FORAMINIFERA FROM THE SUBSURFACE MIOCENE OF WRECK ISLAND, QUEENSLAND.

by

A. R. Lloyd.

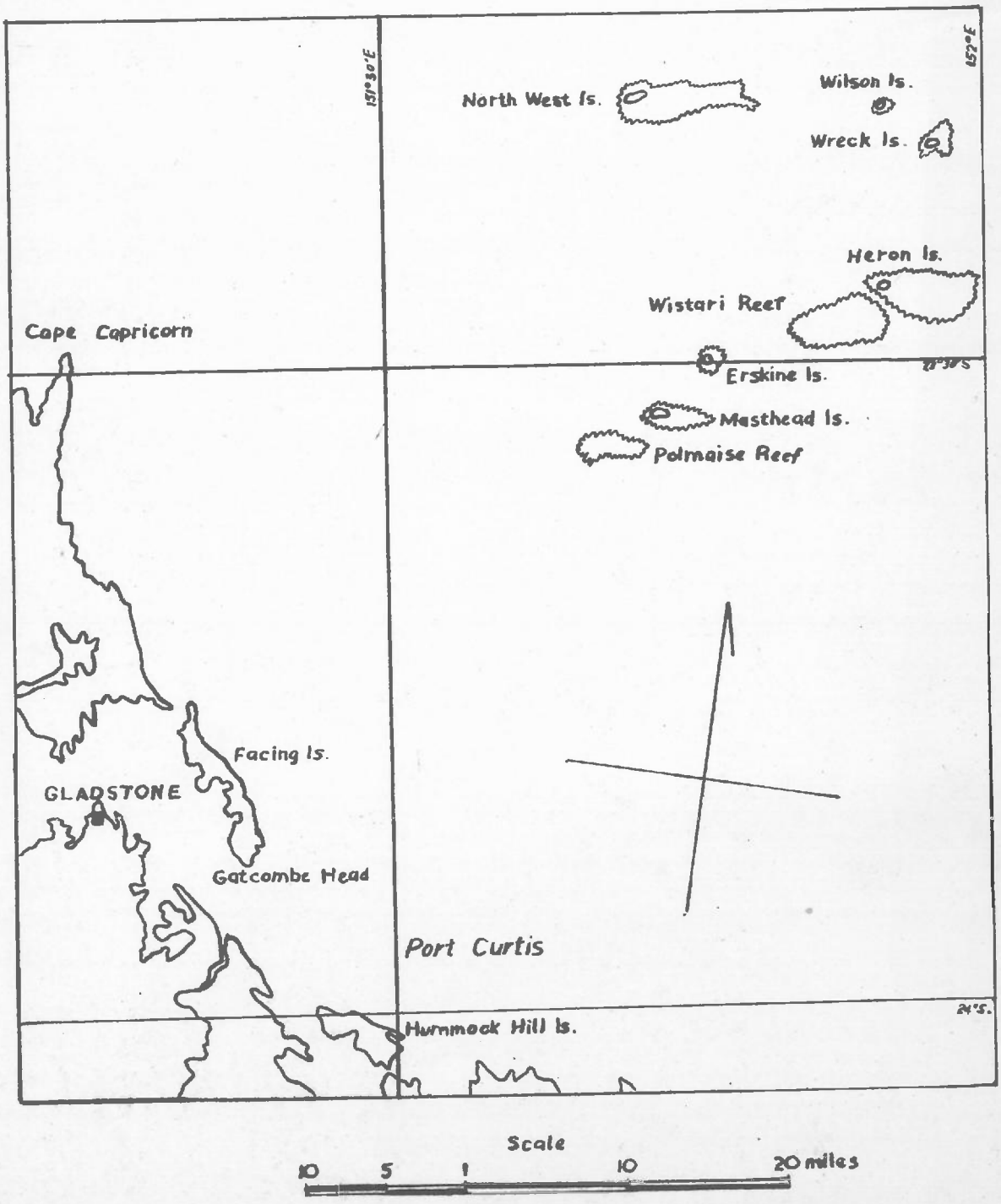
CONTENTS

FIGURES

TABLES

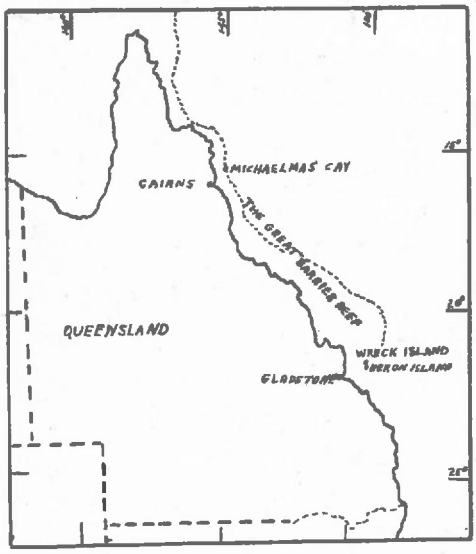
FIGURE 1

LOCALITY MAP



From Derrington, 1960.

FIGURE 2



After. Hill and Denmead, 1960.

ABSTRACT

Foraminiferal faunas from the Miocene limestones, sandstones and siltstones penetrated by H.B.R. No.1 Bore (530-1795 feet) have been studied; the "smaller" foraminifera in some detail. The sequence is overlain disconformably by Recent-Pleistocene limestones and sandstones (0-530 feet).

The Wreck Island faunas afford an important link between the biostratigraphically significant "larger" and planktonic foraminifera. The occurrence of Lepidocyclina (Nephrolepidina) enables correlation with the "F" Stage of Indonesia and with the New Zealand sequence. Globoquadrina altispira altispira (Cushman and Jarvis) appears immediately above, associated with Orbulina universa d'Orbigny and Globorotalia menardii menardii (d'Orbigny). This part of the sequence can thus be correlated with the sequences in Trinidad, Venezuela and Victoria. The occurrence of Globigerina mayeri (Cushman and Ellison) and Pulleniatina praeobliquiloculata n.sp. enables part of the sequence above to be correlated with Trinidad, Venezuela, Victoria, Indonesia and Saipan, Mariana Islands. Correlation Tables 3 and 4 set out these correlations.

Selected species have been discussed or described and illustrated. The following species are new:

Textularia granulifera

Angulogerina capricornica

Operculina praevictoriensis

Parrellina heronica

Parrellina reticulata

Pulleniatina praeobliquiloculata.

Wreck Island is situated at Latitude 23° 20'S., Longitude 151°57'30" East, 58 miles North East of Gladstone at the southern extremity of the Great Barrier Reef, Queensland. It was chosen by Humber Barrier Oil Pty Ltd. as the site for a bore to test for the presence of oil in the Marine Tertiary strata which were thought to underlie the Reef. Mines Administration Pty.Ltd. drilled the hole on behalf of the exploration company in 1959. Samples of cuttings were taken at 5 feet intervals from 505 feet to the bottom, after circulation was achieved at this depth. Cores were taken at regular intervals but the recovery was often poor. Casing was run to 480 and 1,110 feet.

Cuttings and cores covering the sequence from 545 to 1,795 feet were examined at approximately every 50 feet but closer when considered necessary. Except for cores 7 and 10 which were examined in thin sections, the fauna was extracted by washing. The preservation of the foraminifera was variable; from 550 to 1,450 feet the tests were sometimes worn and poorly preserved though usually well preserved except for breakages and damage to the last chambers, which was probably caused by the freeing of the foraminifera during drilling. From 1,550 to 1,795 feet the Orbitoids are infilled or replaced by glauconite, iron stained and badly worn whereas the other forms are better preserved and only slightly replaced by the glauconite.

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SCOPE OF THE WORK.

In this study, the foraminifera with the exception of the genera Cycloclypeus, Lepidocyclina and Miogypsina have been examined in detail. It was found that the material and time available were not adequate for a thorough examination of these genera. The "smaller" foraminifera proved sufficient in number for study in the time available and adequate for comparison with nearby faunas and correlation with well known sequences. The examination of the "larger" foraminifera has been left till a later date when more material will be available. It is also hoped that an examination of samples from the nearby Heron Island Bore will also be undertaken in order to fill in the gap at the top of the Wreck Island Bore.

PREVIOUS WORK.

A preliminary survey of samples from the bore was carried out by Derrington and Crespin (1960). Their results may be summarised as follows:

(a) Palaeontology

Crespin, 1960, without a detailed study of the Fauna, gave only tentative age determinations as follows:

Upper Pliocene or Younger	550 - 625 feet
Lower Pliocene	800 - 850 feet
Middle to Upper Miocene	962 -1050 feet
Lower Miocene	1150 -1750 feet.

The reasons for placing the boundaries as shown are not given but appear to have been based on the assumption of a complete sequence from the Recent to the Miocene, the latter being proved present by the discovery of Lepidocyclina and Miogypsina at 1150 feet.

(b) Stratigraphy.

Derrington, 1960, gave the following stratigraphical sequence, his tentative ages apparently being based on those given by Cushman, 1942, Iredale, 1942 (working on the Heron Island Bore samples) and Crespin, 1960.

11 - 310 feet	Recent	Calcarenite
310 - 398 "		Limestone
398 - 530 "	Pleistocene	Quartz Sandstone
530 - 735 "	Pliocene (Upper)	Limestone
735 - 945 "	Pliocene (Lower)	Calcarenite
945 - 1025 "	Miocene (Upper	Calcarenite
1025 - 1110 "	and Middle)	Quartz Sandstone
1110 - 1385 "	Miocene (Lower)	Calcarenite
1358 - 1540 "		Calcareous Siltstone
1540 - 1780 "		Quartz Sandstone
1780 - 1795 "		Coarse Quartz Sandstone
1795 - 1898 "	Basement	

ANALYSIS OF THE FAUNA

The distribution of the benthonic species shows a marked facies control while that of the pelagic species indicates only limited access of the open seas to the area. Species of Operculina, Elphidium and Parrellina dominate most of the fauna except between 1100 and 1450 feet where Lepidocyclina is the dominant genus. Species of Amphistegina and Cibicides are also abundant down to 1000 feet and the pelagic species are abundant between 600 and 625 feet and 850 and 950 feet. Table 2 sets out the distribution of the important species.

The following faunal zones have been established for the drilled sequence, based partly on benthonic and partly on pelagic species. The names of the zones and subzones are those of characteristic species of the interval or of species which have their highest occurrence at the top of the zone or subzone.

(i) 1715 - 1795 feet. Operculina praevictoriensis/ Parrellina reticulata Zone.

The two species which have given their names to this zone occur abundantly between 1715 and 1750 feet and rarely down to 1795 feet but Derrington, 1960, considers the lower occurrences are most likely due to caving. Operculina praevictoriensis n.sp. is restricted to this zone and Parrellina reticulata n.sp. has its best development within it.

(ii) 1550 - 1715 feet. Parrellina heronica/Hanzawaia scopos Zone.

The fauna within this zone is not well developed and Parrellina heronica n.sp. and Hanzawaia scopos (Finlay), while not being restricted to this zone, are regarded as being the most characteristic of the smaller foraminifera. Operculina victoriensis Chapman and Parr, Hanzawai scopos (Finlay) and Nonion victoriensis Cushman have their first appearance in this zone and many of the species (see Table 2) do not reappear above this zone until 950 feet. The occurrence of worn, glauconite-infilled or replaced Lepidocyclina and Miogypsina, which appear to differ, perhaps specifically, from the higher ones, below 1550 feet serves as the main distinguishing feature of the top of this zone.

(iii) 965 - 1550 feet. Lepidocyclina/Miogypsina Zone.

Well preserved, non-glauconitic Lepidocyclina and Miogypsina (rare) constitute the main faunal element in this zone.

The siltstone sequence from 1385 to 1540 feet appears to be poorly fossiliferous. Core 10, 1400 - 1410 feet contains only rare algae and the Orbitoid faunas recovered from cuttings at 1410 and 1450 feet are most likely cavings

and this interval could actually be unfossiliferous except for the algae.

Miogypsina and Cycloclypeus are rare (and spasmodic) in this zone. Lepidocyclina is abundant up to 1100 feet, whence it becomes rare, until its final appearance at 965 feet. Operculina victoriensis Chapman and Parr and Amphistegina quoyi d'Orbigny are rare and usually poorly preserved up to 1100 feet, becoming well preserved and abundant above this depth and take over the dominance of the fauna from Lepidocyclina. Elphidium parri Cushman and Parrellina reticulata n.sp. are sporadic in occurrence within the zone. Alveolinella quoyii (d'Orbigny) is quite common around 1000 feet as both well preserved and worn, broken specimens but they are suspected to be cavings since the species occurs only as worn specimens in cuttings above this depth. Orbulina universa d'Orbigny and other pelagic species are found in association with the last Lepidocyclina in Core 7, at 965 feet.

(iv) 600 - 965 feet. Globigerina mayeri/Pulleniatina praeobliquiloculata Zone.

Globigerina mayeri (Cushman and Ellisor), while possibly occurring below this zone in the bore, has its best development within it and Pulleniatina praeobliquiloculata n.sp. is restricted to it. The top of the zone is marked by the highest occurrences of the two species.

Operculina victoriensis, Amphistegina quoyi and species of Parrellina, Elphidium and Cibicides are abundant throughout the zone; the pelagics are abundant from 600 to 625 feet and 850 to 950 feet.

The zone is divided into the following subzones.

(a) 940 - 965 feet. Globoquadrina altispira altispira subzone.

Globoquadrina altispira altispira (Cushman and Jarvis) is restricted to the interval of 940 to 950 feet, and occurring abundantly within this interval, lends its name to the subzone. Other pelagic species found in association with it include Orbulina universa d'Orbigny, Globigerinoides triloba triloba (Reuss), G. triloba immatura LeRoy, G. triloba sacculifera (Brady), G. rubra (d'Orbigny), G. obliqua Bolli, Pulleniatina praeobliquiloculata n.sp., Globoquodrina venezuelana (Hedberg), Globigerina mayeri (Cushman and Ellisor), G. obesa (Bolli), Globorotalia menardii menardii (d'Orbigny), G. tumida (Brady), Sphaeroidinella seminulina seminulina (Schwager) and S. seminulina kochi (Caudri). Siphonina australis Cushman and Bolivina uniforminata LeRoy are the only benthonic species restricted to this subzone; Bolivina anastomosa Finlay, Angulogerina capricornica n.sp. and Clavulinoides victoriensis Cushman have their best development within it, and together with the following species have their first occurrence at 950 feet - Anomalinoides macraglabra (Finlay), Cibicides hillae n.sp., Textularia granulifera n.sp., Baggina ampla (Finlay), Plectofrondicularia parri Finlay, Uvigerina hantkeni Cushman and Edwards, U. multicostata LeRoy, Vaginulinopsis aff. acanthonucleus Carter, V. sp. A, Nodosaria cf. vertebralis (Batsch), Saracenaria aff. italica Defrance and Virgulina sp. A. Cibicides victoriensis Chapman, Parr and Collins, C. mediocris Finlay, Hanzawaia scopos (Finlay) and Parrellina heronica n.sp. reappear and the first two species have their best development within this subzone.

(b) 900 - 940 feet. Globigerinoides obliqua Subzone.

Globigerinoides obliqua Bolli, having its highest occurrence at 900 feet, lends its name to this subzone. Sphaeroidinella seminulina seminulina (Schwager) has its highest occurrence at 925 feet and the following species have their highest occurrences at 900 feet - Saracenaria aff. italica Defrance, Nodosaria cf. vertebralis (Batsch), Vaginulinopsis aff. acanthonueleus Carter, Cibicides hillae n.sp. and Angulogerina capricornicus n.sp. Textularia granulifera ~~wreckae~~ n.sp. has its best development at 900 feet.

(c) 600 - 850 feet. Globorotalia tumida/Globoquadrina venezuelana Subzone.

The pelagic species return in abundance towards the top of this subzone and Globorotalia tumida (Brady), Globoquadrina venezuelana (Hedberg), Globigerina mayeri (Cushman and Ellisor) and Pulleniatina praeobliquiloculata n.sp. have their highest occurrences at either 614 or 600 feet.

Hanzawaia scopos (Finlay) does not extend above 750 feet and Lenticulina megalaphota Carter (M.S.), Dimorphina janjukensis Crespin, Baggina ampla (Finlay), Elphidium crespinae Cushman, Textularia granulifera ~~wreckae~~ n.sp., Clavulinoides victoriensis Cushman, Bolivina anastomosa Finlay, Parrellina reticulata n.sp., P. heronicus n.sp., Globigerina juvenilis Bolli and G. falconensis Blow do not occur above either 614 or 600 feet.

(v) 530 - 600 feet. Globigerina obesa Zone

The fauna is not well developed within this interval and the pelagics are almost non-existant. The presence of Globigerina

obesa (Bolli), which does not apparently extend into the Recent, at 550 feet has given the name to this zone. Benthonic species which also occur lower in the bore include Operculina victoriensis Chapman and Parr, Cibicides mediocris Finlay, C. Victoriensis Chapman, Parr and Collins, Anomalinoides macraglabra (Finlay), Elphidium aff. pseudonodosum Cushman and E. parri Cushman.

ECOLOGY

A comparison with the Recent faunal assemblages described from the Great Barrier Reef (Collins, 1958), Saipan (Todd, 1958) and North America (Phleger, 1960) shows that the Wreck Island benthonic assemblages are typical of a tropical to sub-tropical, shallow water, shelf to lagoonal environment associated with reefs, similar to what is present in the area today.

The alternation between quartz sandstone or siltstone and limestones indicates an intermittent supply of clastic material to an area which was otherwise mainly favourable to the formation of limestone. The difference in the sedimentation is reflected in the faunal distribution, giving the major faunal changes in the sequence.

The sporadic occurrence of the planktonic species which also indicate a tropical to sub-tropical climate according to Phleger, 1960, shows that there was only limited, periodic access of the area to the open seas. This indicates that the area was mainly lagoonal or back reef.

Lepidocyclina and Miogypsina appear to have preferred an environment with lime rich water, sheltered from the open seas

so that most of the other benthonic species and all planktonic species were excluded. This has contributed to the marked faunal changes as can be seen on Table 2. The changes in these conditions at 1100 feet was marked by a decline in the numbers of Lepidocyclina and their extinction soon afterwards.

The presence of many benthonic species which do not extend above the Lower or Middle Miocene in New Zealand or southern Australia could indicate a northern migration of these species or survival in the North and extinction in the south in response to a climatic change.

CORRELATION.

The Operculina praevictoriensis/Parrellina reticulata Zone and Parrellina heronicus/Hanzawaia scopos Zone are not correlateable with overseas sequences on present evidence, and will have to await the examination of the Orbitoid fauna. They are considered to fall within the "f" stage of the Indonesian Letter Classification.

The top of the Lepidocyclina/Miogypsina Zone with the highest occurrence of Lepidocyclina (Nephrolepidina) sp. is considered to be coincident with the extinction of the Orbitoids and is thus correlated with the top of the "f" stage of Indonesia as defined by Glaessner, 1959.

LeRoy, 1948, placed the Lowermost Middle Palembang Formation of Sumatra with the highest Lepidocyclina and Miogypsina in the "f" stage. Glaessner, 1959, put the Lower Palembang Formation in the middle of the "f" stage so the lowermost Middle Palembang of

LeRoy is considered to be equivalent in age to at least the Upper part of the Lepidocyclina/Miogypsina Zone at Wreck Island.

Cole, 1957 b, reported Miogypsinoides cupulaeformis (Zuffardi-Comerci) from 880 - 890 feet and 870 - 880 feet in the Eniwetok bores and placed the top of the "f" stage at 860 feet. This species was also reported by Cole, 1954, from 1030 feet in the Bikini Atoll Bore and he placed the top of the "f" stage at that depth but in 1957, he placed it at 980 feet.

Cole, 1958, reported Miogypsinoides dehaarti (Van der Vlerk) and M. bantamensis Tan from the Donni Sandstone, Saipan, but Cloud et. al., 1958, indicated that they were described from fragments of the older Tagpochau Limestone which were reworked and incorporated in the Donni Sandstone.

The presence of Orbulina universa d'Orbigny with Lepidocyclina (Nephrolepidina) sp. at 965 feet and in abundance at 950 feet indicates that the extinction of the Orbitoids post-dated the incoming of this planktonic species. LeRoy, 1948, reported the first appearance of O. universa from the uppermost part of the Telisa Formation, Central Sumatra, which also predates the extinction of the Orbitoids. Hornibrook, 1958, shows O. universa first appearing abundantly in the Lillburnian Stage which again predates the extinction of the Orbitoids in New Zealand. The first appearance of O. universa was placed at the base of the No. 11 zone of Carter and the base of the Orbulina universa Zone of Jenkins in Victoria; in the uppermost part of the Globigerinatella insueta/

Globigerinoides bispherica Subzone of Blow in Venezuela; and topmost part of the Globigerinatella insueta Zone of Bolli in Trinidad.

The Globigerina mayeri/Pulleniatina praeobliquiloculata Zone is considered to be equivalent to the uppermost part of the Globorotalia fohsi robusta Zone and the Globorotalia mayeri Zone and the lowermost part of the Globorotalia menardii miotumida Zone of Jenkins in Victoria; and to fall within the "g" Stage of Indonesia.

The occurrence of abundant Globoquadrina altispira altispira (Cushman and Jarvis) only from 950 to 940 feet with a well developed assemblage of other pelagic species which continue above this depth, is considered to coincide with the extinction of this species. The top of the Globoquadrina altispira altispira Subzone is therefore correlated with the highest occurrence of this species at the base of the Globorotalia mayeri/Globorotalia lenguaensis Zone of Blow in Venezuela; at the base of the Globorotalia mayeri Zone of Bolli in Trinidad and Jenkins in Victoria. The association of Orbulina universa, Globorotalia menardii menardii (d'Orbigny), Globoquadrina venezuelana (Hedberg), Globigerinoides rubra (d'Orbigny), G. obliqua Bolli Sphaeroidinella seminulina (Schwager) kochi (Cavdri) with Globoquadrina altispira altispira adds weight to this correlation. Globorotalia menardii is seen to make its first appearance towards the top of the Globorotalia fohsi robusta Zone of Bolli and Blow, and about the middle of the Orbulina universa Zone of Jenkins just before the last appearance of Globoquadrina altispira altispira.

LeRoy, 1948, records Globorotalia menardii as first appearing in the uppermost part of the Lower Palembang Formation of Central Sumatra and this is soon after the entry of Orbulina universa and just before the highest occurrence of the Orbitoids. LeRoy, 1944, described Globigerina baroemoensis and G.baroemoensis var. quadrata. which are considered to be synonymous with Globoquadrina altispira altispira, from the Telisa, Lower Palembang and the lowermost Middle Palembang Formations. LeRoy's species evidently has its highest occurrence near that of the Orbitoids but the exact time relationship between the two was not differentiated by LeRoy. This association gives further weight to the correlation of the lowermost Middle Palembang Formation with the topmost part of the Lepidocyclina/Miogypsina Zone and the top of the Globoquadrina altispira altispira Subzone would possibly be correlateable with a part of the lowermost Middle Palembang Formation.

Todd, 1958, reported a similar planktonic assemblage from the Donni Sandstone, Saipan, with G. altispira and it would be correlateable in part with the Globoquadrina altispira altispira Subzone.

On the basis of the above evidence, the extinction of the Orbitoids would fall within the uppermost part of the Globorotalia fohsi robusta Zone of Bolli and Blow. The extinction of Globoquadrina altispira altispira appears to be an important

time marker soon after the extinction of the Orbitoids and could prove to be a useful link between the planktonics and larger foraminifera for world wide correlations.

The Globigerinoides obliqua and Globorotalia menardii menardii Subzones do not appear to be correlateable with overseas sequences but could prove to have local value in the event of future work in the area. The cutting out of G. obliqua and G. menardii menardii appears to be due to a restriction of the open seas because of the general reduction in the pelagic populations above 850 feet. Both species have higher reported occurrences in Trinidad and Venezuela. The highest occurrence of Sphaeroidinella seminulina at 925 feet does not seem to coincide in time with its highest occurrence in New Zealand or Venezuela which appear to be later because of the presence of Globigerina mayeri.

The top of the Globigerina mayeri/Pulleniatina praeobliquiloculata Zone is correlated with the top of the Globorotalia mayeri Zones of Bolliand Blow and the lower part of the Globorotalia menardii miotumida Zone of Jenkins, based on the highest occurrences of G. mayeri, but because of the virtual disappearance of the planktonics above 600 feet, the top of the Zone at Wreck Island may actually fall within the Zones of Bolli, Blow and Jenkins as mentioned and not equivalent to the top of their Zones.

Pulleniatina praeobliquiloculata n.sp. was recorded by Todd, 1958, from the Donni Sandstone, Saipan, and by LeRoy, 1941, from East Borneo and Sibroet Island as P. obliquiloculata (Parker and Jones). Banner and Blow, 1960, mention this species from the Upper Miocene of Papua and Fiji; Stainforth, 1948, recorded it from the Upper Miocene of Equador as P.obliquiloculata; and the writer has also seen it in the Upper Miocene of Papua. LeRoy, 1941, also recorded Globigerina cretacea and G. aff. cretacea from East Borneo and Sibroet Island and these are believed to be actually G. mayeri. From this association, the Donni Sandstone fauna is considered to fall within the limits of the Globigerina mayeri/Pulleniatina praeobliquiloculata Zone; and the East Borneo and Sibroet Island faunas fall within the part of the zone above the Globoquadrina altispira altispira Subzone because of the absence of this species.

Glaessner, 1959, placed the top of the "f" Stage equivalent to the top of the Tortonian (Upper part of the Middle Miocene) and the "g" Stage equivalent to the Sarmatian (Upper Miocene) and Lower Pliocene of Europe. The part of the "g" Stage represented at Wreck Island is considered to fall within the Upper Miocene because of the presence of Pulleniatina praeobliquiloculata n.sp.

Banner and Blow, 1960, considered it was replaced by P.obliquiloculata at the beginning of the Pliocene and Loeblich et.al., 1957, give the range of this latter species as being

Pliocene to Recent.

On this evidence, the Donni Sandstone fauna of Todd from Saipan; the East Borneo and Sibroet Island Faunas of LeRoy; the uppermost part of the Orbulina universa Zone and part, if not all of the Globorotalia mayeri Zone of Jenkins; and the Uppermost part of the Globorotalia fohsi robusta Zones and part, if not all, of the Globorotalia mayeri Zones of Bolli and Blow are thought to fall within the Upper Miocene part of the "g" Stage.

The Globigerina obesa Zone lacks any diagnostic planktonic species but ~~because of the presence of~~ contains a benthonic fauna similar to that found in the Globigerina mayeri/Pulleniatina praeobliquiloculata Zone. It includes Cibicides mediocris Finlay and Operculina victoriensis Chapman and Parr which do not extend above the Miocene elsewhere and is considered to fall within the Upper Miocene also, although close to the Miocene/Pliocene boundary.

Table 1 sets out the important benthonic species and their occurrences elsewhere. The general similarities of the benthonic assemblage with the Indonesian, Victorian, and to a lesser extent, New Zealand, shows an important link between the four areas as well as giving a general Miocene age.

Cole, 1957 b, placed the top of the "g" Stage as represented in the Bikini and Eniwetok Bores at 850 and 615 feet respectively. These are not necessarily equivalent in age to the top of the "g" Stage at Wreck Island since there is no supporting fossil evidence.

The sequence in the well from the surface to 530 feet was not

examined but it is regarded as being equivalent in age to the 732 feet sequence penetrated by the bore on Heron Island which is situated 7 miles to the south of Wreck Island. The foraminifera, recorded by Cushman, 1942, do not show anything of correlateable value and all the species appear to range into the Recent. He regarded the age of the strata to be Recent/Pleistocene. Iredale, 1942, from a study of the molluscan fauna, regarded the whole sequence to be Recent in age. The 600 feet penetrated by the bore on Michaelmas Cay, near Cairns, (see fig.2) is also placed in the Recent or Recent/Pleistocene by Richards and Hill, 1942. Similarly with the Bikini and Eniwetok Bores, the dating of the Post Miocene strata in these bores is difficult on present knowledge. The glauconite reported from the quartz sandstone from all three Great Barrier Reef Bores would unfortunately be too young to lend itself to absolute age determinations which would be a valuable check.

The 0 - 530 feet sequence at Wreck Island is taken to be Recent/Pleistocene in age and a disconformity is postulated between the quartz sandstone and limestone at 530 feet on the new evidence now available, but a re-examination of the Heron Island samples is considered necessary to confirm it. The Pliocene strata, if they were deposited, and possibly a part of the Upper Miocene strata, could have been stripped off as the sea level fell during the Pleistocene Glacial phases and the deposition of the quartz sandstone began as the sea level rose again after the last Glacial. According to Fairbridge, 1950,

there was an estimated 300 feet fall in sea level during the Pleistocene glacials. The writer has seen dredging samples from a 20 to 30 fathom channel between coral reefs near Port Moresby, Papua, which contained a similar assemblage of foraminifera. If a similar depth is indicated by the Wreck Island assemblage, the 300 feet drop in sea level could easily account for the removal of the Pliocene strata.

The base of the reef limestone at 383 feet, 506 feet and 378 feet on Wreck Island, Heron Island and Michaelmas Cay respectively is correlated on table 3 only on lithology and does not necessarily represent a time plane.

Tables 3 and 4 set out the proposed correlations on the above evidence. On Table 4, further correlation between the other overseas sequences has been attempted in order to indicate the exact relationship of the Wreck Island Zones to these sequences. It is based on the incoming of Globigerinoides triloba triloba, G. bispherica Todd and Orbulina universa and the highest occurrence of Sphaeroidinella seminulina which is at the top of the Opoitian Stage in New Zealand and at the top of the Sphaeroidinella seminulina Zone in Venezuela. The base of the Lepidocyclina/Miogypsina Zone and the lower zones are not correlateable on the present evidence and are therefore not shown. The correlation with the European divisions is based on Glaessner, 1959, and Drooger, 1956. It varies from the ideas of Blow, 1957 and 1959, and the relationship of Blow's Zones with the European divisions has been readjusted on the above evidence.

TABLE 1.

SIGNIFICANT BENTHONIC SPECIES - THEIR OCCURRENCES ELSEWHERE

SPECIES	AGE	STAGES	LOCALITY
Anomalinoides macraglabra	U. Eocene - Pliocene	Runangan - Waitotaran	New Zealand
	M.Oligocene - L.Miocene		South Australia
	M. Miocene	Balcombian	Victoria
Dimorphina janjukensis	Oligocene	Janjukian	Victoria
Uvigerina hantkeni	Miocene		Hungary
	U. Miocene	"g"	East Borneo
Uvigerina multicostata	L. - U. Miocene	"f"	Sumatra
Bolivina uniforminata	L. - U. Miocene	"f"	Sumatra
Plectofrondicularia parri	U. Oligocene - L. Miocene	Hutchisonian - Clifdenian	New Zealand
Bolivina anastomosa	L. Oligocene - M. Miocene	Whaingaroan - Waiauan	New Zealand
	M. Oligocene - L. Miocene		South Australia
	M. Miocene	Balcombian	Victoria
Baggina ampla	U. Oligocene - L. Pliocene	Waitakian - Opoitian	New Zealand
	U. Miocene	"g"	East Borneo
Cibicides mediocris	L. Oligocene - L. Miocene	Duntroonian - Awamoan	New Zealand
	M. Oligocene - L. Miocene		Victoria
	M. Oligocene - L. Miocene		South Australia
Hanzawaia scopos	L. Oligocene - M. Miocene	Whaingaroan - Waiauan	New Zealand
	M. Oligocene - L. Miocene		South Australia
	M. Oligocene - M. Miocene		Victoria
Svratkina australiensis	M. Oligocene - M. Miocene		Victoria
	M. Oligocene - L. Miocene		South Australia
Siphonina australis Cushman	L. Oligocene - M. Miocene	Whaingaroan - Waiauan	New Zealand
	M. Oligocene - L. Miocene		South Australia
	M. Oligocene - M. Miocene		Victoria
	L. - M. Miocene	"f"	Sumatra
Operculina victoriensis	U. Oligocene - M. Miocene		Victoria
Elphidium parri Cushman	Miocene		Victoria
Elphidium crespinae Cushman	Miocene		Victoria
Clavulinoides victoriensis Cushman	M. Miocene		Victoria
	M. Oligocene - L. Miocene		South Australia

SYSTEMATIC DESCRIPTIONS OF THE FORAMINIFERA

The suprageneric classification used is based mainly on Loeblich and Tappan, 1961, with amendments which were considered necessary.

In the measurements of the specimens, the following abbreviations have been used - D = larger diameter; d = smaller diameter; H = height; T = thickness; W = width.

Where references are made to Barker, 1960, it is to be understood that the specimens referred to were originally figured and described by Brady in his report on the Foraminifera Dredged by H.M.S. Challenger during the years 1873 - 1876.

ORDER FORAMINIFERIDA

SUPERFAMILY LITUOLACEA Lamarck, 1809

Family TEXTULARIIDAE Ehrenberg, 1839

Genus TEXTULARIA Defrance, 1824

Type species: Textularia saggittula Defrance

Textularia granulifera sp.nov.

Plate figures

Description

Test elongate, twice as long as broad, gradually tapering proximally, broadest part formed by last two chambers, rhomboidal in section viewed from distal end; compressed initially and towards

the periphery, thickest along the medial section; periphery acute with distinct keel, slightly lobate initially, becoming more so in the adult, outline rounded at the proximal end; chambers reasonably distinct, initially planispirally coiled, rapidly becoming biserial with about 9 chambers on each side which increase gradually in size, fairly constant in shape, narrow, about three times as wide as high; sutures often indistinct initially, depressed, concave, broad, almost straight, curving near the periphery; medial ridge broad, distinct, raised with coarse granular layer which continues across the chambers or along the sutures and then along the keel; wall coarsely agglutinated, smooth; aperture interior-marginal, rectangular opening.

Holotype

Dimensions: L. 0.97 mm. W. 0.50 mm. T. 0.28 mm.

Paratype

Dimensions: L. 0.86 mm. W. 0.48 mm.

Occurrence: both specimens from 950 feet.

Distribution: Common from 900 to 950 feet, rare in core 5, 614 - 625 feet.

Remarks: The species is close to T. israelskyi Davis but varies from it in having a higher last chamber, a slightly more eliptical section in apertural view, a keel and a coarse granular layer on the medial ridge, sutures and keel. It resembles T. mississippiensis Cushman in the presence of the coarse granular layer but varies from it in having a keel and no marked tendency

towards parallelism of the margins distally.

Family ATAXOPHRAGMIIDAE Schwager, 1873

Subfamily VERNEUILINIDAE Cushman, 1911

Genus CLAVULINOIDES Cushman, 1936

Type species: Clavulina trilatera Cushman

Clavulinoides victoriensis Cushman, 1936

Plate figures

Clavulina angularis Chapman (non d'Orbigny), 1907, Linn. Soc., Lond., Journ. (Zool.), V. 30, p.29, pl.4, figs 68-73.

Clavulinoides szaboi (Hantken) var. victoriensis Cushman, 1936, Cushman Lab. Foram. Res., Spec. Pub. 6, p.22, pl.3, fig. 19, 22; Cushman, 1937, ibid., Spec. Pub. 7, p.134, pl.18, figs 35, 36.

Clavulinoides victoriensis Cushman. Abele, 1961, unpubl. Thesis, p.91, pl.9, figs 5, 6.

Description

Test elongate, triangular in cross section; chambers initially triserial, rapidly becoming uniserial; early chambers indistinct, uniserial chambers becoming more distinct, more embracing, 6 in number, increasing gradually in size, fairly uniform shape, a little wider than high, sutures not very distinct, depressed, slightly arched across the faces; periphery acute to subacute; faces flat

to gently concave; triserial part tapering sharply, uniserial part only gently tapering, edges nearly parallel; walls coarsely agglutinated, smooth; aperture a terminal circular opening at end of small neck with serrated rim.

Figured specimen:

Dimensions: H. 3.28 mm. W. 0.66 mm.

Figured specimen:

Dimensions: H. 2.22 mm. W. 0.66 mm.

Occurrence: both specimens from 945 feet.

Distribution: Rare at 945 and 950 feet, very rare at 600 feet; Middle Miocene of Victoria; Middle Oligocene to Lower Miocene of South Australia.

SUPERFAMILY MILIOLACEA Ehrenberg, 1839

Family MILIOLIDAE Ehrenberg, 1839

Genus SPIROLOCULINA d'Orbigny, 1826

Type species: S. depressa d'Orbigny

Spiroloculina sp. aff. S. corrugata Cushman and Todd

aff. Spiroloculina corrugata C. & T. Todd, 1958, U.S. Geol. Surv., Prof. Paper 280-H, pl.87, fig.8a,b.

One specimen similar to this species as figured by Todd from the Recent of Saipan Island occurred in core 5, 614-625 feet.

Genus ?AUSTROTRILLINA Parr, 1942

Type species: Trillina howchini Schlumberger

?Austrotrillina sp. cf. A. striata Todd and Post, 1954

cf. Austrotrillina striata Todd and Post, 1954, U.S. Geol. Surv., Prof. Paper 260-N, p.555, pl.198, fig.9; Todd and Post, 1960, ibid. 260-X, p.825, pl.261, fig.22a, b.

One specimen similar to this species described from the Miocene of Eniwetok was found at 1750 feet. It varies in the absence of striations and pits on part of the wall, and in having sharper peripheral margins.

Dimensions: H. 1.30 mm. W. 1.14 mm. T. 0.60 mm.

Genus QUINQUELOCULINA d'Orbigny, 1826

Type species: Serpula seminulum Linné

Quinqueloculina sp. cf. Q. cuvieriana d'Orbigny

cf. Quinqueloculina cuvieriana d'Orbingy. LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.3, p.112, pl.1, fig.31-33.

One specimen from cuttings at 1,000 feet is similar to the specimen figured by LeRoy from the Upper Miocene of Indonesia but varies in having fine longitudinal striations, a slightly more compressed test, and a narrower, elongate aperture. The tooth is

very long, mostly straight with only a very small terminal bifid part.

Dimensions: H. 0.72 mm. W. 0.60 mm. T. 0.46 mm.

Quinqueloculina sp. aff. Q. pseudoreticulata Parr, 1941

Quinqueloculina reticulata LeRoy, (non d'Orbingy), 1941. Colorado School Mines, Quart., V.36, No.1, pt.2, p.71, pl.5, fig.1, 2.

aff. Quinqueloculina pseudoreticulata Parr. Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.9, fig.2,3.

One specimen, considered to be the same species as the one figured by LeRoy from the Upper Miocene of Indonesia was found at 1050 feet. It varies from the specimen figured by Barker from the Recent in the presence of a tooth which is mainly straight with a small terminal thickening which is possibly the remnants of the bifid part.

Dimensions: H. 0.96 mm. W. 0.80 mm. T. 0.58 mm.

Quinqueloculina sp. cf. Q. lamarckiana d'Orbigny

cf. Quinqueloculina lamarckiana d'Orbigny. Barker, 1960 Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.5, fig.7.

Two specimens from 1750 feet appear to be closest to this

species as figured by Barker from the Recent of the South Atlantic. They have similar elongate chambers and a very small tooth in a circular aperture at the end of an apertural neck of the last chamber but vary in having a narrower test and chambers; in being more strongly compressed laterally; and in having a flattened margin on the last two chambers giving two peripheral edges on each chamber instead of the strong carinate periphery and fine longitudinal striations.

Dimensions: H. 1.44 mm. W. 0.68 mm. T. 0.42 mm.
H. 1.04 mm. W. 0.41 mm. T. 0.22 mm.

Genus TRILOCULINA d'Orbigny, 1826

Type species: Miliola trigonula Lamarck

Triloculina sp. cf. T. tricarinata d'Orbingy

cf. Triloculata tricarinata d'Orbigny. Todd, 1958, U.S. Geol. Surv. Prof. Paper 280-H, pl.86, fig.15a, b.

One specimen similar to the one figured from the Recent of Saipan was found in cuttings from 600 feet. It appears to be worn and could be a caving.

Dimensions: H. 0.60 mm. W. 0.38 mm.

Genus PYRGO Defrance, 1824

Type species: P. laevis Defrance

Pyrgo sp. cf. P. depressa (d'Orbigny)

cf. Pyrgo depressa (d'Orbigny). Barker, 1960. Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.2, fig.16.

A single worn specimen similar to this Recent species was found in cuttings from 550 feet. It is possibly a caving.

Pyrgo sp. cf. P. lucernula (Schwager)

cf. Pyrgo lucernula (Schwager). Barker, 1960. Soc. Econ. Pal. and Min., Spec. Pub.9, pl.2, fig.5, 6.

Single worn specimens similar to this species were found in cuttings from 600, 650 and 1000 feet and are suspected as being cavings.

Family SORITIDAE Ehrenbarg, 1839

Genus MARGINOPORA Blainville, 1830

Type species: M. vertebralis Blainville

Marginopora vertebralis Blainville, 1830

Marginopora vertebralis Blainville. Cushman, 1942. Great Barrier Reef Comm., Rept., V.5, pl.12, fig.6; Todd and Post, 1958, U.S. Geol. Surv. Prof. Paper 260-N, pl.93, fig.6-8; Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.16, fig.1.

A few fragments of this widespread Miocene to Recent tropical western Pacific species were found in cuttings down to 950 feet but are regarded as cavings.

Family ALVEOLINELLIDAE Cushman, 1927

Genus ALVEOLINELLA Douville, 1906

Type species: Alveolina quoyi d'Orbigny

Alveolinella quoyi (d'Orbigny)

Alveolinella quoyi (d'Orbigny) Todd and Post, 1954, U.S. Geol. Surv. Prof. Paper 260-N, p.558, pl.202, fig.5, 8; Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.17, fig.7, 9.

This species was found in cuttings only down to 1000 feet, rare except at 995 feet where it was common. Most of the specimens were poorly preserved except around 1000 feet where they were mostly well preserved. It is a widespread Upper Miocene to Recent western Pacific tropical species but its presence in the well could be due to cavings although there is a chance that they are not all cavings.

SUPERFAMILY NODOSARIACEA Ehrenberg, 1812

Family NODOSARIIDAE Ehrenberg, 1812

Genus Nodosaria Lamarck, 1812

Type species: Nautilus radicula Linné

Nodosaria sp. cf. N. vertebralis (Batsch)

Plate figures

cf. Nodosaria vertebralis (Batsch) LeRoy, 1944. Colorado School Mines, Quart., V.39, No.3, pt.2, p.80, pl.1, fig.22.

Description

Test elongate, straight to slightly curved; 6 to 9 chambers arranged uniserially, strongly inflated, tending to be globular, increasing rapidly in size, usually a little wider than high, circular in transverse section; proloculus (of megalospheric forms) large, globular, giving only a small degree of tapering, much smaller in the microspheric forms, giving a greater degree of tapering towards the proximal end; sutures depressed, broad, at right angles to direction of growth; wall calcareous, finely perforate with a few scattered larger pores, crossed by strong longitudinal costae, variable in number and width apart in the two generations, being fewer in the megalospheric form, absent on the last chamber; aperture circular, radiate, terminal, at the end of distinct neck.

Figured specimen:

Dimensions: H. 1.08 mm. W. 0.29 mm.

Occurrence: 950 feet.

Figured specimen:

Dimensions: H. 1.50 mm. W. 0.36 mm.

Occurrence: 900 feet.

Figured specimen:

Dimensions: H. 2.94 mm. W. 0.80 mm.

Occurrence: 950 feet.

Distribution: Rare at 900 and 950 feet; LeRoy reported his specimens from the Lower and Middle Miocene of Indonesia.

Remarks: The specimens appear to vary from LeRoy's figured specimen in the height of the chambers being less.

Fragments of very large specimens from the same depths possibly belong to the same species and the smaller ones described could be juveniles. They possess very strong costae which extend to the aperture; chambers that become smaller towards the aperture and tapering distally as well as proximally with the widest part probably about the middle. The degree of inflation of the chambers is not observable because of the strong costae and secondary thickening. The largest fragment is figured, specimen No.

Genus AMPHICORYNE Schlumberger, 1881

Type species: Marginulina falx Jones and Parker

Amphicoryne scalaris (Batsch), 1791

Nodosaria scalaris (Batsch). Cushman, 1913, U.S. Nat. Mus., Bull. 71, pt.3, p.58, pl.24, figs 7a,b.

Lagenonodosaria scalaris (Batsch). LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.28, pl.2, figs 30, 31, pt.2, p.77, pl.2, fig.18; LeRoy, 1944, V.39, No.3, pt.1, p.21, pl.8, fig.12.

This Lower Miocene to Recent Indopacific species was found common at 900 feet and in core 6, 800-810 feet and rare at 850 feet

and in core 5, 614-625 feet.

Dimensions of largest specimen: H. 0.52 mm. W. 0.32 mm.

Amphicoryne compacta Parr, 1950

Amphicoryne scalaris (Batsch) var. compacta Parr, 1950, B.A.N.Z.A.R.E., V.5, pt.6, p.328, pl.11, fig.24

This species occurred rare in cores and cuttings from 614 to 850 feet. It was originally described from the Recent of southern Australia as a variety of A. scalaris (Batsch) but varies from that species in having coarser costae, less inflated chambers, and in being more cylindrical. It is regarded as being distinctive enough to warrant raising to specific rank.

Dimensions vary between: H. 0.46 mm. W. 0.30 mm.
and H. 0.44 mm. W. 0.24 mm.

Genus PLANULARIA Defrance, 1824

Type species: P. aurus Defrance

Planularia australis Chapman, 1915

Cristellaria tricarinella Cushman (non Reuss), 1913, U.S. Nat. Mus., Bull.71, pt.3, p.72, pl.33, fig.2; LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.25, pl.2, fig.93, 94.

Planularia australis Chapman. Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub.9, pl.68, fig.4.

This Upper Miocene to Recent Indopacific species was rare at

950 feet. The specimens have proximal marginal spines as in Cushman's variety but it is considered that they are correctly referred to Chapman's species, which was erected to cover the Recent specimens which were identified as P. tricarinella by Cushman. This latter species was originally described from the Cretaceous of Germany.

Genus LENTICULINA Lamarck, 1804

Type species: L. rotulata Lamarck

Lenticulina sp. aff. L. australis Parr, 1950

aff. Lenticulina (Robulus) australis Parr, 1950, B.A.N.Z.A.R.E. V.5, pt.6, p.322, pl.11, fig.7,8.

Specimens similar to this species which was described from the Recent of Tasmania were rare in core and cuttings from 550 to 650 feet. They have 7 chambers instead of 8 or 9 and are smaller in size, having diameters around 0.84 mm. and could be juveniles of the species.

Lenticulina orbicularis (d'Orbigny)

Cristellaria orbicularis (d'Orbigny) Cushman, 1913. U.S. Nat. Mus., Bull. 71, pt.3, p.67, pl.36, fig.4, 5.

Robulus orbicularis (d'Orbigny). LeRoy, 1944, Colorado School Mines, Quart., V.39, No.3, pt.1, p.17, pl.4, fig.15, 16; Barker, 1960, Soc. Econ. Pal. Min., Spec. Pub.9, pl.69, fig.16, 17.

This Lower Miocene to Recent Indopacific species was rare from 650 to 950 feet. Most specimens had diameters from 0.84 to 1.00 mm.

Lenticulina sp. cf. L. submamilligera (Cushman)

Plate figure

cf. Lenticulina submamilligera (Cushman) Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub.9, pl.70, fig.17, 18.

Description

Test small, tight planispiral coil, involute, biconvex, symmetrical; periphery circular in outline, acute with keel; 8 chambers in the last whorl, increasing slowly in size, constant shape, much wider than long; sutures distinct, raised, broad, strongly recurved; wall calcareous, smooth, finely perforate; large axial boss on each side, raised; aperture exterio-marginal, radiate.

Figured specimen:

Dimensions: O. 0.74 mm. T. 0.58 mm.

Occurrence: 600 feet.

Distribution: Rare from 600 to 750 feet; Cushmans's species originally described from the Recent.

Remarks: These specimens appear to differ from L. submamilligera mainly in their much smaller size, but Cushman does not figure his specimen (vide Ellis and Messina) nor does he give

the number of chambers in the last whorl. Barker's figured specimen is also larger and has 9 chambers in the last whorl.

Lenticulina sp. cf. L. denticulifera (Cushman), 1913

Plate figure

cf. Cristellaria denticulifera Cushman, 1913, U.S. Nat. Mus., Bull. 71, pt.3, p.75, pl.37, fig.1.

cf. Lenticulina denticulifera (Cushman) Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub.9, pl.70, fig.7, 8.

Description

Test a close planispiral coil, involute, biconvex, symmetrical; 7 to 8 chambers in the last whorl, increasing slowly in size, fairly constant shape, wedging towards the axial region, much wider than long; sutures distinct, broad, recurved, flush with surface of test; periphery circular in outline, acute with keel; axial plug on each side, flush with surface; wall calcareous, finely perforate, smooth; aperture exterio-marginal, radiate.

Figured specimen:

Dimenions: D. 1.26 mm. d. 1.16 mm.

Occurrence: 650 feet.

Distribution: Rare in cores and cuttings from 600 to 950 feet. Cushman's species originally described from the Recent of the North Pacific.

Remarks: These specimens differ in their smaller size, entire keel and absence of ornamentation. They could represent a new species.

Lenticulina megalophota Carter, (M.S.), 1959

Plate figures

Robulus costatus LeRoy, (non Fichtel and Moll), 1944, Colorado School Mines, Quart., V.39, No.3, pt.2, p.77, pl.3, fig.15, 16.

Lenticulina megalophota Carter, 1959, Unpub. Thesis, pl.3, fig. 28, 29.

Description:

Test a close planispiral coil, involute, biconvex, symmetrical; periphery circular in plan, rounded with small keel, 5 chambers in last whorl, increasing slowly in size, constant shape, indistinct; sutures indistinct, broad, gently recurved, last suture often distinct, depressed; wall calcareous, finely perforate, with coarse costae more or less parallel to the periphery, sometimes absent or weak on last chamber; small axial boss on each side; aperture exterio-marginal, radiate.

Figured specimen:

Dimensions: D. 0.80 mm. T. 0.56 mm.

Occurrence: 600 feet.

Distribution: Rare to common from 600 to 1050 feet; Mid. Tertiary of Victoria.

Remarks: The specimens are closer to the paratype than the holotype of Carter but vary from both in the absence of costae on the last chamber of some. In this smooth last chamber they resemble Robulus submarinus Cushman described from the Eocene of the eastern

coast of North America. L. megalophota varies from Robulus costatus (Fichtel and Moll) in having fewer chambers and depressed, instead of prominent, raised sutures; and for these reasons LeRoy's specimen from the Lower to Middle Miocene of Indonesia figured as R. costatus is placed in Carter's species.

Genus SARACENARIA Defrance, 1824

Type species: S. italica Defrance

Saracenaria sp. aff. S. italica Defrance, 1824

aff. Cristellaria italica (Defrance) Cushman, 1913. U.S. Nat. Mus., Bull. 71, pt.3, p.78, pl.37, fig.33.

Saracenaria italica LeRoy (non Defrance), 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.28, pl.1, fig.53, 54, pt.2, p.76, pl.7, fig.21-24; LeRoy, 1944, ibid. V.39, No.3, pt.1, p.21, pl.1, fig.24, pt.2, p.81, pl.2, fig.12.

aff. Saracenaria italica Defrance. Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub.9, pl.68, fig.17, 18, 20-23.

The specimens appear to be the same as those figured by LeRoy from the Lower to Upper Miocene of Indonesia. They were rare at 900 and 950 feet only. They are close to figured specimens of Cushman and Barker from the Recent of the Pacific but differ in having more strongly curved faces and strong keels and probably represent a closely related ancestral form. The juveniles of the species closely resemble the specimens figured as S. arcuata d'Orbigny var. ampla by Cushman and Todd, 1945, from

the Miocene of Jamaica.

Dimensions of some of the specimens are as follows:

H. 1.14 mm. W. 0.76 mm. T. 0.74 mm.

H. 1.50 mm. W. 0.76 mm. T. 0.74 mm.

H. 0.78 mm. W. 0.64 mm. T. 0.62 mm.

H. 0.60 mm. W. 0.38 mm. T. 0.38 mm.

Genus VAGINULINA d'Orbigny, 1826

Type species: Nautilus legumen Linné

Vaginulina sp. A

Description

Test elongate, initially loosely planispirally coiled, strongly compressed, with about 6 chambers, increasing rapidly in size, strongly curved; becoming uniserial, only slightly compressed, with 6 chambers the most preserved because of breakage to all specimens, increasing slowly in size at first, more rapidly later, rectangular, constant shape, about 2 to 3 times as wide as high on wide faces; sutures broad, flush with surface of test, strongly curved in coiled part; uniserial part eliptical in transverse section: periphery acute with sharp keel and strong apical spine in coiled part, rounded without keel in uniserial part; wall smooth, calcareous, finely perforate with coarser pores in early sutures; foramen exposed in broken specimen exterio-marginal, radiate.

Figured specimen:

Dimensions: H. 1.60 mm. W. 0.46 mm. T. 0.40 mm.

Occurrence: 850 feet.

Distribution: Common at 850 feet, rare at 900 and 950 feet.

Remarks: The specimens appear to be similar to the specimen figured as V. aff. elegans by LeRoy, 1944, from the Lower to Middle Miocene of Indonesia but absence of a description and a poor figure prevent accurate comparison. They possibly represent a new species.

Genus VAGINULINOPSIS Silvestri, 1904

Type species: NOT DESIGNATED

Vaginulinopsis sp. aff. V. acanthonucleus Carter, 1958

aff. Vaginulinopsis acanthonucleus Carter, 1958, Geol. Surv. Victoria, Bull. 55, p.30, pl.2, fig.3-7.

The specimens are close to Carter's species from the Eocene of Victoria, including similar variations but differ in the absence of proximal marginal spines and in having more globular adult chambers covered with numerous short spines. They probably represent a descendant species.

Distribution: Rare at 900 and 950 feet.

Dimensions of representative specimens:

H. 1.46 mm. W. 0.40 mm. T. 0.40 mm.

H. 0.80 mm. W. 0.34 mm. T. 0.24 mm.

H. 1.08 mm. W. 0.40 mm. T. 0.34 mm.

Vaginulinopsis sp. aff. V. tasmanica Parr, 1950

aff. Vaginulinopsis tasmanica Parr, 1950, B.A.N.Z.A.R.E., V.6, pt.6, p.324, pl.11, fig.13, 14; Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.67, fig.7.

These specimens occur at 700 feet and in core 6, 800-810 feet but are too few and too variable to be identified with certainty. The more normal specimens without overlapping chambers resemble Parr's species from the Recent of Tasmania whereas the more irregular specimens with overlapping chambers resemble his V. pacifica. Parr regarded the irregular forms as abnormalities and not to be placed in the "genus" Polymorphinella Cushman and Hanzawa which was erected to cover such forms. The specimens which Parr placed in V. pacifica are probably abnormal forms of his own species V. tasmanica.

Dimensions: H. 1.30 mm. W. 0.42 mm. T. 0.30 mm.
H. 1.28 mm. W. 0.56 mm. T. 0.32 mm.

Vaginulinopsis sp. aff. V. gippslandicus (Chapman and Crespin), 1930

aff. Vaginulina gippslandica Chapman and Crespin, 1930, Roy. Soc. Victoria, Proc., V.43, pt.1, pl.5, fig.5.

aff. Vaginulinopsis gippslandicus (Chapman and Crespin). Crespin 1950, Cushman Found. Foram. Res., Contr., V.1, pt.3, 4, p.73, pl.10, fig.9.

The specimens differ from this species described from the Oligocene of Victoria in having two proximal marginal spines and a smaller degree of tapering but probably come within the variations of the species. They were rare from 850 to 1100 feet.

Dimensions of typical specimens:

H. 2.32 mm. W. 0.58 mm.

H. 3.10 mm. W. 0.76 mm.

Family POLYMORPHINIDAE d'Orbigny, 1839

Genus GLANDULINA d'Orbingy, 1826

Type species: G. laevigata d'Orbigny

Glandulina sp. aff. G. laevigata d'Orbigny

aff. Glandulina laevigata d'Orbigny. LeRoy, 1941. Colorado School Mines, Quart., V.36, No.1, pt.1, p.29, pl.2, fig.87; LeRoy, 1944, ibid. V.39, No.3, pt.1, p.23, pl.1, fig.20, pt.2, p.83, pl.1, fig.27; Cushman and Todd, 1945, Cushman Lab. Foram. Res., Spec. Pub.15, p.34, pl.5, fig.19.

One specimen from 950 feet is similar to this species as figured by LeRoy from the Miocene of Indonesia and by Cushman and Todd from the Miocene of Jamaica, but varies in not being quite so globular. It possibly comes within the range of variation of the species.

Dimensions: H. 1.06 mm. W. 0.68 mm.

Genus GUTTULINA d'Orbigny, 1839

Type species: G. problema d'Orbigny

Guttulina sp. aff. G. austriaca d'Orbigny, 1846

aff. Polymorphina oblonga Cushman (non d'Orbigny), 1913. U.S. Nat. Mus., Bull.71, p.88, pl.37, figs 6a,b.

Specimens close to those figures by Cushman and Barker from the Recent of the North Pacific were rare at 550 feet and in core 5, 614-625 feet. They differ only in the presence of an extra, smaller, adult chamber and could represent a further growth stage of the same species.

Cushman and Ozawa, 1930, referred the specimens described from the North Pacific by Cushman, 1913, to G. austriaca and Barker followed suit with Brady's specimens which were originally identified as Polymorphina oblonga. Brady's, Cushman's and the Wreck Island specimens show similarities with P. oblonga and G. austriaca (both of which were originally described from the Tertiary of Vienna) but differ in chamber shape and arrangement and could belong to a new species.

Dimensions are: H. 1.52 mm., W. 0.82 mm. for the largest specimen.

Guttulina crassicostata Cushman and Ozawa, 1930

Guttulina regina (Brady, Parker & Jones) var. crassicostata

Cushman and Ozawa, 1930, U.S. Nat. Mus., Proc., V.77, art.6, p.35, pl.11, fig.5 a-c; Parr and Collins, 1937, Roy. Soc. Vict., V.50, Pt.1, (new series), p.194, pl.12, fig.6.

This species originally described from the Lower Pliocene of Victoria, was rare at 750, 850 and 950 feet. It varies from G. regina in the very broad, coarse costae, different shaped test, and chamber shape and arrangement. It is considered to be distinct enough to warrant elevation to specific rank.

Dimensions of typical specimens:

H. 0.88 mm. W. 0.50 mm.

H. 0.90 mm. W. 0.60 mm.

Guttulina regina (Brady, Parker and Jones), 1870

Guttulina regina (B.P. & J.) Cushman and Ozawa, 1930. U.S. Nat. Mus., Proc., V.77, art.6, p.34, pl.6, fig.1,2; Parr and Collins, 1937, Roy. Soc. Vict., V.50, pt.1 (new series), p.193, pl.12, fig.5; Parker, 1960, Soc. Econ. Pal. and Min., Spec. Pub.9, pl.73, fig.11-13.

This species was rare in cores 614-625 feet and at 650 and 750 feet. It appears to be a widespread Recent Pacific species but Parr and Collins report it from the Miocene to Recent of Victoria and Oligocene of New Zealand.

Angulogerina capricornica sp.nov.

Description:

Test small, elongate, greatest width about the middle, 2½ to 3 times as high as wide, triangular in cross section; chambers triserially arranged, tending to become uniserial and more embracing distally, distinct, not inflated, increasing gradually in size, fairly constant shape; sutures distinct, relatively broad, slightly to moderately depressed; faces flat to slightly concave; wall calcareous, smooth, coarsely perforate; peripheral margins subacute, proximal end rounded; aperture terminal, at end of distinct neck with lip.

Holotype:

Dimensions: H. 0.36 mm. W. 0.12 mm.

Occurrence: 900 feet.

Distribution: Abundant around 945 feet, rare at 900 feet.

Remarks: The species is superficially like Trifarina bradyi Cushman but varies from it in being triserial throughout. LeRoy, 1941, pt.1, pl.2, figs 114,115, figures a specimen as Trifarina bradyi (from the Upper Miocene of Indonesia), which appears to be triserial throughout and similar to the Wreck Is. specimens but the figures are not clear. Cushman figures a couple of specimens in his description of T.bradyi (vide Ellis and Messina) which could be similar but the figures are not clear and are not discussed. The specimens could prove to be juveniles of a form like T.bradyi

(Angulogerina (Trifarina) tricarinata (d'Orbigny) of Hofker, 1950, p.196), although this is doubted because no species is present to which it could be related. They are placed in a new species and the name Angulogerina capricornica is proposed, derived from the Capricorn Group of Islands to which Wreck Is. belongs.

Genus SIPHOGENERINA Schlumberger, 1883

Type Species: S.costata Schlumberger.

Siphogenerina raphanus (Parker and Jones)

Siphogenerina raphanus (Parker and Jones) Cushman, 1913, U.S. Nat. Mus., Bull.71, pt.3, p.108, pl.46, figs 1,2; LeRoy, 1944, Colorado School Mines, Quart., V.39, No.3, pt.2, p.86, pl.2, figs 27,28; Mathews, 1945, Journ.Paleont., V.19, p.588, pl.81, figs 16,17,21-23.

This widespread Recent western Pacific species, recorded also from the Miocene of Indonesia, was rare in cores and cuttings from 614 to 950 feet. It includes specimens which are biserial or triserial initially, and can be compressed distally, giving an eliptical cross section and aperture as well as rounded forms with circular apertures; and has a variable number of costae. Bandy, 1952, considered these to be normal variations or an expression of dimorphism and not to be split as done by Mathews, 1945.

Dimensions of representative specimens : H. 1.21 mm. W. 0.34 mm.
H. 0.98 mm. W. 0.22 mm.

Family HYALOVIRGULINIDAE Hofker, 1956.

Genus REUSSELLA Galloway, 1933.

Type species: Verneuilina spinulosa Reuss.

Reussella simplex (Cushman), 1929.

Reussella simplex Cushman, 1945, Cushman Lab. Foram. Res., Contrib., V.21, pt.2, p.40, pl.7, fig.5; Todd, 1958, U.S. Geol. Surv., Prof. Paper 280-H, p.290, pl.89, figs 23a,b.

This species was rare in cores and cuttings from 550 to 950 feet. Originally described from the Recent of the western Pacific, it has been recorded from the Recent and Middle Miocene of Victoria by Cushman.

Family VIRGULINIDAE (after Reiss, 1958)

Genus VIRGULINA d'Orbigny, 1826

Type species: V.squamosa d'Orbigny.

Virgulina sp.A.

Virgulina squamosa LeRoy, (non d'Orbigny) 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.33, pl.2, figs 24,25.

Rare specimens similar to the one figured by LeRoy as V.squamosa from the Upper Miocene of Indonesia were found at 900 and 950 feet. They differ from V.squamosa (as figured and described by Cushman, 1937, from the Pliocene of Italy) in the chamber shape and relative position of the sutures because of the presence of 5 instead of 4 chambers in the adult biserial portion. They could come within the variation of V.squamosa or belong to a new, closely related, species but there are insufficent specimens available to decide this point.

Dimensions: H. 0.72 mm. W. 0.20 mm.

Family SPHAEROIDINIDAE Cushman, 1927.

Genus SPHAEROIDINA d'Orbigny, 1826.

Type species: S.bulloides d'Orbigny, 1826

Sphaeroidina bulloides d'Orbigny. Cushman, 1914, U.S. Nat. Mus., Bull.71, pt.4, p.18, pl.10, fig.7, pl.12, fig.1; Chapman, Parr and Collins, 1934, Linnean Soc., London, Journ.(Zool.), V.38, (No.262), p.568, pl.10, figs 31a,b; LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.43, pl.1, figs 11-13, pt.2, p.86, pl.6, figs 5,6; LeRoy, 1944, ibid. V.39, No.3, pt.1, p.38, pl.4, figs 49,50, pt.2, p.90, pl.3, figs 24,25; Barker, 1960, Soc.econ.Pal. and Min., Spec.Pub.9, pl.84, figs 1,2.

This widespread Lower Miocene to Recent Indo-Pacific species was rare in cuttings only from 600 to 950 feet.

Family ?

Genus CANDEINA d'Orbigny, 1839

Type species: C.nitida d'Orbigny

Candeina nitida d'Orbigny. Bolli, Loeblich and Tappan, 1957, U.S. Nat. Mus., Bull. 215, p.35, pl.6, figs 10a-c; Todd, 1958, U.S. Geol. Surv., Prof. Paper 280-H, p.279, pl.79, figs 10a,b; Barker, 1960, Soc.econ.Pal. and Min., Spec.Pub.9, pl.82, figs 14-17.

This species was rare at 900 feet only; recorded from the Upper Miocene of Saipan by Todd, and ranges from the Miocene to the Recent according to Bolli et al.

Superfamily CASSIDULINACEA d'Orbigny, 1839

Family CASSIDULINIDAE d'Orbigny, 1839

Genus CASSIDULINA d'Orbigny, 1826

Type species: C.laevigata d'Orbigny.

Cassidulina sp. cf. C.subglobosa Brady, 1881

cf. Cassidulina subglobosa Brady, 1881, Quart. Journ. Micr. Sci. London, No.5, V.21, p.60; Brady, 1884, Rept. Voy. Challenger Expd., Zool., V.9, pl.54, Figs 17a-c.

Very rare specimens similar to this species described from the Recent off Brazil (vide Ellis and Messina) occurred in core and cuttings from 614-700 feet. They vary in having

a greater number of chambers, flatter apertural face, more curved sutures and the aperture in a slightly different position relative to the previous chambers.

Dimensions of representative specimen : H. 0.26 mm. W. 0.24 mm. T. 0.20 mm.

Cassidulina sp. aff. C.cushmani R.E. & K.C. Stewart,1930.

aff. Cassidulina cushmani R.E. & K.C. Stewart, 1930, Journ.Paleont. V.4, p.71, pl.9, fig.5; Abele, 1961, Unpub. thesis, p.169, pl.14, figs 20,21.

Specimens close to this species were very rare at 650 feet. They vary in having nearly straight instead of curved sutures.

Dimensions: D. 0.28 mm. d. 0.22 mm. T. 0.14 mm.

Cassidulina sp. aff. C.vitalisi Majzon, 1948

aff. Cassidulina vitalisi Majzon, 1948, Foldt Kozl, Budapest, V.78, No.1-2, p.22, tfs. 2,2a,b.

One specimen close to this species which was described from the Middle Oligocene of Hungary (vide Ellis and Messina) was found at 900 feet. It varies in having a smaller size and small radiating grooves above the aperture.

Dimensions: D. 0.22 mm. d. 0.16 mm. T. 0.10 mm.

Superfamily ?

Family NONIONIDAE

Genus NONION Montfort, 1808

Type species: Nautilus incrassatus Fichtel and Moll.

Nonion victoriense Cushman, 1936

Nonion victoriense Cushman, 1936, Cushman Lab.Foram.Res., Contrib., V.12, pt.3, p.67, pl.12, figs 10a,b; Cushman, 1939, U.S. Geol. Surv., Prof. Paper, 191, p.17, pl.4, fig.14; Carter, 1959, Unpub. Thesis, pl.17, figs 217,218.

Originally described from the Lower Pliocene of Victoria, this species was rare in cores and cuttings from 600 to 950 feet and in core 11, 1600-1610 feet. Many of the specimens had secondarily thickened sutures but were considered as variants.

Average dimensions: D. 0.56 mm. d. 0.36 mm. T.0.24mm.

Superfamily ASTERIGERINACEA d'Orbigny, 1839

Family DISCORBIDAE Cushman, 1927

Subfamily DISCORBINAE Cushman, 1927

Genus DISCORBIS Lamark, 1804.

Type species: D.vesicularis Lamark.

Discorbis bodjongensis LeRoy, 1941

Discorbis bodjongensis LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.2, p.82, pl.3, figs 13-15; pt.3, p.116, pl.1, figs 9-11.

This species, originally described from the Upper Miocene of Indonesia, was very rare at 900 and 945 feet.

Dimensions: D. 0.48 mm. d. 0.38 mm. T. 0.22 mm.

Discorbis sp. cf. D.micens Cushman, 1933

cf. Discorbis micens Cushman. Todd, 1958, U.S.Geol.Surv., Prof.Paper, 280-H, p.290, pl.90, figs 7a-c.

Specimens which appear to be similar to the one figured by Todd from the Recent of Saipan, were common in core 5, 614-625 feet. Some specimens differ in being strongly lobate but these are considered to be more mature forms.

Diameters of the specimens are around 0.40 mm.

Discorbis sp. cf. D.tuberocapitata (Chapman), 1900

cf. Discorbina tuberocapitata Chapman, 1900, Linnean Soc., London, Journ.(Zool.), V.28, No.179, p.11, pl.1, figs 9a-c.

cf. Discorbis tuberocapitata (Chapman). Todd, 1958, U.S.Geol.Surv., Prof.Paper 280-H, pl.91, figs 2a-c.

Specimens, similar to this species from the Recent of the western Pacific, were rare in the core and cuttings from 550 to 650 feet. Some specimens, which are considered to be juveniles of the same species as the larger ones, bear close resemblances to Discorbis australis Parr from the Recent of Victoria (vide Ellis and Messina).

Dimensions of large specimen : D. 0.62 mm. H. 0.36 mm.

Diameter of juvenile : D. 0.26 mm.

Discorbis sp. cf. D.propinqua (Terquem) emend. LeCalvez, 1949.

cf. Discorbis propinqua (Terquem) LeCalvez, 1949, Service Carte Geol., Me'm., Paris, p.17, figs 12-14.

One specimen similar to this species described from the Eocene of the Paris Basin occurred at 1000 feet. It varies in having 9 chambers in the last whorl, a more strongly convex dorsal side with indistinct early chambers due to secondary thickening.

Dimensions: D. 0.92 mm. d. 0.70 mm. T. 0.50 mm.

Genus SVRATKINA Pokorny, 1956

Type species: Discorbis tuberculata (Balkwill and Wright) var. australiensis Chapman, Parr and Collins

Svratkina australiensis (Chapman, Parr and Collins), 1934.

Discorbis tuberculata (Balkwill and Wright) var. australiensis Chapman, Parr and Collins, 1934, Linnean Soc., London, Journ.(Zool.), V.38, p.563, pl.8, fig.9.

Alabamina australiensis (Chapman, Parr and Collins) Carter, 1959, Unpub. Thesis, pl.20, fig. 246-248; Abele, 1961, Unpub. Thesis, p. 199.

This species was rare from 850 to 950 feet. It has been recorded from the Middle Oligocene to Lower Miocene of South Australia and Middle Oligocene to Middle Miocene of Victoria.

Dimensions: D. 0.38 mm. d. 0.34 mm.

Family EPISTOMARIIDAE Hofker, 1954

Genus EPISTOMAROIDES Uchio, 1952

Type species: Discorbina polystomelloides Parker and Jones.

Epistomaroides rimosa (Parker and Jones), 1862

Discorbina rimosa Parker and Jones, 1862, Roy Soc., London, V.155, p.205, pl.19, figs 6a-c.

Recorded by Parker and Jones from the Tertiary of France and the Recent of Australian reefs, this species is rare at 550 feet with a single occurrence at 850 feet. The specimens compare closely with the description and figures of this species (vide Ellis and Messina) but also appear to be close to the specimens figured as Epistomaroides polystomelloides by Todd, 1958, pl.93, fig.10 and by Barker, 1960, pl.91, fig.1. E.rimosa appears to differ from E.polystomelloides only in the absence of the coarse ornamentation but this could come within the variation of the latter species. A comparison with larger populations

would be necessary to ascertain the true relationship. E.polystomelloides is the genotype of Epistomaroides and because of its close similarity with E.rimosa, the latter species is also included in this genus.

Dimensions of largest specimen : D. 1.26 mm. d. 0.84 mm. T. 0.30 mm.

Subfamily ?

Genus EPONIDES Montfort, 1808.

Type species: Nautilus repandus Fichtel and Moll.

Eponides repandus (Fichtel and Moll)

Pulvinulina repanda (Fichtel and Moll) Cushman, 1914, U.S.Nat.Mus., Bull.71, pt.5, p.50, pl.24, figs 3a-c.

Eponides repandus (Fichtel and Moll) Chapman, Parr and Collins, 1934, Linnean Soc. London., Journ. (Zool.), V.38, (No.262), p.565, pl.9, figs 18a-c; Carter, 1958, Geol.Surv. Victoria, Bull.55, p.45, pl.6, figs 51-53.

Poroeponides cribrorepandus Asano, 1951, Illustrated Cat. Jap. Tertiary Smaller Foram., pt.14, p.18, figs 134,135; Todd, 1958, U.S. Geol.Surv., Prof.Paper 280-H, p.290, pl.93, figs 9a-c.

"Eponides repandus" (Fichtel and Moll) Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub.9, pl.104, fig.18.

This species, ranging from the Miocene to Recent in

Victoria, New Zealand and Japan, is rare in cores and cuttings from 550 to 950 feet. It has had a rather hectic history and Reiss, 1960, discussed it fully, declaring that it was a nomen dubium and should be suppressed. The main argument centres around the presence or absence of the large pores on the apertural face. Carter, 1958, states that they are not always present on his specimens and this is the case with the Wreck Is. specimens and appears to depend on the degree of maturity of the specimen and the thickness of the apertural face.

Reiss, 1960, in erecting his new genus Eponidopsis, using Eponides lornensis Finlay as the genotype, found that E.lornensis differed from E.repandus only in the matter of the coarse pores on the apertural face as far as generic features are concerned. The genus Poroeponides was erected to cover such specimens with coarse pores on the apertural face. The writer considers that the presence or absence of the coarse pores is not a generic feature; that lornensis and repandus are congeneric; that the genus Poroeponides is not valid; and that the genus Eponides as redefined by Cushman, 1927, should stand (making Reiss' new genus also unnecessary) but it should be emended to cover only those forms which come under the definition given by Reiss for his genus Eponidopsis.

Todd, 1958, and Barker, 1960, also discussed this problem and Barker used the name cautiously by placing it in inverted commas until some of the confusion is cleared up.

Wade, 1958, considered that E.tethyicus Dorreen was a synonym of E.repandus but it appears to be closer to E.lornensis with the axially enlarged aperture.

Some of the specimens are similar to E.lornensis Finlay in the number of chambers, peripheral outline and rate of chamber growth but differ in the nature of the aperture and the presence of the pores on the apertural face. It is likely that some of the Wreck Is. specimens are intermediate between E.lornensis and E.repandus since E.repandus is supposed to have 7 to 10 chambers and E.lornensis has 5 chambers in the last whorl.

Representative Dimensions :	D. 0.68 mm.	d. 0.60 mm.	T. 0.34 mm.
	D. 0.74 mm.	d. 0.60 mm.	T. 0.36 mm.
	D. 0.66 mm.	d. 0.50 mm.	T. 0.36 mm.
	D. 0.90 mm.	d. 0.80 mm.	T. 0.45 mm.

Genus NEOEPONIDES Reiss, 1960

Type species: Rotalina schreibersi d'Orbigny, 1846.

Neoeponides procera (Brady), 1884

Pulvinulina procera Brady Cushman, 1915, U.S.Nat.Mus., Bull.71, pt.5, p.62, pl.24, figs 2a-c, pl.25, figs 2a-c.

Eponides procerus (Brady) LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.2, p.83, pl.3, figs 31-33; LeRoy,1944, ibid V.39, No.3, pt.2, p.88, pl.5, figs 1-3.

Alabamina procera (Brady) Hofker, 1951, Siboga Exped., pt.3, p.396, figs 274,275.

"Eponides?" procera (Brady) Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub. 9, pl.105, figs 7a-c.

This widespread Lower Miocene to Recent Indo-Pacific species is common in cuttings from 600 to 950 feet and rare in core 7, 965 feet. The sizes and heights of the spires vary considerably within each population.

The species has been placed in a variety of genera and the writer has followed Reiss, 1960.

Representative dimensions:

D. 0.64 mm. H. 0.40 mm.

D. 0.96 mm. H. 0.80 mm.

D. 1.34 mm. H. 0.62 mm.

Subfamily BAGGININAE Cushman, 1927

Genus BAGGINA Cushman, 1927

Type species: B.californica Cushman

Cancris amplus, Finlay, 1940, Trans.Roy.Soc.N.Z., V.69, pt.4, p.463, pl.64, figs 92-94.

This species was rare from 600 to 900 feet and ranges from the Upper Oligocene to Lower Pliocene of New Zealand.

The specimen figured by Carter, 1959, pl.7, figs 77-79 as Baggina philippinensis compares closely with the Wreck Is. specimens and is considered to belong to B.ampla. Similarly, the specimen figured as B. aff. hauerii by LeRoy, 1941, pt.1, pl.3, figs 40-42 appears to belong to B.ampla.

Representative dimensions:

D. 0.84 mm. d. 0.60 mm. T. 0.48 mm.

D. 0.64 mm. d. 0.46 mm. T. 0.41 mm.

Genus CANCRIS Montfort, 1808

Type species: Nautilus auricula Fichtel and Moll.

Cancris sp.

Rare specimens of this genus at 900 feet are similar to the specimen figured by LeRoy, 1944, pt.1, pl.3, figs 10-12, as Cancris sagra (d'Orbigny) var. communis Cushman and Todd from the Lower and Middle Miocene of Indonesia, although they appear to differ from this species as figured by Cushman and Todd, 1942, pl.19, figs.8-11 from the Recent of California.

Dimensions: D. 0.58 mm. d. 0.40 mm. T. 0.26 mm.

Family SIPHONINIDAE Cushman, 1927

Genus SIPHONINA Reuss, 1856

Type species: S.fimbriata Reuss

Siphonina australis Cushman, 1927.

Siphonina australis Cushman. Chapman, Parr and Collins, 1934, Linnean Soc., London, Journ., (Zool.), V.38, p.567, pl.10, figs 10a-c; LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.41, pl.2, figs 88-90; LeRoy, 1944, ibid. V.39, No.3, pt.2, p.89, pl.4, figs 1-3; Carter, 1959, unpubl. thesis, pl.10, figs 117-119; Abele, 1961, unpubl. thesis, p.199, pl.18, fig.3.

This species, recorded from the Lower Miocene to Upper Miocene of Indonesia, Lower Oligocene to Middle Miocene of New Zealand, Middle Oligocene to Lower Miocene of South Australia and Middle Oligocene to Middle Miocene of Victoria, was rare at 950 feet only.

Dimensions: D. 0.48 mm. d. 0.40 mm. T. 0.18 mm.

Family ANOMALINIDAE Cushman, 1927.

Genus ANOMALINOIDES Brotzen, 1942.

Type species: Anomalina pinguis Jennings.

Anomalina glabrata Chapman, Parr and Collins (non Cushman), 1934, Linnean Soc. London, Journ., (Zool.), V.38, p.570, pl.11, fig.39.

Anomalina macraglabra Finlay, 1940, Trans. Roy. Soc. N.Z., V.69, pt.4, p.460, pl.65, figs 141-143; Carter, 1959, Unpubl. thesis, pl.12, figs 153-155.

Anomalinoides macraglabra (Finlay). Abele, 1961. Unpub. thesis, p.202, pl.18, fig.4.

This species was rare in cores and cuttings from 550 to 950 feet. It is recorded from the Upper Eocene to the Pliocene of New Zealand, Middle Oligocene to Lower Miocene in South Australia and the Middle Miocene of Victoria.

Average dimensions: D. 0.52 mm. T. 0.24 mm.

Genus ANOMALINELLA Cushman, 1927.

Type species: Truncatulina rostrata Brady

Anomalinella rostrata (Brady).

Anomalinella rostrata (Brady). LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.46, pl.3, figs 99,100; Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub. 9, pl.94, figs 6a-c.

This Upper Miocene to Recent Indo-Pacific was rare at 600 feet only.

Genus GYROIDINOIDES Brotzen, 1942.

Type species: Rotalina nitida Reuss.

Gyroidinoides sp. aff. G. zealandica (Finlay), 1939.

aff. Gyroidina zealandica Finlay, 1939, Trans. Roy. Soc., N.Z., V.69, pt.3, p.323, pl.28, figs 138-140.

aff. Gyroidinoides zealandica (Finlay). Abele, 1961. Unpub.thesis, p.91, pl.17, figs 1,2.

Small specimens similar to this species were rare in core 5, 614-625 feet and at 650, 945 and 1625 feet. They are also similar to Gyroidina soldanii (d'Orbigny) as figured by LeRoy, 1941, pt.2, pl.4, figs 19-21 from the Upper Miocene of Indonesia but there are insufficient specimens available for a close comparison. G. zealandica ranges from the Upper Eocene to Lower Oligocene in New Zealand and from the Middle Oligocene to Lower Miocene in South Australia.

Diameter of largest specimen : 0.66 mm.

Diameter of other specimens range between : 0.20 mm. and 0.26 mm.

Genus HANZAWAIA Asano, 1944

Type species: H.nipponica Asano.

Hanzawaia scopos (Finlay), 1940.

Discorbis bertheloti Chapman, Parr and Collins (non d'Orbigny) 1934, Linnean Soc. London, Journ., (Zool.), V.38, p.561, pl.9, figs 13a-c.

Discorbis scopos Finlay, 1940, Trans. Roy. Soc. N.Z., V.69, pt.4, p.466, pl.67, figs 212,213.

Rosalina scopos (Finlay) Carter, 1958, Geol.Surv.Victoria, Bull.55, p.41, pl.4, figs 34-36.

Hanzawaia scopos (Finlay) Abele, 1961, Unpub.thesis, p.219, pl.19, figs 9,10.

This species was rare to common in cores and cuttings from 750 to 950 feet and 1600 to 1625 feet. It is recorded from the Lower Oligocene to Middle Miocene in New Zealand, and Middle Oligocene to Lower Miocene in Victoria and South Australia. The specimens of Chapman et al. were from the Middle Miocene of Victoria. The Wreck Island specimens are similar to those figured by Carter and Finlay. Carter's specimen is the less mature, lacking the larger, more inflated last chambers shown by Finlay.

Representative dimensions: D. 0.70 mm. d.0.60 mm.T.0.20mm.
D. 0.52 mm. d.0.40 mm.T.0.12mm.

Genus CIBICIDES Montfort, 1808.

Type species: C.refulgens Montfort.

Cibicides sp. cf. C.cygnorum Carter, 1959 (M.S.)

cf. Cibicides cygnorum Carter, 1959, Unpub. thesis, pl.12, figs. 141-143.

Specimens similar to this species were rare at 950, 900 and 650 feet and in core 5, 614-625 feet. They are very small and closer to Carter's paratypes which are apparently juveniles. Diameters vary between 0.20 mm. and 0.32 mm.

Cibicides victoriensis Chapman, Parr and Collins, 1934.

Cibicides victoriensis Chapman, Parr and Collins, 1934,

Linnean Soc. London, Journ., (Zool.) V.38, p.571, pl.9, figs 16a-c.

Eponides praecintus LeRoy, (non Karrer) 1941, Colorado School Mines, Quart., V.36, No.1, pt.2, p.83, pl.3, figs 25-27, pt.3, p.116, pl.2, figs 22-24; LeRoy, 1944 ibid. V.39, No.3, pt.1, p.34, pl.2, figs 31-33, pt.2, p.89, pl.5, figs 4-6; Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub.9, pl.95, figs 1-3.

This species is rare to abundant from 550 to 950 feet and in core 11, 1600-1610 feet. Originally described from the Middle Miocene of Victoria, Carter, (1958) shows its first appearance in his No.11 Zone there. It has been recorded as Eponides or Cibicides praecintus from the Lower Miocene to the Recent of the Indo-Pacific Region.

Chapman, Parr and Collins stated that C.victoriensis was similar to C.praecinta (Karrer) but differed in the number of chambers being constantly greater. The juveniles were found to have 8 chambers the same number as was shown by Karrer for his species (vide Rotalia praecinta in Ellis and Messina). There appears to be a lot of confusion around C.praecinta which was originally described from the Miocene of Rumania. C.victoriensis could be a synonym but a comparison of actual material would be required from Europe and Victoria to ascertain this. For the moment the above appears to be the better name for the Indo-Pacific specimens.

Representative dimensions: D. 1.36 mm. H. 0.84 mm.
D. 0.78 mm. H. 0.52 mm.
D. 0.40 mm. H. 0.26 mm.

Cibicides hillae sp.nov.

Description:

Test a low trochospiral coil, compressed, almost equally biconvex; dorsal side evolute with about 3 whorls, early chambers indistinct, later chambers distinct, increasing regularly in size, fairly constant in shape, almost as long as wide; ventral side involute, 10 chambers in last whorl, triangular in shape, increasing gradually in size, with small infilled umbilicus slightly depressed; septal sutures broad, depressed, radiate on ventral side, gently to moderately oblique on the dorsal side; spiral suture on dorsal side broad, strongly raised, giving a distinctive spiral ridge on the early whorls, dying out along the last 4 chambers; periphery subcircular in outline, acute with keel, slightly lobate at first, becoming more strongly lobate later; wall smooth, coarsely perforate, calcareous; aperture interio - marginal, an elongate slit running from midway along the base of the apertural face to the periphery and continuing along the spiral suture of the last 3 chambers.

Holotype:

Dimensions: D. 0.58 mm. do. 0.50 mm. T. 0.25 mm.

Occurrence: 950 feet.

Distribution: Rare at 900 feet, common at 950 feet; a single occurrence at 1000 feet which is most likely a caving.

Remarks: The specimens seem to be closest to C.mediocris Finlay from which it can be distinguished by the elongate aperture, coarser perforations, raised, dorsal, spiral suture and absence of the opaline appearance which characterises all specimens of C. mediocris in the bore.

It is regarded as a new species, and the name C. hillae is proposed in honour of Professor Dorothy Hill of the Department of Geology, University of Queensland, who has shown great interest in the Great Barrier Reef and the work on Wreck Island.

Cibicides mediocris Finlay, 1940

Cibicides mediocris Finlay, 1940, Trans.Roy.Soc.New Zealand, V.69, pt.4, p.464, pl.67, figs 198,199; Carter, 1959, unpub. thesis, pl.11, figs 135,137; Abele, 1961, unpub.thesis, p.207, pl.18, fig.5.

Specimens which compare closely with topotype material of this species, as well as with Finlay's figure and description, were rare to common from 950 to 900 feet only, but specimens considered to be juveniles of this species at those depths continued up to 550 feet and were also found in core 11, 1600-1610 feet and at 1625 feet. These juveniles compared closely with the specimen figured as C.thiara by Carter, 1959, pl.11, figs 138-140 and this in turn did not compare closely with topotypes of C.thiara Stache. Specimens at 600 feet

exhibited a more strongly compressed peripheral region than the more typical specimens and showed close resemblance to C. ungerianus as figured by Chapman, Parr and Collins, 1934, pl.11, figs 42a-c but are considered to come within the range of variation of C. mediocris.

Representative dimensions:	D.	0.56 mm.	H.	0.25 mm.
	D.	0.70 mm.	H.	0.30 mm.
	D.	0.38 mm.	H.	0.18 mm.
D. 0.78 mm.	d.	0.64 mm.	H.	0.28 mm.
D. 0.52 mm.	d.	0.44 mm.	H.	0.22 mm.

The first two dimensions are of typical specimens and the third is of a juvenile from 950 feet and the last two are of more compressed specimens from 600 feet.

Cibicides refulgens Montfort, 1808

Truncatulina refulgens (Montfort) Cushman, 1915, U.S.Nat.Mus. Bull.71, pt.5, p.30, pl.12, figs 2a-c.

Cibicides refulgens (Montfort). Cushman, 1942, Great Barrier Reef Comm., Repts., V.5, pl.12, fig.3; Todd and Low, 1960, U.S.Geol.Surv., Prof.Paper, 260-X, p.852, pl.262, figs 14a-c; Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.92, figs 7-8.

Cibicides cf. refulgens (Montfort) Abele, 1961, Unpub.Thesis, p.215, pl.19, figs 1-3.

This species was rare to common in cores and cuttings from 614 to 950 feet. Although Montfort's original figure (vide Ellis and Messina) is very idealised and his description slightly inadequate, the Wreck Island specimens are typical of what has become accepted as C. refulgens by various workers.

Representative Dimensions :	D. 0.46 mm.	d. 0.38 mm.	H. 0.30 mm.
	D. 0.76 mm.	d. 0.58 mm.	H. 0.40 mm.
	D. 0.58 mm.	d. 0.50 mm.	H. 0.34 mm.
	D. 0.52 mm.	d. 0.44 mm.	H. 0.24 mm.

Family ASTERIGERINIDAE d'Orbigny, 1839

Genus AMPHISTEGINA d'Orbigny, 1826.

Type species: A. vulgaris d'Orbigny

Amphistegina quoyii d'Orbigny, 1826.

Amphistegina quoyii d'Orgibny. Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub. 9, pl.111, figs 1,3.

Specimens comparing closely with Barker's figured specimens were common to abundant in cores and cuttings from 550 to 1050 feet and rare down to 1625 feet. There seems to be much confusion with the species of Amphistegina and the name A. lessoni seems to have been applied indiscriminantly.

Representative Dimensions:	D. 2.06 mm.	T. 0.72 mm.
	D. 1.66 mm.	T. 1.20 mm.
	D. 0.90 mm.	T. 0.30 mm.

Amphistegina gibbosa d'Orbigny, 1839

Amphistegina gibbosa d'Orbigny Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub. 9, pl.111, fig. 2.

Specimens similar to the one figured by Barker from the Recent of the South Atlantic Ocean were rare in cores and cuttings from 550 to 1000 feet.

Representative Dimensions: D. 1.46 mm. T. 0.48 mm.
D. 1.19 mm. T. 0.36 mm.
D. 0.40 mm. T. 0.34 mm.

Family PLANORBULINIDAE Schwager, 1877

Genus PLANORBULINELLA Cushman, 1927.

Type species: Planorbulina larvata, Parker & Jones.

Planorbulina larvata Parker and Jones, 1865, Roy.Soc.,London, Philos.Trans., V.155, p.379; Cushman, 1915, U.S.Nat.Mus. Bull.71, pt.5, p.37, pl.8, fig.2.

Planorbulinella larvata (Parker and Jones), LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.47, pl.3, fig. 43, pt.2, p.89, pl.5, fig. 39; Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub.9, pl. 92, figs 5,6.

This widespread Upper Miocene to Recent Indo-Pacific species was rare to common in cores and cuttings from 550 to 1000 feet. The specimens had sizes within the following limits - D. 1.26 mm. T. 0.20 mm. and D. 0.70 mm. and T. 0.10 mm.

Superfamily ROTALIACEA Ehrenberg, 1839.

Family ROTALIIDAE Ehrenberg, 1839.

Subfamily ROTALIINAE Ehrenberg, 1839.

Genus AMMONIA Brunnich, 1771.

Type species: Nautilus beccarii Linné.

Ammonina sp. aff. A.beccarii (Linné)

aff. Rotalia beccarii (Linnaeus) Cushman, 1915, U.S.Nat.Mus., Bull. 71, pt. 5, p.67, pl. 30, fig. 3.

aff. Streblus beccarii (Linnaeus), Todd, 1957, U.S. Geol.Surv., Prof. Paper 280-H, pl.91, figs 3a-c.

Very small specimens close to this species were very rare in core 5, 614-625 feet, in core 11, 1600-1610 feet and at 1000 feet. They had diameters around 0.34 mm. The writer has followed Reiss and Merling, 1958, in placing this species in the genus Ammonia.

Genus PSEUDOROTALIA Reiss and Merling, 1958.

Type species: Rotalia schroeteriana Parker and Jones.

Rotalia schroeteriana Parker and Jones, Carpenter, 1862. Roy. Soc., London, p.213, pl.13, figs 7-9.

Pseudorotalia schroeteriana (Parker and Jones), Reiss and Merling, 1958, Israel Geol. Surv., Bull. 21, p.13.

Streblus schroeteriana (Parker and Jones), Barker, 1960, Soc. Econ.Pal. and Min., Spec.Pub. 9, pl.115, fig. 7.

This species is rare to common in cores and cuttings from 550 to 900 feet with best development around 600 feet. Reiss and Merling, 1958, stated that the genus ranges from the Pliocene to the Recent but the writer has also seen this species in the Upper Miocene of Papua.

Dimensions of average specimen: D. 1.04 mm. H. 0.76 mm.

Pseudorotalia indopacifica (Thalmann), 1935.

Rotalia indopacifica Thalmann, 1935, Eclogae Geol. Helv., Lausanne, Suisse, V.28, p.605, pl.73, figs 1a-c.

This species, described from the "younger Tertiary" of Java, was rare at 550, 600 and 900 feet. Its best development was at 600 feet. It appears to grade into P. schroeteriana and the latter species appears to be the juvenile of the specimens here placed in P. indopacifica. If this is proved to be the case, P. indopacifica should be suppressed, but since the extremes are easily distinguishable, P. indopacifica may be best relegated to subspecific rank. Present material available is not sufficient to allow a more detailed investigation.

Dimensions of the two largest specimens:

D. 3.18 mm. H. 1.34 mm.

D. 2.74 mm. H. 1.94 mm.

Genus OPERCULINA d'Orbigny, 1826.

Type species: Lenticulites complanata Defrance

Operculina ornata Cushman, 1921.

Operculina bartschi Cushman var. ornata Cushman, 1942, Great Barrier Reef Comm., Repts., V.5, pl.11, fig.12.

Specimens similar to the one figured by Cushman from the Heron Island Bore were rare at 600 feet and odd specimens, considered to be cavings, occurred at greater depths. The specimens were more robust and thicker than the original specimen figured by Cushman from the Recent of the Philippines (vide Ellis and Messina), but were otherwise similar.

The variety erected by Cushman appears to be distinct enough from O. bartschi (mainly in the ornamentation) to warrant raising to specific rank.

Dimensions: D. 1.74 mm. T. 0.54 mm.

Operculina victoriensis Chapman and Parr, 1937.

Operculina victoriensis Chapman and Parr (part only) 1937, Roy. Soc. Victoria, V.50, pt. 1 (new series), p.284, pl.16, figs 3,5; Carter, 1959, Unpub. Thesis, pl.25, figs 317, 318.

Description :

Test large, strongly compressed, evolute both sides, planispirally coiled, symmetrical, usually biconvex centrally, becoming flat and parallel-sided but slightly undulating on

large specimens; chambers numerous, up to 18 in last whorl but probably originally more in larger broken specimens, increasing rapidly in size, normally constant in shape, about 3 times as wide as high, but sometimes small and irregular; sutures distinct, broad, slightly raised, normally gently recurved, early sutures often indistinct, marked as a row of small raised beads; periphery subcircular in outline but variable in large specimens, blunt with distinct keel; wall calcareous, finely perforate, thin on smaller specimens becoming thick on the larger specimens, earlier chambers with one or two rows of raised beads, sometimes irregularly placed and together with the beaded sutures gives a coarse ornamentation, later chambers smooth; aperture interio-marginal, a very short narrow slit.

Figured specimen:
Dimensions: D. 1.62 mm. T. 0.24 mm.
Occurrence: Core 5, 614-625 feet.

Figured specimen:
Dimensions: D. 4.06 mm. (broken) T. 0.28 mm.
Occurrence: 600 feet.

Distribution: Abundant in cores and cuttings from 550 to 1050 feet, then rare down to 1625 feet. The species was originally described from the Lower Miocene of Victoria and Carter, 1958b, gives its range as Upper Oligocene to Middle Miocene.

Remarks: The size of some specimens of this species is remarkable, the largest being 10.34 mm. in diameter.

This species as here emended includes only Form A of Chapman and Parr.

Operculina praevictoriensis sp.nov.

Operculina victoriensis Chapman and Parr (in part), 1937, Roy.Soc.Victoria, V.50, pt.1, (new series), p.284, pl.16, fig. 7.

Description:

Test large, compressed; evolute, flat and parallel-sided; planispirally coiled, symmetrical; chambers numerous, increasing moderately in size, about 3½ times as wide as high, usually fairly constant in shape, sometimes small and irregular; sutures distinct, broad, raised, gently to moderately recurved; periphery circular in outline, blunt with strong keel showing distinct parallel striations; wall calcareous, finely perforate, covered with numerous very small beads; aperture not observed because of damage to all specimens.

Holotype
Dimensions: D. 2.70 mm. (broken) T. 0.26 mm.

Paratype
Dimensions: D. 4.36 mm. (broken) T. 0.48 mm.

Occurrence: Both specimens from 1750 feet.

Distribution: Abundant from 1715 to 1750 feet and rare down to 1795 feet; recorded from the Lower Miocene of Victoria.

Remarks: This species, originally designated as form B of the varieties of O. victoriensis by Chapman and Parr, differs from O. victoriensis in having numerous very small beads on the chambers, completely flattened sides, slightly narrower chambers with a slower rate of growth and in the absence of the larger beads on the early chambers and sutures. The occurrence of this species stratigraphically below O. victoriensis in the bore suggests it is the ancestral form and hence the derivation of the name. A similar splitting of the variants in Victoria could verify this and enhance the stratigraphical value of the two species.

Family CALCARINIDAE

Genus CALCARINA d'Orbigny, 1826.

Type species: Nautilus spengleri Linne

Calcarina calcar d'Orbigny, 1826.

Rotalia calcar (d'Orbigny). Cushman, 1915, U.S.Nat.Mus., Bull.71, pt.5, p.69, pl.28, fig.2; LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.2, p.84, pl.7, figs 1-3; Todd and Post, 1954, U.S. Geol.Surv., Prof. Paper 280-N, p.560, pl.202, fig. 1.

Calcarina calcar d'Orbigny. Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.108, fig.3.

This species was very rare in cores and cuttings from 550 to 625 feet. Diameters of specimens were around 0.52 mm.

Genus TINOPORUS Montfort, 1808.

Type species: T.baculatus Montfort.

Tinoporus hispidus (Brady)

Calcarina hispida (Brady). Cushman, 1942, Great Barrier Reef Comm., Repts., V.5, pl.12, fig. 10.

Tinoporus hispidus (Brady). Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl. 108, figs 8,9.

This species was rare in cuttings and cores from 550 to 750 feet with further occurrences from 1050 to 1750 feet which are regarded as cavings. The preservation is usually poor.

Genus BACULOGYPSINA Sacco, 1893.

Type species: Orbitolina sphaerulata Parker and Jones.

Baculogypsina sphaerulata (Parker and Jones)

Tinoporus baculatus Cushman, 1915, U.S. Nat. Mus., Bull. 71, pt. 5, p.73, pl.27, figs 3a,b.

Baculogypsina sphaerulata (Parker and Jones.), Cushman, 1942, Great Barrier Reef Comm., Repts., V.5, p.119, pl.12, fig.11; Barker, 1960, Soc. Econ. Pal. and Min., Spec. Pub. 9, pl.101, figs 4-7.

This species was found in cuttings intermittantly throughout the bore and most are probably cavings.

Family ELPHIDIIDAE Galloway, 1933.

Genus ELPHIDIUM Montfort, 1808.

Type species: Nautilus macellus Fichtel and Moll.

Elphidium craticulatum (Fichtel and Moll.), 1798.

Polystomella craticulata (Fichtel and Moll.), Carpenter, 1862, Roy. Soc., London, p.279, pl.16, figs 1-9; Cushman, 1914, U.S.Nat.Mus., Bull.71, pt.4, p.34, pl.19, figs 4a-b.

Elphidium craticulatum (Fichtel and Moll.), Cushman, 1939, U.S.Geol.Surv., Prof.Paper 191, p.56, pl.15, figs 14-17; LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.2, p.79, pl.6, figs 34,35; Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub. 9, pl.110, figs 16,17.

This Upper Miocene to Recent species was abundant to rare from 550 to 850 feet with best development in core 5, 614-625 feet. The size of some of the specimens was remarkable, the largest having 68 chambers in the last whorl. The dimensions varied between the following limits:
D. 0.82 mm. T. 0.56 mm. and D. 4.54 mm. T. 1.48 mm.

Elphidium sp. aff. E.pseudonodosum Cushman, 1936.

aff. Elphidium pseudonodosum Cushman, 1936, Cushman Lab. Foram. Res., Contrib., V.12, p.82, pl.14, figs 9a-b; Cushman, 1939, U.S. Geol.Surv.,Prof. Paper 191, p.50, pl.13, figs 12a-b; Carter, 1959, Unpub.Thesis, pl.23, figs 293, 294.

Specimens close to this species were rare in cores and cuttings from 550 to 950 feet. They vary in being more strongly compressed towards the periphery with a sharper keel and less inflated chambers. The species has been recorded from the Oligocene, Lower Miocene and Pliocene of Victoria.

Average dimensions: D. 0.58 mm. T. 0.20 mm.

Elphidium parri, Cushman, 1936.

Elphidium parri Cushman, 1936, Cushman Lab.Foram.Res., Contrib., V.12, p.81, pl.14, figs 7a,b; Cushman, 1939, U.S. Geol. Surv., Prof.Paper 191, p.47, pl.12, figs 18a,b; Carter, 1959, Unpub. Thesis, pl.23, figs 288-290.

This species, described from the Miocene of Victoria, was rare to common in cores and cuttings from 550 to 1750 feet. Dimensions varied between the following limits:

D. 0.92 mm. T. 0.56 mm. and D. 0.46 mm. T. 0.28 mm.

Elphidium crespinae Cushman, 1936.

Elphidium crespinae Cushman, 1936, Cushman Lab.Foram.Res., Contrib., V.12, pt.4, p.78, pl.14, figs 1a,b; Cushman, 1939, U.S. Geol. Surv., Prof. Paper 191, p.41, pl.11, figs 1a,b.

Elphidium crassatum Cushman, 1936, ibid., p.81-82, pl.14, figs 8a,b.

Originally described from the Miocene of Victoria, this species was rare from 614-900 feet in a core and cuttings. The specimens differ from E. crespinae as described by Cushman in having about 23 chambers in the last whorl and finer sutures and septal ridges. They are closer to E. crassatum Cushman which Wade, 1957, p.338, placed as a synonym of E. crespinae, and thus the Wreck Island specimens are considered to come within the range of variation of this species.

Average dimensions: D. 0.66 mm. T. 0.20 mm.

Elphidium sp. aff. E. marshallana Todd and Post, 1954.

aff. Elphidium marshallana Todd and Post, 1954, U.S. Geol. Surv., Prof.Paper 260-N, p.556, pl.198, fig.13.

Rare specimens close to E. marshallana (described from the "e" stage of the Bikini Atoll bores) were found in core 5, 614-625 feet. Their only apparent difference is the possession of a smaller number of chambers in the last whorl, namely 8, and they could come within the variation of that species.

Dimensions: D. 0.54 mm. d. 0.28 mm.

Elphidium adelaidensis Howchin and Parr, 1938.

Elphidium adelaidensis Howchin and Parr, 1938, Trans. Roy. Soc., South Australia, V.62, No.2, p.300, pl.19, fig.6.

This species, described from the Pliocene of Adelaide, was rare from 600 to 750 feet. Howchin and Parr seem to have confused the visual effect of the retral processes and the

branches of the septal canal system. They said that there were "up to 22 retral processes extending across the surface of the chamber, or occasionally only a little forward and backwards from the suture line and so forming a double series of shallow pits bordering each chamber". The retral processes and canal branches in the Wreck Island specimens give exactly that impression and the true retral processes are seen to be quite long backward extensions of the chambers with the branches of the septal canal between them, appearing to come forward from the previous chamber.

Average dimensions: D. 1.86 mm. T. 0.82 mm.

Genus PARRELLINA Thalmann, 1951.

Type species: Polystomella imperatrix Brady.

Parrellina heronica sp. nov.

Elphidium verriculatum Cushman, (non Brady), 1942, Great Barrier Reef Comm., Repts., V.5, pl.11, fig.10.

Parrellina aff. verriculata (Brady), Abele, 1961, Unpub. Thesis, p.253, pl.20, figs 21,22.

Description:

Test planispirally coiled, involute both sides, symmetrical, strongly compressed, both sides flat to slightly convex; periphery circular in outline, subacute with small keel;

chambers 13 to 15 in number, increasing gradually in size, fairly constant shape, about 4 times as wide as high; sutures distinct, broad, raised, strongly recurved, radiate; wall calcareous, finely perforate, with 10 to 14 retral ridges completely crossing each chamber, of equal strength to the sutures, occasionally anastomosing to give a coarse ornamentation which hides much of the surface; axial region on each side marked by a number of small beads; apertural face crossed by a number of ridges which run from the base to the edge, sometimes anastomosing; aperture not clear but appears to be a row of small holes at base of apertural face.

Holotype:

Dimensions: D. 1.00 mm. d. 0.84 mm. T. 0.20 mm.

Occurrence: Core 11, 1600-1610 feet.

Distribution: Rare to common in cores and cuttings from 1750 to 1550 feet and 950 to 600 feet with best development around 850 feet; at 673 feet in the Heron Island Bore; and Middle Oligocene to Lower Miocene in South Australia.

Remarks: The Wreck Island specimens are regarded as conspecific with the specimens of Cushman and Abele. There is also a close similarity with the specimen figured as Elphidioides verriculatus by Parr, 1950, pl.18, fig.17 from the Recent of Tasmania. The specimens differ from P. verriculatus (Brady) in having a greater number of retral ridges per chamber, a weaker development of the retral ridges, sutures, and ridges on the apertural face,

and greater compression, but there is possibly a close relationship between them. They are regarded as representing a new species and the name is derived from Heron Island, the site of the bore from which Cushman first figured this species.

Parrellina reticulata sp.nov.

Description:

Test large, planispirally coiled, involute both sides, biconvex, usually symmetrical, strongly compressed, discoidal with on each side an umbilical plug which is usually raised and dome-like, but sometimes flush with surface of test, with numerous small openings; chambers 23 to 33 in number, narrow, much wider than high, normally increasing gradually in size and fairly constant shape but sometimes smaller chambers are added which do not reach the axial region, sometimes irregularly shaped; sutures distinct, broad, raised, varying from strongly to gently recurved, radiate or sometimes irregular and meandering; peripheral outline variable, circular without spines, circular with short robust spines to distinctly irregularly, pentagonal to hexagonal with 5 or 6 robust spines; periphery subacute with strong, well developed, rounded keel; wall calcareous, thick, crossed by a network of ridges; dense fine perforations on sutures, keel and umbilical plugs as well as the chamber walls; keel and spines show many internal canals and their external openings; fine septal canals are visible

from the exterior and are seen to branch and follow the network of ridges on the surface of the chambers and open to the exterior through the keel; apertural face low, not prominent, crossed by ridges of canal system; no apertural openings visible.

Holotype

Dimensions: D. 2.10 mm. T. 0.92 mm.

Paratypes

A.	Dimensions:	D. 3.10 mm.	T. 1.20 mm.
B.		D. 1.20 mm.	T. 0. 44 mm.
C.		D. 1.14 mm.	T. 0.50 mm.
D.		D. 3.40 mm. (broken)	
E.		D. 2.80 mm. (broken)	
F.		D. 2,90 mm. (broken)	
G.		D. 2.80 mm.	
H.		D. 2.50 mm.	T. 1.06 mm.
I.		D. 1.96 mm.	T. 0.86 mm.
J.		D. 2.84 mm.	T. 1.00 mm.
K.		D. 2.00 mm.	T. 0.80 mm.
L.		D. 3.20 mm.	T. 0.50 mm.
	Occurrence:	all specimens from 1750 feet.	
M.		D. 2.10 mm.	T. 1.62 mm.
N.		D. 1.40 mm.	T. 0.72 mm.
O.		D. 1.00 mm.	T. 0.68 mm.
P.		D. 1.40 mm. (broken)	T. 0.80 mm.
	Occurrence:	above 4 specimens from 900 feet.	

Distribution: Rare to common in cores and cuttings from 600 to 1050 feet and at 1300, 1550, 1625 and 1795 feet and abundant from 1715 to 1750 feet.

Remarks: The above description was based on a population from 1750 feet where the species is well developed. At 1625 feet two specimens regarded as juveniles have only 14 chambers and above that depth the specimens are smaller than the typical ones described, have 16 to 20 chambers in the last whorl, umbilical plugs with large deep openings giving rise to a beaded appearance and more strongly biconvex, less compressed tests. Apart from these variations the same diagnostic features are present and the changes are considered to have been brought about by the change from quartz sandstone to limestone sedimentary conditions i.e. an ecological change. The meanderine forms at 1750 feet appear to be the result of twinning.

In thin section, the polygonal and circular forms contain both megalospheric and microspheric generations. In the megalospheric generations, the proloculus and second chamber are similar in both forms. The third chamber is larger than the fourth in the circular forms which thus appear to have 3 chambers in the embryonic stage, whereas the third chamber in the polygonal forms is about the same size as the fourth chamber and they appear to have only 2 chambers in the embryonic stage. The spines seem to appear at the time of the

growth of the second whorl and then continue to the exterior with the addition of each new whorl in the polygonal forms, while in the circular forms spines are either not grown or are occasionally added on the earlier whorls but not on the last whorl or are very small throughout growth and do not interfere with the shape of the peripheral outline. The polygonal outlines appear to have resulted from the growth of large spines and the chambers being displaced over them as added.

The growth of the spines and their size appears to be linked with the canal system and the passage of the protoplasm to the exterior. The main canal systems are developed in the umbilical plugs, spines and keel; those in the spines run along their complete length to the exterior, sometimes collecting other canals along the way; the canals in the keels of earlier whorls are seen to converge towards the outer septa, continue along the septa and then diverge into the keel of the next whorl and so on to the exterior. On the surface of whole specimens the sutural canals are seen to branch and run along the surface of the chambers, forming the reticulate network of ridges, and pass into the keel and open to the exterior along its length. In vertical section, canals are seen to run through the umbilical plugs to the exterior and the septal canals are parallel and coincide with the foramina and appear to be connected with them. The foramina are seen as a row of small holes at the base of each septum and sometimes as similar holes above the

basal holes on the face of the septum, but they may not be true foramina, being actually the positions where the canals have been cut. A section of a specimen from the limestone facies shows a reduction in the number of canals passing into the exterior along the keel and this is possibly offset by the presence of larger umbilical canals, giving rise to the beaded appearance of the umbilical plugs.

Crespin, 1961, compared these specimens with Elphidium reginum (d'Orbigny) var. caucasicum Bogdanowicz but apart from the presence of spines there is no similarity. The spines and canal system are similar to those in Parrellina imperatrix (Brady) and the specimens could represent an ancestral form of this species which was described from the Recent of Port Jackson, New South Wales. The specimens are regarded as representing a new species and the name P.reticulata is proposed because of the reticulate canal system and ridges on the surface of the test.

Superfamily GLOBIGERINACEA Carpenter, Parker and Jones, 1862.
Family GLOBIGERINIDAE Parker and Jones, 1862.
Subfamily GLOBIGERININAE Parker and Jones, 1862.
Genus GLOBIGERINA d'Orbigny, 1826.
Type species: G.bulloides d'Orbigny.

Globigerina falconensis Blow, 1959.

Globigerina falconensis Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.177, pl.9, figs 40,41.

This species was common in core 5, 614-625 feet and at 900 feet; rare in core 11, 1600-1610 feet. It ranges from the upper Globigerinatella insueta/Globigerinoides bispherica Zone to the

Globigerina bulloides Zone of Blow in Venezuela.

The specimens included in this species are small and most are relatively smooth but a few are spinose while others are almost smooth, showing the remnants of spines. Blow does not mention spines but his figure suggests that they are absent. The smoothness appears to have been caused by loss of the spines through abrasion.

The species could represent a juvenile form although its relationship with any other species is not apparent.

Average dimensions: D. 0.28 mm. d. 0.24 mm.

Globigerina juvenilis Bolli, 1957

Globigerina juvenilis Bolli, 1957, U.S.Nat.Mus., Bull.215, p.110, pl.24, figs 5,6.

Globigerina eamesi Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.176, pl.9, figs 39a-c; Jenkins, 1960, Micropaleontology, V.6, No.4, p.350, pl.1, figs 7a-c.

This species is rare to common from 614 feet to 900 feet ; rare in Core 11, 1600-1610 feet. The specimens placed in this species include smooth forms similar to Bolli's species and spinose forms similar to Blow's species with intermediate forms with only a few spines and the two species are regarded as as being synonymous.

The specimens placed in this species bear a close similarity to the early stages of Globoquadrina venezuelana Hedberg and they could be juveniles of this species.

Average dimensions: D. 0.22 mm. d. 0.22 mm. T. 0.18mm.

Globigerina obesa (Bolli), 1957.

Globorotalia obesa Bolli, 1957, U.S. Nat.Mus., Bull. 215, p.119, pl.29, figs 2,3; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.218, pl.19, figs 124a-c; Jenkins, 1960, Micropaleontology, V.6, No.4, p.364, pl.5, figs. 2a-c.

Globigerina obesa (Bolli), 1959. Koninkl. Akademie van Wetenschappen, Amsterdam, Proc. Ser.B, 62, No.3, p.117, pl.1, fig.7.

This species was rare in cores and cuttings from 550 to 950 feet and in core 11, 1600-1610 feet. It ranges from the Catapsydrax dissimilis Zone to the Globorotalia menardii Zone of Bolli in Trinidad; from the Catapsydrax dissimilis Zone to the Globigerina bulloides Zone of Blow in Venezuela; and from the Globoquadrina dehiscens dehiscens Zone to the Globorotalia menardii miotumida Zone of Jenkins in Victoria. Specimens figured as Globigerina bulloides by LeRoy, 1941, pt.2, pl.3, figs 27,27 and 1944, pt.1, pl.3, figs 28,29 from the Lower to Upper Miocene of Indonesia appear to belong to G. obesa (Bolli).

Average dimensions: D.0.50 mm. d.0.28 mm. T.0.34 mm.

Globigerina mayeri (Cushman and Ellisor), 1939.

Globorotalia mayeri Cushman and Ellisor, 1939, Cushman Lab. Foram. Res., Contrib., V.15, pt.1, p.11, pl.2, fig.4; Bolli, 1957, U.S.Nat.Mus., Bull.215, p.118, pl.28, figs 4a-c;

Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.214, pl.18, figs 116a-c.

Globigerina siakensis LeRoy, 1939, Natuurk. tijdschi. Ned.-Indie, afl.6, dul 99, p.262, pl.4, figs 20-22; LeRoy,1939, Colorado School Mines, Quart., V.39, No.3, pt.1, p.39, pl.3, figs 30,31, pl.6, figs 39,40.

Globigerina aff. cretacea LeRoy, 1941, Colorado School Mines, Quart., V.36, No.1, pt.1, p.43, pl.2, figs 108-110.

Globigerina cretacea LeRoy, (non d'Orbigny) 1941, ibid. pt.2, p.86, pl.4, figs 28-30.

Globorotalia (Turborotalia) mayeri Cushman and Ellisor, Cushman and Bermudez, 1949, Cushman Lab.Foram.Res., Contrib., V.25, pt.2, p.44, pl.8, figs 16-18.

Globorotalia siakensis (LeRoy) Jenkins, 1960, Micropaleontology V.6, No.4, p.366, pl.5, figs 7a-c.

This species was common from 900 to 950 feet and rare at 600 feet and in core 5, 614-625 feet with a possible occurrence in core 11, 1600-1610 feet. It ranges from the Globigerina opima opima Zone to the top of the Globorotalia mayeri Zone of Bolli in Trinidad and from the Catapsydrax stainforthi Zone to the top of the Globorotalia mayeri Zone of Blow in Venezuela. Jenkins gives the range of his Globorotalia siakensis as Globigerinoides triloba triloba Zone to the Globigerinoides bispherica Zone and of his G.mayeri, from the Globorotalia mayeri Zone to the Globorotalia menardii miotumida

Zone in Victoria. LeRoy gave the range of his species as Lower and Middle Miocene while his specimens identified as Globigerina cretacea or G. aff. cretacea occurred in the Upper Miocene of Indonesia.

The Wreck Island specimens contain forms typical of G. siakensis LeRoy and G.mayeri (Cushman and Ellisor) and it is considered that they come within the range of variation of the one species. LeRoy's species, published just after that of Cushman and Ellisor, should therefore be suppressed as a synonym. The specimens figured as G.cretacea and G.aff. cretacea are also considered to belong to G.mayeri.

The specimen figured as Globorotalia siakensis by Jenkins appears to be similar to the Wreck Island specimens but his G.mayeri is not typical but could be a variant or a juvenile form. Jenkins considered that G. siakensis was the ancestral species of G.mayeri but the Wreck Island evidence does not support this.

One specimen from core 5, 614-625 feet bears close resemblance to Globigerina subcretacea Chapman (vide Ellis and Messina) which was described from the Recent of Fiji and it may be possible that Chapman's species represents a descendant species of G.mayeri.

Representative dimensions :

D. 0.50 mm. H. 0.34 mm.

D. 0.56 mm. H. 0.36 mm.

D. 0.34 mm. H. 0.22 mm.

Genus GLOBIGERINOIDES Cushman, 1927.

Type species : Globigerina rubra d'Orbigny.

Globigerinoides obliqua Bolli, 1957

Globigerinoides obliqua Bolli, 1957, U.S. Nat.Mus., Bull. 215, p.113, pl.25, figs 9,10; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.191, pl.11, figs 68 a,b.

This species was common from 900 to 950 feet only. It ranges from the Globorotalia kugleri Zone to the Globorotalia menardii Zone of Bolli in Trinidad and from the Catapsydrax stainforthi Zone to the Globigerina bulloides Zone of Blow in Venezuela.

Average dimensions: D. 0.62 mm. d. 0.54 mm.

Globigerinoides rubra (d'Orbigny), 1839.

Globigerinoides rubra (d'Orbigny) LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.2, p.86, pl.7, figs 13-15, pt.3, p.118, pl.3, figs 4-6; Bolli, 1957, U.S.Nat.Mus., Bull.215, p.113, pl.25, figs 12,13; Carter, 1958, Geol.Surv., Victoria, Bull.55, p.55, pl.8, figs 81-84; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.192, pl.11, fig.70, pl.13, figs 69a,b; Jenkins, 1960, Micropaleontology, V.6, No.4, p.353, pl.2, figs 8,9; Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub.9, pl.79, figs 11-16.

This species occurred in cores and cuttings from

600 to 950 feet with the best development between 900 and 950 feet. It has its first occurrence in the Catapsydrax dissimilis Zone of Bolli in Trinidad, Globorotalia mayeri/ Globorotalia lenguaensis Subzone of Blow in Venezuela, No.8 Zone of Carter and Globigerinoides triloba triloba Zone of Jenkins in Victoria. It occurs in the Upper Miocene of Indonesia and ranges into the Recent.

Dimensions vary between D. 0.30 mm. d. 0.26 mm. and D. 0.50 mm. d. 0.46 mm.

Globigerinoides triloba (Reuss) sacculifera (Brady)

Globigerinoides sacculiferus (Brady), LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.2, figs 68-70, pt.2, p.87, pl.4, figs 25-27, pt.3, p.118, pl.3, figs 19-21.

Globigerinoides triloba (Reuss) sacculifera (Brady), Bolli, 1957, U.S. Nat.Mus., Bull. 215, p.113, pl.25, figs 5,6; Todd, 1958, U.S.Geol.Surv., Prof.Paper 280-H, p.279, pl.78, fig.12; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.188, pl.11, figs 63a,b; Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub.9, pl.80, figs 11-16.

This species was rare to common from 614 to 950 feet. Ranging up into the Recent, it has its beginnings in the Globorotalia fohsi lobata Zone of Bolli in Trinidad and in the Catapsydrax stainforthi Zone of Blow in Venezuela. It was recorded from the Upper Miocene in Indonesia and on Saipan.

Average dimensions: D. 0.66 mm. d. 0.50 mm.

Globigerinoides triloba (Reuss) immatura LeRoy.

Globigerinoides sacculiferus (Brady) var. immatura LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.1, figs 37-39, pt.2, p.87, pl.7, figs 16-18, pt.3, p.118, pl.3, figs 31-33.

Globigerinoides triloba (Reuss) immatura LeRoy, Blow, 1959, Bull. Amer.Paleont., V.39, No.178, p.188, pl.11, figs 62a,b: Jenkins, 1960, Micropaleontology, V.6, No.4, p.354, pl.2, figs 7a-c.

This species was rare to common from 600 to 950 feet. While the extremes are easily placed in this subspecies, all gradations are present between it and Globigerinoides triloba triloba on the one hand and between it and G.triloba sacculifera on the other.

The subspecies was originally recorded from the Upper Miocene to Pleistocene of Indonesia. It ranges up from the Globorotalia fohsi robusta Zone of Bolli in Trinidad; from the Catapsydrax stainforthi Zone of Blow in Venezuela; and from the Globigerinoides triloba triloba Zone of Jenkins in Victoria.

Average dimensions: D. 0.72 mm. d. 0.62 mm.

Globigerinoides triloba triloba (Reuss), 1850.

Globigerinoides triloba triloba (Reuss), Bolli, 1957,

U.S. Nat. Mus., Bull.215, p.112, pl.25, figs 2a-c; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.187, pl.11, figs 60a,b; Jenkins, 1960, Micropaleontology, V.6, No.4, p.353, pl.2, figs 5a-c.

Globigerinoides triloba (Reuss) Carter, 1958, Geol. Surv. Victoria, Bull.55, p.52, pl.7, figs 67-69.

This species was rare to abundant from 550 to 950 feet with a very rare occurrence in core 11, 1600-1610 feet. It ranges up from the Catapsydrax dissimilis Zone of Bolli in Trinidad; from the Catapsydrax stainforthi Zone of Blow in Venezuela; from the No.7 Zone of Carter and the Globigerinoides triloba triloba Zone of Jenkins in Victoria; and from the base of the Awamoan Stage in New Zealand (Hornibrook, 1958).

Some small specimens have a slightly greater degree of overlap of the previous chambers by the last chamber than in the larger specimens. They may come within Globigerinoides bispherica Todd of some authors but are considered to be juveniles.

Dimensions vary between D. 0.60 mm, d. 0.44 mm. and D. 0.34 mm., d, 0.28 mm.

Genus ORBULINA d'Orbigny, 1839.

Type species: O.universa d'Orbigny.

Orbulina universa d'Orbigny, 1839.

Orbulina universa d'Orbigny, LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.1, fig.4; LeRoy, 1944, ibid. V.39, No.3, pt.1, p.41, pl.3, fig.44, 45, pt.2, p.91, pl.3, fig. 19; Bolli, 1957, U.S.Nat.Mus., Bull.215, p.115, pl.27, fig.5; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.200, pl.13, fig. 83; Jenkins, 1960, Micropaleontology, V.6, No.4, p.356, pl.3, fig. 12; Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub.9, pl.81, figs 8,9.

This species was rare to abundant from 614 to 965 feet with best development between 900 and 950 feet. Its origin has been placed in the No.11 stage of Carter (1958) and in the Orbulina universa Zone of Jenkins in Victoria; in the Lillburnian stage in New Zealand (Hornibrook, 1958) and in the uppermost part of the Telisa Formation of Sumatra (LeRoy, 1948). It also comes in towards the top of the Globigerinatella insueta Zone of Bolli in Trinidad and the Globigerinatella insueta/ Globigerinoides bispherica Subzone of Blow in Venezuela.

This species is typically developed with only one or two specimens which appear to be intermediate between Orbulina suturalis and O.universa.

Diameters vary between 0.76 mm. and 0.52 mm.

Orbulina bilobata d'Orbigny.

Orbulina bilobata d'Orbigny. Bolli, 1957, U.S.Nat.Mus., Bull.215, p.116, pl.27, fig.6.

Biorbulina bilobata (d'Orbigny) Blow, 1959, Bull.Amer. Paleont., V.39, No.178, p.199, pl.13, figs 80,81.

This species was very rare at 945 and 900 feet. A couple of the specimens from 900 feet appear to be intermediate between O.universa and O.bilobata, having a reduced second chamber.

Genus GLOBOQUADRINA Finlay, 1947.

Type species: Globorotalia dehiscens Parr and Collins.

Globoquadrina altispira altispira (Cushman and Jarvis), 1936.

Globigerina altispira Cushman and Jarvis, 1936, Cushman Lab.Foram.Res., Contrib., V.12, p.5, pt.1, figs 13,14.

Globigerina baroemoenensis LeRoy, 1944, Colorado School of Mines, Quart., V.39, No.3, pt.1, p.39, pl.3, figs 36,37, pl.6, figs 43,44.

Globigerina baroemoensis var. quadrata LeRoy, 1944, ibid. p.39, pl.3, figs 34,35, pl.7, figs 37-39.

Globoquadrina altispira altispira (Cushman and Jarvis) Bolli, 1957, U.S.Nat.Mus. Bull.215, p.111, pl.24, figs 7,8; Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.183, figs 51a-c; Jenkins, 1960, Micropaleontology, V.6, No.4, p.355, pl.3, figs 5a-c.

Globoquadrina altispira (Cushman and Jarvis). Todd, 1958, U.S.Geol.Surv., Prof.Paper 280-H, p.279, pl.79, figs 11a,b.

This species was abundant from 940 to 950 feet only. The variant of the population at Wreck Island include forms similar to the species and its variety of LeRoy as well as typical specimens of the species as figured by Bolli. It is considered that LeRoy's species should be suppressed as a synonym.

The recorded ranges of the species are: Lower and Middle Miocene of Indonesia; Upper Miocene of Saipan; Catapsydrax stainforthi Zone to top of the Globorotalia fohsi robusta Zone of Bolli in Trinidad; Catapsydrax stainforthi Zone to base of Globorotalia mayeri/Globorotalia lenguaensis Subzone of Blow in Venezuela; and Globigerinoides triloba triloba Zone to base of Globorotalia mayeri Zone of Jenkins in Victoria. Hornibrook (pers.comm.) said it occurs sporadic in the Tongaporutuan and Waiauan stages and possibly in the Clifdenian stage of New Zealand.

Average dimension: D. 0.50 mm.

Globoquadrina venezuelana (Hedberg), 1937

Globigerina venezuelana Hedberg, 1937, Journ.Paleont., V.11, No.8, p.681, pl.92, figs 7a,b; Bolli, 1957, U.S.Nat.Mus., Bull.215, p.110, pl.23, figs 6-8.
Globoquadrina venezuelana (Hedberg). Blow, 1959, Bull.Amer. Paleont., V.39, No.178, p.186, pl.11, figs 58,59.

Rare specimens of this species were found in cores and cuttings from 600 to 950 feet. They include a single specimen with a rudimentary last chamber as figured by Bolli. There also appears to be similarities with Globigerina pachyderma (Ehrenberg) as figured by Phleger, 1960, pl.10, from the Recent of the North Atlantic.

The species ranges from the Globigerina ampliapertura Zone to the Globorotalia menardii Zone of Bolli in Trinidad and from the Catapsydrax stainforthi Zone to the Globigerina bulloides Zone of Blow in Venezuela.

Representative dimensions: D. 0.32 mm. d. 0.32 mm.
D. 0.42 mm. d. 0.40 mm.
D. 0.66 mm. d. 0.58 mm.

Genus HASTIGERINA Thomson, 1876.

Type species: H. murrayi

Hastigerina aequilateralis (Brady).

Globigerinella aequilateralis (Brady), LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.2, figs 43,44; LeRoy, 1944, ibid., V.39, No.3, pt.1, p.40, pl.3, figs 24,25, pl.6, figs 37,38, pt.2, p.91, pl.4, figs 13,14; Todd, 1958, U.S.Geol.Surv., Prof.Paper 280-H, p.279, pl.78, figs 13a,b.

Hastigerina aequilateralis (Brady), Barker, 1960, Soc. Econ.Pal.and Min., Spec.Pub.9, pl.80, figs 18,19.

This Lower Miocene to Recent species was rare at 900 and 950 feet.

Genus PULLENIATINA Cushman, 1927.

Type Spedies: Pullenia obliquiloculata Parker and Jones.

Pulleniatina praeobliquiloculata sp.nov.

Pulleniatina obliquiloculata LeRoy (non Parker and Jones), 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.2, figs 105-107, pt.2, p.87, pl.4, figs 16-18;

Stainforth (non Parker and Jones) 1948, Journ.Paleont., V.22, No.2, p.125, pl.26, figs 21-23; Todd (non Parker and Jones) 1958, U.S.Geol.Surv.,Prof.Paper 280-H, p.279, pl.79, figs 9a,b.

Description:

Test small, a low trochospiral coil becoming slightly streptospiral in the adult, fairly tightly coiled; dorsal side flat to slightly convex, evolute with about 13 chambers in 2½ whorls, 4 or 5 chambers in the last whorl, inflated, becoming flattened distally; ventral side strongly convex, involute, early chambers inflated, globular, becoming flattened in the last two chambers, last chamber sometimes small and aberrant; slight depression sometimes present near top of ventral side; sutures narrow, slightly depressed, tending to be radiate on both sides; periphery rounded to subacute but not well defined; wall calcareous, thick, coarsely perforate, smooth and polished except for cluster of small beads on chamber below aperture; aperture a broad arch, interio-marginal, extending to full width of the last chamber, opening above the 4th and 5th last chambers and sometimes above the 3rd last as well, depending on the tightness of coiling, with a distinct thickened rim.

Holotype:

Dimensions: D. 0.46 mm. H. 0.40 mm.

Occurrence: 950 feet.

Paratypes

A. Dimensions: D. 0.38 mm. H. 0.32 mm.

B. " D. 0.32 mm. H. 0.32 mm.

C. " D. 0.38 mm. H. 0.32 mm.

D. " D. 0.32 mm. H. 0.26 mm.

E. " D. 0.38 mm. H. 0.32 mm.

Occurrence: All specimens from 950 feet.

Distribution: Rare in core 5, 614-625 feet, and at 650 feet, common at 950 feet. Specimens now placed in this species have been recorded from the Upper Miocene of Indonesia, Saipan and Ecuador. The writer has also seen it from the Upper Miocene of Papua.

Remarks: This species is similar to P.obliquiloculata (Parker and Jones) but varies mainly in the less strongly developed streptospiral coiling in the adult, which gives a different apertural position in relation to the previous chambers.

Banner and Blow, 1960, discussed this species from Papua. They considered it was probably ancestral to P.obliquiloculata. Bolli et al., 1957, stated that this latter species ranged from the Pliocene to the Recent.

The writer agrees with Banner and Blow. It it can be traced in a continuous Miocene-Pliocene sequence as a definite evolutionery trend, the change from one species to the other may prove useful as a marker for the Miocene/Pliocene boundary.

As mentioned by Stainforth, 1948, the characteristic features of the species are the large lunate aperture, smooth polished surface and the tendency for the adult chambers to overlap further over the dorsal surface.

Examination of earlier whorls in broken specimens and in thin section shows a close similarity with the earlier whorls in Globigerina mayeri and suggests a common Globigerinid ancestery of the two species.

To separate this species from P.obliquiloculata and to preserve its apparent ancestral relationship, it is proposed to call it P.praeobliquiloculata.

Genus SPHAEROIDINELLA Cushman, 1927.

Type species: Sphaeroidina dehiscens Parker and Jones.

Sphaeroidinella seminulina seminulina (Schwager)

Globigerina seminulina (Schwager) LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.1, p.44, pl.1, figs 105-107 pl.3, fig.108.

Sphaeroidinella seminulina (Schwager), Todd, 1958, U.S. Geol.Surv.,Prof.Paper 280-H, pl.79, figs 7a,b.

Sphaeroidinella seminulina seminulina (Schwager), Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.197, pl.12, figs 74-77.

This species is common at 950 feet and rare at 925 feet only. It has been recorded from the Upper Miocene of Saipan and Indonesia and ranges from the Globigerinatella insueta/Globigerinoides triloba Subzone to the Sphaeroidinella seminulina Zone of Blow in Venezuela.

Dimensions vary between D. 0.42 mm. d. 0.36 mm. and D. 0.84 mm. d. 0.60 mm.

Sphaeroidinella seminulina (Schwager) kochi (Caudri).

Sphaeroidinella kochi (Caudri) Todd, 1958, U.S.Geol.Surv. Prof.Paper 280-H, pl.79, figs 6a,b.

Sphaeroidinella seminulina (Schwager) kochi (Caudri), Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.198, pl.12, figs 78,79.

This species was very rare at 950 feet only. It was recorded from the Upper Miocene of Saipan and ranges from the Globorotalia fohsi lobata Zone to the Sphaeroidinella seminulina Zone of Blow in Venezuela.

Dimensions: D. 0.68 mm. d. o.58 mm.

Sphaeroidinella dehiscens dehiscens (Parker and Jones).

Sphaeroidinella dehiscens (Parker and Jones) Bolli, Loeblich and Tappan, 1957, U.S.Nat.Mus., Bull.215, p.32, pl.6, fig.2; Barker, 1960, Soc.Econ.Pal.and Min., Spec.Pub.9, pl.84, figs 8,9.

Sphaeroidinella dehiscens dehiscens (Parker and Jones) Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.195.

This Miocene to Recent species was common to rare from 900 to 950 feet with a single occurrence at 1000 feet.

Average dimensions: D. 0.56 mm. d. 0.50 mm.

Sphaeroidinella dehiscens (Parker and Jones) subdehiscens Blow, 1959.

Sphaeroidinella dehiscens (Parker and Jones) subdehiscens Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.195, pl.12, figs 71a-c, 72.

This subspecies was rare at 950 feet only. It possibly ranges up to the Recent but was not previously differentiated. Blow split the original species on the presence of 1 or 2 apertures but it is not easy to differentiate them at times. He gives the range as Globorotalia fohsirobusta Zone to Globigerina bulloides Zone in Venezuela.

Average dimensions: D. 0.56 mm. d. 0.48 mm.

Family GLOBOROTALIIDAE Cushman, 1927.

Genus GLOBOROTALIA Cushman, 1927.

Type species: Pulvinulina menardii d'Orbigny.

Globorotalia menardii (d'Orbigny) LeRoy, 1944, Colorado School of Mines, Quart., V.39, No.3, pt.2, p.92, pl.5, figs 13,15; Bolli, 1957, U.S.Nat.Mus., Bull.215, p.120, pl.29, figs 6-10.

Globorotalia menardii menardii (d'Orbigny) Blow, 1959, Bull.Amer.Paleont., V.39, No.178, p.215, pl.18, figs 119,120;

Jenkins, 1960, Micropaleontology, V.6, No.4, p.362, pl.4, figs 8a-c.

This species was common to rare from 950 to 850 feet. Most specimens have 6 chambers in the last whorl, a few have 7 while one had 8, depending on the rate of growth of the chambers. Blow gives the range of this species as Lower Miocene to Recent. Its incoming has been recorded in the uppermost part of the Lower Palembang Formation of Sumatra by LeRoy; in the Globorotalia fohsi robusta Zone of Bolli in Trinidad; in the middle of the Globorotalia fohsi robusta Zone of Blow in Venezuela; and in the Orbulina universa Zone of Jenkins in Victoria.

Representative dimensions: D. 0.80 mm. d. 0.58 mm.
D. 0.78 mm. d. 0.70 mm.
D. 0.60 mm. d. 0.54 mm.

Globorotalia tumida (Brady), 1884.

Pulvinulina tumida Brady. Cushman, 1915, U.S.Nat.Mus., Bull.71, pt.5, p.56, pl.22, fig.3.

Globorotalia tumida (Brady). LeRoy, 1941, Colorado School of Mines, Quart., V.36, No.1, pt.2, p.88, pl.4, figs 1-3; Barker, 1960, Soc.Econ.Pal. and Min., Spec.Pub.9, pl.103, figs 4-6.

This species is common to rare in cores and cuttings from 600 to 950 feet with best development between 900 and 950 feet. It has 5 chambers in the last whorl and differs from G.menardii menardii because of a greater growth rate. There are gradations between the two species and they most likely belong to the one population. G.tumida should possibly be placed as a subspecies of G.menardii. Hamilton, 1957, also mentions the gradations between the two species. Jenkins, 1960, erected his subspecies G.menardii panda for a form which is similar to G.tumida and he possibly recognised the similarity between G.tumida and G.menardii.

Rare specimens from core 6, 800-810 feet are similar to the specimen figured by Jenkins as his new subspecies G.menardii miotumida but they are considered to be juveniles of G.tumida.

The range of G.tumida does not appear to have been determined but appears to be Upper Miocene to Recent.

Representative dimensions: D. 0.78 mm. d. 0.60 mm.
D. 0.78 mm. d. 0.56 mm.
D. 0.90 mm. d. 0.66 mm.

Abele, C. 1961. Unpub. Thesis, Dept. of Geol., Adelaide University.

Asano, K. 1951. Illustrated Catalogue of Japanese Tertiary Smaller Foraminifera. Pt.14, Rotaliidae. Instit.Geol. and Paleont., Tohuku University, Sendai, Japan.

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TABLE 2

DISTRIBUTION OF SELECTED SPECIES

SCALE 1 inch = 200 feet

SYMBOLS
○ = RARE
◑ = COMMON
● = ABUNDANT

RECENT—
PLEISTOCENE

SAMPLES EXAMINED

UPPER MIOCENE

G. obesa Zone

G mayeri / P praeobliquiloculata Zone

Gr tumida / Gg venezuelana Subzone

Gr. menardii menardii Subzone

Gd. obliqua Subzone

Gg. altispira altispira Subzone

MIDDLE MIOCENE

Lepidocyclina / Miogypsina Zone

?

Parrellina heronicaɜ / Hanzawaia scopos Zone

Operculina praevictoriensis / Parrellina reticulata Zone

BASEMENT

550
600
CORE 5 614-625
650
700
750
CORE 6 800-810
850
900
950
CORE 7 962-977
1000
1050
1100
1150
CORE 8 1175-1185
1200
1250
1300
1350
CORE 10 1400-1410
1410
1450
1500
1550
CORE 11 1600 1610
1625
1665
1750
1795

UNFOSSILIFEROUS

UNFOSSILIFEROUS

Globigerinoides triloba
G. triloba immatura
G. triloba sacculifera
G. obliqua
G. rubra
Globigerina falconensis
G. juvenilis
G. obesa
G. mayeri
Pulleniatina praeobliquiloculata
Globorotalia menardii
G. tumida
Globoquadrina venezuelana
G. altispira altispira
Orbulina universa
Hastigerina aequilateralis
Sphaeroidinella dehiscens dehiscens
S. seminulina kochi
S. seminulina seminulina
Elphidium parri
E. cruticulatum
Amphistegina quoyi
Anomalinoides macraglabra
Operculina victoriensis
Cibicides refulgens
Elphidium aff. pseudonodosum
Parrellina reticulata
P. heronicaɜ
Cibicides victoriensis
C. mediocris
Lenticulina megalaphota
Dimorphina janjukensis
Baggina ampla
Gyroidinoides aff. zealandica
Elphidium crespinae
Textularia ~~virgulae~~ granulifera
Bolivina anastomosa
Nonion victoriensis
Clavulinoides victoriensis
Cyclocypeus sp.
Hanzawaia scopos
Plectofrondicularia parri
Svratkina australiensis
Uvigerina multicostata
U. hantkeni
Vaginulinopsis aff. gippslandicus
V. sp. A.
Saracenaria aff. italica
Angulogerina capricornica
Vaginulinopsis aff. acanthonucleus
Nodosaria cf. vertibralis
Virgulina cf. squamosa
Cibicides hillae
Siphonina australis
Bolivina uniformiata
Lepidocyclina sp.
Miogypsina sp.
Operculina praevictoriensis

TABLE 3

PROPOSED CORRELATION OF BORES AND SURFACE SECTIONS IN AUSTRALIA, INDONESIA, AND WESTERN PACIFIC ISLANDS

EUROPE	INDONESIA
POST MIOCENE	
UPPER MIOCENE	"g"
MIDDLE MIOCENE	"f"

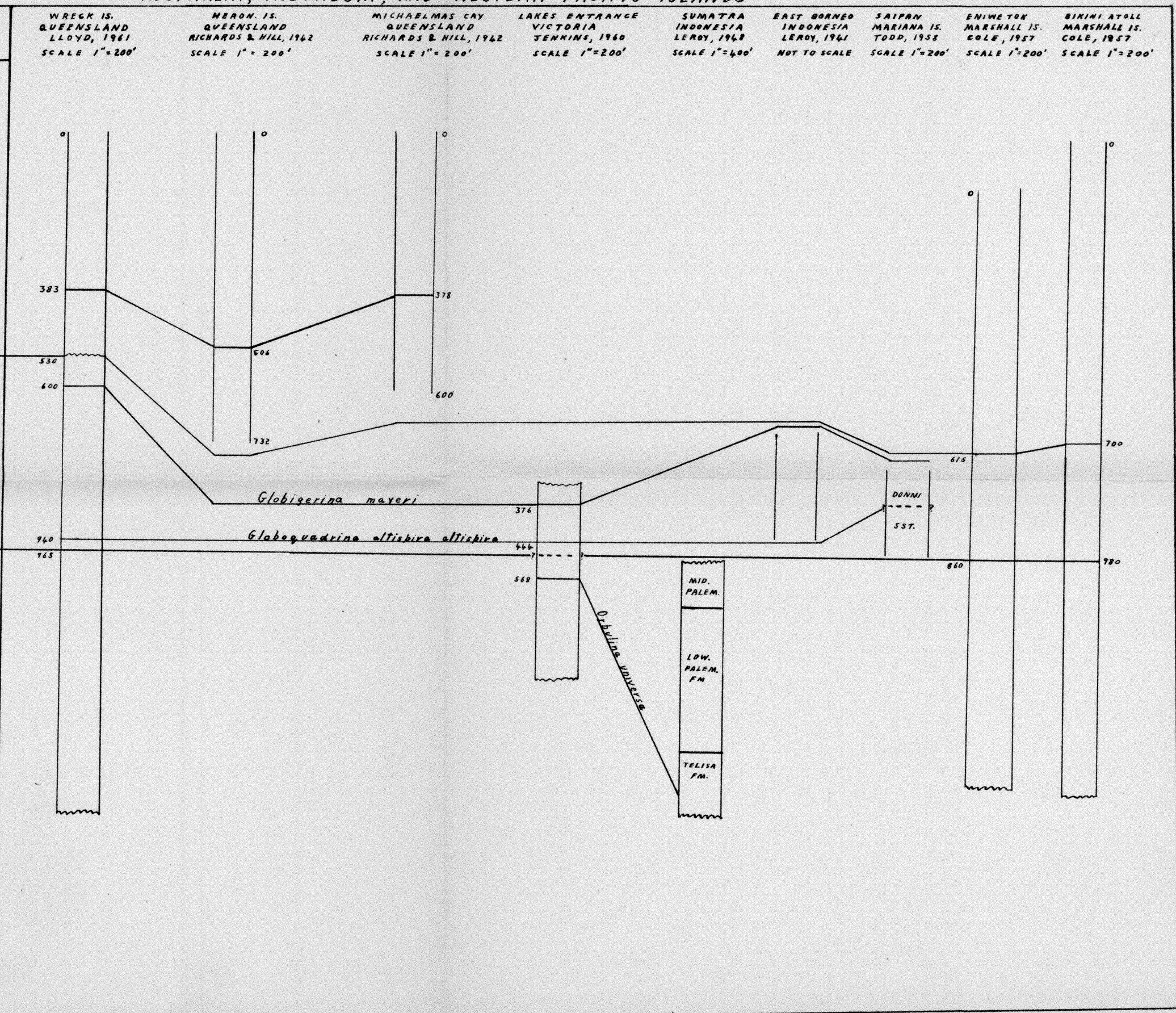


TABLE 4.

PROPOSED CORRELATION WITH RELEVANT OVERSEAS STAGES AND ZONES.

EUROPE		INDONESIA	WRECK. IS. QUEENSLAND LLOYD, 1961.	LAKES ENTRANCE VICTORIA JENKINS, 1960.	VICTORIA CARTER, 1958	NEW ZEALAND HORNIBROOK, 1958.	TRINIDAD BOLLI, 1957.	VENEZUELA after BLOW, 1959.
		"h"				WAITOTARAN		
PLIOCENE						OPOITIAN		S. seminulina Zone
			— —?— —?— —?— —	— —?— —?— —?— —			— —?— —?— —?— —	— —?— —?— —?— —
			G. obesa Zone	Gr. menardii miotumida Zone		KAPITEAN	Gr. menardii Zone	Gr. menardii / G. nepenthes Zone
UPPER MIOCENE	SARMATIAN	"g"	G. mayeri / P. praecobliquiloculata Zone	Gr. mayeri Zone		TONGAPORUTUAN Zone	Gr. mayeri Zone	Gr. mayeri Zone; Gr. mayeri / G. nepenthes Subzone; Gr. mayeri / Gr. lenguaensis Subzone
			Gr. tumida / Gq. venezuelana Subzone; Gr. menardii menardii Subzone; Gd. obliqua Subzone; Gq. altispira altispira Subzone					
MIDDLE MIOCENE	TORTONIAN		Lepidocyclina / Miogypsina Zone	Orbulina universa Zone	—?— —?— 11	WAIAUAN LILLBURNIAN	Gr. fohsi robusta Zone; Gr. fohsi lobata Zone; Gr. fohsi fohsi Zone; Gr. fohsi barisanensis Zone	Gr. fohsi robusta Zone; Gr. fohsi lobata Zone; Gr. fohsi fohsi Zone; Gr. fohsi barisanensis Zone
			— —?— —?— —?— —	Can. glomerosa circularis Zone	10	CLIFDENIAN	Gl. insueta Zone	Gl. insueta / Gd. bisphe rica Zone
MIOCENE	HELVETIAN	"f"		Can. glomerosa glomerosa Zone	9			
				Gr. praemenardii Zone	8	ALTONIAN		
LOWER MIOCENE	BURDIGALIAN			Gd. bisphe rica Zone				Gl. insueta / Gd. triloba Zone
				Gd. triloba triloba Zone	7	AWAMOAN	Cat. stainforthi Zone; Cat. dissimilis Zone	Cat. stainforthi Zone; Cat. dissimilis Zone

Abbreviated generic names: G. = Globigerina ; Gd = Globigerinoides ; Gr = Globorotalia ; Gq. = Globoquadrina ; Gl. = Globigerinatella.
Can. = Canorbulina ; Cat = Catapsydrax ; P = Pulleniatina ; S. = Sphaeroidinella

NOT TO SCALE.

X65

HOLOTYPE

900'

PARATYPE X100

900'

X100

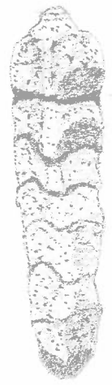
HOLOTYPE

Textularia wrechtae sp nov

Bolivina aff. shinescens

X80

900'



X20

945'

X20

945'

Clavulinoides victoriensis

Bolivina uniforminuta

X 90

945'

JUVENILE

550'

X90

CORE 6.

800-810'

X70

CORE 6

800-810

X90

Juvenile

945'

X90

CORE 5

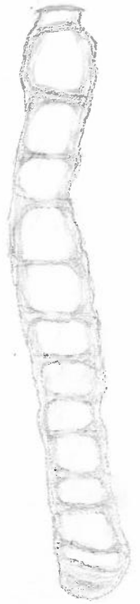
614-625'

X75

LAXOSTOMUM limbatum

X70 900'

Plectofrondicularia



X70 900'

parri

900' X75

X35

900'

X80

900'

X70

900

X70

Uvigerina hanzkeni X35

900'

Uvigerina

X100

900'

multicostata

X80

900'

X80

X35

950'

X90

0.34

950'

X85

HOLOTYPE

945 ft

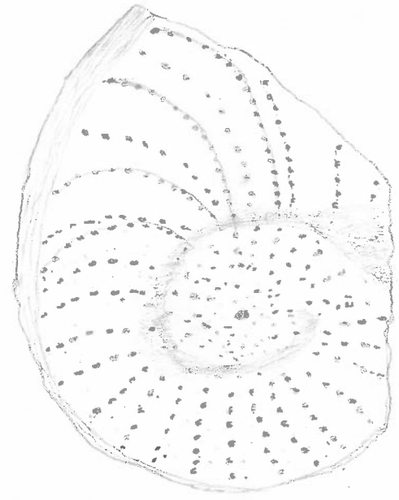
X130

X130

Angulogerina capricornicus sp. nov

CORE 5 616-625'

X20



600'

X20

Operculina victoriensis

X20

PARA TYPE

1750'

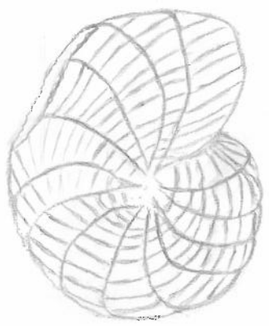
X20

HOLOTYPE

1750'

Operculina praevictoriensis

HOLOTYPE

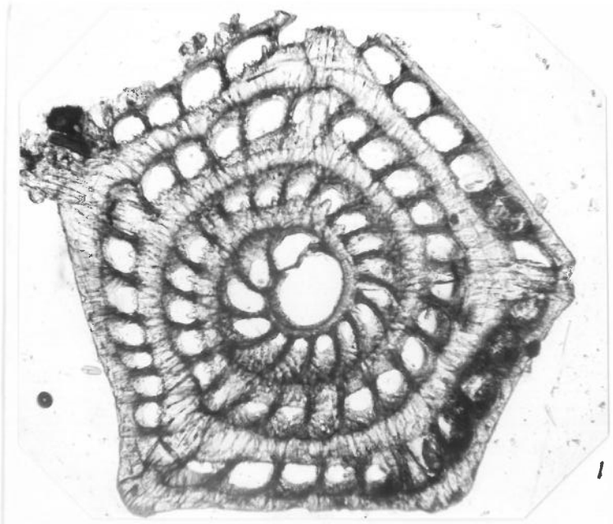


X50.

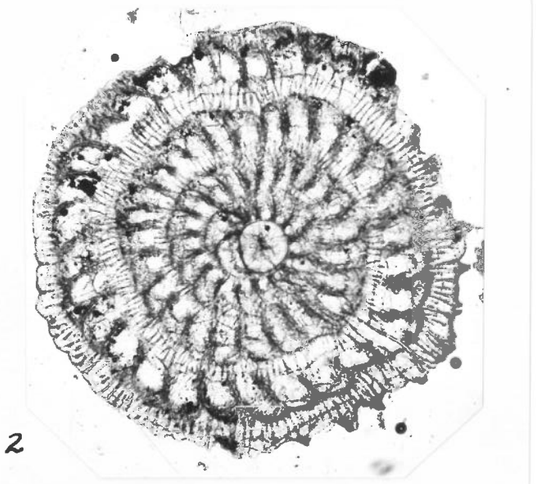
X50

1625 feet

Parrellina hexonicus

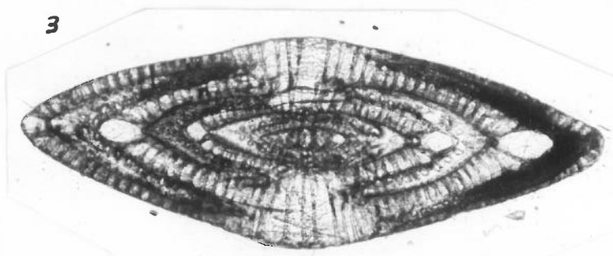


1



2

3



PARRELLINA RETICULATA

1, 2 Equatorial sections, pentagonal and ~~a~~circular forms

3 Axial section

(X 40 approx.)

Wreck Is., 1730 ft.