)
N – Neogene, unclassified
P – Pliocene (Th approximately)
M – Miocene, not classified
UM – Late Miocene, in part (Tg, Odengian, also Antjam Beds, E. Borneo; Upper Dingle Formation, Panay, Philippines; Palabuanratu, Java)

Pr – Preangerian (Tf3) s. str.: Java:
  Nj – Njalindung Beds
  Tj – Tjilanang Beds
  Ta – Tjadasngampar
  Pa – Parungponteng = Selatjau
NT – Preangerian equivalents, including:
  E. Borneo:
  Mandul I., coll. W. van Holst Pellekaan (Shell), unpublished Menkrawit Beds, coll. W. Leupold, L.114 a.o. (Beets, 1941)
  Muara Kobun, coll. M. Schmidt (Beets, 1983a)
  Pulu Senumpah, coll. L.M.R. Rutten: loc. 156, Rutten (Beets, 1983a)
  Gelingseh Beds, partly published (Martin, 1914; Beets, 1941), including: Sg. Gelingseh, 'layers 1 & 2', coll. Rutten; Source area Sg. Gelingseh, coll. Rutten; loc. 144, Rutten; loc. 149, Rutten; loc. 150, Rutten

Kari Orang, coll. H. Witkamp (Beets, 1983b)
Sekurau, coll. M. Schmidt (Shell), unpublished
Gunung Batuta, coll. L.M.R. Rutten (Beets, 1981b)
Gunung Madupar, coll. L.M.R. Rutten and J. Wanner, unpublished
West Borneo: coll. Shell, unpublished
Sumatra: Lower Palembang Beds

pPr – pre-Preangerian (Tfl-2), including:
LM – Lower Miocene, East Africa: Kenya; Pemba I.
UG – Upper Gaj & equivalents: Pakistan (Sind); India (Garo Hills, Assam; Quilon, S. India)
K – Kama, Burma; perhaps approximately UG
Rr – Rembang equivalents:
Ra – Api Api, Pasir, E. Borneo, coll. K. Goldschmid (Shell), unpublished
Tsk – Tandjung Sepada Ketjil, Pasir, E. Borneo, coll. K. Goldschmid (Shell), unpublished
Rm – Madura, coll. R. Gsell (Shell), unpublished
Rl – Langkang, S. Sumatra, coll. W. van Holst Pellekaan (Shell), unpublished
R – Rembang Beds, Java
W – Westprogo Beds, Java

Table 1. Stratigraphical records of the molluscs from Rutten's Loc. 141.

	pPr						Pr											
	W	R	Rr	K	UG	LM	Nj	Tj	Ta	Pa	NT	UM	M	P	N	PQ	Q	Re
Vermetus javanus	W	R	Rr	K	UG?	—	Nj	Tj	Ta	—	NT	UM	M	P	N	PQ	Q	—
Paludomus conicus	—	—	—	—	—	—	—	—	—	—	NT	—	—	—	—	—	—	Re
Rhinoclavis erecta	—	—	—	—	UG	—	—	—	—	—	—	—	—	P	—	—	—	—
Cerithium traillii	—	—	—	—	—	—	—	—	—	—	NT	—	—	P	—	PQ	Q	Re
Strombus aff. *S. sedanensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polinices callosior	—	—	—	—	—	—	—	Tj	—	—	NT	—	—	P	—	—	—	—
Polinices orangensis	—	—	—	—	—	—	—	—	—	—	NT	—	—	—	—	—	—	—
Natica vitellus	—	R	Rr	—	UG?	—	Nj	—	—	—	NT	UM	M	P	N	PQ	Q	Re
Ancilla cinnamomea	—	—	Rr	—	—	—	Nj	Tj	—	—	NT	—	—	P	—	—	Q	Re
Ancilla rembangensis	—	R	Rr	—	UG	—	—	—	—	—	NT	—	—	—	—	—	—	—
Oliva rufula djocdjocartae	—	—	Rr	—	—	—	—	—	—	Pa	NT	UM	M	P	—	—	—	—
Mitra menkrawitensis	—	—	—	—	—	—	—	—	—	—	NT	—	—	—	—	—	—	—
Nihonia witkampi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lophiotoma indica	—	—	—	—	—	—	—	Tj	—	—	NT	UM	—	P	N	PQ	Q	Re
Conus decollatus	—	R	—	K	UG	—	Nj	—	Ta	—	NT	—	—	—	—	—	—	—
Conus kutaiensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Conus pamotanensis	W	R	—	K	—	—	—	—	—	—	NT	—	—	—	—	—	—	—
Conus cf. *C. sinensis*	—	R	n	o	t	a	s	c	e	r	t	a	i	n	e	d		Re
Laevicardium rutteni	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Corbula socialis	W	R	Rr	K	UG	LM	—	Tj	—	—	NT	UM	M	P	N	—	—	—

Number of species recorded in each zone:	pPr	Pr	UM	P	PQ	Q	Re
	10	14	5	9	4	5	6

From the above faunal list (Table 1) it follows that no more than 20 species are considered for an age determination. Some of these, however, are of little use for this purpose, being either little known or there being some doubt concerning their identity or stratigraphical range, Thus, *Strombus* aff. *S. sedanensis, Nihonia witkampi, Conus kutaiensis*, and *Laevicardium rutteni* are excluded altogether, leaving 16 species used for age determination, while of these, *Conus* cf. *C. sinensis* is used in a restricted sense.

If one now considers the percentage of living species it is obviously out of the question to rely on the figures arrived at, from 6 living species out of 16, or 37.5% , to 6 out of 20, or 30% (figures in themselves compatible with a Preangerian age) because the assemblage is simply too small for even an approximate assessment of its age by means of the percentage method.

We seem to fare a little better if the actual records of the various species are plotted (see Table 1 above) for now it appears that a Preangerian age indeed may seem most likely.

The inferred time ranges give the following composite picture (Table 2).

Table 2. Time range of the molluscs from Rutten's locality 141.

	pPr	Pr	UM	P	PQ	Q	Re	
	pPr —						Re:	3
	pPr —					Q	:	1
	pPr —			P			:	3
	pPr —	Pr					:	3
		Pr					:	2
		Pr —		P			:	1
		Pr —					Re:	3
(a)	10	16	11	11	7	7	6	(16 species considered)
(b)	7	13	8	8	4	4	3	(13 species considered)

(a) Number of species recorded in each zone.
(b) Ditto, when omitting the 3 longest lived species.

The above distribution again points unwaveringly at a Preangerian age rather than a pre-Preangerian one, a conclusion at variance with Leupold & van der Vlerk's views. One could have one's doubts because, (1) the number of species is rather small and differences in dating could of course be merely due to vagaries in distribution, errors of random sampling, and facies differences. In this context it should also be remembered that Preangerian and post-Preangerian faunas of S.E. Asia are far better known than the older Miocene faunas; (2) the presence of *Ancilla rembangensis* seemingly enhances the chances that we are dealing with a fauna of Rembang character. That is to say, if one were to rely on the value assigned to certain species as index fossils for one or the other of the S.E. Asian faunal zones (which the present writer emphatically does not), for in that case *A. rembangensis* would pose something of a problem. Martin (1912, p. 159) considered the species a common element, even an index fossil for the Javanese Rembang Beds. Pannekoek (1936, p. 13) apparently could not altogether agree with this view, on account of the absence of *A. rembangensis* at

some of the Rembang localities. Subsequently to Martin's investigations, however, Haanstra & Spiker (1932) recorded the species from the Lower Palembang Beds which are now generally accepted as Preangerian, and finally, Dey (1962) reported it from Quilon. Therefore, the alleged stratigraphical value of *A. rembangensis*, until recorded from a Preangerian level, was on a par with that of a number of other species which, until reported by the present writer from the Menkrawit Beds (Tf3), were exclusively known from either the Westprogo Beds (7 species), or the Westprogo and Rembang Beds (1 species: *Conus pamotanensis*, now also occurring in Rutten's collection from loc. 141) (Beets, 1941, p. 186), or the Rambang Beds (*Tibia butaciana*, recently recorded from Muara Kobun: Beets, 1983a). In other words there would be nothing enigmatic about the occurrence of *A. rembangensis* in a Preangerian fauna either.

If we now compare the relationships between the fauna of loc. 141 and Preangerian faunas, we obtain the following diagram (Table 3).

Table 3. Preangerian records of the species from Loc. 141.

Loc. 141, Rutten	a	b	c	e	f	gb	g	i	k	l	p	pr	lop
Vermetus javanus	–	b	–	–	–	gb	–	–	–	–	p	pr	–
Paludomus conicus	–	b	–	–	–	–	–	–	–	–	–	–	–
Cerithium traillii	–	–	–	–	–	gb	–	–	k	–	–	–	–
Polinices callosior	–	b	–	–	–	gb	–	–	–	–	–	pr	–
Polinices orangensis	–	–	–	–	–	gb	–	–	–	–	–	–	–
Natica vitellus	–	–	–	–	–	–	g	–	–	–	–	pr	lop
Ancilla cinnamomea	–	b	c	–	–	gb	–	i	–	l	–	pr	–
Ancilla rembangensis	–	–	–	–	–	–	–	–	–	–	–	–	lop
Oliva rufula djocdjocartae	–	–	–	–	f	gb	–	–	–	–	–	pr	–
Mitra menkrawitensis	–	b	–	–	–	–	–	i	–	–	–	–	–
Lophiotoma indica	a	–	–	e	f	–	–	–	–	–	–	pr	–
Conus decollatus	–	–	–	–	–	gb	–	–	–	–	p	pr	–
Conus pamotanensis	–	b	–	–	–	–	–	–	–	–	–	–	–
Corbula socialis	–	–	–	–	–	gb	–	–	–	–	p	pr	lop

The number of species in common with: a: 1 (7.1%); b: 6 (42.8%); c: 1 (7.1%); e: 1 (7.1%); f: 2 (14.2%); gb: 8 (57.1%); g: 1 (7.1%); i: 2 (14.2%); k: 1 (7.1%); l: 1 (7.1%); p: 3 (21.4%); pr: 8 (57.1%); lop: 3 (21.4%).

a - Mandul
b - basal Menkrawit Beds, L. 114
c - Lower Menkrawit Beds
e - Muara Kobun
f - Pulu Senumpah, loc. 156
gb - Gelingseh Beds
g - Kari Orang, Witkamp
i - Sekurau
k - Gunung Batuta
l - Gunung Madupar
p - West Borneo
pr - classical Preangerian, Java (Nj, Tj, Ta, Pa)
lop - Lower Palembang Beds, Sumatra

Conclusion: it is certainly remarkable that although the relationships between the assemblages of Witkamp's Kari Orang locality (g in Table 3) and Rutten's loc. 141 are negligible, both show comparatively close ties not only with the Gelingseh fauna, gb in the table (70.6% for Kari Orang and 57.1% for loc. 141), but also with the classical Preangerian, pr (10.6% for Kari Orang and

57.1% for loc. 141), while loc. 141 in addition has fairly strong ties with the basal Menkrawit fauna, b (42.8% , versus 17.6% for Witkamp's Kari Orang fauna). These results would certainly be compatible with an assignment of a Preangerian age to loc. 141.

If finally a comparison is made between the two Kari Orang faunas as based on the overall time ranges of their respective species, rather interesting similarities emerge, but also differences:

	pPr	Pr	UM	P	PQ	Q	Re
Loc. 141, Rutten	10	16	11	11	7	7	6
	(62.5%)	(100%)	(68%)	(68%)	(43.7%)	(43.7%)	(37.5%)
Kari Orang, Witkamp	9	17	12-13	12-13	11	11	8
	(42.8%)	(80.9%)	(57.1-61.9%)	(57.1-61.9%)	(52.3%)	(52.3%)	(38.1%)

Remembering that only 21 species from Kari Orang and 16 species from loc. 141 are involved and that consequently even one record more or less in any of the stratigraphical zones would appreciably change the corresponding percentage figures, there seems to be no valid reason for stressing the "older look" of loc. 141 when comparing the pPr-figures, any more than the "younger look" of the same locality when taking into account the Pr-figures. Indead, one should not set too much store by such considerations when small faunas are involved, as the figures compared could well be spurious, up to a point. The danger of such a procedure is most convincingly demonstrated by even much larger assemblages than the ones compared above, for instance by the classical Rembang fauna, with about 212 species, of which merely 29 (13.6%) occur in the Njalindung fauna (193 species), which has about the same percentage of living species but is generally considered to be younger than Rembang, though perhaps not much. On the other hand, no less than 71 Rembang species or 33.5%, occur in other Javanese Preangerian and post-Preangerian Miocene faunas. Facies differences would appear to account for these quaint distributions.

As before, the present writer prefers establishing the centre of gravity, if any, in the composite stratigraphic distribution diagrams of faunal assemblages and these, of both Kari Orang faunas discussed above, beyond question stress a Preangerian age, the composition of the faunas in other respects also being quite compatible with that age.

It should be recalled at this stage that the Lower Sangkulirang Marls conformably overlie the Pulubalang Layers or, alternately, the Mentawir Beds, into which they pass laterally and may even replace entirely. The Lower Sangkulirang Marls were first classified as Tf2 (Leupold & van der Vlerk, 1931, p. 620, and table), as were the Mentawir Beds s. str. and Lower Balikpapan Layers. Recently the writer proposed updating of at least a part of both the last mentioned formations as Tf3 (Beets, 1981a). That, however, was not to say that presently all of the Lower Sangkulirang Marls without further ado should be updated as well, as insufficient data on the stratigraphical relations between the

formations mentioned above is available from published sources. Again, the position of Rutten's locality in the Lower Sangkulirang Marl Formation has not been ascertained. Consequently, all one can say is that part of the Lower Sangkulirang Marls, comprising loc. 141 and overlying deposits, should be relegated to Tf3.

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Plate 4

Figs. 1- 3. *Polinices (Conuber?) orangensis* sp. n. Holotype; height 26+ mm; loc. 150 (L.M.R. Rutten), Sungai Gelingseh area.

Figs. 4- 5. *Polinices (Conuber?) orangensis* sp. n. Paratype; height 22+ mm; loc. 141 (L.M.R. Rutten), Kari Orang.

Figs. 6- 7. *Nihonia witkampi* sp. n. Holotype; length 31.5+ mm; loc. 141 (L.M.R. Rutten), Kari Orang.
Fig. 7: ornament extra enlarged.

Figs. 8-10. *Conus kutaiensis* sp. n. Holotype; height 76 mm; loc. 141 (L.M.R. Rutten), Kari Orang.

Figs. 11-12. *Laevicardium (Discors) rutteni* sp. n. Holotype, left valve; length 25+ mm, height 29.4 mm, inflation 8 mm; loc. 141 (L.M.R. Rutten), Kari Orang.

Plate 4