RECONSIDERATION OF THE SO-CALLED OLIGOCENE FAUNA IN THE ASPHALTIC DEPOSITS OF BUTON (MALAY ARCHIPELAGO)

1. MIO-PLIOCENE MOLLUSCA

BY

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INTRODUCTION

Ever since his first experience with the remarkable "Upper Oligocene" molluscan fauna of the Isle of Buton, the present writer has endeavoured to find more convincing evidence for its age. One of the most tempting problems was why this fauna showed so few relationships to other fossil faunas or to the living mollusca (See MARTIN, 1933, 1935; BEETS, 1942, a, d). Since the only firm point emerging from a number of more or less confusing data was that the closest relationships existed with the Neogene fauna of the East Indies, the writer started extensive comparisons with a number of undescribed fossil collections from that region kept in Netherlands museums (Leyden Geological Museum, Delft Mining Institute, Utrecht Geological Institute). Meanwhile, additional fossils from Buton at first still believed to be of an Oligocene age were received in 1943 from both the "Rijkswegenbouw-Laboratorium", The Hague, and the "Naturhistorisches Museum", Basle, the latter fauna accompanied by notes concerning the locality compiled by its collector, Dr. F. WEBER, Lugano.

The comparisons mentioned above bore their first fruits late in 1943 and early in 1944 when species described from Buton were discovered in an undescribed collection of mollusca from East-Borneo which apparently indicated unusually deep water deposition. It soon became apparent that the "oligocene" mollusca from Buton too should be considered as a "deep water" fauna. This seemed to explain a number of puzzling facts which up till that time did not fit the picture of Tertiary faunal development in the East Indies. Moreover, it appeared that the age of the fauna most probably was to be considered as Mio-Pliocene. Following researches with the aid of the collections in the Zoological Museum, Amsterdam, the Leyden Museum of Natural History and the British Museum (Natural History) confirmed the above revised views.

It is most fortunate indeed, that other fossils from the asphaltic deposits of Buton were studied simultaneously. Dr. TH. REINHOLD, Haarlem, undertook an examination of the diatoms, while Dr. F. G. KEYZER, Utrecht, made an extensive study of the foraminifera. The results of these investigations carried out in close cooperation are published here as three separate contributions under the same general title.

I wish to record my thanks to all those Institutions mentioned in this paper who have so kindly contributed material for study. I am happy to acknowledge the cordial cooperation of my co-workers Dr. TH. REINHOLD and Dr. F. G. KEYZER. Particularly I wish to acknowledge the trouble taken by Dr. C. O. VAN REGTEREN ALTENA in reading the proofs. I also wish to thank the "Zoölogisch Insulinde Fonds" for financial aid granted for research on mollusca during the period 1940—1944. Finally, I am indebted to the "Bataafsche Petroleum Maatschappij", The Hague, for permission to publish this paper.

CONCLUSIONS

1. Previous work.

A summary of the main results and conclusions based on previous investigations may be given here. The late K. MARTIN was the first to describe fossils from the asphaltic deposits of Buton (1933). His conclusions were that the mollusca indicated deposition in shallow water, their age apparently being either Upper Oligocene or Lowermost Miocene. These fossils derived from the localities Waisioe, Ktolemando and Tesoh. Additional fossils from Waisioe? were described by MARTIN in 1935, their age now being considered as Upper Oligocene. In 1936, HETZEL published the results of a geological investigation of Buton. According to him, the localities from which the mollusca derived which were described by MARTIN are situated in an area in which only deposits of an Upper Miocene to Pliocene age outcrop, the Sampalokossa Beds. In order to explain the peculiar character of the mollusca, HETZEL suggested the possibility of the existence of special facies conditions. When accepting MARTIN's assumption of shallow-water conditions, however, HETZEL's suggestion could not explain a number of zoological puzzles. Below, it is outlined how HETZEL's hypothesis, which was not based on factual zoological considerations, indeed has to be accepted as right, though in an unexpected fashion. In this connection it may be emphasized that the examination of any given fauna invariably leaves unsatisfactory points if no detailed geological data on its locality are available, a point rightly raised by MARTIN (1937). When dealing with such intricate problems as presented by the fossils from Buton asphalt one is bound to come to uncertain results even if the reasoning be as sound as MARTIN's.

MARTIN finally (1937) tried to explain the apparent difference in age between the mollusca contained in asphaltic deposits and the Sampalokossa Beds by the assumption of "mudvolcano" activity resulting in Oligocene mollusca being thrown up by gaseous oil-eruption and mixed with fragments of the Sampalokossa Beds. No Young-Tertiary fossils were recognized at all. Furthermore, the Sampalokossa Beds outcropping in the neighbourhood of the localities yielding "Oligocene" fossils were reported as being unfossiliferous while the only fossiliferous deposits belonging to this formation outcrop far to the North of the asphaltic deposits and merely yielded a few mollusca which, as reported by C. H. OOSTINGH, did not show any relationships to the "Oligocene" species. This last point also seemed to support MARTIN's views. In the meantime, THÖENES (1936) had published the results of a physico-chemical study of the Buton asphalts and though MARTIN claimed that THÖENES's results could support his "mud-volcano" hypothesis, it may be stressed that THÖENES at the time was of the opinion that at least a part of the asphaltic deposits could have been formed *in situ*. THÖENES recorded *Siphonalia semisulcata* (described from Waisioe) from the more northerly locality Kaboengka from which the present writer (1942, a) described a number of additional fossils while adhering to a shallow-water origin and an Oligocene age. The mollusca from Waisioe, Ktolemando, Tesoh and Kaboengka appeared to be both similar and (approximately) contemporaneous.

UMBGROVE in 1942 published the results of a study of corals from Buton and while supporting MARTIN's views on mud-volcano activity, he emphasized that the corals yet made the puzzle with regard to the age of the Molluscan fossils even more intricate as the former are definitely Neogene and younger. Some of the corals, mainly from Waisioe, are from one and the same sample of asphalt as the mollusca described by MARTIN, but most, if not all, are still living. There is, moreover, a mixture of deep water corals and shallow water species. The first are of the solitary type and beautifully preserved, the latter are reef corals and angularly fragmentary, apparently belonging to a different stratigraphical horizon.

2. Results of the revision of the mollusca.

a. Summary.

Summing up the present views, the mollusca from the asphaltic deposits of Buton are considered to be of a Miopliocene age and to have lived in the deepest part of the neritic zone (about 100 fathoms or more) or at least in cold water. So far, no data have come to light supporting the assumption of a mixture of mollusca derived from different stratigraphical horizons, but the possibility cannot be entirely excluded. Most, if not all fossils may therefore occur *in situ* in the asphalt-impregnated foraminifera deposits of the Sampalokossa Beds, but the possibility of displacement through mud-volcano activity cannot be denied altogether either.

The above conclusions are in good agreement with F. G. KEYZER's results. Both foraminifera and algae indicate a Miopliocene age for samples also yielding mollusca and for most of the other samples as well, with the exception of a sample from Wariti (Nr. 10) which is evidently of an Upper Miocene age. However, no mollusca have ever been reported from Wariti. Except for Wariti sample Nr. 10 (of a shallow water facies), the foraminifera examined by KEYZER would indicate a depth of deposition at from 100—250 fathoms. The algae, however, would rather suggest deposition at lesser depths, though the indications are somewhat contradictory and still leave the possibility of deposition at from 60—110 fathoms. KEYZER therefore concludes that the fauna may have lived at a probable depth of some 50—100 fathoms, in cold clear water.

TH. REINHOLD, finally, arrives at the conclusion that the diatoms examined by him, indicate a probable Upper Miocene age (equivalent to the "Globigerina Marls" of Java) and deposition in cold water. These results are obtained from the examination of samples from Waisioe and Kaboengka.

KEYZER in his paper on the foraminifera produces arguments supporting MARTIN's hypothesis of mud-volcano activity. Whether some of the mollusca could have been ejected from the Sampalokossa Beds in which they now appear to be *in situ*, I cannot judge, not knowing the situation at their localities.

b. Age determination.

It is quite evident at present, that the mollusca from the asphaltic marls of Buton are of a Neogene age since there appear to be living species among them. These are: *Polinices apora, Genota obsolescens* and *Limopsis dautzenbergi.* Using these for evaluation of the percentage of living forms as a means of determining the age of the Buton fauna would, however, be a fallacy since the facies conditions prevailing at the time of its existence were entirely different from the facies conditions known from a large number of Neogene localities in Java, Sumatra and Borneo. They are, however, best comparable to some of the "Miopliocene" and "Young-Neogene" or Pliocene localities in Timor and I am quite convinced that an increase in knowledge of the deeper neritic and deep-sea fauna will eventually result in revised age determinations of some of the "Young-Neogene" or "Miopliocene" faunas from Timor studied by Miss KOPERBERG and TESCH. Since faunal comparisons indicate closer ties between the Buton fauna and the Young-Neogene fauna of Timor than with other faunas, no more accurate age determination of the former can be given either than "Miopliocene".

I am also confident at present, that the percentage of living species in the Buton fauna may actually be considerably higher than apparent due to our imperfect knowledge of the living fauna of the deeper parts of the neritic zone and the bathyal region. The percentage method is therefore not used here for an age determination. However, in doing so, no harm is done since it is never fully relied on and if instead the new data available on the stratigraphic distribution of the fossils from Buton are considered, a not too vague age determination is arrived at anyway.

A few species have so far been exclusively observed in Young-Miocene faunas. However, these are rarely recorded forms, viz.,

Lyria overmanae (Young-Miocene of Sekoerau, East Borneo)
Diacra mbaënsis (Young-Miocene of Fiji)
Cavolina globulosa cranioides (Young Miocene of Fiji)

A species of fish, *Carcharodon megalodon,* is well-known from Miocene deposits and occurs occasionally in the Pliocene as well.

A number of mollusca are at present known to occur in "Young-Neogene" faunas. These are:

Cerithium gerthi (Young-Neogene = ? Pliocene of Nias)
Natica butonensis (Young-Neogene = ? Pliocene of Timor and of Tanah Belang, E. Borneo)
Latirus waisiuensis (Young-Neogene = ? Pliocene of Tanah Belang)
Genota obsolescens (Pliocene of Timor; Pliopleistocene of Nias)
Turris tricincta (Pliocene of Timor; Young-Neogene = ? Pliocene of Nias)

It need hardly be emphasized that these scant data are far from adequate for an accurate age determination. Nevertheless, they allow the assumption of a Miopliocene age. Since no detailed geological data are available yet on the fossil localities, the possibility cannot be excluded that we are dealing with both truly Miocene and Pliocene mollusca. This does not imply a belief in a Miocene age for the few fossils recorded exclusively from Miocene, nor, that all the other species are of the same age and younger than Miocene. For the time being, the present writer is inclined to believe that most of the mollusca recorded so far, if not all, are from approximately the same stratigraphic horizon and thus form a faunal unit. However, most important of all considerations at this stage is, that at least some of the fossils recorded from the asphaltic deposits occur in Young-Neogene faunas partly definitely of a Pliocene age and a comparable deep water facies apparently more or less confined to certain areas in Timor, Nias and East-Borneo (and Ceram). This may also explain the various, sometimes very close, relationships discovered between some of the fossils from Buton asphalts and forms derived from the islands mentioned above. These relationships are outlined in previous papers (BEETS, 1942, a, d; 1943; 1944) and also in the Systematical Part below. Here, we may refer to: *Alvania asphaltodes, Buccinaria retifera, Latirus venemai altenai, L. waisiuensis, Ancilla stupaeformis, A. latifasciata, Clavatula oostinghi, Genota hetzeli, G. tesohensis, Turris timorensis ktolemandoënsis, Borsonia rotundata, Lucina butonensis* and *Corculum weberi*. As to close relationships between fossils from Buton and living species, reference is made to *Buccinaria asphaltodes, Turricula ijzermani, Conus petrolei, Conus umbgrovei, Arca perinusitata, Vesicomya alberdinae* and *V. margotae*.

It is hoped that the Sampalokossa fossils derived from non-asphaltic deposits in North-Buton which were briefly examined by OOSTINGH and reported to show no relationships to the fossils first described by MARTIN, will be re-examined in the future.

c. Facies.

K. MARTIN (1933) regarded the fossils described by him to represent a shallow water facies. The present writer (1942, a) was of the same opinion on purely general grounds and also by being struck by the fact that a number of gastropods showed reparations of damaged shells. However, both the latter point as well as the presence of thick-walled shells actually do not appear to plead against a deep-water facies at all as is yet often misleadingly stated in literature.

Shortly after the start of revisions and the search for comparable fossils, things began to shape up differently. A definite deep-sea species was discovered in addition to the recognition of fossils from Buton in undescribed fossil faunas from East-Borneo which appeared to indicate an unusually deep water facies. A great many puzzling facts fell quite naturally into place.

The following new data have come to hand. Among the fossils appear to be present:

(1) a few species which apparently are deep-sea elements. These are:
Polinices apora, a living form recorded from depths of from 959—2060 m (temp. 39°5′ Fahr.).
Genota obsolescens, a living species recorded from depths ranging between 918—1143 m.

These species, though possibly by no means indicative of the considerable depths recorded, at least have never been recorded from the litoral and shallow neritic zone.

(2) elements which are usually dredged in the deep-sea but do also occur in the deeper parts of the neritic zone: *Euciroa* (represented by *Verticordia sparsa*), *Waisiuconcha* (represented by two Vesicomyas) and *Ledella*.

(3) species which either have been dredged from depths not far exceeding the lower boundary of the neritic zone (*Limopsis dautzenbergi*: 281 m) or which occur in Neogene deposits most probably formed at comparable depths: *Natica butonensis* and *Latirus waisiuensis*. Both occur at Tanah Belang, the former also in Timor in a deposit probably formed at a depth of from 250—300 m.

(4) species which occur in deposits which to all appearances were formed under shallower neritic conditions (*Lyria overmanae, Turris tricincta*).

The above data do not strongly suggest a mixture of fossils of different facies, with the possible exception of *Lyria overmanae* and *Turris tricincta*. However, similar indications for the possibility of a mixture are presented by other fossil faunas definitely occurring *in situ* as a faunal unit and are here no doubt due to vagaries of observation on bathymetric ranges of the living species. To mention an instance, *Lyria overmanae* occurs in a Miocene fauna of Sekoerau (East Borneo), which lived in shallow water, yet it contains a "deep-water" element, *Daphnella batjanensis* SCHEPMAN, which with a recorded depth of 397 m is seemingly out of place between a number of litoral-neritic species. One should also take into account that the fauna of the litoral and shallow neritic region is infinitely better known than the deep water fauna. Consequently, our knowledge of the bathymetric ranges of species can safely be assumed to show considerable gaps.

If one considers the fossils from Buton discussed here as one faunal unit, as I am inclined to do for the present, the tentative conclusion may be arrived at that this fauna lived at a depth around the lower limit of the neritic zone, or at least in cold water normally characterizing such depths.

This assumption is partly based on the absence of any species characterizing the shallower neritic or litoral zones (although this could be the result of vagaries in sampling), on the presence of teeth of *Carcharodon megalodon* which are usually found in deposits formed at depths exceeding those of the litoral and shallow neritic. Finally, on the affinities between fossils from Buton and others occurring in deposits evidently formed at depths ranging from 175—300 m approximately. Faunas occurring in deposits representing the last-mentioned category are:

Tanah Belang, East-Borneo (with forms closely related to *Cerithium gerthi, Buccinaria retifera, Genota tesohensis* and *Conus petrolei*).

Certain localities in Timor (yielding species closely related to *Buccinaria retifera, Ancilla stupaeformis* and *Genota tesohensis*) and Ceram (with species related to *Buccinaria retifera* and *Ancilla latifasciata*).

In addition, *Buccinaria asphaltodes, Turricula ijzermani, Conus petrolei* and *Arca perinusitata*, all show close affinities to living deep-sea species.

It is rather striking to notice that occurrences of Young-Neogene deposits of the particular facies described above should all be distributed so as to support the theory of a late Tertiary origin of the deep basins in the East Indies.

A fact which was very puzzling until now, is also readily explained by the apparent deep-water facies of the Buton fauna, viz. the curiously archaic character of part of the fauna: See BEETS, 1942, a, pp. 322—323. This is a quite common characteristic of the living deep-sea fauna. Apart from the data listed in the paper quoted, which at present do not appear to be confusing any more when accepting both the revised age and facies determination the presence of such peculiar groups as *Dentalloporna, Waisiolia, Butonius, Butonina* and *Clinura* as well as a number of species of strange appearance, emphasizes the archaic character of the Butonese fauna which compares well with archaic features of the living deep-sea fauna. This is also enhanced by the presence of presumable relics such as *Buccinaria* and *Eosipho*.

SYSTEMATICAL PART

The following abbreviations have been used throughout this section of the paper:

B. M. L.: "British Museum (Natural History)", London.
L. G. M.: "Rijksmuseum van Geologie en Mineralogie", Leyden.
N. H. B.: "Naturhistorisches Museum", Basle.
N. H. L.: "Rijksmuseum van Natuurlijke Historie", Leyden.
Z. M. A.: "Zoölogisch Museum", Amsterdam.

A. Mollusca

TURBO (DENTALLOPOMA) DENTICOLUMELLARIS BEETS

Ref.: BEETS, 1942 (a), pp. 267, 325, pl. 27, figs. 43—44. One additional specimen is available from the locality Waisioe (coll. N. H. B.). It is of about the same size as the holotype, but its frontal part is damaged while the apical portion is missing. As the outer shell layer is better preserved than in the type, some obsolete, rather broad and oblique costae are visible on the early portions of the spire. These disappear quite rapidly on the younger whorls. Growth-lines are not visible.

The posterior half of the outer lip is preserved, bearing a rather strong varix overridden by the spiral sculpture. The edge of the varix is quite sharp, its inside for the greater part smooth but for a few obsolete lirae.

ALVANIA ASPHALTODES BEETS

Ref.: BEETS, 1942 (a), pp. 268, 325, pl. 27, figs. 34—35. This species appears to be closely related to an undescribed species occurring in a Pliocene fauna from the Soengei Boesoe, East Borneo (coll. RUTTEN, L. G. M.).

CERITHIUM FLEMISCHI MARTIN

Refs.: MARTIN, 1933, p. 29, pl. 4, figs. 30—31; MARTIN, 1935, p. 111; BEETS, 1942 (a), pp. 272, 325, pl. 27, fig. 50. Two additional specimens are available, both from the locality Waisioe (coll. N. H. B.; coll. L. G. M., a specimen recently extracted from asphalt obtained from the "Rijkswegenbouw-Laboratorium", The Hague). The apex of this species is not known. The earliest postembryonic whorls appear to bear rather conspicuous riblets and a couple of less conspicuous spirals, the posterior one being stronger than the anterior and also bearing granules at an earlier stage. A third flat spiral is developed at an early stage. It is at best delicately granulate and is soon smooth. It disappears completely on the younger whorls.

CERITHIUM GERTHI BEETS

Refs.: BEETS, 1942 (a), pp. 272, 325, pl. 28, figs. 53—54; BEETS, 1942 (d), p. 352; WISSEMA, 1947, p. 73. A series of specimens from SCHROEDER's loc. 96 (Nias) became accessible in 1943, while previously specimens from SCHROEDER's loc. 95 were the only ones available for comparison. These prove to be rather extreme representatives. Consequently, I assumed them to be "closely related" instead of synonymous.

It may be added that a closely related species is present in an undescribed collection from Young-Neogene, probably Pliocene deposits of East-Borneo (coll. M. SCHMIDT, L. G. M., loc. Tanah Belang). The Tanah Belang fauna evidently lived at a quite considerable depth.

POLINICES APORA (WATSON)

Refs.: WATSON, 1885—1886, p. 454, pl. 27, figs. 11a—b; SCHEPMAN, 1908—1913, prt. 2, p. 217. This recent deep-sea species was originally recorded from a locality near the Aroe Islands (depth 800 fathoms, green mud, bottom temp. 39°5′ Fahr.). SCHEPMAN recorded it from the following depths: 959, 1788, 2029 and 2060 m.

Two recently acquired specimens from the locality Waisioe (coll. L.G.M.) were first identified by means of the literature and the "Siboga" specimens (Z. M. A.) and finally also compared with the type material in the B. M. L. The fossils are perfectly similar to the *forma typica* which has a comparatively high spire. They are also comparable to some of the "Siboga" specimens. [1]

It may be added that *Natica atricapilla* MARTIN (MARTIN, 1883—1887, p. 167, pl. 8, fig. 162, from the well Ngembak, B, interval between 104—112 m) is probably synonymous with *P. apora*, but the absence of intermediates connecting the juvenile type of MARTIN's species with the more mature specimens so far available of *P. apora*, prevents deciding this point.

NATICA BUTONENSIS BEETS

The above new name for *N. radians* MARTIN (nec BOETTGER) was recently proposed (BEETS, 1950, p. 331) and a synonym quoted from the Pliocene of Timor. The species appears to be also present in SCHMIDT's collection from Tanah Belang, East-Borneo (coll. L. G. M.), which is most probably of a Pliocene age and represents a comparatively deep-water facies.

N. butonensis is represented by a series of additional specimens from Waisioe (coll. N. H. B., nine specimens); (coll. L. G. M., a number of specimens, recently extracted from Waisioe asphalt).

PHALIUM (SEMICASSIS) VANDERVLERKI (MARTIN)

Refs.: MARTIN, 1933, p. 27, pl. 4, figs. 27—27a; MARTIN, 1935, p. 111. An additional well preserved specimen about equal in size to the type is available from Waisioe (coll. N. H. B.).

BUCCINARIA (EOSIPHO) ASPHALTODES (BEETS)

Refs.: BEETS, 1942 (a), pp. 279, 325, pl. 28, figs. 62—63; BEETS, 1942 (d), p. 352. As was pointed out before, the species is distantly related to the living *B. smithi* (SCHEPMAN) from the Celebes Sea.

For observations on the affinities between *Buccinaria, Eosipho* and *Ootomella*, I refer to previous papers (BEETS, 1943, 1944). It may be pointed out here that the genus *Dalium* DALL, 1889, which was described from the West Indies (DALL, 1886—1889, II (1889), p. 230, pl. 19, fig. 10a; WENZ, 1942—1943, prt. 5, 1942, p. 1048, text fig. 3001) may well be synonymous with *Eosipho* (WENZ, l. c., p. 1154, fig. 3280, compare particularly SCHEPMAN's figures of the type, *E. smithi*). DALL, however, compared *Dalium* with *Oocorys*, while WENZ also considered *Dalium* a member of the Cassididae, placing it near *Sconsia*. A re-examination of the type material may solve the problem.

BUCCINARIA (OOTOMELLA) RETIFERA (MARTIN)

Refs.: MARTIN, 1933, p. 26, pl. 4, figs. 25—25a; MARTIN, 1935, p. 111; BEETS, 1942 (a), pp. 280, 325. There is one additional specimen from Waisioe (coll. N. H. B.), 25 mm long and belonging to the more slender variety of this species.

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[1] Some of these, from Station 300, E. Timor, depth 918 m., are provided with a blunt apex. In my opinion they represent a separate species.

B. retifera is closely related to *B. jonkeri* (KOPERBERG), *B. martini* (KOPERBERG) and *B. koperbergae* (MARTIN). These species form a group of Young Neogene Ootomellas recorded from Java, Nias, Timor, Ceram and East-Borneo (Tanah Belang).

LATIRUS (PERISTERNIA) VENEMAI ALTENAI (BEETS)

Ref.: BEETS, 1942 (a), pp. 277, 325, pl. 28, figs. 59—61. This subspecies was described as *Neptunea* (*Sipho* ?) *altenai*. A single additional specimen (alt. 40 mm) is available from Waisioe (coll. N. H. B.) and the body-whorl of a damaged specimen recently extracted from asphalt from the same locality (coll. L. G. M.). The first-mentioned specimen is slender, its features necessitating a revision of the complete material of *L. altenai* in close comparison with *Sipho* (?) *venemai* KOPERBERG (1931, p. 98). The relationships between these species were not stressed sufficiently by the present writer in 1942, the existing slight differences probably being only of a subspecific value.

The new shell from Waisioe has 17 - 15 - 13 - 12 - ? 11 ribs per whorl (in apical direction). Recent comparisons revealed that the previously assumed differences in the number of ribs between *L. altenai* and *L. venemai* actually do not exist at all. In addition, the costae of *L. venemai* actually are not clearly wider than in *L. altenai*, at least not constantly so, while in most cases they appear to be perfectly similar in both species. The whorls of *L. venemai* are more obese than in the holotype of *L. altenai* and in the specimen of fig. 61 quoted above, but certainly not more than in its paratype. The "channelled" appearance of the suture in *L. altenai* actually appears to be caused merely by a peculiarity of the preservation of the Butonese specimens. Underneath an outer, more resistant shell layer, which is, however, missing along the suture, occurs a powder-like substance, which was corroded when no longer protected by the outer layer. The new specimen from Waisioe shows a very obsolete anterior columellar "plait", or rather, spiral inflation, as in *L. venemai*.

There are, however, certainly some differences between *L. venemai* and *L. altenai*: (1) the columella of *L. venemai* is decidedly more concave than in *L. altenai*; (2) the costae of *L. venemai* are more curved than in *L. altenai*; (3) on its younger whorls, *L. venemai* bears much wider spirals than *L. altenai* and these are separated by markedly narrower interspaces.

LATIRUS (PERISTERNIA) WAISIUENSIS (MARTIN)

Ref.: MARTIN, 1933, p. 24, pl. 3, figs. 21—21a. This species appears to be present also in the deep-water fauna of Tanah Belang, East-Borneo (coll. M. SCHMIDT, L. G. M.).

It appears to be quite difficult to distinguish *L. waisiuensis* from *L. jonkeri* KOPERBERG (1931, p. 96, pl. 3, fig. 35). Representatives of the latter species occurring in the fauna of Tanah Belang are often merely slightly slenderer than *L. waisiuensis*. They have, however, invariably a smaller number of spirals on the shoulder than *L. waisiuensis*, viz. 4 (and 5 spirals in front of the shoulder-angle), instead of 5 (and 4 anterior spirals). The type of *L. jonkeri* bears 13 ribs on its penultimate whorl and 13 - 12 - 11 - 10 costae on the earlier whorls. The profiles of the whorls may be almost similar in both species, i. e., in case the shoulder-angle in *L. jonkeri* has moved in an anterior direction while the whorls are flat behind it. Usually, however, the rounded earlier whorls in *L. jonkeri* change much later into shouldered ones than in *L. waisiuensis.*

LATIRUS (PERISTERNIA) KTOLEMANDOENSIS (MARTIN)

Ref.: See below, discussion of *Manaria.* This species shows affinities to "*Euthriofusus*" *wanneri* FISCHER from Ceram and Timor (KOPERBERG, 1931, p. 93). Both species belong to a distinct group of species within *Latirus.*

Notes on Manaria E. A. SMITH, 1906

This genus was proposed for a specimen dredged in the Gulf of Manaar, *Manaria thurstoni* SMITH (1899—1906, vol. 18, p. 167; Illustr. "Investigator", prt. 6, 1909, moll. pl. 21, figs. 6, 6a; depth 401 fathoms). Its whorls are slightly convex and covered with flat axial costae and spirals. Its aperture is rather narrow, with a short anterior canal. The outer lip has a sharp edge though it is supported by a varix-like rib which on its inside bears some toothlike plications. The columella is somewhat concave and bears a slightly oblique fold. SMITH remarked: "This genus has the general aspect of a costate *Tritonofusus,* but is distinguished by the fold on the columella and the lirate aperture".

So far, no additional recent species of *Manaria* have been described. However, in the last two decades a few fossil species of *Latirus* were described from the East Indies which were not compared with *Manaria* up to now, but appear to show similar features. These are: *L. jonkeri* (KOPERBERG) KOPERBERG, 1931, p. 98 [*Sipho*], pl. 3, fig. 36), *L. venemai* (KOPERBERG) (KOPERBERG, 1931, p. 99 [*Sipho*], pl. 3, fig. 37) and *L. venemai altenai* (BEETS) [*Sipho* ?] (see above), all three having been compared at the time with *Tritonofusus.* They show an obsolete or more conspicuous columellar fold and would fit well in *Manaria.* This is made even more acceptable by the features of a few other related species, viz. *Latirus* (*Peristernia*) *ktolemandoënsis* (MARTIN) (MARTIN, 1933, p. 25, pl. 3, figs. 22—22a) and *L.* (*P.*) *waisiuensis* (MARTIN) (see above). Both the latter species possess an obsolete columellar fold and the features of their outer lips combined with other characteristics, refer them to *Peristernia* with which I would also identify *Manaria.* Another species belonging to the group of the above-mentioned species is *Latirus jonkeri* KOPERBERG (1931, p. 96). This is not the same species as was described as *Sipho jonkeri* (see above) which should be renamed¹). *L. jonkeri* was described as a species with obsolete columellar plaits. Yet, a close comparison of the type material reveals that its columella actually bears one rather well developed fold (*forma β*: Loc. Nitoe Papan) and in addition may have two or three more (obsolete) folds, in the latter case one behind the primary fold and two in front of it.

To this group of species may be added *Euthriofusus wanneri* FISCHER (KOPERBERG, 1931, p. 93) from Ceram and Timor. This species does not belong to *Euthriofusus* at all but compares very well with the group of *Latirus* discussed in the present paper²). A specimen recorded from Timor by Miss KOPERBERG is quite similar to the type of *L. ktolemandoënsis* but its

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¹) I refrain from doing so, until the classification followed here should eventually be accepted by other malacologists.

²) v. REGTEREN ALTENA (1948) came independently to the conclusion that this species should be assigned to *Pisania.* The present writer is unable to share this opinion.

columella is smooth; a co-type from Ceram in the L. G. M. has a well developed siphonal fasciole.

A number of the above species occur in the Pliocene "deep-water" deposits of Tanah Belang, East Borneo (Coll. M. SCHMIDT, L. G. M.) and form there a very well-represented group of inter-related species; viz. *Latirus thurstoni* [*Manaria*], *L. jonkeri* (originally described as a *Latirus*), *L. waisiuensis* and two undescribed species.

After a careful comparison of the features of the species mentioned above, the writer is firmly convinced that they all belong to one and the same systematical unit. The more typical Peristernias amongst them (*L. waisiuensis, L. ktolemandoënsis, L. jonkeri*), with more conspicuously shouldered whorls, are clearly linked with *Manaria thurstoni* (with flatter whorls) by a number of intermediate forms (*"Sipho" jonkeri, "S." venemai, "S." venemai altenai,* and the two new species of *Latirus* from Tanah Belang).

The development of the columellar folds is quite variable in this group of species, even within the confines of each species. The "Siphos" among them, from Timor and Buton, show an obsolete columellar fold which may be absent. The Butonese species of *Latirus* bear an obsolete fold; others from Tanah Belang and Timor, a columellar fold which may be rather well developed (as in *Manaria*) but varies quite considerably in *L. jonkeri*: from very obsolete to quite strong and in the latter case sometimes accompanied by additional obsolete folds (two or three).

There is little variation in the development of the siphonal fasciole. *Latirus jonkeri* and *L. ktolemandoënsis* have an obsolete siphonal fasciole, *L. waisiuensis* a very obsolete one. *Manaria thurstoni* has a rather obsolete fasciole and the same applies to the fossils described as "Siphos" in which it may be even absent altogether.

The whorls of *Manaria thurstoni* are covered with broad flat spirals lying at close intervals and so are the whorls of the "Siphos" mentioned above which, however, in this respect overlap on the variation of the group of *Latirus* species some of which show narrow spirals lying at wide intervals.

The variation shown by the species discussed compares well with that of *Peristernia* in general: the siphonal fasciole varies from being very obsolete to well-developed, the columella may bear but one well-developed fold, but in the most typically developed species there may be one to two additional but less conspicuous folds; the whorls may be inflated, shouldered or flat (cf. *Ascolatirus* BELLARDI, 1884).

Therefore, the writer is of the opinion that *Manaria* and *Peristernia* are synonymous. Their genotypes happen to be quite extreme representatives of what I am convinced is actually a single systematic unit.

FUSINUS (BUTONIUS) PECTINATUS (MARTIN)

Refs.: MARTIN, 1933, p. 23, pl. 3, figs. 20—20a; 1935, p. 111; BEETS, 1942 (a), pp. 284, 325, pl. 28, fig. 69. From the locality Waisioe (coll. N. H. B.), a fragment of a shell is available consisting of the body-whorl and penultimate whorl. It shows the straight columella typical for the species and the spiral sculpture which is stronger, and the outer lip less callous than in *F. perinusitatus* BEETS (1942, a, p. 284, pl. 28, figs. 70—72). The ribs are less curved and the profile of the body-whorl flatter than usual.

F. perinusitatus might prove to be synonymous with *F. pectinatus* when more material becomes available.

SIPHONALIA (PSEUDONEPTUNEA) SEMISULCATA MARTIN

Refs.: MARTIN, 1933, p. 25, pl. 3, figs. 23—24; BEETS, 1942 (a), pp. 281, 325, pl. 28, fig. 68. Two damaged specimens are available from Waisioe (coll. N. H. B.), while two fragments from the same locality, perhaps belonging to one specimen, were recently added to the Leyden collection (L. G. M.).

LYRIA (HARPELIA) OVERMANAE BEETS

Ref.: BEETS, 1942 (a), pp. 294, 325, pl. 29, figs. 86—88. There is a specimen of a *Lyria* present in a Young-Miocene collection from Sekoerau, East-Borneo, which is strikingly similar to the type of *L. overmanae*. Unfortunately, the Bornese specimen is damaged, only its spire being left. Consequently, its identity cannot be fully ascertained.

BUTONINA

Some years ago (BEETS, 1942, a, pp. 290—291), representatives of *Butonina* were compared with other Mitridae but a comparison with *Volutomitra* was omitted. The type of *Volutomitra* is the living *V. groenlandica* (MÖLLER) which has also been recorded from post-tertiary deposits of England. There can be no doubt that the Volutomitras do resemble the Butoninas in many ways, particularly *Volutomitra* s.str., but the latter's representatives have 3—4 columellar plaits running more obliquely than in *Butonina* and placed more anteriorly. Again, the whorls of *Volutomitra* are inflated and there is a distinct, though inconspicuous siphonal fasciole and a corresponding shallow sinus of the anterior canal (contrary to THIELE's statement: 1929—1935, p. 351). The edge of the outer lip fails to form a broad and shallow posterior sinus as is present in *Butonina*.

An undescribed *Butonina* from the Pliocene of Timor (coll. MOLENGRAAF, loc. XVIII) appears to combine the possession of fairly conspicuous columellar plaits with a more conspicuous axial sculpture than normally occurs in *Butonina*. Oddly enough, it seems also possible to connect *Butonina* with a group of Psephaeas from the "deep-water" deposits of Tanah Belang, East-Borneo (coll. L. G. M.).

CLAVATULA OOSTINGHI BEETS

Ref.: BEETS, 1942 (a), pp. 295, 325, pl. 29, figs. 89—90. This species appears to be very closely related to an undescribed species from Nias (coll. SCHROEDER, L. G. M.). The Nias specimen has a few more ribs, viz. 10-10-10-8-7-7 ribs per whorl instead of 8-7-7-8 as in *C. oostinghi*, while its ribs do not disappear on the body-whorl. The characteristic callous inflation of the columella is perfectly similar to the one in *C. oostinghi*. However, the anal notch of the Nias specimen is shallower and wider than in *C. oostinghi* in which it is deep and rather narrow. Behind the anal notch, the outer lip is merely slightly protruded and the notch not so close to the suture as in *C. oostinghi*. The posterior depression of the earlier whorls of the Nias specimen is much shallower and the ribs narrower and more oblique than in *C. oostinghi*. The Nias specimen is also plumper than *C. oostinghi*.

I believe, however, that the differences outlined are merely of a subspecific value.

TURRICULA IJZERMANI (MARTIN)

Ref.: MARTIN, 1935, p. 114, pl. 2, figs. 5—5a. This species appears to be closely related to the living *T. eurina* SMITH (1899—1906, vol. 4, p. 239 (1899); Illustr. "Investigator", prt. 3, 1901, moll. pl. 9, figs. 4—4a) while also showing affinities to *T. thisbe* SMITH (1899—1906, vol. 18, p. 162 (1906); Illustr. "Investigator", prt. 5, 1908, moll. pl. 20, figs. 1—2).

GENOTA (BATHYTOMA) HETZELI (MARTIN)

Ref.: MARTIN, 1933, p. 21, pl. 3, figs. 16—16a. This species appears to be very closely related to an undescribed species from the Pliocene of Besleo, Timor (coll. L. G. M.).

GENOTA (BATHYTOMA) OBSOLESCENS (VON MARTENS)

Refs.: VON MARTENS & THIELE, 1903, pp. 86—87, pl. 1, fig. 12 (var.: fig. 12a); SCHEPMAN, 1908—1913, prt. 6, 1913, p. 405 (*Dolichotoma atractoides* var. *obsolescens*). A specimen from Buton recorded by the present writer as *G. tesohensis* (BEETS, 1942 (a), p. 298 (pars), 326 (pars), pl. 29, fig. 108 exclusively) appears to agree in every respect with a recent specimen from the Timor Sea (depth 918 m) recorded by SCHEPMAN (coll. Z. M. A.), as was pointed out some time ago (BEETS, 1950, p. 335). Both specimens agree with VON MARTENS' figure of a specimen dredged near Nias at a depth of 1143 m. Additional fossil specimens of *G. obsolescens* appear to be present in Pliocene collections from Timor (Besleo) and Nias (coll. SCHROEDER, loc. 94), in the L. G. M.

GENOTA (BATHYTOMA) TESOHENSIS MARTIN

Refs.: MARTIN, 1933, p. 21, pl. 3, figs. 17—17a; BEETS, 1942 (a), pp. 298 (pars), 326 (pars: excluding the specimen from ? Waisioe: fig. 108: see *G. obsolescens* above), pl. 29, fig. 109.

A closely related form appears to occur in Pliocene deposits of Timor and East-Borneo. It was described as *Pleurotoma herklotsi* MARTIN by TESCH (1915—1920, prt. 1, 1915, p. 35, pl. 6, figs. 72—73) and in addition considered to be synonymous with *G. ornatissima* (MARTIN). I believe that the material described by TESCH is decidedly not con-specific with *G. ornatissima* but warrants description as a subspecies of *G. tesohensis*, a paper on the subject being in preparation.

TURRIS BUTONENSIS (MARTIN)

Ref.: MARTIN, 1933, p. 19, pl. 2, figs. 12—13. As MARTIN pointed out, this species shows affinities to both *T. gendinganensis* (MARTIN) [*T. indica* (Roeding)] and *T. unedo* (VALENC.). It is also reminescent of, but plumper than, *T. tigrina* (Lamarck) [*T. acuta* (Perry)].

TURRIS TIMORENSIS KTOLEMANDOENSIS (MARTIN)

Refs.: MARTIN, 1933, p. 20, pl. 2, figs. 14—14a; 1935, p. 114, pl. 2, fig. 4; BEETS, 1942 (a), pp. 298, 320, 326. The close relationships between *T. timorensis* (TESCH) and *T. ktolemandoënsis* were first pointed out by R. IJZERMAN (teste MARTIN). After a careful comparison between the type specimens of these forms, I am convinced that the slight differences existing between them are at best of a sub-specific value and that additional material that may come to hand, may well prove them to be con-specific.

TURRIS TRICINCTA (MARTIN)

Ref.: MARTIN, 1935, p. 113, pl. 2, figs. 2—2a. As was pointed out recently (BEETS, 1950, p. 335), a specimen from Timor figured by TESCH as *Pleurotoma carinata* GRAY (TESCH, 1915—1920, prt. 1, 1915, p. 25 (pars), pl. 4, figs. 44a—b exclusively) actually represents *T. tricincta*. The type was only partially cleared from asphalt and consequently some of its features remained unobserved. After careful cleaning, its close relationships with TESCH's *P. carinata* ("bauchige Form") became most apparent. *T. tricincta* is also present in Young Neogene deposits of Nias (coll. SCHROEDER, loc. 96; L. G. M.).

The Nias specimen agrees with both TESCH's specimen mentioned above and the type of *T. tricincta*. The first and last-mentioned shells and a few additional specimens from the Pliocene of Besleo, Timor (L. G. M.), prove that the keel bearing the anal notch may be narrower than in TESCH's specimen. Also, that the posterior of the three spirals over this keel may detach itself from it, moving backwards onto the shoulder of the whorls until it runs at about 1½ mm distance from the keel. This detached spiral becomes simultaneously elevated. Posteriorly of it, the shoulder bears two spirals which are decorated with densely arranged transverse denticles whereas the newly added spiral in front of these bears granules lying at equal but wider intervals and being similar to those on the spirals of the main keel.

The hindermost spiral of the shoulder, lying just in front of the suture, may be less conspicuous than the one in front of it. Sometimes, however, it is stronger. Both may be subdivided, particularly the posterior spiral. Sometimes, both are almost smooth. In case a third spiral detaches itself from the main keel, the distance between this third spiral and the one behind is less than between the latter and the posterior spiral.

Finally, the spirals present in front of the main keel on the body-whorl appear to be variable. These may be either flat, elevated, strong, broad or comparatively inconspicuous.

PERRONA NUDATA (MARTIN)

Refs.: MARTIN, 1935, p. 113, pl. 2, fig. 3; BEETS, 1942 (a), p. 326. This species might actually be a *Bathytoma*, although the type specimen does not bear a columellar plait. Plaits are, however, frequently absent in part of the specimens of certain species of *Bathytoma*. Additional material should indicate the correct systematic position of *P. nudata*.

CONUS (LEPTOCONUS) PETROLEI MARTIN

Refs.: MARTIN, 1933, p. 17, pl. 2, figs. 9—9a; 1935, p. 111; BEETS, 1942 (a), pp. 301, 326. A fine additional specimen from Waisioe is available (coll. L. G. M.) and two other specimens from the same locality (coll. N. H. B.).

An undescribed species from Pliocene "deep-water" deposits of Tanah Belang, East-Borneo (coll. L. G. M.) appears to be closely related to *C. petrolei*.

The same seems to apply to an East African deep-sea specimen described as *C.* cf. *torquata* by VON MARTENS & THIELE (1903, p. 75, pl. 1, fig. 1). Another related species appears to be *C. papillaris* ADAMS et REEVE, the type of which was compared in the B. M. L.

CONUS (LEPTOCONUS) PLAGIARIUS MARTIN

Plate, Figs. 3—4

Ref.: MARTIN, 1935, p. 112, pl. 2, figs. 1—1a. At present, two specimens are available from Waisioe (coll. N. H. B.), 22 and 33 mm long respectively. The biggest specimen is well preserved, especially its protoconch which appears to be composed of 1½ smooth whorls. There are 8½ post-embryonal whorls, six of these bearing peripheral granules. The upper portion of the spire is steeper than in the type specimen.

CONUS (LEPTOCONUS) ASPHALTODES spec. nov.

Plate, Figs. 1—2

The holotype is 54 (+ ?) mm long. The spire is more turreted than in *C. petrolei* (see above), its stepped whorls being excavated and separated by a keel lying close to the anterior suture. The steps are much more inclined than in *C. petrolei* and the profile of the spire is different too. The apical portion is damaged but it may be stated that the early whorls bear a granulate keel which becomes smooth on the younger whorls. The whorls of the spire are covered with numerous delicate spiral striae. The growth-lines are well-developed and more concave than in *C. petrolei,* the deepest part of the sinus being more distant from the posterior suture than in *C. petrolei.*

The body-whorl is plumper than in *C. petrolei* and in addition not constricted anteriorly. The columella is not concave as in *C. petrolei* and its basal portion shows but little curvation. In front of the keel runs a conspicuous spiral and anteriorly of this, numerous delicate spiral striations. The latter are wider on the anterior portion of the body-whorl (though more delicate than in *C. petrolei*) and separated by conspicuous grooves. According to the growth-lines, the outer lip is protruding slightly more than in *C. petrolei.*

The type is from Waisioe (coll. N. H. B.).

DIACRA MBAENSIS LADD

Ref.: LADD, 1934, p. 237, pl. 42, figs. 6—7. A synonym is *D. kipasiformis* BEETS (1942, a, p. 304, pl. 29, figs. 98—100) as was pointed out recently (BEETS, 1950, p. 336). *D. mbaensis* was described from Upper Miocene deposits of Fiji.

CAVOLINA BITUMINATA spec. nov.

Plate, Figs. 5—7

The holotype is from Waisioe (coll. N. H. B.). It is more or less intermediate between *C. limatula* BEETS (1942, a, p. 305, pl. 29, figs. 117—119) and *C. globulosa cranioides* (see below). The type is 3.3 mm long, 2.1 mm wide and 1.5 mm in vertical diameter. The dorsal lip moderately convex, for its greater part smooth but for three anterior radial folds. These are inconspicuous, the median fold being best developed. Anteriorly, the lip is folded over the aperture. Posteriorly, it widens much more than in *C. limatula* and ends in a spine which is flat above and has a narrower base than in *C. limatula*. It is also more curved but the various growth-stages even in one and the same species of Cavoliniinae may vary considerably in this respect. On either side of the median spine, the shell forms a short spine, which is better developed than in *C. limatula*. Unlike in *C. limatula*, the anterior portion of the dorsal lip of *C. bituminata* fails to form a fold almost along its periphery.

The ventral lip is more inflated than in *C. limatula* and more conspicuously truncated anteriorly, its edge along the aperture barely turned back. The aperture is narrower than in *C. limatula*, its central portion slightly widened because of the presence of a very shallow median sinus of the ventral lip.

CAVOLINA GLOBULOSA CRANIOIDES BEETS

Ref.: BEETS, 1942 (a), p. 306, pl. 29, figs. 120—123. As was pointed out recently (BEETS, 1950, p. 336), fossils of the same size recorded by LADD (1934, p. 235, pl. 42, figs. 2—3) from Upper Miocene deposits of Fiji as *C. globulosa* RANG, appear to be synonymous with *C. cranioides*. After repeated careful comparisons between *C. cranioides* and recent specimens of *C. globulosa*, I am convinced that *C. cranioides* is but a small-sized subspecies of *C. globulosa*, the living form usually having more than twice the size of the fossil form. It may be added that NOMURA & ZINBÔ (1934, p. 128) recorded *C. globulosa* from Pliocene deposits of the Ryukyu Islands, these fossils also being smaller than is usually the case, though they are somewhat bigger (up to 5.5 mm long) than the representatives of *C. globulosa cranioides*.

C. moluccana FISCHER (1927, p. 109, pl. 4, figs. 96a—c) is related to *C, globulosa cranioides*, as was pointed out in 1942. Though FISCHER described the edge of the dorsal lip as being thickened, it may be assumed that he actually referred to the peripheral fold as is present in *C. globulosa* too. The relationships between *C. moluccana* and *C. globulosa cranioides* may be closer than FISCHER's description and figures indicate, but the writer is not in a position any more to undertake a comparison between the type specimens.

ARCA ASPHALTODES BEETS

Ref.: BEETS, 1942 (a), p. 309, pl. 30, figs. 136—138. A related species is the living *Bathyarca pisum* DALL, BARTSCH et REHDER (1938, p. 19, pl. 3, figs. 1—4) from Hawaii.

ARCA (ACAR) PERINUSITATA BEETS

Ref.: BEETS, 1942 (a), p. 310, pl. 30, figs. 124—127. This species appears to be more closely related to the living *A. incerta* SMITH than was thought when comparing the material collected on the Siboga-Expedition (See PRASHAD, 1932, p. 52), any special reference to *A. incerta* therefore being omitted in my paper of 1942. The type material in the B. M. L. (compare SMITH, 1899—1906, vol. 4, p. 25 (1899); Illustr. "Investigator", prt. 3, 1901, moll. pl. 13, figs. 3—3a) attains larger sizes than the Siboga-material and approaches *A. perinusitata* more than does the "Siboga" material. However, although *A. incerta* and *A. perinusitata* have the same general outlines and sculpture, the fossil species is considerably larger and lacks a radial depression with a corresponding sinus in the ventral margin as are developed in *A. incerta*.

LIMOPSIS DAUTZENBERGI PRASHAD

Ref.: PRASHAD, 1932, p. 60, pl. 2, figs. 13—14. A synonym is *L. butonensis* BEETS (1942, a, p. 311, pl. 30, figs. 139—142) as was pointed out recently (BEETS, 1950, p. 337).

LIMA FULGURANS MARTIN

Refs.: MARTIN, 1933, p. 14, pl. 1, fig. 1; 1935, p. 111. This species is represented by a cast, about 130 mm high, with part of the shell still adhering to it: Loc. Waisioe? (coll. VAN NELLENSTEYN, "Rijkswegenbouwlaboratorium", The Hague).

VOLSELLA FLEMISCHI MARTIN

Refs.: MARTIN, 1933, p. 14, pl. 1, figs. 2—3; 1935, p. 111. This species is represented in the N. H. B. collection by a number of poorly preserved valves. Loc. Waisioe.

LUCINA (PSEUDOMILTHA) spec. nov.

Ref.: MARTIN, 1933, p. 16, pl. 1, fig. 6. A single valve is available from the locality Waisioe (?) (coll. "Instituut voor Mijnbouwkunde", Delft) which compares very well with the specimen figured by MARTIN. A full description of this new species, which is distantly related to *L. hetzeli* MARTIN (1933, p. 15, pl. 1, figs. 5—5a; BEETS, 1942, a, p. 313, pl. 30, figs. 152—153), is omitted for the time being.

LUCINA BUTONENSIS BEETS

Ref.: BEETS, 1942 (a), p. 314, pl. 30, figs. 143—146. This species is closely related to both *L. petrolei* MARTIN (as was pointed out in 1942) and an undescribed species from the Pliocene of Timor in the collections of the "Instituut voor Mijnbouwkunde", Delft (labelled: *Lucina* spec., loc. M. XIX). The latter has a comparatively longer lunule and different posterior, ventral and anterior outlines. Distantly related to both *L. butonensis* and *L. petrolei* are *L. tenuicrusta* MARTIN and *L. serana* FISCHER.

CORCULUM (CTENOCARDIA) WEBERI spec. nov.

Plate, Figs. 8—10

The holotype is a small left valve (loc. Waisioe, coll. N. H. B.). It is 3.3 mm long, 3 mm high, its inflation (1 ×) 1.3 mm. It has a distinct posterior radial keel in front of which the valve is moderately inflated, posteriorly of it inconspicuously concave. In front of the keel are 17 flat radial ribs, the anterior ones narrower. Their interspaces are finely punctate due to the presence of concentric striae which do not override the ribs. The lunule small and narrow as well as inconspicuous. Posteriorly of the radial keel, there are 11 ribs of different sizes. Some of the riblets on the anterior portion of the valve, particularly the anterior-most of these, bear 2—3 or sometimes a few more short, concentrically stretched denticles. The area is narrow and rather deeply concave.

The inside of the valve with delicate radial grooves, the margin accordingly crenulated. The hinge consisting of an anterior lateral tooth, a conical cardinal tooth (behind it a deep socket) and a posterior inconspicuous lateral tooth accompanied below by a shallow socket for the lateral of the right valve.

C. weberi is related to an undescribed species from the Miocene of East-Borneo which will be described in a separate paper.

WAISIUCONCHA

Waisiuconcha was proposed as a new genus of Veneridae (BEETS, 1942, a, p. 315), the diagnosis being based on a left valve described as *W. alberdinae*. This valve shows an impression on its inside close to the anterior adductor scar which at the time was erroneously interpreted as a socket for an anterior tooth of the right valve so far not observed. Comparisons have shown since that *Waisiuconcha* undoubtedly belongs to the Vesicomyinae. The hinges of the left valves of Vesicomyas are often truly Venerid, the hinges of the right valves, of course, are entirely different. Similar misinterpretations have been made previously, according to the literature.

Waisiuconcha is at present considered a section of *Vesicomya*, the "socket" mentioned above being merely a more or less separate muscle scar of the main anterior adductor.

W. alberdinae and the new species described below, as well as certain living Vesicomyas, form a group which cannot easily be included in the genus *Kellyella* as does THIELE (1929—1935, prt. 2, p. 854), judging from the hinge characters. For the time being, I prefer considering *Vesicomya* a separate genus. When comparing its representatives with the Butonese Waisiuconchas, I obtained the impression that *Waisiuconcha* might be tentatively retained as a separate section of *Vesicomya*.

Living species belonging to *Waisiuconcha* are: *Vesicomya indica* SMITH (SMITH, 1899—1906, vol. 14, 1904, p. 7; Illustr. "Investigator", prt. 4, 1907, moll. pl. 17, figs. 4, 4a—c); *V. brevis* SMITH (SMITH, 1899—1906, vol. 18, 1906, p. 261; Illustr. "Investigator", prt. 5, 1908, moll. pl. 20, figs. 7—8); *V. solidissima* PRASHAD (PRASHAD, 1932, p. 152, pl. 9, figs. 1—4). Perhaps also: *V. lepta* (DALL) (SMITH, 1900, pp. 82—83, text fig. 2; DALL, 1908, p. 416, pl. 18, figs. 13—14) and *V. stearnsii* DALL (DALL, 1921, p. 40, pl. 1, figs. 6—7).

The Waisiuconchas are quite different from *Vesicomya* s.str., the type of which is *V. atlantica* (SMITH) (SMITH, 1885, p. 157, pl. 6, figs. 8, 8a—b). The former are also different from *Callogonia* DALL, 1889, the type of which, *V. leeana* (DALL), possesses a distinct angular pallial sinus, as does *V. angulata* DALL (DALL, 1908, p. 419, pl. 6, fig. 12). *Veneriglossa* DALL, 1886, appears to be different from *Waisiuconcha* too. THIELE considered *Atopodonta* COSSMANN, 1887, as a synonym of *Veneriglossa*. A tentative analysis of *Veneriglossa* was made some years ago in connection with the discovery of *Atopodonta* in the Neogene of the East Indies and Philippines (BEETS, 1942, b), but no confirmation of the assumed differences between *Veneriglossa* and *Atopodonta* could be obtained since the type of *Veneriglossa* was not figured by DALL. The genotype is *V. vesica* (DALL) (DALL, 1886—1889, vol. 12, 1886, pp. 275—276). A photograph showing the outside, and pen and ink sketches of the hinges of co-types kept in the Museum of Comparative Zoology, Harvard College, were kindly put at the writer's disposal by Mr. R. W. FOSTER, Department of Mollusks. It appears to be a small-sized species, with conspicuous concentric sculpture and hinge characters which do not agree with *Waisiuconcha*. *Veneriglossa* is, I believe, more closely related to *Vesicomya* s.str.

The last section of *Vesicomya*, *Archivesica* DALL, 1908, appears to be closely related to *Waisiuconcha*. Its type is *V. gigas* DALL (DALL, 1908, p. 418, pl. 16, fig. 9). Its lunule is not circumscribed by a line and its shape very different from *Waisiuconcha*. However, the last point may have no significance at all. The hinge appears to be different from that of *Waisiuconcha* too, although it is similar in a general way. At first, I believed the hinges to be sufficiently different to justify retaining *Waisiuconcha* as a separate section with a strongly developed hinge. However, the typical Waisiuconchas are apparently connected with *Archivesica* in this respect by such species as *V. stearnsii* and *V. lepta*.

Apart from the literature quoted above, the following papers may be consulted: LAMY, 1920; THIELE & JAECKEL, 1931; OLLSON, 1931 (OLLSON referred casts from the Oligocene of Peru to *Vesicomya*: pp. 54—55, pl. 4, figs. 3, 6, 8). It may be added that the type of *Meretrix boettgeri* MARTIN from the Upper Eocene of Nanggoelan, Java (compare MARTIN, 1914—1915, p. 189) may well prove to be a *Vesicomya* (*Waisiuconcha* ?). Unfortunately, its hinge was not observed.

VESICOMYA (WAISIUCONCHA) MARGOTAE spec. nov.

Plate, figs. 11—15

The type (coll. N. H. B.) is a left valve, 23.1 mm long, 17.9 mm high. Its inflation is 7.3 mm. The valve is arcuate both anteriorly and posteriorly, its ventral margin somewhat flattened. The anterior extremity is shorter and less high than the posterior extremity. The lunule is bounded by a sharply incised line. The surface is partly still covered with an epidermis and is smooth but for fine concentric sculpture of growth-lines and a few very inconspicuous radial lines on the posterior-most portion of the shell. The ligament external, long, set in a groove. The adjoining escutcheon narrow and not deeply excavated, bounded by an obtuse keel.

The hinge not as strongly developed as in *V. alberdinae*. The ridge along the ligament longer than in *V. alberdinae*, bearing a radial tooth which is faintly grooved. The central tooth narrow and joined to an anterior wavy lamina; between these the shallow socket for the central of the right valve. No lateral teeth developed.

Interior smooth, margins bearing fine lines which are concentric but for the anterior and posterior parts of the dorsal margin on which they are oblique. Pallial line forming a very faintly indicated "sinus". The anterior adductor scar well defined, with an almost separate extension near the anterior lamina of the hinge, the posterior scar shorter and broader.

V. indica SMITH quoted above is quite similar to *V. margotae*, especially in the hinge characters. Its shape, however, is sufficiently different to avoid any confusion.

It may be added that *V. brevis* SMITH, also quoted above, is closely related to *V. alberdinae* BEETS, especially in hinge characters. However, the living species is bigger and comparatively higher than the fossil; anteriorly, it is broadly rounded instead of pointed.

V. alberdinae (BEETS, 1942, a, p. 316, pl. 30, figs. 147—151) is very similar to *V. margotae* in general outline, but its hinge is strongly developed and conspicuously Venerid.

V. cretacea SMITH, a comparatively large species which was never figured (SMITH, 1904—1906, vol. 18, 1906, p. 261) appears to have a different shape from both Butonese species judging from the dimensions given by SMITH. Compare:

	length	height	inflation	
V. cretacea	57	40	25	mm or 57—40 —25
V. margotae	23.1	17.9	7.3	mm or 57—44 —18
V. alberdinae	23.3	18.2	6.9	mm or 57—44.6—16.9

B. Pisces

CARCHARODON MEGALODON (AGASSIZ)

A fine, very characteristic tooth was added to the Buton collection of the L. G. M. in recent years. The species is widespread in Miocene deposits, but is known to occur in the Pliocene too. Refs.: LADD, 1934, p. 242; Leidsche Geol. Meded., 5 (Feestbundel K. MARTIN), p. 462.

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PLATE I

Page

Conus asphaltodes spec. nov.

Figs. 1—2: Holotype, alt. 54 mm, diameter 26 mm; Loc. Waisioe, Coll. N. H. B. 251

Conus plagiarius MARTIN

Figs. 3—4: Specimen from Waisioe, alt. 33 mm (Fig. 3: protoconch magnified); Coll. N. H. B. 251

Cavolina bituminata spec. nov.

Figs. 5—7: Holotype, length 3.3 mm, width 2.1 mm, vertical diameter 1.5 mm; Loc. Waisioe, Coll. N. H. B. 251

Corculum weberi spec. nov.

Figs. 8—10; Holotype, length 3.3 mm, height 3 mm, inflation (1 ×) 1.3 mm; Loc. Waisioe, Coll. N. H. B. 253

Vesicomya margotae spec. nov.

Figs. 11—15: Holotype, length 23.1 mm, height 17.9 mm, inflation (1 ×) 7.3 mm (Fig. 15: hinge magnified); Loc. Waisioe, Coll. N. H. B. 255


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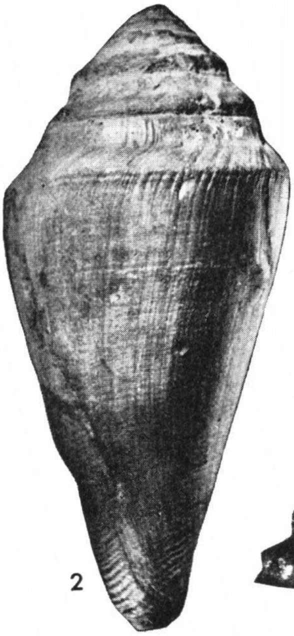
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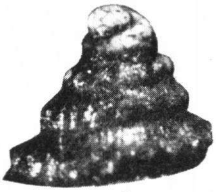
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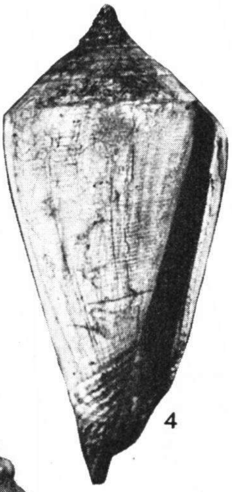
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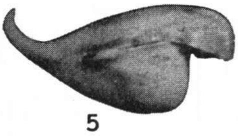
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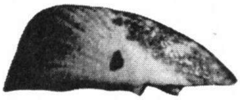
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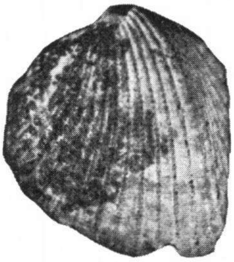
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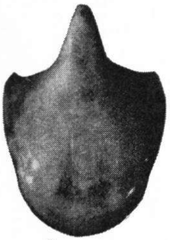
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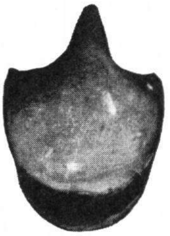
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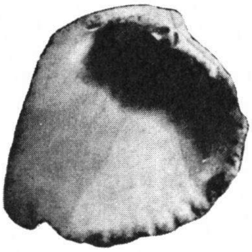
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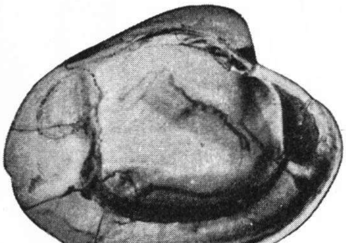
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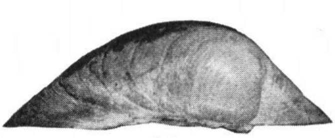
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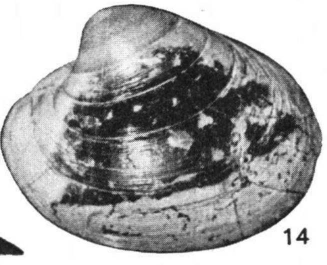
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