57. PLANKTONIC FORAMINIFERA DSDP LEG 34—NAZCA PLATE

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ABSTRACT

This paper details the occurrence of planktonic foraminifera from Sites 319, 320, and 321, recovered from Leg 34 of the DSDP—the Nazca Plate leg. In addition, the report includes discussion of the planktonic foraminifera from two piston cores (DWBP 134 and AMPH 30P) also from the Nazca Plate, both close to the East Pacific Rise and at a latitude close to that (9°- 13°S) drilled on the Nazca Plate during the operation of Leg 34.

Foraminifera and sediments from the piston cores are Quaternary. Sediments containing foraminifera are at Site 319, early Miocene (N8) to late Miocene or Pliocene (N18/19); at Site 320, Oligocene (N2), early Miocene (N4-N8) and Quaternary, and at Site 321 late Eocene (P16) to Oligocene (N2/3).

At each DSDP site, records are made of residue percentage, small planktonic percentage (both defined herein), planktonic percentage, planktonic diversity and age.

The following species are described as new: *Globorotalia (Turborotalia) akersi, G (T.) bauerensis* and *Clavigerinella nazcaensis*.

INTRODUCTION

Three sites (319, 320, 321) on the Nazca plate were drilled by D/V *Glomar Challenger* on Leg 34 of the Deep Sea Drilling Project. The positions of the sites are shown in Figure 1 which includes the locality of Site 157 of Leg 16—which also falls on the Nazca plate—and the localities of two piston cores also studied.

Table 1 is a summary of the basic information for each hole.

This chapter discusses primarily the planktonic foraminifera from the three Leg 34 sites and also includes occasional data from Site 157 and two piston cores. Remarks are restricted mainly to discussion of the planktonic foraminiferal faunas of all sites listed. Biostratigraphic relationships are discussed further in Quilty et al. (this volume).

PREVIOUS STUDIES

Very little is known of the distribution of planktonic foraminifera in the Cenozoic of the Nazca plate. Apart from the three sites reported on here, only Site 157 from DSDP Leg 16 (Kaneps, 1973) has penetrated anything other than Pleistocene on this plate. That hole penetrated 437 meters of late Miocene to Recent section before entering basalt basement.

Blow (1969) produced his comprehensive middle Eocene to Recent zonation of planktonic foraminiferal faunas and this has won almost universal acceptance, and any studies carried out here will be referred directly to Blow's scheme wherever possible.

There have been several papers in the last few years critical of the use of Blow's (1969) "letter-number" scheme for Cenozoic planktonic foraminiferal zonation (e.g., Jenkins and Orr, 1972). The criticisms are of two kinds. One is that the zonation is not universally applicable or the ultimate zonation. This is a valid criticism, but is true of any zonation, no matter what the terminology. Another criticism is that the zonation is not allowed by codes of stratigraphic nomenclature. Blow's scheme is an extremely valuable shorthand method of communicating effectively even with non-stratigraphers. This is perhaps a criticism of codes of nomenclature more than of Blow's scheme. It is perhaps a classic example of the possible stultifying effect that rigid adherence to a defined code can have.

An excellent zonation for use in the area was developed by Jenkins and Orr (1972) on faunas collected by DSDP Leg 9 a little west of the area studied by Leg 34. This work has proved invaluable in the present study. However, Blow's zonation can be applied directly here and has been used in preference.

The other very important work of immediate use is that by Brönnimann and Resig (1969) which did a great deal to document the systematics of faunas which have been encountered in Leg 34 samples. The systematics outlined by Parker (1962) are very relevant to the piston core samples and those from the shallower cores at Site 320.

As well as these few papers, there is a very large number of papers which cannot be overlooked in any study of this type. Many will be referred to elsewhere in this paper.

SAMPLES

Two types of samples are used in analyzing DSDP sediment—core catcher and section samples. Core-catcher samples come from the short tube leading into the base of the core barrel. Core-catcher samples contain the oldest material from each core and are probably the least disturbed.

Section samples are taken later than core-catcher samples and consist of a 20-cc sample (not all of which has been used in any instance in preparing this paper),

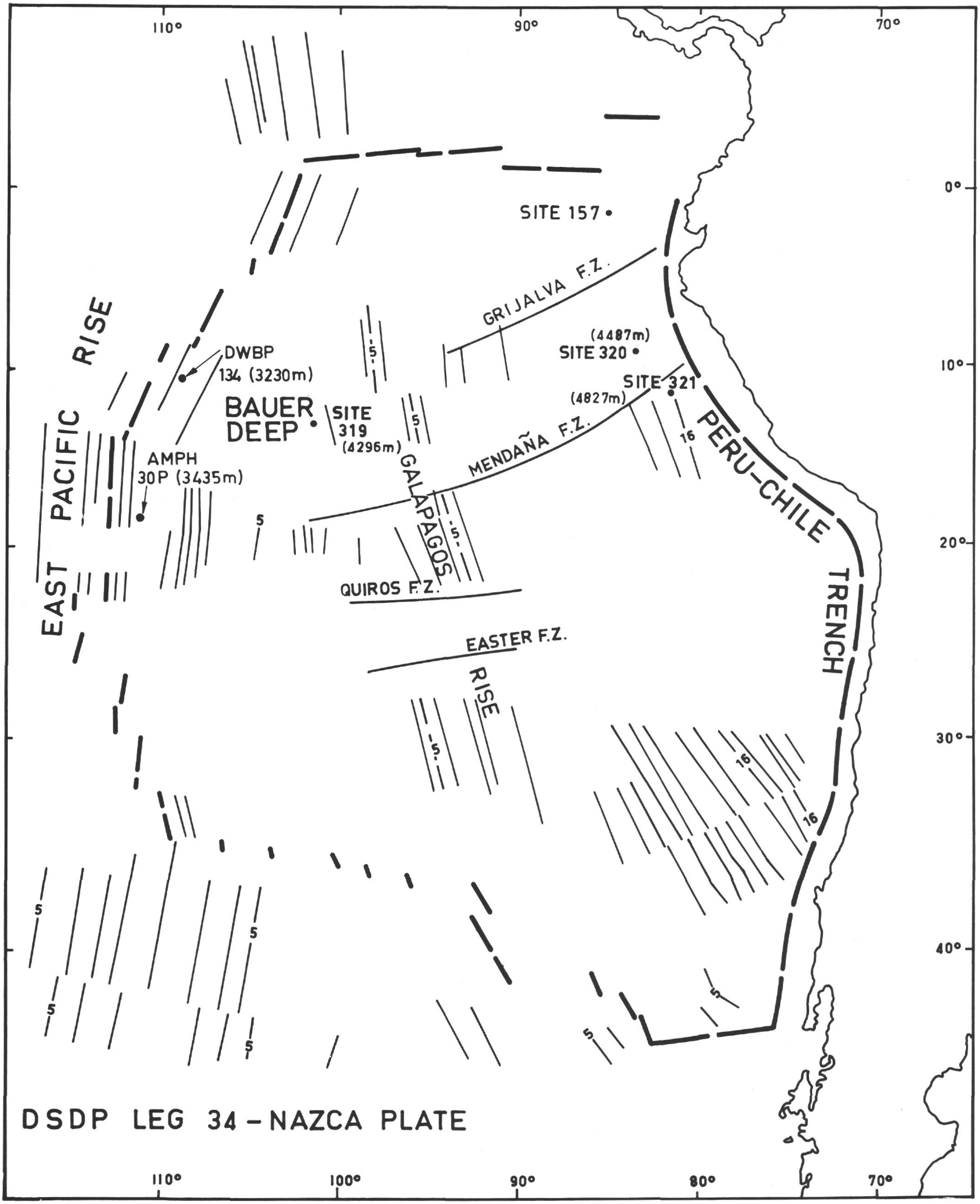

Figure 1. *Location map showing Leg 34 drill sites, Site 157 of Leg 16, and piston cores sites discussed in this report.*

TABLE 1
Summary of Basic Information for Holes Drilled on Leg 34, Deep Sea Drilling Project

Site	Latitude	Longitude	Water Depth (m)	Total Depth (m)	Sediment Thickness (m)	Cored Intervals (m)
DSDP Sites						
319	13°01.04'S	101°31.46'W	4296	111.5	111.5	0-111.5
319A				157		98-157
320	9°00.40'S	83°31.80'W	4487	111.5	111.5	6-15.5 73.5-83 102-111.5
320A				9.5	9.5	0-95
320B				183.5	155	136-183.5
321	12°01.29'S	81°54.24'W	4827	134.5	124	0-87 96.5-134.5
Piston Cores						
AMPH 30 P	18°31'S	111°09'W	3435	–	–	–
DWBP 134	11°42'S	109°43'W	3230	–	–	–

taken in a polythene tube from the middle of the core after the core has been cut longitudinally. These are the most accurately taken and repeatable samples.

In this study, the two sample types have been used differently. Onboard ship, core-catcher samples are used to provide fast stratigraphic age data and foraminifera are picked haphazardly to obtain key species. Thus, no reliance can be placed on planktonic percentages or species ratios or abundances from the samples. Their main use is in giving data for range charts and stratigraphic age. The only other useful features of core-catcher samples is the ratio of large to small planktonic foraminifera.

Section samples are processed more carefully (see below) and specimens are picked accurately to represent the fauna contained therein. Curves of planktonic percentage, foraminiferal abundance, and other features studied on the range charts and accompanying diagrams are from these samples.

Preparation and Processing Techniques

Initial preparation of core-catcher samples onboard *Glomar Challenger* was by simple washing of large samples over a 63μ (Tyler sieve 240 mesh) sieve with water, supplemented by a Calgon spray. Samples high in the section contained a large proportion of broken fragments, and it was not clear whether this was their state in the sediment or whether it was due to fragmentation during processing.

To minimize mechanical breakage, all other samples were allowed to soak 24 hr in Calgon solution and then gently washed. The same phenomenon of fragments in the upper part of the section was observed supporting the probability that these are remnants of specimens which have been partly dissolved below the carbonate compensation depth (CCD).

Residue examined consists of those specimens held on a 63μ sieve (Tyler sieve 240 mesh).

FEATURES STUDIED AT EACH SITE

Apart from the distribution of species shown on the accompanying range charts, several other features were measured wherever possible.

Each DSDP Leg 34 site has a one-page summary sheet (Figures 2-4) to summarize the features measured. In order, these are: residue percentage, small planktonic foraminiferal percentage, planktonic percentage, and planktonic diversity.

Residue Percentage

This is a measure of the percentage volume of a sample retained on a 63μ sieve. In the upper, low carbonate part of each Leg 34 site, this figure may give some idea of terrigenous and siliceous microfossil sedimentation rates. In carbonate sediments, this figure gives an approximate idea of nannoplankton/planktonic foraminifera production in the water column. This percentage varies widely and is markedly affected by dissolution and reworking effects.

Small Planktonic Foraminiferal Percentage

During examination of the residues just mentioned, one feature stands out. From sample to sample there is a marked variation in the proportion of the residue made up of "large" and "small" planktonic foraminifera. To make an objective measurement of this variation, all carbonate residues were passed through a 125μ sieve and the volume measured. The percentage volume of the residue made up of small species is the figure plotted on the summaries. Even though core-catcher samples are not used for residue percentage studies, they are used for this figure and are plotted.

The small foraminiferal percentage varies greatly and several factors can be invoked to explain this. One which can be documented (as at Site 319) is winnowing of the finer elements of a carbonate sediment from elsewhere to be redeposited, inflating the small particle component of the final sediment.

A second possibility is variation in the rate of production of small and large forms, especially where the two size grades represent different species groups as appears to be the case in all samples studied here.

Several groups of planktonic organisms (organic walled microplankton, some siliceous plankton) are known to "bloom" in vast numbers under certain conditions when nutrients are supplied in abundance, especially in the "upwelling" situation well known particularly in association with the west coast of Southern Hemisphere continents. This phenomenon has not, to my knowledge anyway, been documented in planktonic foraminifera.

A "blooming" situation in planktonic foraminifera could be expected to favor the small test as the rate of assimilation of nutrients and growth of chambers would be greater. Forms needing large amounts of calcium carbonate to produce large individual chambers would be at a disadvantage.

As "blooming" seems to be dominant in cooler water current regimes, it could perhaps be expected that a high small planktonic foraminiferal percentage could, other factors excluded, indicate cool water conditions.

Another possible explanation for high small planktonic foraminiferal percentages may also depend on cool water conditions. It is generally true among invertebrates that for any given species, smaller adults indicate cooler conditions. Bé et al. (1974) have recently given evidence that this holds for *Orbulina universa* in the Indian Ocean. Small size is not in itself enough to prove cold water conditions. *Globigerina pachyderma* is not a small species in the sense used here, but it is a useful indicator of cool waters.

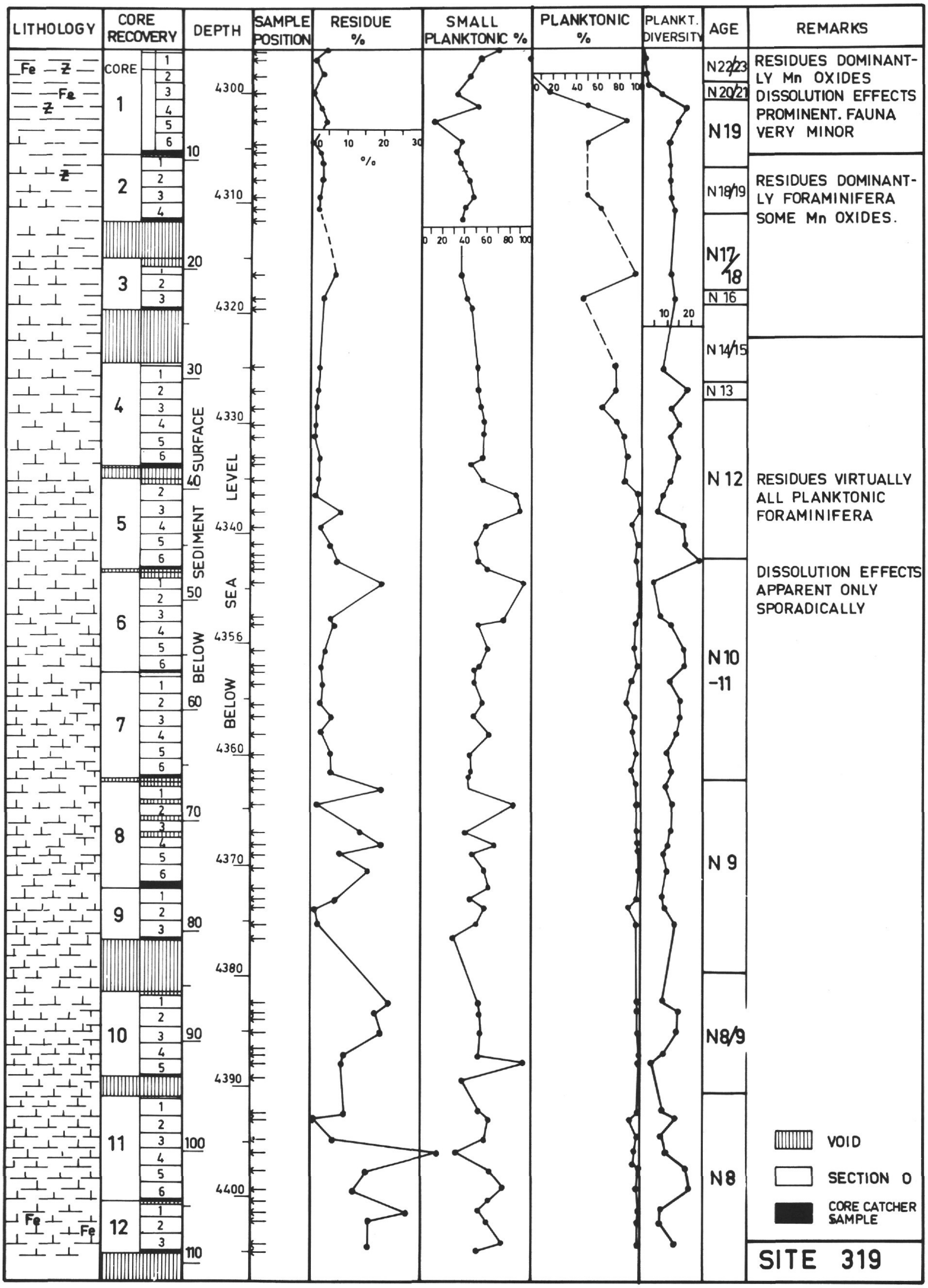

Figure 2. *Summary diagram, Site 319.*

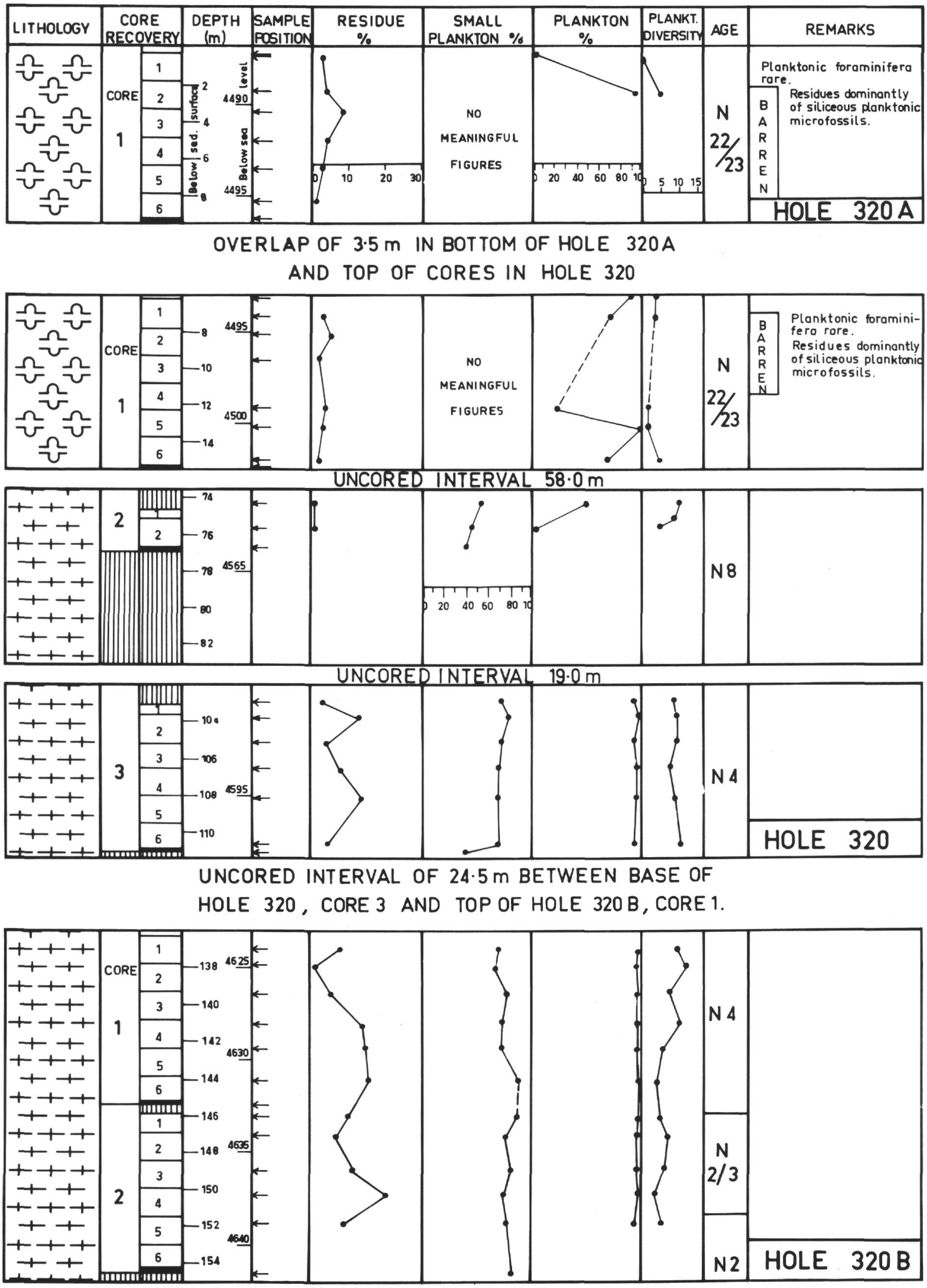

Figure 3. *Summary diagram, Site 320.*

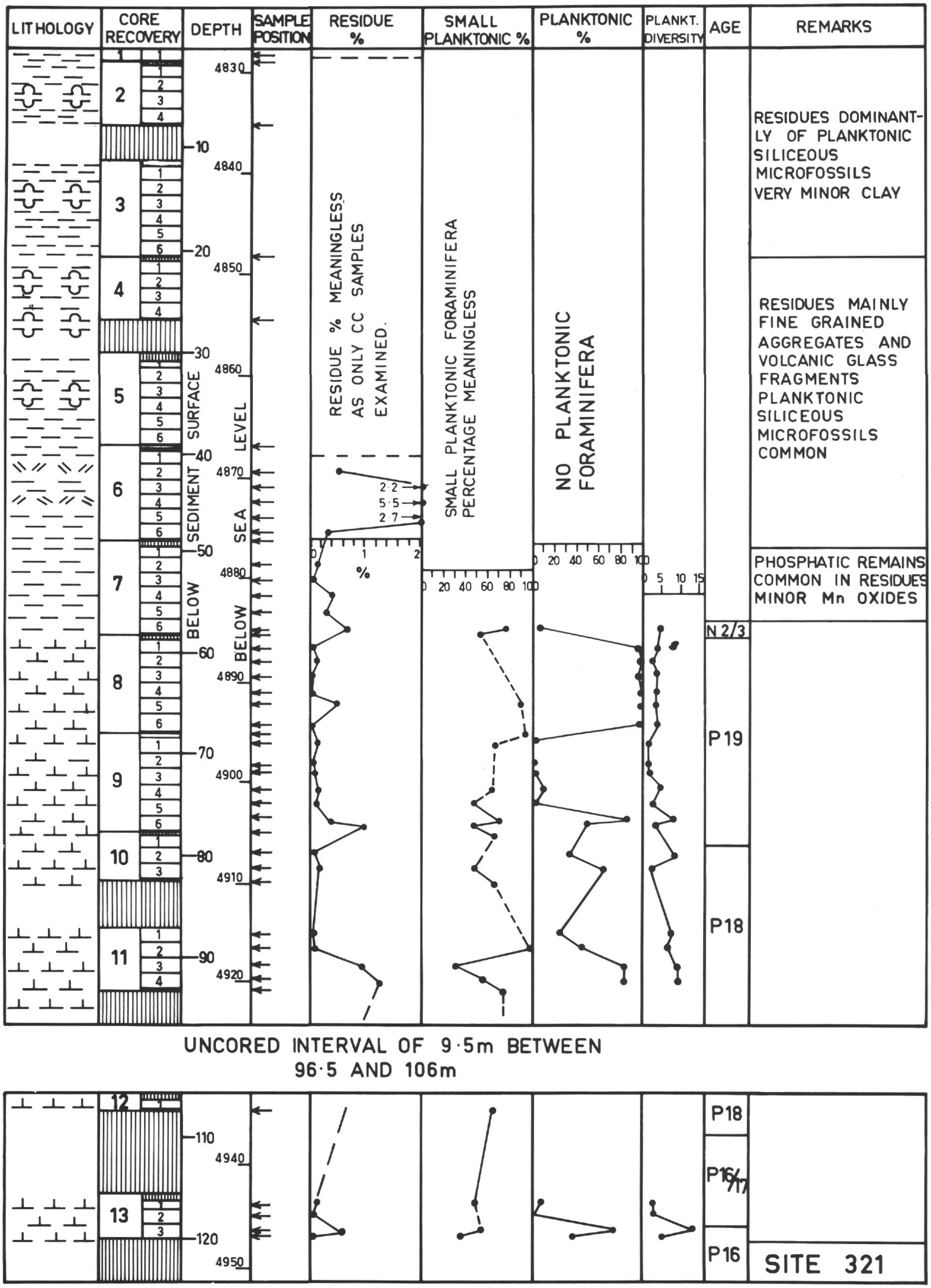

Figure 4. *Summary diagram, Site 321.*

Where small species are dominant in Leg 34 samples, they are very much dominated by one or two species leading to a reduced diversity, again a feature well documented for cool water faunas (Bandy, 1964, and others).

Planktonic Percentage

This is a measure of the percentage of foraminiferal fauna composed of planktonic specimens. It has been used to give an indication of depth of sedimentation (Phleger, 1960) but must be applied warily where sedimentation occurred at, near or below the CCD (Berger, 1971, etc.). Planktonic foraminifera have a wall structure which allows them to go into solution more readily than benthonic tests, and the planktonic percentage may be artificially depressed. This is obvious in several Leg 34 sections.

Planktonic Diversity

This is a record of the number of taxa (species and subspecies) making up 95% of the planktonic fauna, in a sample consisting of a significant number of specimens. It is used in the same sense that species diversity was employed by Walton (1964) in dealing with benthonic foraminifera. The figure of 95% is used to remove differences caused by variation in sample size.

Planktonic diversity is affected by three factors: (1) Surface water temperature. Planktonic diversity is higher in warm than in cool water (Bandy, 1964). (2) Dissolution effects. The tests of some species are much more readily soluble than others. *Catapsydrax* is notably resistant to solution. (3) Reworking. If reworking has occurred, the fauna recovered has the superimposed diversity of more than one regime. The greater the age difference between the two regimes represented, the greater will be the diversity.

SITE 319

Two holes were drilled at Site 319. The first (Hole 319) cored continuously for 111 meters before reaching basaltic basement. Only samples from this hole are reported on here. Measurements made are summarized in Figure 2. Below 35 meters the sediments are dominantly nannofossil-foraminifer oozes and dissolution effects are apparent only sporadically. Core 1 (0-9.5 m) consists almost entirely of brown metalliferous clays with minor carbonate ooze in the core-catcher sample. Carbonate content increases very uniformly to 35 meters.

In response to carbonate compensation depth phenomena, major changes have been effected on the faunas, especially in the upper 35 meters. These are most obvious in the carbonate content of residues and in planktonic percentage and planktonic diversity. Apparent sedimentation rates are markedly affected in the upper part of the section.

The main effects of dissolution are an increase in the concentration of clay and fish teeth in samples, the representation of keeled globorotalids only by the robust, less easily soluble keels, and of other planktonic species by internal molds.

Notably absent from the upper part of this hole are the rich radiolarian faunas so characteristic of sections in this part of holes at the other two sites, 320 and 321.

Drilling at this site proved the existence of sediments older than late Miocene on the Nazca plate. The main section cored is middle Miocene and the lower part also penetrated early Miocene.

Residue Percentage

Residue percentages in the interval 0-65 meters are usually on the order of 1%-5% except for one peak (20%) at 50 meters. Below 65 meters there is a general increase of residue percentages to an average value of about 12%. The higher value in the deeper part of the section suggests a higher rate of production of planktonic foraminifera over calcareous nannoplankton. This in turn could suggest a cooler water regime in the later part of the early Miocene (N8) than in the middle Miocene (N9) and younger.

Small Planktonic Foraminiferal Percentage

The average value for this factor is about 50% with a higher value (about 60%) below 70 meters and a lower value (about 40%) above 25 meters. Marked deviations from the norm are paralleled quite strongly by the residue percentage curve.

The deviation at 50 meters is accompanied by reworking of nannoplankton (Blechschmidt, personal communication) and planktonic foraminifera. The evidence for the latter is the presence of early Miocene forms, such as *Globigerinatella insueta,* in the middle Miocene. It is highly probable that the deviation in both curves is due to winnowing of small forms from elsewhere into this different area.

Although the parallelism in the two curves below 75 meters is not as marked as at about 50 meters, it is certainly present and the explanation may be the same as above, although in this case it may be that the reworking is simply by bottom currents from one area to another with no significant age difference of material transported.

Planktonic Percentage

Below 40 meters, planktonic percentages are very high, greater than 90%. Above 40 meters, the value decreases up to the sediment surface. The latter feature also corresponds to an upward decrease in carbonate content which is clearly related to carbonate dissolution effects above 40 meters.

This factor suggests very little dissolution below 40 meters and is supported by the good preservation of the faunas recovered.

Benthonic Faunas

Below 319-1-3 (the first core section in which planktonic foraminifera became common downhole), all faunas contain common calcareous benthonic elements, always calcareous foraminifera and echinoid spines, usually fish teeth and bone fragments, and occasionally ostracodes. The benthonic fauna is a relatively larger proportion of all faunas in the shallower parts of the hole, particularly above 319-3-2.

Planktonic percentage (percentage of the foraminiferal fauna composed of planktonic species) has been plotted against depth for all samples studied. Above Core 3, the planktonic percentage is below what it should be due to dissolution effects. Benthonic species, with their more robust walls and with a smaller percentage of pore volume, go into solution less readily than planktonic forms and thus a biased fauna remains.

SITE 320

Three holes (320, 320A, 320B) were drilled at this site and encountered the thickest sediment column of Leg 34—155 meters. Three cores were taken in Hole 320, one almost at the surface and two deeper. Hole 320A provided a single core mainly to provide details on the depth of the true sediment-water interface. Hole 320B drilled without cores until 136 meters when two cores were taken above basement. The information on these holes is summarized in Figure 3.

Samples from Hole 320A and Core 1 of Hole 320 contain abundant siliceous planktonic microfossils in the residues. The other four cores at this site were all nannofossil-foraminifer oozes.

Dissolution effects are very obvious in the top cores but much less obvious in deeper samples. The ooze section penetrated in this hole consists of early Miocene and Oligocene, the oldest sediments encountered on the Nazca plate to that date.

Residue Percentage

Residue percentage is about 5% or less in the upper three cores where dissolution effects are obvious. In the bottom cores, the percentage is quite erratic but averages some 10%-12%, increasing generally downhole. These figures are roughly comparable with equivalent measurements for the deeper parts of Site 319.

Small Planktonic Percentage

Due to dissolution effects, this measure is meaningless in the upper two cores. The value for Hole 320, Core 2 is about 50%, comparable with the early and middle Miocene of Hole 319.

In the deeper three cores, the figure is closer to 75%-80% and is thus considerably higher than at any level in Hole 319. The figure is notably uniform throughout the interval 103-155 meters below the sediment surface.

Planktonic Percentage

The pattern is comparable with the general pattern in Hole 319. Where dissolution effects are important, planktonic percentage is low and in the bottom three cores, the value is very high again, comparable with the deeper parts of Hole 319.

All these features combine to suggest little or no dissolution below 74 meters. The upper limit of obvious dissolution effects is not known.

Benthonic Faunas

All samples processed from Site 320 contained benthonic foraminifera although a few samples from Holes 320 and 320A were barren of calcareous fauna altogether.

The foraminiferal faunas are discussed in more detail by Resig (this volume). Hole 320A, Core 1 contained a fauna at the surface wholly unlike any other seen on Leg 34. It is dominantly of agglutinated species including *Bathysiphon filiformis, Reophax guttifer, R. dentaliniformis, Alveolophragmium globosum, and Botinella labyrinthica.*

In other cores from this site the benthonic foraminiferal faunas are much less diverse and make up a smaller percentage of the fauna than those at Site 319.

SITE 321

A single hole was drilled at this site and 13 sediment cores were taken. One core length (9.5 m) was not sampled (96.5-106 m). Several features of the sediments and fauna in this hole distinguish them from the sediments and faunas at the other two sites. The information is summarized in Figure 4.

Virtually no calcareous fossils were recovered above 58 meters. Calcareous oozes below this depth also show considerable dissolution effects. Present water depth is 4827 meters so the area is about 1100 meters below the CCD. The upper 58 meters consist of metalliferous clays with abundant siliceous planktonic microfossils, and between 40 and 50 meters, volcanic glass fragments. Phosphatic remains are particularly common between 50 and 60 meters.

This hole encountered the only Eocene known from the Nazca plate.

Residue Percentage

Carbonate residue percentages are so low, usually less than 0.5%, that a different scale is used on the summary diagram than on the equivalent diagrams for other holes. There is no plot above 42 meters as the residue above that depth contains virtually no calcium carbonate. The low carbonate residue percentage reflects a much more intense carbonate dissolution regime that at other sites on the Nazca plate.

Small Planktonic Percentage

This curve is very erratic and the average value is about 60%-70%. A possible consequence of this distribution is that small and large planktonic species undergo dissolution below the CCD at much the same rate. If this were not the case, an enrichment of either large or small species could be expected as a result of dissolution effects.

Planktonic Percentage

In deep water sediments deposited above the CCD, high planktonic percentages can be expected, normally 95%-98%. This certainly is the case in the deeper parts of the ooze section at Sites 319 and 320. The curve for Site 321 indicates minimal dissolution effects in Core 8, but very significant effects above and below that core.

In support of this contention, samples from Core 8 contain reasonably diverse planktonic foraminiferal faunas whereas from samples above and below, there is a marked concentration of large robust species of genera such as *Globorotaloides* and particularly *Catapsydrax*.

Eocene faunas overall do not appear to show much obvious dissolution, but *Hantkenina* is identified by its spines, the only part of the test capable of resisting solution.

Planktonic Diversity

Two factors (other than reworking) can affect this parameter markedly. One is water temperature and the other is CCD effects.

In Leg 34 sediments, particularly at Site 321, CCD effects are the more important. The concentration of robust *Globorotaloides* and *Catapsydrax* has already been alluded to.

Paleomagnetic Versus Paleontologic Dating

Drilling at Site 321, provided an excellent example of the potential for paleomagnetic dating of the sea floor.

Site 321 was drilled on Magnetic anomaly 16, late Eocene, 39-40 m.y. The fauna recovered from within 3 cm of the top of the basalt basement, indicated a late Eocene (P16) age. The estimated radiometric age (Berggren, 1972) is 39 m.y. The agreement is these age estimates is extremely good and especially noteworthy, as the interpretation of magnetic striping anomalies is difficult on rocks close to the equator.

PISTON CORES

Samples from two piston cores (AMPH 30-P and DWBP 134) were examined and are included briefly in this report. Both piston cores penetrated only Quaternary sediment, both N22 and N23 being present. Sediments in both are foraminifer-nannofossil ooze, taken from above the carbonate compensation depth. In contrast to Quaternary sediments from the three DSDP sites, they are very calcareous and contain no Radiolaria, indicating that they are well outside the influence of the Humboldt current and that the dominance of siliceous microfossils in other Quaternary sediments is not only a dissolution effect but also reflects a basic difference in water chemistry.

SYSTEMATICS

Genus GLOBIGERINA d'Orbigny, 1826

Globigerina ampliapertura Bolli
(Plate 1, Figures 1-2)

Globigerina ampliapertura Bolli, 1957, p. 108, pl. 22, fig. 5-7.
Stratigraphic range (Nazca plate): Late Eocene-Oligocene, P16-N3.
Occurrence: 320B-2; 321-9 to 13-3.

Globigerina cf. ampliapertura
(Plate 1, Figures 3,4)

Remarks: The specimen figured is from the lower Oligocene and demonstrates well the effects of dissolution. It differs from *G. ampliapertura s.s.* in having a laterally restricted ultimate chamber with a concomitantly higher, more laterally restricted aperture.) As a result of partial decortication by dissolution, the species takes on a great resemblance to *G. pseudoampliapertura*.
Stratigraphic range: Early Oligocene, P18.
Occurrence: 321-12, CC.

Globigerina angiporoides Hornibrook
(Plate 1, Figures 5,6)

Globigerina angiporoides Hornibrook, 1965, p. 145, fig. 3a-d. (= *G. angipora* Stache, 1865, p. 287, pl. 24, fig. 36).
Stratigraphic range: Late Eocene-Oligocene, P16 to P19.
Occurrence: 321-8 to 13.

Globigerina anguliofficinalis Blow
(Plate 1, Figures 7,8)

Globigerina anguliofficinalis Blow, 1969, p. 379, pl. 11, fig. 1-5.
Stratigraphic range: Oligocene, P19.
Occurrence: 321-8.

Globigerina angulisuturalis Bolli
(Plate 1, Figures 9-11)

Globigerina angulisuturalis Bolli, 1957, p. 109, pl.22, fig. 11a-c.
Stratigraphic range: Middle Miocene, N9-N12.
Occurrence: 319-5,10; 320-1 (reworked).

Globigerina angustiumbilicata Bolli
(Plate 1, Figures 12-15)

Globigerina angustiumbilicata Bolli, 1957, p. 109, pl. 22, fig. 12a-13c; pl. 36, fig. 6a, b.
Stratigraphic range: Late Oligocene-Pliocene, N2-N21.
Occurrence: 319-2 to 319-12, CC; 320-2,3; 320B-1,2; 321-7, CC.

Globigerina binaiensis Koch
(Plate 1, Figures 16, 17)

Globigerina binaiensis Koch, 1935, p. 558. (= *G. aspera* Koch, 1926, p. 746, fig. 22a-23c).
Remarks: The figured specimen does not have the flattened apertural face as well developed as in the excellent specimen figured by Blow (1969, pl. 13, fig. 1,2), but the degree of development is too great for the specimens to be included in *G. sellii*.
Stratigraphic range: Early Miocene, N4-8.
Occurrence: 320-2,3.

Globigerina cf brevis Jenkins
(Plate 1, Figures 18, 19)

Globigerina cf. *brevis* Jenkins, 1965, p. 1100, fig. 7, no. 58-63.
Remarks: The only reason for the slightly tentative identification of this species is the variation in aperture size between Jenkins' figures which have a moderately large aperture and the specimen figured here which has a more restricted aperture.
Stratigraphic range: Oligocene, P19.
Occurrence: 321-9-6.

Globigerina bulbosa LeRoy
(Plate 1, Figures 20, 21)

Globigerina bulbosa LeRoy, 1944, p. 39, fig. 26, 27.
Stratigraphic range: Early-middle Miocene, N8-N12.
Occurrence: 319-5 to 319-11, CC.

Globigerina cf bulbosa
(Plate 2, Figures 1, 2)

Remarks: The coiling pattern of the specimen figured is virtually identical with that of *G. bulbosa*. However, the thin lip is expanded a little into a weak tooth-like projection. There is also a weak distal flattening of the ultimate chamber.
Stratigraphic range: Middle Miocene, N10-12.
Occurrence: 319-5,6.

Globigerina bulloides bulloides d'Orbigny
(Plate 2, Figures 3,4)

Globigerina bulloides d'Orbigny, 1826, p. 277, modeles no. 76.
Stratigraphic range: Middle Miocene-Recent, N13-N23.
Occurrence: 319-4; 320-1; 320A-1; AMPH 30P, 2-200 cm; DWBP 134, 0-500 cm.

Globigerina bulloides concinna Reuss
(Plate 2, Figures 5, 6)

Globigerina bulloides concinna Reuss (= *G. concinna* Reuss) 1850, p. 375, pl. 47, fig. 8.
Stratigraphic range: Quaternary, N23.
Occurrence: 320-1.

Globigerina conglomerata Schwager
(Plate 2, Figures 7, 8)

Globigerina conglomerata Schwager, 1866, p. 255, pl. 7, fig. 113.
Remarks: I have followed Blow (1969) in his differentiation of this species from *G. venequelana*. It seems that teeth in planktonic foraminifera evolved several times and are not a feature unique to any monophyletically defined *Globoquadrina* or *Neogloboquadrina*.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globigerina druryi Akers
(Plate 2, Figures 9, 10).

Globigerina druryi Akers, 1955, p. 654, pl. 65, fig. 1A-C.
Stratiraphicrange: Early-middle Miocene, N8-N12.
Occurrence: 319-5 to 319-10.

Globigerina eamesi Blow
(Plate 2, Figures 11, 12)

Globigerina eamesi Blow, 1959, p. 176, pl. 9, fig. 39a-c.
Stratigraphic range: Middle Miocene, N12.
Occurrence: 319-5.

Globigerina "eamesi"
(Plate 2, Figures 13,14)

Remarks: This form differs from *F. eamesi* in having regular raised ridges between performati.
Stratigraphic range: Middle Miocene, N10/11.
Occurrence: 319-6, CC.

Globigerina euapertura Jenkins
(Plate 2, Figures 15, 16)

Globigerina euapertura Jenkins, 1960, p. 351, pl. 1, figs. 8a-c.
Stratigraphic range: Oligocene-middle Miocene, P19-N12.
Occurrence: 319-5; 320B-1; 321-10.

Globigerina falconensis Blow
(Plate 2, Figures 17, 18)

Globigerina falconensis Blow, 1959, p. 177, pl. 9, fig. 40, 41.
Remarks: A notable feature on the figured specimen is the imperforate area of apertural face immediately above the lip.
Stratigraphic range: Early Miocene-Pliocene, N8-N19.
Occurrence: 319-1 to 319-12.

Globigerina foliata Bolli
(Plate 2, Figures 19, 20)

Globigerina foliata Bolli, 1957, p. 111, pl. 24. fig. 1a-c.
Remarks: As can be seen on the figured specimen, the surface of the test is very different from that figured by Blow (1969, pl. 16, fig. 2, 3). The pores seem much more widely spaced and "pustules" are present between the perforations. The significance of this difference is not clear.
Stratigraphic range: Middle Miocene-Quaternary, N12-N22/23.
Occurrence: 319-1 to 319-5.

Globigerina galavisi Bermudez
(Plate 2, Figures 21, 22)

Globigerina galavisi Bermudez, 1961, p. 1.183, pl. 4, fig. 3.
Remarks: In several instances it has been difficult to separate *G. galavisi* and *G. winkleri* except perhaps by spire height.
Specimens from Holes 320 and 320B vary from typical *galavisi* to forms with no trace of an apertural tooth-like flap.
Stratigraphic range: Oligocene-early Miocene, P18-N4.
Occurrence: 320B-1, 2; 321-9, 12.

Globigerina gortanii gortanii (Borsetti)
(Plate 3, Figures 1, 2)

Globigerina gortanii gortanii (Borsetti), 1959 (described as *Catapsydrax)* p. 205, pl. 1, fig. 1a-d (= *G. turritilina turritilina* Blow and Banner, 1962 in Eames et al., 1962, p. 98, pl. 13, fig. D-G).
Stratigraphic range: Oligocene, P18-N3.
Occurrence: 320B-2; 321-11, CC.

Globigerina linaperta Finlay

Globigerina linaperta Finlay, 1939a, p. 125, pl. 13, fig. 54-57.
Remarks: Only two fragmentary specimens were recovered. Neither is figured.
Stratigraphic range: Late Eocene, P16.
Occurrence: 321-13-3, 88-90 cm.

Globigerina nepenthes nepenthes Todd
(Plate 3, Figures 3-5).

Globigerina nepenthes nepenthes Todd, 1957, p. 301, pl. 78, fig. 7a, b.
Remarks: Some specimens recorded as this species from the upper part of its range may be or may intergrade with *G. rubescens decoraperta.*
Stratigraphic range: Middle Miocene-Quaternary, N12-N19.
Occurrence: 319-1 to 319-4.

Globigerina nepenthoides Brönnimann and Resig
(late 3, Figures 6, 7)

Globigerina nepenthoides Brönnimann and Resign, 1969, p. 1269, pl. 7, fig. 4-9.
Stratigraphic range: Early-middle Miocene, N8-N13/14.
Occurrence: 319-4, 7, 12.

Globigerina officinalis Subbotina
(Plate 3, Figures 8, 9)

Globigerina officinalis Subbotina, 1953, p. 78, pl. 11, fig. 1a-c.
Stratigraphic range: Late Eocene-Oligocene, P16-N2.
Occurrence: 320B-2, CC; 321-8 to 13.

Globigerina quachitaensis group
(Plate 3, Figure 10)

Remarks: Members of this group are very similar to the *G. praebulloides* group except that there are usually 4½-5 chambers in the final whorl. The figured specimen is closest to *G. o. gnaucki.*
Stratigraphic range: Late Eocene-early Miocene, P16-N4.
Occurrence: 320-3; 320B-1, 2; 321-8 to 13.

Globigerina pachyderma (Ehrenberg)
(Plate 3, Figures 11, 12)

Globigerina pachyderma (Ehrenberg), p. 303. (? = *G. borealis* Brady - Blow 1969, p. 316).
Remarks: The specimen figured is typical of the forms recovered.
Stratigraphic range: Quaternary, N22/23.
Occurrence: 320A-1; 320-1.

Globigerina picassiana Perconig
(Plate 3, Figures 13, 14)

Globigerina picassiana Perconig, 1968, p. 224, pl. 7, fig. 18, 19.
Stratigraphic range: Middle Miocene-Quaternary, N12-N22/23.
Occurrence: 319-1 to 5.

Globigerina praebulloides group
(Plate 3, Figures 15, 16)

Remarks: This term is used to encompass the many small globigerines with the aperture opening directly over the antepenultimate chamber. The group is particularly abundant in the Oligocene-middle Miocene. Specimen variation is mainly in the width and height of the aperture and the presence or absence of an apertural lip. Included are *G. parabulloides* and all forms of *G. praebulloides.*
Stratigraphic range: Oligocene-middle Miocene, P19-N14/15.
Occurrence: 319-4 to 12; 320-2, 3; 320B-1, 2; 321-9, CC.

Globigerina prasaepis Blow
(Plate 3, Figures 17, 18)

Globigerina prasaepis Blow, 1969, p. 382, pl. 10, fig. 13, pl. 18, fig. 3-7.
Stratigraphic range: Oligocene-early Miocene, P18-N4.
Occurrence: 320-3; 320B-1; 321-9 to 11.

Globigerina pseudodruryi Brönnimann and Resig
(Plate 3, Figures 19, 20)

Globigerina pseudodruryi Brönnimann and Resig, 1969, p. 1270, pl. 7, fig. 1, 2.
Stratigraphic range: Early-Miocene-Quaternary, N4-N22/23.
Occurrence: 319-1 to 4, 11; 320-2, 3.

Globigerina aff. pseudodruryi
(Plate 3, Figures 21, 22)

Remarks: This form has the same coiling and wall structure characters as *G. pseudodruryi.* There is a distinct difference. The form

figured here has a wide, very low, slit-like, rimless aperture. Wall structure suggests a close relationship with the *G. pseudodruryi* group.
Stratigraphic range: Early/middle Miocene-N8/N9.
Occurrence: 319-10CC.

Globigerina rubescens decoraperta Takayanagi and Saito
(Plate 4, Figures 1, 2)

Globigerina rubescens decoraperta Takayanagi and Saito, 1962, p. 85, pl. 28, fig. 10.
For comments see *G. r. rubescens* Hofker.
Stratigraphic range: Middle Miocene-Quaternary, N13-N22/23.
Occurrence: 319-1 to 4.

Globigerina rubescens rubescens Hofker
(Plate 4, Figures 3, 4)

Globigerina rubescens rubescens Hofker, 1956, p. 234, pl. 35, fig. 18-21.
Remarks: Blow (1969) made the comment that this form is only subspecifically different from *G. r. decoraperta.* The author agrees with this judgment and accordingly has transferred the two subspecies into the same species.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2-300; DWBP 134, 400.

Globigerina sellii (Borsetti)
(Plate 4, Figures 5, 6)

Globigerina sellii (Borsetti), 1959, p. 209, pl. 1, fig. 3 a-d.
Remarks: The oldest true *G. sellii* from Leg 34 occurs in 321-9,CC. Below that depth, several identifications are recorded on the range charts as *G.* cf. *sellii* and strictly probably refer to specimens *internec tapuriensis-sellii.* This evolutionary sequence suggests that the true base of P19 is accurately placed in 321-9, CC.

The top of the range of *G. sellii* is not N3 as indicated by Blow (1969). In Leg 34 material, and in material from oil exploration wells in northwestern Australia, *G. sellii* occurs into N4, earliest Miocene.
Stratigraphic range: Oligocene-early Miocene, P18-N4.
Occurrence: 320-3; 320B-1, 2; 321-9, CC to 11, CC.

Globigerina senilis Bandy
(Plate 4, Figures 7, 8)

Globigerina senilis Bandy, 1949, p. 121, pl. 22, fig. 5a-c.
Stratigraphic range: Oligocene, P18-P19.
Occurrence: 321-8, 10, 11.

Globigerina tripartita Koch
(Plate 4, Figures 9, 10)

Globigerina tripartita Koch, 1926, p. 746, text-fig. 21a-b.
Stratigraphic range: Oligocene-early Miocene, P19-N4.
Occurrence: 320-3; 320B-1, 2; 321-9.

Globigerina utilisindex Jenkins and Orr
(Plate 4, Figures 11, 12)

Globigerina utilisindex Jenkins and Orr, 1973, p. 133, pl. 1-3 (esp. pl. 1, fig. 4-6).
Remarks: It is possible that the specimen recorded by Quilty (1969, fig. 7, no. 37-39) as *G. tapuriensis* may belong to this species. It has been an anomaly for several years that *G. tapuriensis* could be recorded in late Eocene sediments. If Quilty's earlier record is of this species, an apparent anomaly is removed.
Stratigraphic range: Oligocene, P18.
Occurrence: 321-11-2.

Globigerina venezuelana Hedberg
(Plate 4, Figures 13, 14)

Globigerina venezuelana Hedberg, 1937, p. 681, pl. 92, fig. 7a, b.
Remarks: The specimens recorded in the Pleistocene of DWBP 134, 100-102 cm are genuine members of this species and distinct from *G. conglomerata.* This seems to be the youngest true record of this species.
Stratigraphic range: Early Miocene-Quaternary, N4-N23.
Occurrence: 319-1 to 12, CC; 320-2, 3; 320B-1; DWBP 134, 100 cm.

Globigerina winkleri Bermudez
(Plate 4, Figures 15, 16)

Globigerina winkleri Bermudez, 1961, p. 1.208, pl. 6, fig. 4a-c.
Remarks: see also *G. galavisi.*
Stratigraphic range: Oligocene early Miocene, P18-N4.
Occurrence: 320-3; 320B-1; 321-11.

Globigerina (?) winkleri
(Plate 4, Figures 17, 18)

Remarks: The specimen has features in common with many coeval species but differs from all in some unique respect. *G. angiporoides* has a wider, lower arched aperture and more compact test. *G. linaperta* has a more flattened distal side of each chamber. *G. galavisi* and true *G. winkleri* have well-developed teeth.
Stratigraphic range: Oligocene, P18.
Occurrence: 321-11.

Globigerina woodi connecta Jenkins
(Plate 4, Figure 19)

Globigerina woodi connecta Jenkins, 1964, p. 72, fig. 1a-c.
Stratigraphic range: Early Miocene-Pliocene, N4-N19.
Occurrence: 319-1 to 12; 320B-1.

Globigerina woodi s.l.
(Plate 4, Figures 20, 21)

Remarks: The specimens identified here are very similar to *G. W. Woodi,* but the aperture is a lower arch without any trace of lip or rim. It occurs here almost at the youngest end of the world range recorded by Jenkins (1971).
Stratigraphic range: Early Miocene-Pliocene, N6 or 8-N18/19.
Occurrence: 319-3, 4, 6; 320-2.

Globigerina sp. 1
(Plate 5, Figures 1, 2)

Remarks: This species may be that recorded by Bronnimann and Resig (1969, pl. 5, fig. 7) as *G. venezuelana.*

The specimens in 319-1-4, 100-102 cm are distinctly different from *G. venezuelana* in the same sample. They have a slightly depressed spire with otherwise the same coiling characters as *G. venezuelana.* The chambers are more flattened distally so the dorsal view is typical of the more inflated members of the *Globoquadrina dehiscens* group. There are no globoquadrine teeth or toothlike projections over the aperture, but often there is a final chamber significantly reduced in size. The apertural face is flattened, the aperture is very large, and there is no lip or rim on the aperture. The ventral parts of many chambers are spinose in a form reminiscent of *G. conglomerata.*

The species has the appearance of being a direct descendant of *Globoquadrina dehiscens advena* by loss of the tooth and enlargement of the aperture at the expense of the apertural face which has otherwise maintained its globoquadrine characteristic.
Stratigraphic range: Pliocene, N18-N19.
Occurrence: 319-1 to 3.

Globigerina sp. 2
(Plate 5, Figures 3, 4)

Remarks: This form may be an unusual variant of *G. venezuelana.*
Stratigraphic range: Middle Miocene-Pliocene, N10-N19.
Occurrence: 319-1 to 6.

Globigerina sp. 3
(Plate 5, Figures 5, 6)

Description: Test small (0.12-0.14 mm) robust, slightly ovate in equatorial and lateral outline. sutures very little depressed almost flush, not incised. Final whorl of four chambers, each chamber less than hemispherical. Aperture central on ventral surface; umbilicus virtually absent. Aperture either a low wide arch or a narrow small, high arch. Lip sharp-edged, narrow, imperforate. Wall relatively very thick, with coarse perforations.
Remarks: Relationships of this species are obscure. There may be some similarities with *Turborotalita primitiva* Bronnimann and Resig or with *G. picassiana* Perconig.
Stratigraphic range: Middle Miocene-N10/11.
Occurrence: 319-7-4 and 319-7-6.

Globigerina sp 4
(Plate 5, Figures 7, 8)

Remarks: The true features of the species to which this unnamed form belongs, are masked by the peculiar prolongation of the anterior edge of the ultimate chamber. The final whorl thus has only three chambers, whereas earlier whorls seem to have four.

Some relationship with *G. venezuelana* is likely.

Stratigraphic range: Middle Miocene, N9.

Occurrence: 319-9, CC.

Globigerina sp 5
(Plate 5, Figures 9, 10)

Description: Test small (0.13 mm), robust, a low trochospire with slightly more than 4 chambers in the final whorl. Both dorsal and ventral surfaces weakly convex. Dorsal sutures straight, radial, very slightly depressed proximally, becoming more depressed distally but even then only broadly depressed. Ventral sutures straight, radial, broadly depressed. Umbilicus narrow, deep. Aperture umbilical, perhaps a little extraumbilical, a low arch without coarse, widely spaced performations.

Remarks: No obvious relationship with other species has been established.

Stratigraphic range: Early Oligocene-P18 to P19.

Occurrence: 321-9-6 to 321-11-3 (intermittent).

Globigerina sp. 6
(Plate 5, Figures 11, 12)

Description: Test small (0.15 mm), compact, consisting of a moderately low trochospire, with 4 chambers in each of the last two whorls. Dorsal sutures clearly, broadly depressed, a little recurved distally. Ventral sutures straight, radial, depressed. Umbilicus small, quadrate, quite deep. Aperture small, a low arch without lip or rim, opening symmetrically over the proximal edge of the antepenultimate chamber. Wall structure quite thick, perforations widely spaced. Wall of ultimate chamber coarser than for earlier chambers.

Remarks: The main feature differentiating this form is the lack of any lip or rim to the aperture.

Stratigraphic range: Early Oligocene-P18-19.

Occurrence: 321-9-6 to 321-11-4 (intermittent).

Globigerina sp. 7
(Plate 5, Figures 13, 14)

Remarks: This form could be a variant of *G. euapertura* or *G. woodi woodi* in which the aperture is very much restricted.

Stratigraphic range: Oligocene, P19.

Occurrence: 321-9-6.

Globigerina sp. 8
(Plate 5, Figures 15, 16)

Remarks: There is doubt over even the generic assignment of this species. It is placed in *Globigerina* because of the umbilical aperture.

There are four chambers in the final whorl but probably were 4½ in earlier whorls. All but the last few chambers have moderately incised sutures. The aperture, set in an imperforate apertural face, is a symmetrical arch with well-developed rim.

Stratigraphic range: Oligocene, P18.

Occurrence: 321-12, CC.

Genus GLOBIGERINOIDES Cushman, 1927

Globigerinoides bollii Blow
(Plate 5, Figures 17, 18)

Globigerinoides bollii Blow, 1959, p. 189, pl. 10, fig. 65a-c.

Stratigraphic range: Early Miocene-Pliocene, N10-N19.

Occurrence: 319-1 to 7.

Globigerinoides aff. bollii Blow
(Plate 5, Figures 19-21)

Remarks: Gross coiling characters, supplementary aperture distribution and chamber shape seem identical with *G. bollii.* The umbilicus is covered by a reduced final chamber with the same wall structure as the rest of the test. Thus no primary aperture was available.

The wall structure was well described by Brönnimann and Resig (1969, p. 1270) in their discussion of *Globigerina pseudodruryi.*

Stratigraphic range: Pliocene, N19.

Occurrence: 319-1-4 to 319-2CC (intermittent).

Globigerinoides conglobatus (Brady)
(Plate 6, Figures 1, 2.)

Globigerinoides conglobatus (Brady), 1879, p. 286 (figures Brady 1884, pl. 8, fig. 1-5). Banner and Blow, 1960a, p. 6, pl. 4, fig. 4.

Stratigraphic range: Pleistocene, N22/23.

Occurrence: AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globigerinoides diminutus Bolli
(Plate 6, Figure 3)

Globigerinoides diminutus Bolli, 1957, p. 114, pl. 25, fig. 11a-c.

Remarks: The few specimens recovered are very poorly preserved and the identification is a little tentative.

Stratigraphic range: Early-middle Miocene, N8-N9.

Occurrence: 319-10, 11.

Globigerinoides elongatus (d'Orbigny)
(Plate 6, Figures 4, 5)

Globigerinoides elongatus (d'Orbigny), 1826, p. 277. Banner and Blow 1960a, p. 12, pl. 3, fig. 10a-c.

Stratigraphic range: Quaternary, N22/23.

Occurrence: 319-1; AMPH 30P, 2-100 cm; DWBP 134, 300-500 cm.

Globigerinoides inusitatus Jenkins
(Plate 6, Figures 6, 7)

Globigerinoides inusitatus Jenkins, 1965, p. 1108, fig. 9, no. 72-80.

Remarks: This appears to be the first record of this unusual species outside New Zealand.

Stratigraphic range: Early Miocene, N4.

Occurrence: 320-3, CC.

Globigerinoides obliquus extremus Bolli and Bermudez
(Plate 6, Figures 8, 9)

Globigerinoides obliquus extremus Bolli and Bermudez, 1965, p. 139, pl. 1, fig. 10-12.

Stratigraphic range: Late Miocene-Quaternary, N17-N22/23.

Occurrence: 319-1 to 3; 320-1.

Globigerinoides obliquus obliquus Bolli
(Plate 6, Figure 10)

Globigerinoides obliquus obliquus Bolli, 1957, p. 113, pl. 25, fig. 9, 10.

Stratigraphic range: Late Miocene-Pliocene, N17-N19.

Occurrence: 319-1, 2.

Globigerinoides quadrilobatus altiaperturus Bolli
(Plate 6, Figures 11, 12)

Globigerinoides quadrilobatus altiaperturus Bolli, 1957, p. 113, pl. 25, fig. 7, 8)

Stratigraphic range: Early Miocene, N4.

Occurrence: 320-3.

Globigerinoides quadrilobatus immaturus LeRoy
(Plate 6, Figures 13, 14)

Globigerinoides quadrilobatus immaturus LeRoy, 1939, p. 263, pl. 3, fig. 19-21. Bolli, 1957, p. 113, pl. 25, fig. 13, 14.

Stratigraphic range: Early Miocene-Quaternary, N8 to N23.

Occurrence: 319-1 to 12, CC; 320-2; AMPH 30P, 2-300 cm; DWBP 134, 100-500 cm.

Globigerinoides quadrilobatus primordius Blow and Banner
(Plate 6, Figures 15, 16)

Globigerinoides quadrilobatus primordius Blow and Banner, 1962, p. 115, pl. 9, fig. Dd-Ef.

Stratigraphic range: Early Miocene, N4.

Occurrence: 320-3.

Globigerinoides quadrilobatus quadrilobatus (d'Orbigny)
(Plate 6, Figures 17, 18)

Globigerinoides quadrilobatus quadrilobatus (d'Orbigny), 1846, p. 164, pl. 9, fig. 7-10. Banner and Blow, 1960a, p. 17, pl. 4, fig. 3a, b.
Stratigraphic range: Early Miocene-Quaternary, N8-N23.
Occurrence: 319-1 to 12, CC; AMPH 30P, 2-100 cm; DWBP 134, 0-300 cm.

Globigerinoides quadrilobatus sacculifer (Brady)
(Plate 6, Figures 19, 20)

Globigerinoides quadrilobatus sacculifer (Brady) 1877, p. 535 (figures Carpenter et al., 1862, pl. 12, fig. 11). Banner and Blow, 1960, p. 21, pl. 4, fig. 1a, b.
Stratigraphic range: Early Miocene-Quaternary, N4 to N23.
Occurrence: 319-1 to 12; 320-2, 3; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globigerinoides quadrilobatus sacculifer form α Blow
(Plate 6, Figure 21)

Globigerinoides quadrilobatus sacculifer form α. Blow, 1969, p. 326 (figure, Brady, 1884, pl. 8, fig. 11).
Stratigraphic range: Quaternary, N22/23.
Occurrence: DWBP 134, 300-400 cm.

Globigerinoides quadilobatus trilobus (Reuss)
(Plate 6, Figures 22, 23)

Globigerinoides quadrilobatus trilobus (Reuss), 1850, p. 374, pl. 47, fig. 11a-d. Bolli, 1957, p. 112, pl. 25, fig. 2a-c.
Stratigraphic range: Early Miocene-Quaternary, N8-N23.
Occurrence: 319-1 to 12, CC; DWBP 134, 0-500 cm.

Globigerinoides ruber (d'Orbigny)
(Plate 7, Figures 1, 2)

Globigerinoides ruber (d'Orbigny), 1839b, p. 82 (fig. 8, pl. 4, fig. 12-14). Banner and Blow, 1960a, p. 19, pl. 3, fig. 8a, b.
Stratigraphic range: Late Miocene-Quaternary, N14-N23.
Occurrence: 319-3, CC; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globigerinoides sicanus De Stefani
(Plate 6, Figures 3-5)

Globigerinoides sicanus De Stefani, 1950, p. 9 (figures, Cushman and Stainforth, 1945, pl. 13, fig. 6)
Remarks: The specimens reworked into the late Miocene of Hole 319 include those forms described by Brönnimann and Resig (1969) as *G. sicanus praesicanus,* and also possibly *G. pseudosellii.*.
Stratigraphic range: Early late Miocene, N8-N16.
Occurrence: 319-3, 4, 9-12.

Globigerinoides subquadratus Brönnimann
(Plate 6, Figures 6-8)

Globigerinoides subquadratus Brönnimann, 1954, p. 680. pl. 1, fig. 5.
Remarks: In the interval N8-early N9, some small specimens of this species may be included with *G. diminutus* and the converse may also hold.

One of the figured specimens is aberrant in having well-developed lips to the multiple apertures, thus mimicing *Globigerapsis.*
Stratigraphic range: Early-middle Miocene, N6 or 8-N15.
Occurrence: 319-4 to 12; 320-2.

Genus CATAPSYDRAX Bolli, Loeblich, and Tappan, 1957.

Catapsydrax boweni (Bröonnimann and Resig)
(Plate 7, Figures 9, 10)

Catapsydrax boweni (Brönnimann and Resig) 1969, p. 127l, pl. 26, fig. 1-4
Stratigraphic range: Early Miocene, N8.
Occurrence: 319-12, CC.

Catapsydrax dissimilis ciperoensis (Blow and Banner)
(Plate 7, Figure 11)

Catapsydrax dissimilis ciperoensis (Blow and Banner), 1962, p. 107, pl. 14, fig. A-C.
Stratigraphic range: Oligocene-early Miocene, N2-N4.
Occurrence: 320-3; 320B-1,2; 321-7.

Catapsydrax dissimilis dissimilis (Cushman and Bermudez)
(Plate 7, Figures 12, 13)

Catapsydrax dissimilis dissimilis (Cushman and Bermudez), 1937, p. 25 pl. 3, fig. 4-6.
Stratigraphic range: Oligocene-early Miocene, P18-N4.
Occurrence: 320-3; 320B-1,2; 321-7, 10-12.

Catapsydrax aff. howei (Blow and Banner)
(Plate 7, Figures 14, 15)

Catapsydrax aff. *howei* (Blow and Banner), 1962.
Remarks: The specimen figured here differs from typical *C. howei* in that the aperture opens over the suture between the antepenultimate and penultimate chambers and is thus perpendicular to the normal position.
Stratigraphic range: Oligocene, P18.
Occurrence: 321-11.

Catapsydrax martini martini (Blow and Banner)
(Plate 7, Figures 16, 17)

Catapsydrax martini martini (Blow and Banner), 1962, p. 110, pl. 14, fig. 0.
Remarks: The identification of this species is somewhat tentative because the specimens are modified by dissolution effects.
Stratigraphic range: Oligocene, P18.
Occurrence: 321-10 to 12.

Catapsydrax parvulus Bolli, Loeblich, and Tappan
(Plate 7, Figures 18, 19)

Catapsydrax parvulus Bolli, Loeblich, and Tappan, 1957, p. 36, pl. 7, fig. 10a-c.
Stratigraphic range: Early-middle Miocene, N8-N15.
Occurrence: 319-4 to 10.

Catapsydrax pera (Todd)
(Plate 7, Figures 20, 21)

Catapsydrax pera (Todd), 1957, p. 301, pl. 70, fig. 10, 11.
Stratigraphic range: Late Eocene-Oligocene, P16-P18.
Occurrence: 321-10 to 13.

Catapsydrax stainforthi stainforthi Bolli, Loeblich, and Tappan
(Plate 7, Figures 22, 23)

Catapsydrax stainforthi stainforthi Bolli, Loeblich, and Tappan, 1957, p. 37, pl. 7 fig. 11a-c.
Stratigraphic range: Early Miocene-Pliocene, N4-N18
Occurrence: 319-3 to 10; 320-3, CC; 320B-1.

Catapsydrax unicava primitiva (Blow and Banner)
(Plate 8, Figure 1)

Catapsydrax unicava primitiva (Blow and Banner), 1962, p. 114, pl. 14 fig. J-L.
Stratigraphic range: Late Eocene-early Miocene, P16-N4.
Occurrence: 320B-1, 2; 321-9 to 13.

Catapsydrax unicava unicava Bolli, Loeblich, and Tappan
(Plate 8, Figures 2, 3)

Catapsydrax unicava unicava Bolli, Loeblich, and Tappan, 1957, p. 37 pl. 7 fig. 9a-c.
Stratigraphic range: Oligocene-early Miocene, P19-N6 or 8.
Occurrence: 320-2, 3; 320B-1, 2; 321-7 to 9.

Genus GLOBIGERINITA Brönnimann, 1951

The genus *Globigerinita s. l.* (for example, as used by Blow, 1969) can be divided into phylogenetically distinct groups. One has a robust test (often large) resistant to dissolution and with an Eocene-Miocene time range. This can be equated with *Catapsydrax* Bolli, Loeblich, and Tappan. The other group includes thinner walled, smaller, less robust forms with an Oligocene-Recent time range. This latter usage would include *Globigerinita* and *Tinophodella* Loeblich and Tappan.

A wide variety of forms from Leg 34 can be placed in *Globigerinita* and there is a great deal of confusion over the nomenclature to be employed. For this paper, I have adopted the following convention, based mainly on the features of the bulla.

Most species can be placed with reasonable certainty in one genus or the other. However, there are several Eocene or Oligocene forms of doubtful assignation. For simplicity, several forms are here taken as *Catapsydrax.* These forms, though robust, are usually smaller than most *Catapsydrax* but have other characters more in common with *Catapsydrax* than with *Globigerinita.*

Phylogeny within *Catapsydraz* and *Globigerinita* is uncertain.

Globigerinita ambitacrena Loeblich and Tappan possesses multiple apertures to the bulla. The apertures are not confined to the sutural position, but also occur over the preexisting chamber surface. Commonly, these apertures are accompanied by tunnel-like extensions. This is consistent with the usage of Blow (1969).

G. incrusta Akers possesses an umbilical bulla, elongate parallel to the umbilicus and with an aperture in each sutural position (total of four apertures). Each aperture is accompanied by a short tunnel-like extension. This usage follows the type usage (Akers, 1955; Blow, 1969).

G. glutinata (Egger) possesses an inflated umbilical bulla usually with simple apertures in sutural positions. There may be one, two or three such sutural apertures to the bulla.

Several forms or subspecies have been recognized within this species, but I am not familiar with the disposition of apertures in the type specimen. Until this is known, differentiation into subgroups cannot be meaningfully attempted.

As used here, this name includes *G. g. flparkerae* (Brönnimann and Resig, 1969), *G. naparimaensis* (Blow, 1969), *G. g. glutinata* (in several senses), and those specimens of *Globigerina juvenilis* which Parker (1962) and Brönnimann and Resig (1969) would place in *Globigerinita.*

Parker (1962) made the point that a division into a variety of forms served no purpose ecologically or stratigraphically. This is difficult to accept although she is correct in suggesting that there probably is no biological basis for doing so. If, however, the divisions are referred to forms (for this is all they are; see Quilty, 1969) there may be some stratigraphic or ecologic value to strictly nonbiologic division.

Globigerinita ambitacrena (Loeblich and Tappan)
(Plate 8, Figures 4, 5)

Globigerinita ambitacrena (Loeblich and Tappan), 1957, p. 114, fig. 2a-3c.

Stratigraphic range: Early Miocene-Quaternary N8-N23.

Occurrence: 319-6, 10; AMPH 30P, 200, 300 cm; DWBP 134, 0-500 cm.

Globigerinita glutinata (Egger)
(Plate 8, Figures 6-11)

Globigerinita Glutinata (Egger) 1893, p. 371, pl. 13, fig. 19-21. Parker, 1962, p. 246, pl. 9, fig. 10-14, 16.

Stratigraphic range: Early Miocene-Quaternary, N4-N23.

Occurrence: 319-1, 5-12, CC; 320-3; 320A-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globigerinita cf. glutinata
(Plate 8, Figures 12, 13)

Remarks: Questionably related to *G. glutinata* are specimens with a final whorl of three chambers and a small true bulla which, in the figured specimen, is not regular in shape but may be pointed. There is only one aperture.

Stratigraphic range: Late Oligocene, N3.

Occurrence: 320B-2-4 to 320B-2-5.

Globigerinita incrusta Akers
(Plate 8, Figures 14-16)

Globigerinita incrusta Akers, 1955, p. 655, pl. 65, fig. 2A-D.

Stratigraphic range: Oligocene-Quaternary, N2-N23.

Occurrence: 319-1 to 12, CC; 320-3; 320B-1, 2; AMPH 30P, 2-300 cm; DWBP 134, 0-400 cm.

Globigerinita riveroae Bermudez
(Plate 8, Figure 17)

Globigerinita riveroae Bermudez, 1961, p. 1.266, pl. 7, fig. 7a-c.

Stratigraphic range: Oligocene-early Miocene, P14-N4.

Occurrence: 320B-1; 321-7, 8.

Globigerinita uvula (Ehrenberg)
(Plate 8, Figure 18)

Globigerinita uvula (Ehrenberg), 1861, p. 276 (figures, Ehrenberg, 1873, pl. 2, fig. 24, 25). (= *Globigerina bradyi* Wiesner, 1931, p. 133. (figures, Brady, 1884, p. 603, pl. 82, fig. 8, 9).

Stratigraphic range: Oligocene-Quaternary, N2-N23.

Occurrence 319-4 to 12; 320-3; 320A-1; 320B-1, 2.

Globigerinita sp. 1
(Plate 8, Figures 19-21)

Description: Test small (0.15 mm), compact, with four chambers in each whorl, with the possible exception of the first which was not studied. Dorsal surface weakly convex, ventral uniformly convex. Lateral profile somewhat compressed with a weak tendency to develop an equatorial shoulder. Chambers less than hemispherical, markedly longer tangentially than radially. Sutures broadly, shallowly depressed, radial on the ventral surface, strongly recurved on the dorsal. Dorsal aspect distinctly globoquadrine or turborotaline.

Aperture umbilical, details unknown. Aperture covered by bulla, which is elongate parallel to the apertural face; bulla covers aperture and has a single aperture over the penultimate chamber of the normally coiled part of the test. Bulla terminates at the periphery without supplementary apertures. Bulla aperture without raised rim or lip, but bordered by a narrow imperforate region.

Wall of test thick, coarsely perforate. Bulla wall thicker and more coarsely perforate than in most bullae, but still thinner and less coarsely perforate than elsewhere on this species. Ridges between perforations on umbilical face sometimes elongate radially, giving a "stretched" appearance.

Remarks: The most similar species seems to be *Catapsydrax parvulus* from which G. sp. 1 differs mainly in being dorsoventrally compressed and in having chambers which are tangentially elongate and almost globoquadrine in dorsal aspect.

The characters of the bulla are almost like *Turborotalita,* but neither end of the bulla extends far enough.

Stratigraphic range: Early-middle Miocene N8/9.

Occurrence: 319-8-1 to 319-8-4 (continuous).

Genus GLOBIGERINATELLA Cushman and Stainforth, 1945.

Globigerinatella insueta Cushman and Stainforth
(Plate 8, Figure 22; Plate 9, Figures 1, 2)

Globigerinatella insueta Cushman and Stainforth, 1945, p. 69, pl. 13, fig. 7-9.

Stratigraphic range: Early-middle Miocene, N8-N12.

Occurrence: 319-5 to 12, CC.

Genus GLOBIGERAPSIS Bolli, Loeblich, and Tappan 1957

Globigerapsis index (Finlay)
(Plate 9, Figures 3, 4)

Globigerapsis index (Finlay), 1939a, p. 125, pl. 14, fig. 85-88.

Remarks: In the specimens identified here, the intercameral sutures are not as deeply incised as in the typical cases discussed by Quilty (1969).

Stratigraphic range: Late Eocene-Oligocene, P16-P18.

Occurrence: 321-10 to 13.

Globigerapsis mexicana (Cushman)
(Plate 9, Figures 5, 6)

Globigerapsis mexicana (Cushman), 1925, p. 6, pl. 1, fig. 8a, b. Blow and Saito, 1968, p. 359, text-fig. 1-4.
Stratigraphic range: Late Eocene, P16.
Occurrence: 321-13-3.

Globigerapsis sp.
(Plate 9, Figures 7-9)

Remarks: This unidentified form differs from *G. index* in lacking incised sutures and in having a less thickened wall. In this negative sense it shows characters in common with *G. tropicalis.* The specimens recovered have a maximum of only two apertures to the "bulla," and the normal ultimate chamber is not as large as would be expected in *G. tropicalis.*
Stratigraphic range: Late Eocene, P16.
Occurrence: 321-13-3.

Genus ORBULINA d'Orbigny, 1839

Orbulina suturalis Brönnimann
(Plate 9, Figures 10, 11)

Orbulina suturalis Brönniman, 1951, p. 135, text-fig. 2, no. 1, 2, 5-8, 10; text-fig. 3, no. 3-8, 11, 13-16, 18, 20-22; text-fig. 4, no. 2-4, 7-12, 15, 16, 19-22.
Stratigraphic range: Middle Miocene-Pliocene, N9-N19.
Occurrence: 319-1 to 8.

Orbulina universa parkerae Brönnimann and Resig
(Plate 9, Figure 12)

Orbulina universa parkerae Brönnimann and Resig, 1969, p. 1284, pl. 45, fig. 1-4.
Stratigraphic range: Pliocene, N19.
Occurrence: 319-l.

Orbulina universa universa d'Orbigny
(Plate 9, Figure 13)

Orbulina universa universa d'Orbigny, 1839, p.2 (figure v. 3, pl. 1).
Remarks: It is noteworthy that this species is never particularly abundant in Nazca plate samples and in a very general way becomes less abundant further back in the section. This is in marked contrast to northwestern Australia at the same latitute where the species is abundant down to the *Orbulina* datum.
Stratigraphic range: Middle Miocene-Quaternary, N9-N23.
Occurrence: 319-1 to 9, CC; 320-1; 320A-1; AMPH 30P; 2-200 cm; DWB 134, 0-500 cm.

Genus BIORBULINA Blow, 1956

Biorbulina bilobata (d'Orbigny)
(Plate 9, Figure 14)

Biorbulina bilobata (d'Orbigny), 1846, p. 164, pl. 9, fig. 11-14.
Remarks: An unusual variant if figured.
Stratigraphic range: Middle Miocene-Pliocene, N10-N19.
Occurrence: 319-1 to 6.

Genus CANDEINA d'Orbigny, 1839

Candeina nitida nitida d'Orbigny
(Plate 9, Figure 15)

Candeina nitida nitida d'Orbigny, 1839, p. 107 (figures v. 8, pl. 2, fig. 27, 28)
Stratigraphic range: Quaternary, N22/23.
Occurrence: *AMPH* 30P, 2-100.

Genus SPHAEROIDINELLA Cushman, 1927

Sphaeroidinella dehiscens dehiscens (Parker and Jones)
(Plate 9, Figures 16, 17)

Sphaeroidinella dehiscens dehiscens (Parker and Jones), 1865, p. 369, pl. 19, fig. 5a, b. Cushman, 1927, p. 90, pl. 19, fig. 2.
Stratigraphic range: Quaternary, N22/23.
Occurrence: *AMPH* 30P, 2-300 cm; DWBP 134, 0-500 cm.

Sphaeroidinella dehiscens dehiscens form immatura Cushman

Sphaeroidinella dehiscens dehiscens form *immatura* Cushman, 1919.
Remarks: Morphotypes identifiable as this form were recorded onboard ship from Sample 319-1, CC. This identification now seems invalid although the age assigned is still correct.

It now seems probable that the *S. d. d. immatura* morphotypes in this fauna are dissolution artifacts formed by preferential dissolution at the triple chamber junction on the dorsal side of specimens of *Sphaeroidinellopsis subdehiscens paenedehiscens*, leading to a synthetic dorsal sutural supplementary aperture.

Brönnimann and Resig (1969) suggested that to identify *S. d. d. immatura*, the specimen should have an obvious elevated border to this aperture. This is an excellent criterion to use where there is doubt concerning the identification of the dorsal sutural supplementary aperture, for example, in the case cited here. In many circumstances, for example, in shallower water sediments, the difference between *Sphaeroidinella* and *Sphaeroidinellopsis,* is distinct and the evolution of *Sphaeroidinella* can be taken as "instantaneous" (Brönnimann and Resig, 1969, p. 1237).

Sphaeroidinella dehiscens dehiscens forma *immatura* is thus not recorded in this work.

Sphaeroidinella dehiscens excavata Banner and Blow
(Plate 9, Figures 18, 19)

Sphaeroidinella dehiscens excavata Banner and Blow, 1965a, p. 1164 (figures [i] Brady, 1884, pl. 84, fig. 8 [ii] Banner and Blow 1967, p. 153, pl. 4, fig. 5)
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2 cm; DWBP 134, 0-300 cm

Genus SPHAEROIDINELLOPSIS Banner and Blow, 1959

Sphaeroidinellopsis seminulina kochi (Caudri)
(Plate 9, Figures 20-22)

Sphaeroidinellopsis seminulina kochi (Caudri), 1934, p. 144, fig. p. 351, fig. 8a, b. Blow, 1959, pl. 198, p. 12, fig 78, 79. Blow, 1969, p. 337, pl. 30, fig. 3.
Remarks: One of the figured specimens has not reached the final smooth-surfaced stage of development and shows a stage of development only a little removed from *Globigerinoides quadrilobatus sacculifer.*
Stratigraphic range: Middle Miocene, N10-N15.
Occurrence: 319-3 to 7.

Sphaeroidinellopsis seminulina seminulina (Schwager)
(Plate 10, Figures 1, 2)

Sphaeroidinellopsis seminulina seminulina (Schwager), 1866, p. 256, pl. 7, fig. 112. Blow 19 9, p. 337, pl. 30, fig. 7.
Stratigraphic range: Early Miocene-Pliocene, N8-N21
Occurrence: 319-1 to 12, CC; 320-2.

Sphaeroidinellopsis subdehiscens paenedehiscens Blow
(Plate 10, Figures 3, 4)

Sphaeroidinellopsis subdehiscens paenedehiscens Blow, 1969, p. 386, pl. 30, fig. 4, 5, 9.
Remarks: See also *Sphaeroidinella dehiscens dehiscens* form *immatura.*
Stratigraphic range: Middle Miocene-Pliocene, N12-N19.
Occurrence: 319-1 to 5.

Sphaeroidinellopsis subdehiscens subdehiscens (Blow)
(Plate 10, Figures 5, 6)

Sphaeroidinellopsis subdehiscens subdehiscens (Blow), 1959, p. 195, pl. 12, fig. 71a-c. Blow, 1969, pl. 30 fig. 1-3, 6; pl. 31, 32.
Stratigraphic range: Middle Miocene-Pliocene, N12-N19.
Occurrence: 319-1 to 4.

Genus GLOBOQUADRINA Finlay, 1947

Globoquadrina altispira altispira (Cushman and Jarvis)
(Plate 10, Figures 7, 8)

Globoquadrina altispira altispira (Cushman and Jarvis), 1936, p. 5, pl. 1, fig. 13, 14.
Stratigraphic range: Early Miocene-Pliocene, N6 or 8-N19.
Occurrence: 319-1 to 12; 320-2.

Globoquadrina altispira globosa Bolli
(Plate 10, Figures 9, 10)

Globoquadrina altispira globosa Bolli, 1957, p. 111, pl. 24, fig. 9, 10.
Stratigraphic range: Early-middle Miocene, N4-N12.
Occurrence: 319-5, 10, 11; 320B-1.

Globoquadrina altispira globularis Bermudez
(Plate 10, Figures 11, 12)

Globoquadrina altispira globularis Bermudez, 196l, p. 1.311, pl. 13, fig. 4-6.
Stratigraphic range: Early Miocene, N4.
Occurrence: 320-3.

Globoquadrina baroemoenensis (LeRoy)
(Plate 10, Figures 13)

Globoquadrina baroemoenensis (LeRoy) 1939, p. 263, pl. 6, fig. 1, 2.
Remarks: The specimen figured shows well the degree of convergence of *G. baroemoenensis* and *G. larmeui obesa* which can occur at markedly different times.
Stratigraphic range: Oligocene-early Miocene, N2-N6 or 8.
Occurrence: 320-2; 320B-1, 2.

Globoquadrina dehiscens advena Bermudez
(Plate 10, Figures 14, 15)

Globoquadrina dehiscens advena Bermudez, 1949, p. 287, pl. 22, fig. 36-38.
Stratigraphic range: Early-late Miocene, N6 or 8-N16.
Occurrence: 319-3 to 12, CC; 320-2.

Globoquadrina dehiscens dehiscens s. s.
(Chapman, Parr, and Collins)
(Plate 10, Figures 16, 17)

Globoquadrina dehiscens dehiscens s. s. (Chapman, Parr, and Collins), 1934, p. 569, pl. 11, fig. 36a-c. Bolli, 1957, p. 111, pl. 24, fig. 3a-c.
Remarks: Included here, as *G. d. dehiscens s. s.* are forms coincident with the original concept of Chapman, Parr, and Collins (1934). This has a clearly quadrate dorsal aspect, well-developed quadrately arranged ventral shoulder on each chamber and an imperforate apertural face with well-marked triangular tooth.
Stratigraphic range: Early-middle Miocene, N8-N13.
Occurrence: 319-4 to 12, CC.

Globoquadrina dehiscens dehiscens form β
(Plate 10, Figures 18, 19)

Remarks: This form, often included without qualification in *G. d. dehiscens*, is quite different from the original concept of the species. It seems to be intermediate between *G. d. dehiscens* and *G. langhiana.*
Stratigraphic range: Early-middle Miocene, N8-N11.
Occurrence: 319-7 to 12.

Globoquadrina dehiscens praedehiscens Blow and Banner
(Plate 10, Figures 20, 21)

Globoquadrina dehiscens praedehiscens Blow and Banner, 1962, p. 185, pl. 11, fig. 57a-c.
Remarks: There is no dorsal supplementary aperture, and this feature seems to be the main differentiation between *Globoquadrina dehiscens praedehiscens* and *Globigerinoides pseudosellii* Brönnimann and Resig.
The aperture has been retouched in the figured specimen to emphasize the presence of the tooth.
Stratigraphic range: Early Miocene, N4-N6 or 8.
Occurrence: 320-2; 320B-1.

Globoquadrina aff. langhiana Cita and Gelati
(Plate 10, Figures 22, 23)

Remarks: This species is the same as recorded by Jenkins and Orr (1972) as *G. langhiana*. It cannot be referred unequivocally to *G. langhiana* as the flattened apertural face is much more developed than seems to the case in *G. langhiana.*
Stratigraphic range: Early-middle Miocene, N8-N19.
Occurrence: 319-5 to 12.

Globoquadrina larmeui larmeui Akers
(Plate 11, Figures 1, 2)

Globoquadrina larmeui larmeui Akers, 1955, p. 661, pl. 65, fig. 4a-c.
Stratigraphic range: Early Miocene-Pliocene, N8-N19.
Occurrence: 319-1 to 12, CC; 320-2.

Globoquadrina larmeui obesa Akers
(Plate 11, Figures 3, 4)

Globoquadrina larmeui obesa Akers, 1955, p. 661, pl. 65, fig. 5a-c.
Stratigraphic range: Middle late Miocene, N10-N16.
Occurrence: 319-3 to 7.

Globoquadrina sp. 1
(Plate 11, Figures 5, 6)

Remarks: This form is very similar to *G. larmeui obesa*, but occurs here in the earliest Miocene (N4), considerably earlier than true *G. larmeui obesa.*
In the figures, the aperture has been retouched to emphasize the tooth.
Stratigraphic range: Early Miocene, N4.
Occurrence: 320-3.

Genus GLOBOROTALIA Cushman, 1927

Subgenus TURBOROTALIA Cushman and Bermudez, 1949

Bandy (1972) has made a welcome advance in the terminology of globorotaline species by proposing phylogenetically defined subgenera *Hirsutella, Fohsella,* and *Menardella*. These lineages are well known and defined, and Bandy has been justifiably conservative in defining subgenera. While having great sympathy for the concept of defining higher categories phylogenetically—the only true basis in fact—until the phylogeny is well established, it is better to follow the traditional morphologic approach.

Fleisher (1974) has defined *Tenuitella* to include another group. Unfortunately, the lineages within this group are not so well defined or known, and I believe definition of this genus (or subgenus) is a little premature. Two lineages seem to be included. One includes *G. gemma* and *G. minutissima*. The other, perhaps derived from the former, includes *G. insolita, G. anfracta,* and two new intermediate species described herein.

In this discussion I have followed Blow (1969), but only as an interim measure.

Globorotalia (Turborotalia) acostaensis acostaensis Blow
(Plate 11, Figure 7)

Globorotalia (Turborotalia) acostaensis acostaensis, Blow, 1959, p. 208, pl. 17, fig. 106, 107.
Stratigraphic range: Late Miocene-Pliocene, N16-N19.
Occurrence: 319-1 to 3.

Globorotalia (Turborotalia) acostaensis humerosa
Takayanagi and Saito
(Plate 11, Figure 8)

Globorotalia (Turborotalia) acostaensis humerosa Takayanagi and Saito, 1962, p. 78, pl. 28, fig. 1, 2.
Stratigraphic range: Pliocene, N19.
Occurrence: 319-1.

Globorotalia (Turborotalia) anfracta Parker
(Plate 11, Figures 9, 10)

Globorotalia (Turborotalia) anfracta Parker, 1967, p. 175, pl. 28, fig. 3-8. Brönnimann and Resig, 1969, pl. 43, fig. 2, 3, 6. (NB not Jenkins and Orr, 1972, pl. 20, fig. 4-6).
Remarks: The species identified by Jenkins and Orr (1972) as this species has a much coarser wall structure and lacks the marked apertural flap of true *G. anfracta.* See also Fleisher (1974).
Stratigraphic range: Early Miocene-Pliocene, N8-N18/19.
Occurrence: 319-2, 10, 12.

Globorotalia (Turborotalia) birnageae Blow
(Plate 11, Figures 11, 12)

Globorotalia (Turborotalia) birnageae Blow, 1959, p. 210, pl. 17, fig. 108a-c.
Stratigraphic range: Early-middle Miocene, N8/N9.
Occurrence: 319-10 to 12.

Globorotalia (Turborotalia) clemenciae Bermudez
(Plate 11, Figures 13, 14)

Globorotalia (Turborotalia) clemenciae Bermudez, 1961, p.1. 321, pl. 17, fig. 10a, b.
Stratigraphic range: Oligocene-middle Miocene, P19-N12.
Occurrence: 319-5, 8; 321-9, CC.

Globorotalia (Turborotalia) continuosa Blow
(Plate 11, Figures 15, 16)

Globorotalia (Turborotalia) continuosa Blow 1959, p. 218, pl. 19, fig. 125a-c.
Remarks: The single specimen found in 319-2-4, 59-60 cm, probably is actually part of *G. acostaensis acostaensis* if Blow (1969) is correct in stating that *G. continuosa* does not extend younger than N16 and if *G. a. acostensis* evolves from *G. continuosa.*
The specimen figured from 319-5-5, 90-92 cm has a well-developed cord-like rim to the aperture and thus perhaps should not be referred to *G. continuosa.* However, it seems to be the same form that Jenkins and Orr (1972) referred to the same species.
Stratigraphic range: Early Miocene-Pliocene, N8-N18/19.
Occurrence: 319-2, 6, 11, 12.

Globorotalia (Turborotalia) crassaformis Galloway and Wissler
(Plate 11, Figures 17, 18)

Globorotalia (Turborotalia) crassaformis Galloway and Wissler, 1927, p. 41, pl. 7, fig. 12.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globorotalia (Turborotalia) dutertrei dutertrei (d'Orbigny)
(Plate 11, Figures 19-22; Figure 5)

Globorotalia (Turborotalia) dutertrei dutertrei (d'Orbigny), 1839, p. 84 (figures, v. 8, pl. 4, fig. 19-21). Bandy et al., 1967, p. 152, pl. 14, fig. 2-12.
Remarks: Bandy et al. (1967) used this as the type species for their genus *Neogloboquadrina*. While they noted that there is no phylogenetic link with *Globoquadrina,* they unfortunately implied a relationship with the name they chose. The important point of their paper is that the species referred to *Neogloboquadrina* are derived from a globorotaline ancestor, not globigerine. Thus, although the name *Neogloboquadrina* has not won general acceptance, they showed quite convincingly that this species should not be referred to *Globigerina.* As a consequence, this species is here placed in *Globorotalia,* a usage employed by Jenkins and Orr (1972). Perhaps eventually *Neogloboquadrina* will be useful as a subgenus within *Globorotalia.*
Bandy et al. (1967) differentiated two subspecies on the basis of the presence or absence of globoquadrina teeth or apertural flaps. Their distinction is followed here.
Stratigraphic range: Pliocene-Quaternary, N19-N23.
Occurrence: 319-1; 320-1; 320A-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globorotalia (Turborotalia) dutertrei subcretacea (Lomnicki)

Remarks: This form has no teeth and is thus taken as distinct from *G. d. dutertrei* (d'Orbigny) which has well-developed teeth.
At Site 320, only *G. d. subcretacea* occurs and is always very dominantly dextrally coiled (see Figure 5).
Stratigraphic range (Nazca plate): Pleistocene (NN20/21, Blechschmidt, personal communication).

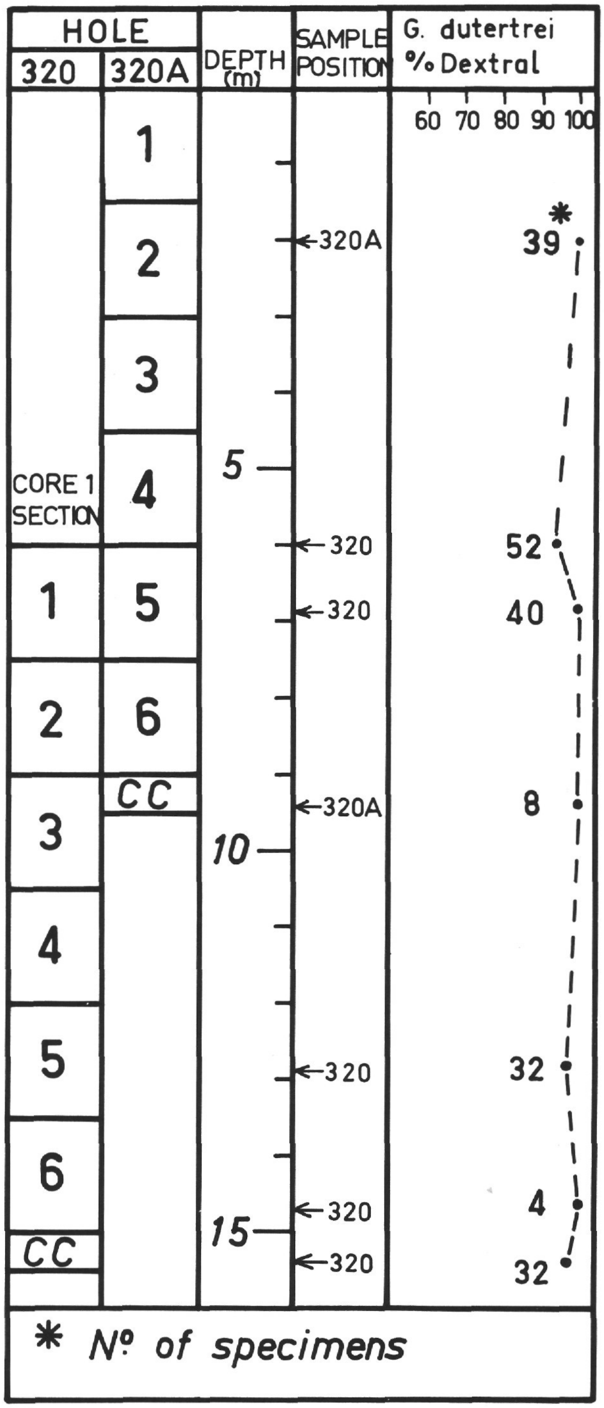

Figure 5. *Percentage of dextrally coiled* G. d. subcretacea, *Site 320.*

Globorotalia (Turborotalia) fohsi lobata Bermudez
(Plate 12, Figures 1, 2)

Globorotalia (Turborotalia) fohsi lobata Bermudez, 1949, p. 286, pl. 22, fig. 15-17.
Stratigraphic range: Middle Miocene, N10-N12.
Occurrence: 319-4 to 6.

Globorotalia (Turborotalia) fohsi peripheroacuta Blow and Banner
(Plate 12, Figures 3, 4)

Globorotalia (Turborotalia) fohsi peripheroacuta Blow and Banner, 1966, p. 294, pl. 1 fig. 2a-c; pl. 2, fig. 4, 5. Bolli, 1967, p. 502, et seq. text-fig. 2.2.
Stratigraphic range: Middle Miocene, N9-N12.
Occurrence: 319-5 to 8.

Globorotalia (Turborotalia) fohsi peripheroronda Blow and Banner
(Plate 12, Figures 5, 6)

Globorotalia (Turborotalia) fohsi peripheroronda Blow and Banner, 1966, p. 294, pl. 1, fig. 1a-c.
Remarks: There is an evolutionary feature on this species, apparently not recorded previously. At Site 319, the dorsal surface of this species is a lower trochospire in deeper cores (Core 10) than in younger. In younger samples it is a higher trochospire and thus forms a more convex surface.
Stratigraphic range: Early-middle Miocene, N6 or 8-N12-13.
Occurrence: 319-4, 10, 12; 320-2.

Globorotalia (Turborotalia) gemma Jenkins
(Plate 12, Figure 7)

Globorotalia (Turborotalia) gemma Jenkins, 1966, p. 1115-1116, fig. 11, no. 97-103.
Stratigraphic range: Late Eocene-Oligocene, P16-N2/3.
Occurrence: 320B-2; 321-7, 9 to 13.

Globorotalia (Turborotalia) globorotaloidea (Colom)
(Plate 12, Figures 8, 9)

Globorotalia (Turborotalia) globorotaloidea (Colom), 1954, p. 212, pl. 17, fig. 1-25.
Remarks: Specimen in DWBP-134, 400-402 cm could be juvenile *G. d. dutertrei* but this seems most unlikely.
Stratigraphic range: Quaternary, N22.
Occurrence: DWBP 134, 400 cm.

Globorotalia (Turborotalia) increbescens Bandy
(Plate 12, Figure 10)

Globorotalia (Turborotalia) increbescens Bandy, 1949, p. 120, pl. 23, fig. 3a-c.
Stratigraphic range: Late Eocene-Oligocene, P16-P19.
Occurrence: 321-8, 12, 13.

Globorotalia (Turborotalia) insolita Jenkins
(Plate 12, Figures 11-13)

Globorotalia (Turborotalia) insolita Jenkins, 1966, p. 1120, fig. 15, no. 113-118.
Remarks: Reworking into the middle Miocene is evident at Site 319.
Stratigraphic range: Late Eocene-middle Miocene, P16-N9.
Occurrence: 319-8 to 11; 320-3; 321-13.

Globorotalia (Turborotalia) cf. insolita
(Plate 12, Figure 13)

Remarks: The few poorly preserved specimens recovered lack the prominent apertural flap or lip of *G. insolita.*
Stratigraphic range: Lower Oligocene, P19.
Occurrence: 321-8-5.

Globorotalia (Turborotalia) kugleri Bolli
(Plate 12, Figures 15, 16)

Globorotalia (Turborotalia) kugleri Bolli, 1957, p. 118, pl. 28, fig. 5a-6.
Remarks: As with so many other species in the middle Miocene at Site 319, this species shows reworking.
Stratigraphic range: Early-middle Miocene, N4-N9.
Occurrence: 319-7 to 9; 320-3; 320B-l.

Globorotalia (Turborotalia) mayeri Cushman and Ellisor
(Plate 12, Figures 17, 18)

Globorotalia (Turborotalia) mayeri Cushman and Ellisor, 1939, p. 11, pl. 2, fig. 4a-c.
Stratigraphic range: Early-middle Miocene-N8-N13.
Occurrence: 319-4 to 11.

Globorotalia (Turborotalia) aff. mayeri
(Plate 12, Figures 19, 20)

Remarks: Differs from true *G. (T.) mayeri* in having too few chambers per whorl. It bears some similarity to *G. (T.) opima s. l.*
Stratigraphic range: Middle Miocene, N12.
Occurrence: 319-5.

Globorotalia (Turborotalia) mendacis Blow
(Plate 12, Figures 21, 22)

Globorotalia (Turborotalia) mendacis Blow, 1969, p. 390, pl. 38, fig. 5-9.
Stratigraphic range: Oligocene-early Miocene, N2-N4.
Occurrence: 320-3; 320B-1, 2.

Globorotalia (Turborotalia) minima Akers
(Plate 13, Figures 1, 2)

Globorotalia (Turborotalia) minima Akers, 1955, pl. 659, pl. 65, fig. 3a-3d.
Stratigraphic range: Early-middle Miocene, N8-N12.
Occurrence: 319-4 to 12, CC.

Globorotalia (Turborotalia) minutissima Bolli
(Plate 13, Figures 3, 4)

Globorotalia (Turborotalia) minutissima Bolli, 1957, p. 119, pl. 29, fig. la-c.
Stratigraphic range: Early-middle Miocene, N4-N13.
Occurrence: 319-4 to 12, CC; 320-2; 320B-1.

Globorotalia (Turborotalia) obesa Bolli
(Plate 13, Figures 5, 6)

Globorotalia (Turborotalia) obesa Bolli, 1957, p. 119, pl. 29, fig. 2a-3.
Stratigraphic range: Early-middle Miocene, N4-N16.
Occurrence: 319-3 to 9, 11, 12; 320-3; 320B-1; DWBP 134, 400 cm.

Globorotalia (Turborotalia) aff. obesa
(Plate 13, Figure 7)

Remarks: This form is like *G. obesa* but has a cord-like rim to the aperture. It differs from *G.* cf. *obesa* in that the rim is not developed into a flange with tooth.
Stratigraphic range: Early Miocene, N4.
Occurrence: 320-3.

Globorotalia (Turborotalia) cf. obesa
(Plate 13, Figures 8, 9)

Remarks: This form is related to *G.* sp. 4 of Jenkins and Orr (1972) but the tooth is not so well developed.
Stratigraphic range: Oligocene-middle Miocene, N2-N9.
Occurrence: 319-9 to 11; 320-3 to 6, CC; 320B-1, 2.

Globorotalia (Turborotalia) opima nana Bolli
(Plate 13, Figures 10, 11)

Globorotalia (Turborotalia) opima nana Bolli, 1957, p. 118, pl. 28, fig. 3a-c.
Remarks: As well as typical *G. (T.) o. nana*, a form is figured which has the typical coiling pattern but has a reduced ultimate chamber, more open umbilicus, and no obvious development of a strong apertural lip. In all aspects other than coiling patterns, it is very like *G. (T.) o. opima*.
Stratigraphic range: Late Eocene-early Miocene, P16-N4.
Occurrence: 320-3; 320B-1, 2; 321-9 to 13.

Globorotalia (Turbortotalia) opima opima Bolli
(Plate 13, Figures 12, 13)

Globorotalia (Turborotalia) opima opima Bolli, 1957, p. 117, pl. 28, fig. 1, 2.
Remarks: There is some doubt about this identification as there may be too many chambers per whorl for true *G. opima opima.*
Stratigraphic range: Oligocene-early Miocene, N2-N4.
Occurrence: 320B-1, 2.

Globorotalia (Turborotalia) permicra Blow and Banner
(Plate 13, Figures 14, 15)

Globorotalia (Turborotalia) permicra Blow and Banner, 1962, p. 120, pl. 12, fig. N-P.
Stratigraphic range: Oligocene, P19.
Occurrence: 321-8.

Globorotalia (Turborotalia) pseudokugleri Blow
(Plate 13, Figures 16, 17)

Globorotalia (Turborotalia) pseudokugleri Blow, 1969, p. 391, pl. 10, fig. 4-6.
Stratigraphic range: Early Miocene, N4.
Occurrence: 320-3; 320B-1

Globorotalia (Turborotalia) pumilio Parker
(Plate 13, Figures 18, 19)

Globorotalia (Turborotalia) pumilio Parker, 1962, p. 238, pl. 6, fig. 2, 3.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2-100 cm.

Globorotalia (Turborotalia) scitula gigantea Blow
(Plate 13, Figures 20, 21)

Globorotalia (Turborotalia) scitula gigantea Blow, 1959, p. 220, pl. 16, fig. 127a-c.
Stratigraphic range: Middle Miocene, N10/11.
Occurrence: 319-6, 7.

Globorotalia (Turborotalia) scitula praescitula Blow
(Plate 13, Figures 22, 23)

Globorotalia (Turborotalia) scitula praescitula Blow, 1959, p. 221, pl. 19, fig. 128a-c.
Stratigraphic range: Early-middle Miocene, N8/9.
Occurrence: 319-10, 11.

Globorotalia (Turborotalia) scitula scitula (Brady)
(Plate 14, Figures 1, 2)

Globorotalia (Turborotalia) scitula scitula (Brady), 1884, pl. 103, fig. 7a-c.
Stratigraphic range: Early Miocene-Quaternary, N8-N23.
Occurrence: 319-4 to 5; 319-10; AMPH 30P, 2-300 cm.

Globorotalia (Turborotalia) scitula n. subsp.
(Plate 14, Figures 3, 4)

Remarks: This new subspecies, which remains unnamed, has the essential apertural and coiling characters of *G. scitula s. l.* but has a looser spiral leading to the development of an open umbilicus, 5 chambers to the final whorl, and it is also dorsoventrally more compressed, although the periphery is no more angular than in other subspecies. Ventral intercameral sutures are markedly more recurred distally than is other subspecies of *G. scitula.*
Stratigraphic range: Middle Miocene, N9-N12.
Occurrence: 319-5, 8.

Globorotalia (Turborotalia) siakensis LeRoy
(Plate 14, Figures 5, 6)

Globorotalia (Turborotalia) siakensis LeRoy, 1939, p. 262, pl. 4, fig. 20-22.
Stratigraphic range: Early Miocene-Quaternary, N4-N22/23.
Occurrence: 319-4 to 12, CC; 320-2, 3; 320A-1; 320B-1, 2.

Globorotalia "sp. 2" Jenkins and Orr
(Plate 5, Figures 7, 8)

Globorotalia "sp. 2" Jenkins and Orr, 1972, pl. 19, fig. 5-7.
Remarks: The specimen recovered seems identical with what Jenkins and Orr referred to his category.
Stratigraphic range: Middle Miocene, N10/11.
Occurrence: 319-5, CC.

Globorotalia (Turborotalia) n. spp.

Two new species are described here. Remarks are made after the description of the second of the new forms.

Globorotalia (Turbototalia) akersi Quilty n. sp.
(Plate 14, Figures 9-13)

Diagnosis; Distinguished from similar species by its small, high arched aperture which extends from the periphery halfway to the umbilicus. Apertural flap small, distinct.

Description: Test small (0.12-0.20 mm), smooth, 4 to 4-1/4 chambers in the final whorl, chambers longer tangentially than radially. Dorsal surface, a low convex dome, central details obscured by overgrowth. Intercameral sutures of the final whorl broadly and shallowly depressed, the actual chamber contact well marked; quite markedly recurved distally.

Periphery lobulate; angled but not keeled. Ventral surface also a low dome. Intercameral sutures straight, radial, broadly and shallowly depressed, chamber contact distinct. Surface of first two chambers of final whorl finely pustulose, whether naturally or by overgrowth is not clear. Umbilicus shallow, broadly depressed. Aperture completely extraumbilical, a small, high arch beginning ½ to ⅔ of distance to the periphery and extending to or slightly over the periphery; furnished with a small but obvious apertural flap which is most strongly developed at the midpoint of the aperture.

Wall thin, extremely finely perforate.
Remarks: See under *G. (T.) bauerensis* n. sp.
Origin of name: In honor of Dr. W.H. Akers, a pioneer worker in the field of planktonic foraminifera.
Stratigraphic range: Middle Miocene, N12.
Occurrence: 319-4-5 to 319-5-4.

Globorotalia (Turborotalia) bauerensis Quilty n. sp.
(Plate 14, Figures 14, 15)

Diagnosis: Distinguished by the lack of an umbilicus and the presence of a narrow, slightly concave distal portion of the ventral surface of each chamber, parallel to the periphery.

Description: Test small (0.13 mm), smooth. Four chambers in the final whorl. Chambers markedly longer tangentially than radially. Dorsal surface a low convex dome, central details obscured by overgrowth. Intercameral sutures of the final whorl, broadly and shallowly depressed, chamber contact well marked; quite markedly recurved distally. Periphery lobulate; angled but not keeled. Ventral surface a low dome. Intercameral sutures a little recurved distally, broadly and shallowly depressed, chamber contact distinct. Surface of first chamber (perhaps second also) of final whorl finely pustulose but whether naturally or by overgrowth is not clear. Umbilicus absent. Aperture a low arch from the proximal part of the last chamber to the periphery; bordered by a small distinct lip best developed distally. Wall thin.

Distal part of ventral surface of all chambers slightly depressed near periphery.

Remarks: Three species must be discussed here. They are *G. (T.) anfracta* Parker, *G. akersi* n. sp., and *G. bauerensis* n. sp. They are closely related.

G. akersi and *G. bauerensis* have in common tangentially elongate chambers, markedly different from *G. anfracta. G. akersi* has the aperture completely extrambilical. *G. bauerensis* has a slight concavity parallel to the periphery on the distal edge of the ventral surface of each chamber. *G. anfracta* has a rounded periphery whereas *G. akersi* and *G. bauerensis* have angled but not keeled margins. *G. anfracta* has a wide, well-developed apertural flap. In both new forms the apertural flap is small and of varying width.

The stratigraphic distribution of these forms suggests an evolutionary sequence from *G. baurensis* (middle Miocene, N9-N12) through *G. akersi* (middle Miocene, N12) to *G. anfracta* (late Miocene-Pliocene, N18/19 in this area). This evolution involves movement in time of the aperture from the peripheral to extraumbilical position, general lessening of the angularity of the periphery and decrease in the relative tangential length of the chambers.

Origin of name: The Bauer Deep in which Site 319 was drilled.
Stratigraphic range: Middle Miocene, N9-N12.
Occurrence: 319-5, 7, 8.

Globorotalia sp. 1
(Plate 14, Figures 16, 17)

Remarks: The main characteristic of the species listed here is the ultimate chamber which is different in wall structure from the rest of the test, has a marked apertural lip and, in the figured specimen, has an unusual depression on the dorsoperipheral side. Its relationships are unknown.
Stratigraphic range: Early-middle Miocene, N8-N10.
Occurrence: 319-6 to 8, 10.

Globorotalia (Turborotalia) sp. 2
(Plate 14, Figures 18, 19)

Description: Test very small (0.20 mm), delicate. Four chambers in the final whorl. Wall structure features apparently obscured by dissolution. Dorsal surface almost plane, ventral surface convex. Ventral sutures more depressed but still only broadly and shallowly depressed; straight, radial. Chambers increase rapidly in size. Umbilicus small, quite deep. Aperture entirely extraumbilical extending from halfway to the periphery to the periphery; a low arch of uniform height, with weakly developed rim.

Remarks: No obvious relationships with other species are known. There are similarities with a specimen of *G. (T.) nkbrowni* Brönnimann and Resig, figured by them (1969, pl. 40, fig. 6).

There is no dorsal sutural supplementary aperture and the aperture of the specimen figured is entirely extraumbilical. Another possible relationship is with *Hastigerina siphonifera praesiphonifera* Blow, of which it could be a juvenile.

Stratigraphic range: Middle Miocene, N10/11.

Occurrence: 319-7-5.

Globorotalia (Turborotalia) sp. 3
(Plate 14, Figures 20-22)

Remarks: A very distinctive small species with 5 chambers in the final whorl, a high arched aperture opening over the distal ventral part of each chamber and a chamber wall with coarse, irregularly spaced blunt spinose structures. In these it is similar to *Globigerina eamesi* Blow, but differs in having 5 chambers per whorl and in having a completely extraumbilical aperture.

Stratigraphic range: Early-middle Miocene, N4-N11.

Occurrence: 319-6 to 11; 320B-1.

Globorotalia (Turborotalia) indet.

Remarks: Unidentifiable, unfigured specimens are placed here.

Subgenus GLOBOROTALIA Cushman, 1927

Globorotalia (Globorotalia) cultrata cultrata (d'Orbigny)
(Plate 15, Figures 1, 2)

Globorotalia (Globorotalia) cultrata cultrata (d'Orbigny), 1839, p. 76 (plates v. 8, pl. 5, fig. 7-9).

Stratigraphic range: Middle Miocene-Quaternary, N12-N23.

Occurrence: 319-1 to 4; 320-1; 320A-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500.

Globorotalia (Globorotalia, cultrata cf. limbata (Fornasini)
(Plate 15, Figure 5)

Globorotalia cultrata cf.*limbata* (Fornasini), 1902, p. 56, text-fig. 55.

Remarks: The identification is tentative due to the poor preservation obvious on the figured specimen.

Stratigraphic range: Pliocene, N19.

Occurrence: 319-1.

Globorotalia (Globorotalia) cultrata s.l.
(Plate 15, Figures 4, 5)

Remarks: Included here are forms not identifiable to subspecies level and may also include some *G. tumida* showing dissolution effects.

Stratigraphic range: Middle Miocene-Pliocene, N14-N19.

Occurrence: 319-1-3.

Globorotalia (Globorotalia) fimbriata (Brady)
(Plate 15, Figure 6)

Globorotalia (Globorotalia) fimbriata (Brady), 1884, p. 691, pl. 103 fig. 3.

Stratigraphic range: Quaternary, N22/23.

Occurrence: 320-1.

Globorotalia (Globorotalia) miozea miozea Finlay
(Plate 15, Figures 7, 8)

Globorotalia (Globorotalia) miozea miozea Finlay, 1939b, p. 326, pl. 29, fig. 159-161.

Remarks: Study of this species has been hampered by minor dissolution effects and carbonate overgrowths. In the latter case, it is impossible to distinguish diagenetic from biologic overgrowth. The net effect is to mark limbation by growing on the chamber walls.

Stratigraphic range: Early-middle Miocene, N8-N14.

Occurrence: 319-4 to 11-4.

Globorotalia (Globorotalia) miozea cibaoensis Bermudez
(Plate 15, Figures 9, 10)

Globorotalia (Globorotalia) miozea cibaoensis Bermudez, 1949, p. 285, pl. 22, fig. 21-23.

Stratigraphic range: Late Miocene-Pliocene, N16-N19.

Occurrence: 319-2 to 319-3.

Globorotalia (Globorotalia) miozea subsp.
(Plate 15, Figures 11, 12)

Remarks: The specimen figured comes from sediments far too old to yield *G. tumida tumida* or *G. t. flexuosa*, yet that is the assignation one would normally give to the figured specimen.

It has too many chambers (6-7) to be placed in *G. miozea s.s.*, but that species seems the most similar, extensively thickened species which is known, at this particular time.

Stratigraphic range: Middle Miocene, N9-N11.

Occurrence: 319-4, 9.

Globorotalia (Globorotalia) miozea ? cibaoensis Bermudez

Globorotalia (Globorotalia) miozea ? cibaoensis Bermudez, 1949, p. 285, pl. 22, fig. 21-23.

Remarks: The few fragments recorded here are unidentifiable suspecifically. They are not figured. By virtue of their age, they should be *G. m. cibaoensis.*

Stratigraphic range: Pliocene, N19.

Occurrence: 319-1-6 to 319-1,CC.

Globorotalia (Globorotalia) praefohsi Blow and Banner
(Plate 15, Figures 13, 14)

Globorotalia (Globorotalia) praefohsi Blow and Banner, 1960, p. 295, pl. 1, fig. 3, 4; pl. 2, fig. 6, 7, 10, 11. Bolli, 1967, p. 502 et al. fig. 2, 3.

Stratigraphic range: Early-middle Miocene, N8-N13.

Occurrence: 319-4 to 10.

Globorotalia (Globorotalia) praemenardii archeomenardii Bolli
(Plate 15, Figures 15, 16)

Globorotalia (Globorotalia) praemenardii archeomenardii Bolli, 1957, p. 119, pl. 18, fig. 7a-c.

Stratigraphic range: Early-middle Miocene, N8-N12.

Occurrence: 319-5 to 11.

Globorotalia (Globorotalia) praemenardii praemenardii Cushman and Stainforth
(Plate 15, Figures 17, 18)

Globorotalia (Globorotalia) praemenardii praemenardii Cushman and Stainforth, 1945, p. 70, pl. 13, fig. 14a-c.

Stratigraphic range: Middle Miocene, N10-N13.

Occurrence: 319-4, 5, 6.

Globorotalia (Globorotalia) truncatulinoides truncatulinoides (d'Orbigny)
(Plate 15, Figures 19, 20)

Globorotalia (Globorotalia) truncatulinoides truncatulinoides (d'Orbigny), 1839, p. 132, pl. 2, fig. 25-27.

Stratigraphic range: Quaternary, N22/23.

Occurrence: AMPH 30P, 2-300 cm; DWBP 134, 0-300 cm.

Globorotalia (Globorotalia) tumida flexuosa (Koch)
(Plate 15, Figures 21, 22)

Globorotalia (Globorotalia) tumida flexuosa (Koch), 1923, p. 357, text-fig. 9, 10.

Stratigraphic range: Pliocene, N19.

Occurrence: 319-1.

Globorotalia (Globorotalia) tumida plesiotumida Banner and Blow
(Plate 16, Figures 1, 2)

Globorotalia (Globorotalia) tumida plesiotumida Banner and Blow 1965b, p. 1353, fig. 2a-c.

Stratigraphic range: Pliocene, N18/19.

Occurrence: 319-2, 3.

Globorotalia (Globorotalia) tumida tumida (Brady)
(Plate 16, Figures 3, 4)

Globorotalia (Globorotalia) tumida tumida (Brady), 1877, p. 535 (plates Brady, 1884, p. 692, pl. 103, fig. 4-6)

Remarks: It is noteworthy that some Pleistocene specimens from the piston cores have incipient development of two keels suggesting homeomorphy with the Cretaceous Globotruncanidae. One is illustrated.

Stratigraphic range: Pliocene-Quaternary, N19-N23.
Occurrence: 319-1, 2; 320-1; 320A-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globorotalia (Globorotalia) tumida subsp.
(Plate 16, Figure 5)

Remarks: This term is used for subspecies which, due to dissolution effects, are unidentifiable in any more detail. The specimens usually occur in the younger, less calcareous part of the section.
Stratigraphic range: Quaternary, N22/23.
Occurrence: 320-1

Globorotalia (Globorotalia) ungulata Bermudez
(Plate 16, Figures 6, 7)

Globorotalia (Globorotalia) ungulata Bermudez, 1961, p. 1.304, pl. 15, fig. 6a, b.
Stratigraphic range: Quaternary, N22/23.
Occurrnce: DWBP 134, 0-400 cm.

Genus TURBOROTALITA Blow and Banner, 1962

Turborotalita cristata (Heron-Allen and Earland)
(Plate 16, Figures 8, 9)

Turborotalita cristata (Heron-Allen and Earland), 1929, p. 331, pl. 4, fig. 33-39. Banner and Blow, 1960a, p. 10, pl. 7, fig. 5a-c.
Stratigraphic range: Pleistocene-N23.
Occurrence: AMPH 30P, 2-4 cm.

Turborotalita humilis (Brady)
(Plate 16, Figures 10, 11)

Turborotalita humilis (Brady), 1884, p. 665, pl. 94, fig. 7a-c. Banner and Blow, 1960a, p. 36, pl. 8, fig. 1a-c.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Turborotalita iota (Parker)
(Plate 16, Figures 12, 13)

Turborotalita iota (Parker), 1962, p. 250, pl. 10, fig. 26-30.
Stratigraphic range: Quaternary, N22/23.
Occurrence: AMPH 30P, 200, 300 cm.

Turborotalita primitiva Brönnimann and Resig
(Plate 16, Figure 14)

Turborotalita primitiva Brönnimann and Resig, 1969, p. 1287, pl. 26, fig. 5-9.
Stratigraphic range: Oligocene, N2/3.
Occurrence: 321-7,CC.

Turborotalita quinqueloba (Natland)
(Plate 16, Figures 15, 16)

Turborotalita quinqueloba (Natland), 1938, p. 149, pl. 6, fig. 7a-c.
Stratigraphic range: Quaternary, N22/23.
Occurrence: 320A-1; AMPH 30P, 100-300 cm; DWBP 134, 0-500 cm.

Genus GLOBOROTALOIDES Bolli, 1957

Globorotaloides hexagona hexagona (Natland)
(Plate 16, Figures 17, 18)

Globorotaloides hexagona hexagona (Natland), 1938, p. 149, pl. 7, fig. 1a-c.
Stratigraphic range: Early Miocene-Quaternary, N8-N23.
Occurrence: 319-1,CC to 11-5; 320-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Globorotaloides hexagona variabilis Bolli
(Plate 16, Figures 19, 20)

Globorotaloides hexagona variabilis Bolli, 1957, p. 117, pl. 27, fig. 15-20.
Stratigraphic range: Middle Miocene, N12-N13.
Occurrence: 319-4 to 319-5.

Globorotaloides suteri Bolli
(Plate 17, Figures 1-4)

Globorotaloides suteri Bolli, 1957, p. 166, pl. 37, fig. 10-12.
Stratigraphic range: Late Eocene-middle Miocene, P16-N12.
Occurrence: 319-5, 319-12; 320-3; 320B-1, 2; 321 7,CC to 13-3.

Globorotaloides sp.
(Plate 17, Figures 5, 6)

The single specimen referred to here has much in common with *G. suteri,* of which it is probably an extreme variant. The points of departure are (1) this form has a distinctly concave dorsal surface, and (2) the ultimate chamber (bulla?) is more similar to that expected on *Turborotalita.*
Stratigraphic range: Oligocene, N2/3.
Occurrence: 320B-2,CC.

Genus HASTIGERINA Thomson, 1876

Hastigerina pelagica (d'Orbigny)
(Plate 17, Figures 7-10)

Hastigerina pelagica (d'Orbigny), 1839, p. 27, pl. 3, fig. 13, 14. Brady, 1884, p. 613, pl. 83, fig. 1-4, 6. Banner and Blow 1960b, p. 20 text-fig. 11
Stratigraphic range: Pliocene-Quaternary, N17-N23.
Occurrence: 319-2,CC, 320-1, 320A-1; AMPH 30P, 2-200 cm; DWBP 134, 0-500 cm.

?Hastigerina sp.
(Plate 17, Figures 11, 12)

Stratigraphic range: Early-middle Miocene, N8-N12.
Occurrence: 319-5,CC, 11.

Genus GLOBIGERINOPSIS Bolli, 1962

Globigerinopsis aguasayensis Bolli
(Plate 17, Figures 13-14)

Globigerinopsis aguasayensis Bolli, 1962, p. 282, pl. 1, fig. 1-7.
Stratigraphic range: Middle Miocene, N12.
Occurrence: 319-5,CC.

Genus CLAVATORELLA Blow, 1965

Clavatorella bermudezi (Bolli)
(Plate 17, Figures 15-20)

Clavatorella bermudezi (Bolli), 1957, p. 112, pl. 25, fig. 1a-c. Blow, 1965, p. 365 et seq.
Remarks: Two distinct forms occur within a population of this species and could perhaps warrant subspecies distinction if some stratigraphic or systematic value could be shown for such a move.

The more prominent form consists of specimens with markedly radially elongate chambers with inflated distal extremities. The other, less startling form, has very little radial elongation or distal inflation to its adult chambers. On the contrary, the final chamber is often much reduced, and assumes the appearance of a bulla. It is usually ventrally placed close to an umbilical-extraumbilical aperture.
Stratigraphic range: Early-middle Miocene, N8-earliest N12.
Occurrence: 319-5 to 11,CC.

Genus CLAVIGERINELLA Bolli, Loeblich, and Tappan, 1957

Clavigerinella vs. *Clavatorella* Blow: The new species described below fits into the original diagnosis of *Clavatorella* which differed from *Clavigerinella* only in being trochospiral whereas *Clavigerinella* is planispiral. Recently it has become obvious that the difference is much more significant and it is now doubtful whether any relationship exists between the two genera. Apart from the difference in coiling pattern, it is now clear that a more important differentiation is on the basis of wall structure.

Clavatorella has a coarsely perforate wall obvious on the specimens discussed above and also well illustrated in many papers.*Clavigerinella* has a much more delicate, more finely perforate wall.

The new species described below does not fit uniquely into either genus as it is trochospiral and has a finely perforate wall. It is also quite clear that the new species is a descendant of *Clavigerinella.* Several courses are open. (1) Define a new genus, (2) Emend *Clavigerinella* to include trochospiral forms and erect a new subgenus for the trochospiral forms, (3) As an interim measure, place the species in *Clavigerinella* until the nature of its radial spines is known.

The latter course is adopted here. To include the new species in *Clavigerinella,* it is necessary to tentatively allow that genus to have a group of trochospiral species.

Clavigerinella nazcaensis Quilty n. sp.
(Plate 18, Figures 1-12)

Hastigerinoides (?) sp. Jenkins and Orr, 1972, p. 1106, pl. 37, fig. 7.

Diagnosis: Distinguished from other members of the genus by the extreme radial elongation of clavate chambers which are structurally weak so that the species is most easily identified by its individual broken chambers.

Description: Test delicate, almost planispiral, ventral side of test very weakly concave. Early part of test globigerine with four chambers per whorl with umbilical or umbilical-extraumbilical, moderately low arched rimless aperture. After slightly more than one whorl, chambers start to be a little radially elongate and parallel sided, the aperture becomes entirely extraumbilical-peripheral and develops a weak to strong rim or lip. At this stage there are 4 to 5 chambers per whorl. After 2 to 3 such chambers, later chambers increase markedly in the degree of radial elongation developing a knob-like distal extremity which is of the same diameter as the proximal end. Intermediate parts of the chamber have a smaller diameter, providing a structurally weak zone for later breakage. At this stage there are 5 to 6 chambers per whorl and the aperture has shifted distally from extraumbilical-peripheral to become entirely within the anteroventral proximal part of each chamber. It seems to lie always within the thicker, proximal part of each chamber. There seems to be no lip or rim. This aperture forms the weakest part of the chamber and breakage usually occurs here. The ultimate mature chambers have a well differentiated, parallel-sided portion between the knob-like distal extremity and the expanded proximal end. This is only rarely seen on more complete specimens.

Wall structure is of finely perforate, radial calcite.

Remarks: The new species is most readily identified in samples by the common presence of broken, discrete very elongate, clavate chambers as shown in Plate 18, Figure 12 which illustrates a random selection of such chambers. I have seen no complete specimens but about 50 fragmentary specimens were separated. The marked ontogenetic development described above is very striking.

This species illustrates once again the degree of homeomorphy possible in Late Cretaceous and Tertiary planktonic foraminifera. The similarities with *Hastigerinoides* (particularly *H. alexanderi, H. watersi*), *Clavatorella*, and species of more recent genera such as *Hastigerinella* and *Hastigerina* are obvious.

Until now, it seemed that the lineage including previously described species of *Clavigerinella* died out at the end of the Eocene. This now seems not to be the case.*Clavigerinalla nazcaensis* is a direct descendant of the Eocene species. Srinivasan and Kennett (1974) have recently described *Clavatorella nicobarensis* from the Pliocene of Car Nicobar, taking it to be a direct descendant of *C. bermudezi.*It is much more probably that the species is a direct descendant of *Clavigerinella nazcaensis* n. sp. and that there is no link with *Clavatorella* at all.

More recently, Buckley (1974) has described *Clavatorella oveyi* from the Recent of the Indian Ocean. *C. oveyi* is a descendant of *C. bermudezi.*

Two lineages are now reasonably well known although many intermediate links are missing.

1) The two species of *Clavatorella* (*C. bermudezi* and *C. oveyi*) are large, robust forms with coarsely perforate walls and radially clavate chambers which are relatively short. An important consideration of this evolution is that the change over about 15 million years is not very great and the use of *C. bermudezi* as an index for N8-N11 may be suspect. In Hole 319, it occurs in the basal part of N12.

2) All species of *Clavigerinella* have radially elongate chambers with finely perforate walls. At the end of the Eocene, planispiral coiling gave way to very low trochospiral coiling. In the Eocene and Oligocene, adult chambers were distinctly clavate, but by the Pliocene, the clavate distal extremities of chambers had given way to a tapering extremity.

The evolution from *C. nicobarensis* is not known. Several possibilities should be considered. If any member of the post Eocene *Clavigerinella* lineage can be shown to have tribrachiate spines, these members of *Clavigerinella* can probably be placed in *Hastigerinella.* Another possible descendant is *Bolliella.*

The evolution of the species mentioned and some tentative suggestions are included in Figure 6.

A lesson to be learned form the evolution of *Clavigerinella* and *Clavatorella* is that, despite the enormous amount of information available on Tertiary planktonic foraminifera, there are major lineages of important species whose evolution is still virtually unknown.

The new species was recorded by Jenkins and Orr (1972) from the *C. cubensis* Zone (approximately N2) from DSDP Hole 77B, to the west-northwest of the Nazca plate.

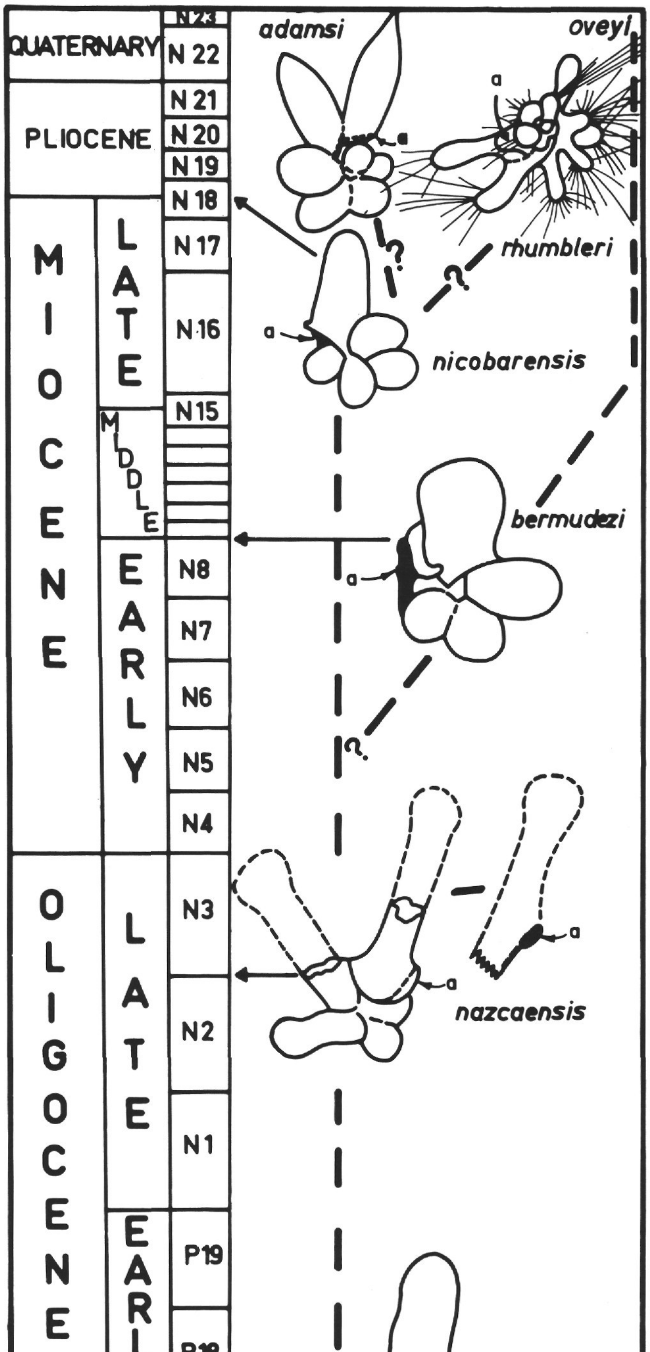

Figure 6. *Evolution of species and tentative suggestions.*

Stratigraphic range: *C. nazcaensis* is so far known from the Oligocene and early Miocene (N2-N4) of Blow (1969)

Occurrence: 320B-1, 2.

Measurements: Longest individual broken chamber 0.5 mm. Estimated maximum diameter of species 0.9 mm.

Derivation of name: The species is named for the Nazca plate, drilled by Leg 34 of the DSDP.

Genus HASTIGERINELLA Cushman, 1927.

Hastigerinella digitata (Rhumbler)
(Plate 17, Figure 21)

Hastigerinella digitata (Rhumbler), 1911, p. 202. pl. 37, fig. 9a, b.

Stratigraphic range: Pleistocene, N22.

Occurrence: DWBP 134, 500 cm.

Genus PULLENIATINA Cushman, 1927

Pulleniatina obliqueloculata obliqueloculata (Parker and Jones)
(Plate 19, Figures 1-4)

Pulleniatina obliqueloculata obliqueloculata (Parker and Jones), 1862, p. 183. Parker and Jones, 1865, p. 365, pl. 19, fig. 4a, b. Cushman, 1927, p. 90, pl. 19, fig. 5a, b.

Stratigraphic range: Quaternary, N22/23.

Occurrence: 320A-1; AMPH 30P, 2-300 cm; DWBP 134, 0-500 cm.

Genus PSEUDOHASTIGERINA Banner and Blow, 1959

Pseudohastigerina barbadoensis Blow
(Plate 19, Figure 5)

PseudohasCigerina barbadoensis Blow, 1969, p. 409, pl. 53, fig. 7-9; pl. 54, fig. 1-3.

Remarks: The continuous occurrence of this species in samples below 321-7,CC suggests that the base of Core 7 is truly the top of P19.

Stratigraphic range: Oligocene, P18-P19.

Occurrence: 321-8 to 12,CC.

Pseudohastigerina micra (Cole)
(Plate 19, Figure 6)

Pseudohastigerina micra (Cole), 1927, p. 22, pl. 5, fig. 12. Glaessner, 1937, p. 30, text-fig. 2. Banner and Blow, 1959, p. 19, pl. 3, fig. 6a, b.

Remarks: Most specimens recorded are typical but the specimens in 321-8,CC (P19) have laterally compressed chambers, overhanging the previous whorl. The specimen is virtually identical with Blow's (1969), pl. 53, fig. 4.

Stratigraphic range: Oligocene, P19.

Occurrence: 321-8 to 9,CC.

Pseudohastigerina naguewichiensis (Myatliuk)
(Plate 19, Figure 7)

Pseudohastigerina naguewichiensis (Myatliuk), 1950, p. 281, pl. 4, fig. 4a, b.

Stratigraphic range: Late Eocene, P16-17.

Occurrence: 321-13-3.

Genus HANTKENINA Cushman, 1924

Hantkenina alabamensis Cushman
(Plate 19, Figures 9, 10)

Hantkenina alabamensis Cushman, 1925b, p. 3, pl. 1, fig. 1-6; pl. 2, fig. 5.

Remarks: Both species of *Hantkenina* identified here are identified on the characters of the spines. Both species occur only in one sample. Identifications at species level are tentative only.

Stratigraphic range: Late Eocene, P16.

Occurrence: 321-13-3.

Hantkenina primitiva Cushman and Jarvis
(Plate 19, Figure 8)

Hantkenina primitiva Cushman and Jarvis, 1929, p. 16, pl. 3, fig. 2, 3.

Remarks: Some of the specimens referred to could belong to *Cribrohantkenina inflata.*

Stratigraphic range: Late Eocene, P16.

Occurrence: 321-13-3.

Genus CASSIGERINELLA Pokorny, 1955

Cassigerinella chipolensis (Cushman and Ponton)
(Plate 19, Figures 11, 12)

Cassigerinella chipolensis (Cushman and Ponton), 1932, p. 98, pl. 15, fig. 2a-c. Blow, 1959, p. 169, pl. 7, fig. 30a-c.

Stratigraphic range: Oligocene-middle Miocene, P18-N12.

Occurrence: 319-4 to 12,CC; 320-3; 320B-l, 2; 321-8 to 12,CC.

Cassigerinella sp.
(Plate 19, Figures 13, 14)

Stratigraphic range: Oligocene, P19.

Occurrence: 321-8.

Genus CHILOGUEMBELINA Loeblich and Tappan, 1956

Chiloguembelina cubensis (Palmer)
(Plate 19, Figure 15)

Chiloguembelina cubensis (Palmer), 1934, p. 74, text-fig. 1-6. Beckmann, 1957, p. 89, pl. 21, fig. 21.

Stratigraphic range: Oligocene-early Miocene, P18-N4.

Occurrence: 320-3,CC; 321-8 to 13-2.

Chiloguembelina martini(Pijpers)
(Plate 19, Figure 16)

Chiloguembelina martini (Pijpers), 1933, p. 57, fig. 6-10. Beckmann, 1957, p. 89, pl. 21, fig. 14.

Stratigraphic range: Late Eocene, P16, 17.

Occurrence: 321-13-3.

Genus STREPTOCHILUS Brönnimann and Resig

Streptochilus pristinum Brönnimann and Resig
(Plate 19, Figure 17)

Streptochilus pristinum Brönnimann and Resig, 1969, p. 1289, pl. 51, fig. 4.

Stratigraphic range: Early to middle Miocene, N8-N12.

Occurrence: 319-4 to 319-11.

Questionable planktonic (? Lepidocylina sp.)
(Plate 19, Figure 18, 19; Figure 7)

Description: The single specimen consists of a spherical proloculus 70 μ in diameter followed by a much larger reniform chamber 140μ in greatest diameter. From this second chamber originate two series of chambers, each consisting of 3 chambers. If the proloculus is taken as anterior (see Figure 7), these series of chambers begin at the posterior of the reniform chamber and coil in opposite directions towards the anterior, at the side of and slightly below the plane of the first two chambers.

The two series of chambers are symmetrical about the plane of symmetry of the first two chambers. The chambers in each coil increase only very gradually in size, the last chamber of each coil being approximately equal in size to the proloculus. Each of the last two chambers has two apertures, each with a well-defined lip. These apertures are not equatorial in position but open "dorsally" and "ventrally."

Remarks: Although chamber form, sutural characters and wall appearance are very reminiscent of planktonic species, the coiling

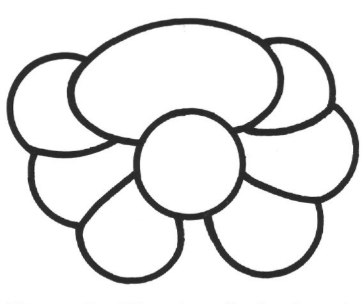

Figure 7. *Sketch of planktonic (?* Lepidocylina *sp.) showing arrangement of chambers.*

pattern and the reniform second chamber are very much more similar to the embryonic apparatus of *Lepidocyclina*.

If this form is a juvenile *Lepidocyclina*, its presence in a deep-sea sediment implies the existence of a pelagic phase in *Lepidocyclina* ontogeny and also helps to explain the fairly widespread distribution of lepidocyclines in the tropical regions of the world.

Stratigraphic range: Oligocene, P18.

Occurrence: 321-11-3.

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RANGE CHARTS—PLANKTONIC FORAMINIFERA

Note: For obvious reasons, generic names on the following range charts are abbreviated. The following convention is adopted:

Ga	-	*Globigerina*	Tu	-	*Turborotalita*
Gs	-	*Globigerinoides*	Gd	-	*Globorotaloides*
Ct	-	*Catapsydrax*	Ha	-	*Hastigerina*
Gi	-	*Globigerinita*	Go	-	*Globigerinopsis*
Gl	-	*Globigerinatella*	Cl	-	*Clavatorella*
Gp	-	*Globigerapsis*	Hl	-	*Hastigerinella*
O	-	*Orbulina*	Pu	-	*Pulleniatina*
Bi	-	*Biorbulina*	Ps	-	*Pseudohastigerina*
Cn	-	*Candeina*	Hn	-	*Hantkenina*
Sa	-	*Sphaeroidinella*	Ca	-	*Cassigerinella*
So	-	*Sphaeroidinellopsis*	Ci	-	*Chiloguembelina*
Gq	-	*Globoquadrina*	St	-	*Streptochilus*
Glt	-	*Globorotalia s.l.*			

The figures quoted in the "No. of Specimens" column refers only to the specimens of planktonic foraminifera and takes no account of benthonic species. The figures for each species are percentages that that species comprises of the total planktonic foraminiferal fauna. Percentages less than unity are shown as trace (tr). The core-catcher samples are plotted simply as occurrences as the samples were picked only for species content as a time-stratigraphic tool. This convention also applies to the piston core samples AMPH 30P and DWBP 134.

LEG 34 SITE 319 CORES 1 – 5

LITHOLOGY

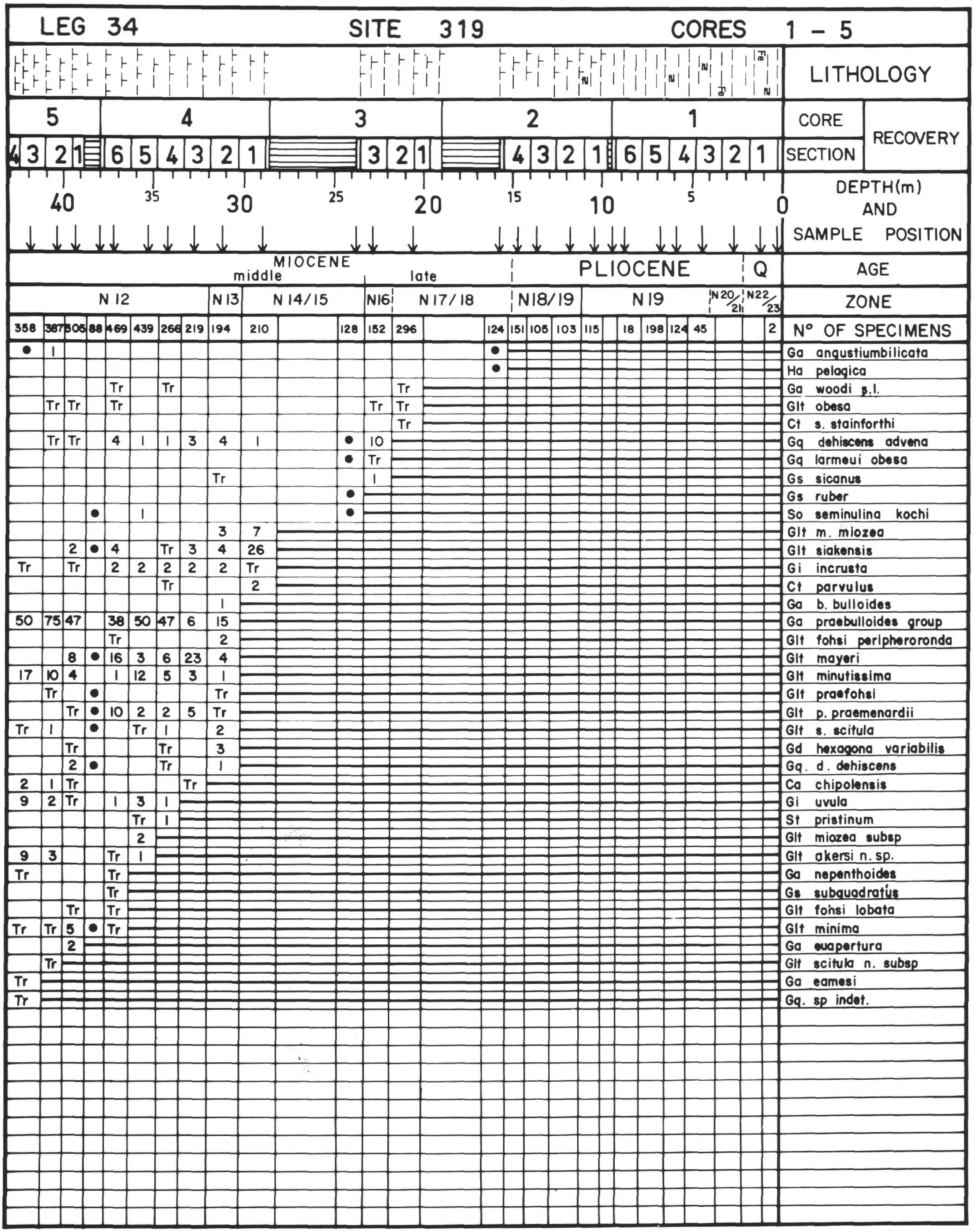
CORE: 5, 4, 3, 2, 1 — SECTION: 4 3 2 1 | 6 5 4 3 2 1 | 3 2 1 | 4 3 2 1 | 6 5 4 3 2 1 — RECOVERY

DEPTH(m) AND SAMPLE POSITION: 40, 35, 30, 25, 20, 15, 10, 5, 0

AGE: middle MIOCENE, late MIOCENE, PLIOCENE, Q

ZONE: N 12, N13, N 14/15, N16, N 17/18, N18/19, N 19, N20/21, N22/23

358	387	305	88	469	439	266	219	194	210		128	152	296		124	151	105	103	115		18	198	124	45			2	N° OF SPECIMENS
																		1	2			Tr					100	Ga sp.
				Tr?					Tr			Tr	Tr		●				8	●			2	2		B		Gs bollii
											●		1			3	8	2	7	●				2	B			Gs quad. trilobus
																								5				Glt dutertrei
																				●	26		4	5	A	A		Glt tumida subsp.
	Tr	7	●	1	1	2	2	2	2		●	9	3		●	15	8	10	12	●		10	11	7	R	R		O. u. universa
																				●			3	7		R		O. u. parkerae
				2	Tr			2	4		●	5	4		●	18	12	18	20	●		15	26	40	R	E		So s. subdehiscens
																		6		●	11		2	16				So s. paenedehiscens
	Tr	Tr	●	1	Tr	1	Tr	6	6		●	7	2		●	18	1	4	9	●	11	4	12	11	E	N		So s. seminulina
	3	11	●	5	5	5	14	7	8		●	5	13		●	18	2	37	13	●	5	19	10		N			Ga venezuelana
						2																	1					Ga foliata
					Tr															●			1					Ga r. decoraperta
					7	6	14	22	24		●	5	3		●	2	2	4	12	●	5		1					Ga n. nepenthes
											●	Tr							1		5	Tr	3					Ga sp 1
																1						Tr	1					Ga sp 2
													Tr			1			6	●		Tr	1					Gs obliquus extremus
																							1					Gs elongatus
																						14	2					Glt cultrata cf. limbata
											●				●								1					Glt cultrata s.l.
		Tr	●	Tr	Tr	1	Tr	2	Tr											●			1					O. suturalis
				1																●		1	2					Bi bilobata
													3		●	3	4	3		●		12	10					Tu quinqueloba
																							1					Gi incrusta aberrant
															●		2						2					Gs aff. bollii
				9		19	10	10	10			5					1	3		●		2						Ga picassiana
												4	Tr		●	2		2	1	●		3						Gs q. quadrilobatus
				Tr	Tr	Tr	1	Tr				7	5		●		6		1		5	1						Gs q. immaturus
															●							1						Gs o. obliquus
													Tr									Tr						Glt a. acostaensis
																				●		Tr						Glt a. humerosa
																3						2						Glt t. tumida
																				●		3						Glt t. flexuosa
					1	2						Tr								●	11	4						Glt c. cultrata
		2	●			Tr		1			●	2	Tr			1						6						Gq a. altispira
																				●	5							Glt m. ? cibaoensis
							Tr				●	2	3		●	5		1	3		5							Gs q. sacculifer
				Tr															1	●								Gd h. hexagona
																				●								Glt "sp 2"
	Tr		●	2	Tr	3														●								Gq l. larmeui
Tr		2							Tr				2		●		3	1	2	●								Gi glutinata
		6	●		7				8				Tr		●	8	3	2										Ga falconensis
												8						9										Glt m. cibaoensis
												26	52				57											Glt tumida plesiotumida
							8									1												Glt continuosa
																1												Glt anfracta


LEG 34
SITE 319
CORES 1 – 5
LITHOLOGY
CORE
RECOVERY
SECTION
DEPTH(m) AND SAMPLE POSITION
MIOCENE
middle
late
PLIOCENE
Q
AGE
N 12
N 13
N 14/15
N16
N 17/18
N18/19
N 19
N20/21
N22/23
ZONE
Nº OF SPECIMENS
Ga angustiumbilicata
Ha pelagica
Ga woodi s.l.
Glt obesa
Ct s. stainforthi
Gq dehiscens advena
Gq larmeui obesa
Gs sicanus
Gs ruber
So seminulina kochi
Glt m. miozea
Glt siakensis
Gi incrusta
Ct parvulus
Ga b. bulloides
Ga praebulloides group
Glt fohsi peripheroronda
Glt mayeri
Glt minutissima
Glt praefohsi
Glt p. praemenardii
Glt s. scitula
Gd hexagona variabilis
Gq. d. dehiscens
Ca chipolensis
Gi uvula
St pristinum
Glt miozea subsp
Glt akersi n. sp.
Ga nepenthoides
Gs subquadratus
Glt fohsi lobata
Glt minima
Ga euapertura
Glt scitula n. subsp
Ga eamesi
Gq. sp indet.

LEG 34 SITE 319 CORES 5 – 9

LITHOLOGY

CORE	9			8				7						6						5		
SECTION	3	2	1	6	5	2	1	6	5	4	3	2	1	6	5	4	3	2	1	6	5	4

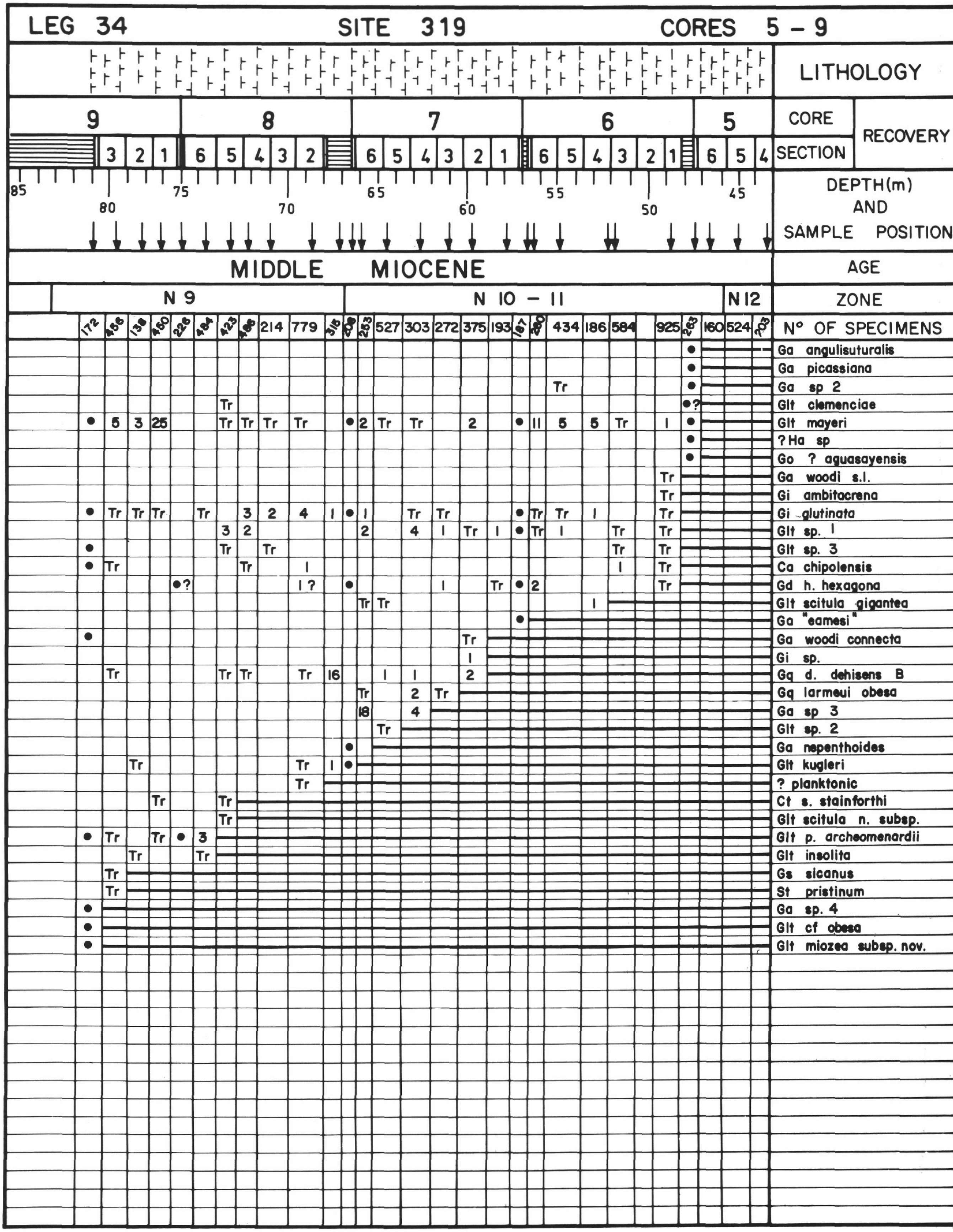
RECOVERY

DEPTH (m) AND SAMPLE POSITION: 85 80 75 70 65 60 55 50 45

AGE: MIDDLE MIOCENE

ZONE: N9 | N 10 – 11 | N12

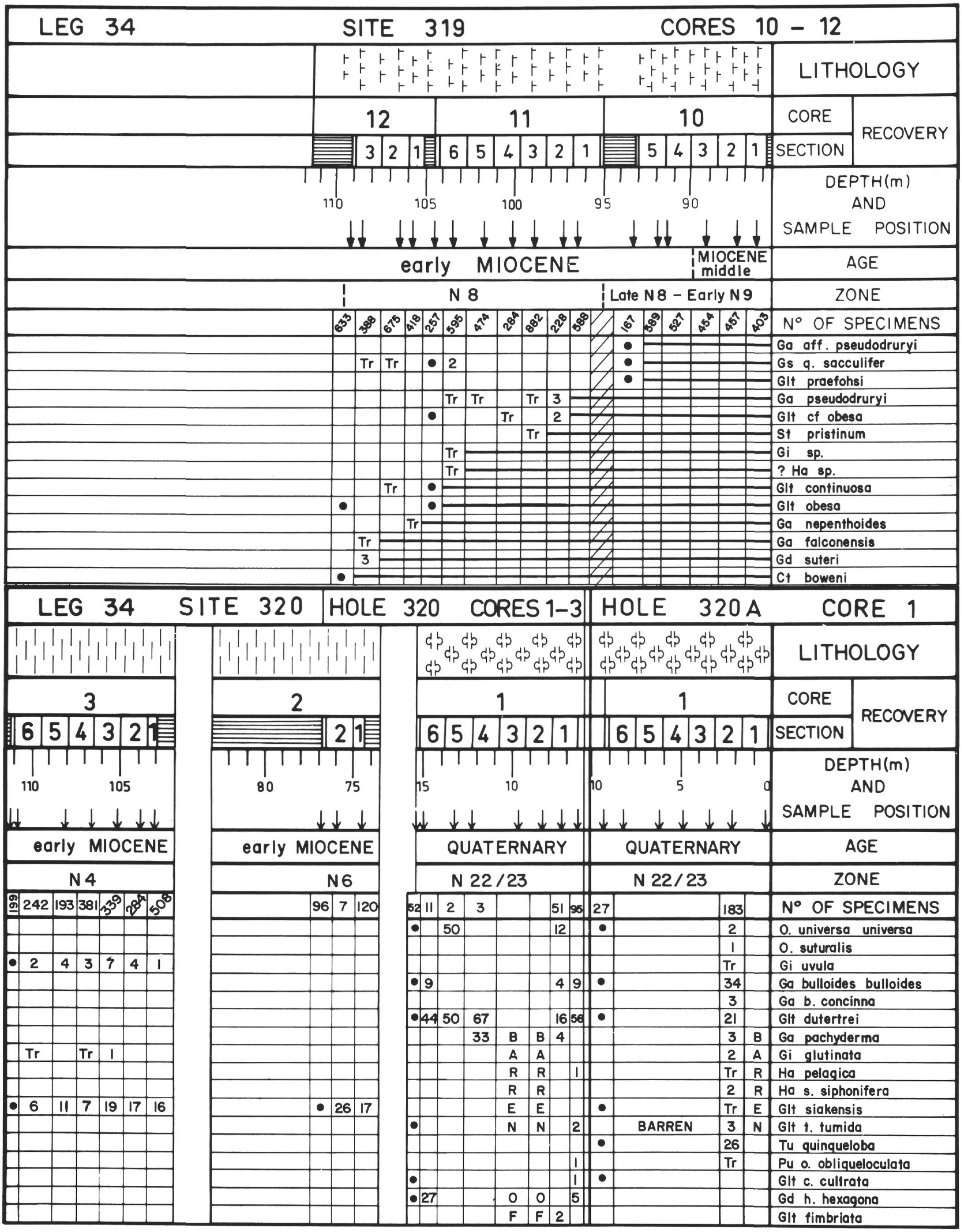
172	456	138	450	226	484	423	486	214	779	315	208	253	527	303	272	375	193	187	260	434	186	584		925	263	160	524	203	N° OF SPECIMENS
		Tr	Tr		Tr						•	Tr	Tr			Tr			5	Tr	Tr				•			Tr	Ga sp.
	Tr		Tr	•			2	2		Tr					Tr			•						Tr	•		2	2	Gi uvula
				•		Tr												•		1						Tr		Tr	Ga bulbosa
•	43	49	60	•	62	74	71	43	78	41	•	48	70	54	54	58	48	•	37	54	52	85		80	•	2	59	54	Ga praebulloides gp
•	3	3	1	•	2		2	9		7	o	Tr	2	2	5	4	13	•	5	5	8	Tr			•	9	3	15	Ga venezuelana
																												2	Ga euapertura
															Tr				1									1	Gs bollii
•							Tr	Tr	1		•						1		1	1				Tr	•	8		1	Gs q. trilobus
	21	24	5	•	Tr	3								Tr		Tr						Tr		2				1	Ct parvulus
•	1	1	1	•	3	2	2	3	1	7	•	4	2	1	1	3	2	•	Tr	1	Tr	Tr			•	6	1	2	Gq a. altispira
																												Tr	Gq a. globosa
•	1							Tr	Tr	3	•	Tr		1	5		1	•	1	2	2	Tr		Tr	•	5		2	Gq d. dehiscens ∝
		1	Tr		Tr	Tr	Tr	7	Tr		•		Tr	2	2	Tr			2		2				•	1	Tr	3	Gq d. advena
•	1	Tr	Tr	•	2		1	5	1	2	•			Tr		2	5	•		Tr	4					2	2	4	Gq l. larmeui
																						Tr					Tr	1	Glt continuosa
																		•		Tr					•	7	3	2	Glt fohsi lobata
					Tr						•	Tr		Tr		Tr			4	3		3		Tr	•		Tr	2	Glt minima
	5		4	•	5	6	8	3	9	3	•	7	12	10		3				3		5		9	•	10	Tr	1	Glt minutissima
	Tr			•	Tr								Tr			Tr	2	•	Tr	Tr	Tr	Tr			•		Tr	Tr	Glt m. miozea
	Tr	1	Tr			Tr	1	2					2		Tr									1	•	3	Tr	Tr	Glt obesa
•														3	2	3	10	•	4		3	Tr						Tr	Glt praefohsi
																				Tr		Tr				2		2	Glt p. praemenardii
																											2	2	Gd. hexagona variabilis
						Tr	Tr				•		Tr	Tr	Tr		Tr	•	Tr	Tr	1	Tr		Tr	•		Tr	1	O. suturalis
•							Tr				•	1		Tr	Tr	Tr	Tr	•	1	Tr	Tr				•	2	Tr	1	O. u. universa
•	1		Tr	•	7				2			Tr				2			2	1							2	—	Ga angustiumbilicata
													2			Tr			1	6		Tr					2	—	Ga druryi
																											Tr	—	Ga foliata
•	2	3	Tr	•	1	Tr	Tr	Tr	1	2		2	13	3	2	1	Tr	•				Tr			•		2	—	Gs q. immaturus
•										Tr					Tr					Tr	Tr	Tr			•	1	2	—	Gs q. quadrilobatus
	2	Tr	Tr			Tr	Tr		Tr		•								1	Tr					•	12	1	—	Gs subquadratus
•	Tr	Tr	Tr	•	Tr			Tr	Tr		•		Tr	Tr	1	Tr		•		Tr		Tr		Tr		Tr	3	—	Gi incrusta
•	Tr					Tr					•															1	—	—	Gl insueta
•				•	2	Tr	Tr	5	1	6	•	1	1	Tr				•	16	8	5	Tr			•	7	11	—	Glt siakensis
										Tr						Tr										3	Tr	—	Glt bauerensis n. sp.
																											5	—	Gq. aff. langhiana
																											4	—	Glt. aff. mayeri
																											Tr	—	Gd suteri
•	2	9	Tr	•	1	Tr	Tr	3		2	•	3	Tr	2	Tr	3	2	•	1	Tr	7				•	2	Tr	—	So s. seminulina
																		•								Tr	—	—	Gi glutinata
																										2	—	—	Ga cf. bulbosa
									Tr		•															2			Gs q. sacculifer
						3	5	15	Tr	9	•	6	2	4	10	8	5	•	1	Tr	1					Tr	—	—	Glt peripheroacuta
•	5		1	•	6	Tr			1		•	2	1		3		1	•	Tr	2				2	•	6	—	—	Glt peripheroronda
•	Tr			•				Tr	Tr																•	1	—	—	Cl. bermudezi
																			Tr							Tr	—	—	Bi bilobata
																	Tr	•							•	Tr	—	—	So seminulina kochi
•	Tr		Tr	•	3	2	1		2	Tr	•	Tr	Tr	2	1	Tr	1	•		Tr				1	•			—	Glt s. scitula


LEG 34
SITE 319
CORES 5 - 9
LITHOLOGY
CORE
SECTION
RECOVERY
DEPTH(m) AND SAMPLE POSITION
MIDDLE MIOCENE
AGE
N 9
N 10 - 11
N 12
ZONE
Nº OF SPECIMENS
Ga angulisuturalis
Ga picassiana
Ga sp 2
Glt clemenciae
Glt mayeri
? Ha sp
Go ? aguasayensis
Ga woodi s.l.
Gi ambitacrena
Gi glutinata
Glt sp. 1
Glt sp. 3
Ca chipolensis
Gd h. hexagona
Glt scitula gigantea
Ga "eamesi"
Ga woodi connecta
Gi sp.
Gq d. dehisens B
Gq larmeui obesa
Ga sp 3
Glt sp. 2
Ga nepenthoides
Glt kugleri
? planktonic
Ct s. stainforthi
Glt scitula n. subsp.
Glt p. archeomenardii
Glt insolita
Gs sicanus
St pristinum
Ga sp. 4
Glt cf obesa
Glt miozea subsp. nov.

LEG 34	SITE 319	CORES 10 – 12

LITHOLOGY			
CORE	12	11	10
SECTION	3 2 1	6 5 4 3 2 1	5 4 3 2 1
DEPTH (m) AND SAMPLE POSITION	110 105	100 95	90
AGE	early MIOCENE		MIOCENE middle
ZONE	N8		late N8 – early N9

633	388	675	418	251	595	474	284	882	228	588	167	889	527	454	457	403	N° OF SPECIMENS
●	Tr			●	Tr	Tr	1		Tr				Tr			Tr	Ga sp
●	12	10	13	●	17	24	10	1		7	●			3	11	7	Ga angustiumbilicata
	2				1		Tr						Tr	Tr		3	Gi uvula
				●						Tr	●				Tr	Tr	Ga bulbosa
●	39	73	50	●	49	32	14	57	52	71	●	80	79	57	46	37	Ga praebulloides gp
●	2		2	●	1	4	3	Tr	1	1	●	Tr	2	Tr	Tr	1	Ga venezuelana
●	Tr				Tr	Tr										9	Gs q. trilobus
	Tr				Tr	Tr		Tr			●				Tr	Tr	Gs sicanus
●	5		Tr		2	1				Tr	●	Tr		2	4	7	Gs subquadratus
●			Tr			Tr ?	1	Tr	2	1		Tr	Tr	Tr	2	2	Gi glutinata
																3	Ct parvulus
	1	Tr	2	●	2	3	11	Tr	1	1	●	Tr	1	4	Tr	3	Gq a. altispira
						Tr									Tr	Tr	Gq a. globosa
●	1		Tr	●	Tr		Tr	1		Tr	●				Tr	1	Gq d. advena
			Tr	●	2	1	4	Tr	Tr	Tr	●			1		1	Gq d. dehiscens α
●		Tr	Tr	●	2	2	3	Tr	Tr	Tr			Tr	1	1	Tr	Gq l. larmeui
●	5	3	Tr		4	2	Tr	6	4	3	●	10	6	6	3	2	Glt minutissima
●	8	Tr	13	●	8	9	17	3	2	Tr	●	2	3	5	7	11	Glt f. peripheroronda
						1	Tr	Tr		Tr	●		Tr	3	2	2	Glt p. archeomenardii
																Tr	Glt s. scitula
●	7	3	6	●	2	3	3	4	Tr	2	●		1	1	4	2	Glt siakensis
																2	Glt sp. 1
●	6	1	6		4	2		2		1		Tr		Tr	1	1	Ca chipolensis
				●	Tr	Tr							Tr	Tr	Tr	Tr	Cl bermudezi
●		Tr	1	●	2	Tr	Tr			Tr					Tr	1	Gl insueta
●		Tr		●	1		8	Tr	Tr		●	Tr	Tr	1	Tr	Tr	So s. seminulina
															Tr	—	Ga druryi
				●		Tr	2		2	Tr					Tr	—	Gs diminutus
●	4		Tr	●	3	3	Tr				●		Tr	4	3	—	Gs q. immaturus
●	2		Tr		Tr								Tr		Tr	—	Gs q. quadrilobatus
															Tr	—	Gi ambitacrena
●	Tr	Tr		●				Tr	Tr	Tr	●		Tr	Tr	Tr	—	Gi incrusta
															Tr	—	Ct s. stainforthi
		Tr	Tr		Tr		Tr		Tr	Tr	●		2	2	Tr	—	Gq. d. dehiscens β
●	Tr	2				Tr	Tr	Tr				Tr			Tr	—	Glt birnageae
									3						Tr	—	Glt mayeri
●	Tr	Tr		●	1	3 ?				2				Tr	2	—	Glt minima
							Tr				●		1		Tr	—	Glt m. miozea
●					2	Tr						Tr	1	2	2	—	Gq. aff. langhiana
									19	7					8	—	Glt insolita
									Tr						Tr	—	Glt sp. 3
						Tr							Tr		Tr	—	Gd hi hexagona
				●		3		Tr	Tr		●	Tr		Tr	—	—	Glt s. praescitula
●	Tr	3	3	●	7	3	Tr	19			●	4	2	—	—	—	Gl sp 1
												Tr?	—	—	—	—	Ga angulisuturalis
		Tr										Tr	—	—	—	—	Ga woodi connecta
●												Tr	—	—	—	—	Glt anfracta


LEG 34
SITE 319
CORES 10 – 12
LITHOLOGY
CORE
SECTION
RECOVERY
DEPTH(m) AND SAMPLE POSITION
early MIOCENE
MIOCENE middle
AGE
N 8
Late N8 – Early N9
ZONE
N° OF SPECIMENS
Ga aff. pseudodruryi
Gs q. sacculifer
Glt praefohsi
Ga pseudodruryi
Glt cf obesa
St pristinum
Gi sp.
? Ha sp.
Glt continuosa
Glt obesa
Ga nepenthoides
Ga falconensis
Gd suteri
Ct boweni
LEG 34 SITE 320
HOLE 320 CORES 1–3
HOLE 320A CORE 1
LITHOLOGY
CORE
SECTION
RECOVERY
DEPTH(m) AND SAMPLE POSITION
early MIOCENE
QUATERNARY
AGE
N4
N6
N 22/23
ZONE
N° OF SPECIMENS
O. universa universa
O. suturalis
Gi uvula
Ga bulloides bulloides
Ga b. concinna
Glt dutertrei
Ga pachyderma
Gi glutinata
Ha pelagica
Ha s. siphonifera
Glt siakensis
Glt t. tumida
Tu quinqueloba
Pu o. obliqueloculata
Glt c. cultrata
Gd h. hexagona
Glt fimbriata
BARREN

LEG 34 SITE 320 | HOLE 320A CORES 1–3 | HOLE 320 CORE 1

Core	3							2			1			1		
Section	6 5 4 3 2 1							2 1			6 5 4 3 2 1			6 5 4 3 2 1		
Depth (m) and sample position	110–105							80–75			15–10			10–5–0		
Age	early MIOCENE							early MIOCENE			QUATERNARY			QUATERNARY		
Zone	N 4							N8			N22/23			N22/23		
Nº OF SPECIMENS		242	193	381	339	284	508	96	7	120	52	11	51	27	183	
Gs obliquus extremus													2			
Glt tumida subsp.												9				
Ga. angulisuturalis											●					
Ga angustiumbilicata	●	9	5	7	38	4				Tr						
Ga binaiensis	●					Tr				Tr						
Ga praebulloides group	●	62	65	63	27	57	55			6						
Ga pseudodruryi							Tr			Tr						
Ga venezuelana	●	2	6	3	Tr	3	4	●	13	16						
Ga woodi s.l.										Tr						
Ct u. unicava	●	Tr		Tr	2	1	Tr			Tr						
Glt minutissima										8						
Glt fohsi peripheroronda										8						
Gq a. altispira									13	4						
Gq baroemoenensis										2						
Gq dehiscens advena									26	2						
Gq d. praedehiscens										Tr						
Gq l. larmeui										3						
Gs subquadratus										Tr						B
Gs quadrilobatus immaturus								●								
Gs q. sacculifer					Tr			●								A
So s. seminulina								●								
Ga ouachitaensis group	●	5					16									R
Ga prasaepis			1				Tr									
Ga sellii	●	Tr	1		Tr	3	2									R
Ga tripartita	●			3	3	-	3									
Ga winkleri		Tr	1	2	Tr		Tr									E
Ct d. dissimilis	●	Tr					2									
Ct d. ciperoensis	●					Tr	Tr									N
Gi incrusta	●	4	Tr	Tr	1	Tr	2									
Glt aff. obesa				Tr		Tr	Tr									
Glt insolita	●	9	1	6	12	1	9									
Gs quadrilobatus altiaperturus	●			Tr		Tr	Tr									
Glt kugleri	●	3			Tr	2										
Glt pseudokugleri	●	2		2	1	1										
Gq altispira globularis	●					Tr										
Gd suteri						2										
Glt obesa				Tr												
Gq sp. 1				Tr												
Glt mendacis			1													
Gs quadrilobatus primordius			2													
Ca chipolensis		1														
Glt opima nana		Tr														
Glt cf. obesa	●															
Ci cubensis	●															
Ct s. stainforthi	●															
Gs inusitatus	●															

LEG 34 SITE 320 HOLE 320B CORES 1,2

LITHOLOGY

CORE: 2 | 1

RECOVERY

SECTION: 6 5 4 3 2 1 | 6 5 4 3 2 1

DEPTH (m) AND SAMPLE POSITION: 155 150 145 140

AGE: late OLIGOCENE | early MIOCENE

ZONE: N2 | N2/3 | N4

597	466	480	335	404	452	357	1131	532	392	236	442	552	N° OF SPECIMENS
		Tr		2			Tr	Tr	Tr	Tr	Tr	1	Gi uvula
												Tr	Ga euapertura
									Tr		Tr	Tr	Ga sp. indet
•	63	57	67	72	70	•		14	39		43	28	Ga ouachitaensis
						•	80	20	4	57	8	14	Ga praebulloides gp.
						•			Tr			Tr	Ga prasaepis
							Tr	Tr	2	4	2	Tr	Ga venezuelana
						•	Tr					Tr	Ct riveroae
		Tr		Tr	3	•	Tr	Tr		Tr	1	Tr	Ct u. unicava
						•	Tr	Tr	Tr			Tr	Gq d. praedehiscens
							17	15	28		11	11	Glt kugleri
									10		7	10	Glt minutissima
			2	1		•					5	4	Glt cf. obesa
•												1	Glt o. opima
•	1	18		Tr		•		2	1	4	1	Tr	Glt siakensis
												Tr	Glt sp. 3
•	Tr	Tr					Tr	Tr	Tr	Tr	Tr	Tr	Ca chipolensis
•	Tr	Tr	3	3	Tr	•	2	19	3	13	14	24	Gd suteri
•							Tr		Tr		Tr		Ga sellii
								Tr	Tr		Tr		Ga winkleri
•	Tr	1	Tr	Tr	2	•				1	Tr		Ct d. dissimilis
•		Tr	Tr	Tr		•	Tr	Tr	Tr	1	Tr		Ct d. ciperoensis
				Tr					Tr	Tr	3		Gi incrusta
•		Tr	Tr	1							Tr		Ct u. primitiva
		Tr	Tr				Tr				Tr		Ct sp.
	Tr						Tr		1	Tr	1		Glt opima mana
	5	7			1				5	4			Ga angustiumbilicata
•	3	Tr	3	2	1					2			Ga galavisi
•	Tr	Tr	1	2	2					5			Ga tripartita
•	5		14	11	13					3			Glt mendacis
									Tr				Gq a. globosa
•								5	1				Glt obesa
								Tr					Ga woodi connecta
					Tr	•	Tr	Tr					Gq baroemoenensis
•							Tr	Tr					Cl nazcaensis n. sp.
							Tr						Ct s. stainforthi
						•							Glt pseudokugleri
•	17	10	8	6	5								Glt gemma
			Tr	Tr									Ga ampliapertura
				Tr									abnormal planktonic
		Tr											Ga g. gortanii
	Tr	Tr											Gi ct. glutinata
•													Ga officinalis
•													Gd sp.

LEG 34 SITE 321 CORES 5 – 9

CORE	9			8							7						6						5					
SECTION	3	2	1	6	5	4	3	2	1	6	5	4	3	2	1	6	5	4	3	2	1	6	5	4	3	2	1	

DEPTH(m) AND SAMPLE POSITION: 70, 65, 60, 55, 50, 45, 40, 35

AGE: OLIGOCENE

ZONE: P19 | N2/3

Nº. OF SPECIMENS	2	2	2	620	289	305	115	265	661	232	60	10
Ct d. dissimilis												10
Ct d. ciperoensis											●	50
Gd suteri		50		●	48	18	51	37	19	27	●	10
Ct u. unicava											●	20
Ga angustiumbilicata											●	
Ct riveroae				●	1	1					●	
Glt gemma			50	●	10	18	10	9	15	4	●	
Tu primitiva											●	
Ci cubensis				●	3	22	4	6	2	3		
Ga angiporoides							Tr			Tr		
Ga anguliofficinalis						Tr				Tr		
Ga ouachitaensis	50			●	34	68	44	43	60	60		
Ca chipolensis				●	2	2	Tr	1	Tr	1		
Ps barbadoensis				●	1	3	3	3	2	3		
Ca sp.				●					Tr	Tr		
Ga officinalis		50			Tr		Tr		Tr			
Glt permicra									Tr			
Ga senilis								Tr				
Ga sp								Tr				
Glt of insolita						Tr						
Glt increbescens				●								
Ps micra				●								
Ct u. primitiva	50		50									

LEG 34					SITE 321						CORES 9-13						
Core	13	13	13	12	12	11	11	11	11	11	10	10	10	9	9	9	9
Age	late EOCENE	late EOCENE	late EOCENE	late EOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE	OLIGOCENE
Zone	P16	P16	P16/17	P16/17	P18	P18	P18	P18	P18	P18	P18	P18	P18	P19	P19	P19	P19
N° OF SPECIMENS	58	135	2	33	568	151	164	189	160	52	101	210	44	92	353	5	20
Ga officinalis	2	10								2					Tr		5
Ct u. primitiva	5	1			•	•	2	Tr	17	23	•	53	29	•	8		20
Glt gemma				15	•	•	57	8	3	10	•	13		•	47	40	50
Glt indet.																	5
Ga chipolensis					•			Tr							3		5
Ci cubensis		2			•		1	7	2					•	25		15
Ct u. unicava														•	2	40	
Ga suteri		10	50	79	•	•	9	26	19	12	•	11				20	
Ga ampliapertura	2		50		•	•	2	2				Tr			2		
Ga angiporoides		4		3	•	•	Tr	6	4					•	2		
Ga galavisi					•										Tr		
Ga prasaepis						•	13	28	8	6	•	1		•	4		
Ga tripartita															Tr		
Ga sp 5								5					2	•	1		
Ga sp 6							2						16	•	2		
Ga sp 7															Tr		
Glt opima nana		Tr			•	•			9	2	•	4	16	•	Tr		
Ps barbadoensis					•				2						1		
Ps micra															Tr		
Ga cf brevis															Tr		
Ga praebulloides		Tr												•			
Ga sellii						•*	4*	4*			•*	Tr*		•			
Glt clemenciae														•			
Ga angustiumbilicata						•		4	35	40			4				
Ga senilis								1					2				
Ga euaperture													2				
Gp index	33	20						1					4				
Ct m. martini					•	•	2					4	6				
Ct pera		8					Tr			2		Tr	2				
Ga ouachitaensis s.l.	2				•							10					
Ga sp 8					•												
Ct d. dissimilis					•					2	•						
Ga sp.		Tr									•						
Ga utilisindex									Tr								
Ga winkleri							7	3									
unusual planktonic								Tr									
Ga (?) winkleri								Tr									
Ct aff howei							Tr										
Ga g. gortanii						•											
Ga cf ampliapertura					•												
Ct m. scandretti					•												
Ct sp.				3													
Ga linaperta		Tr															
Gp mexicana	12	14															
Glt insolita	12	3															
Ps naguewichiensis	2	1															
Ci martini		2															
Hn alabamensis	31	15															
Hn primitiva																	
Gp. sp		2															
Glt increbescens		1															

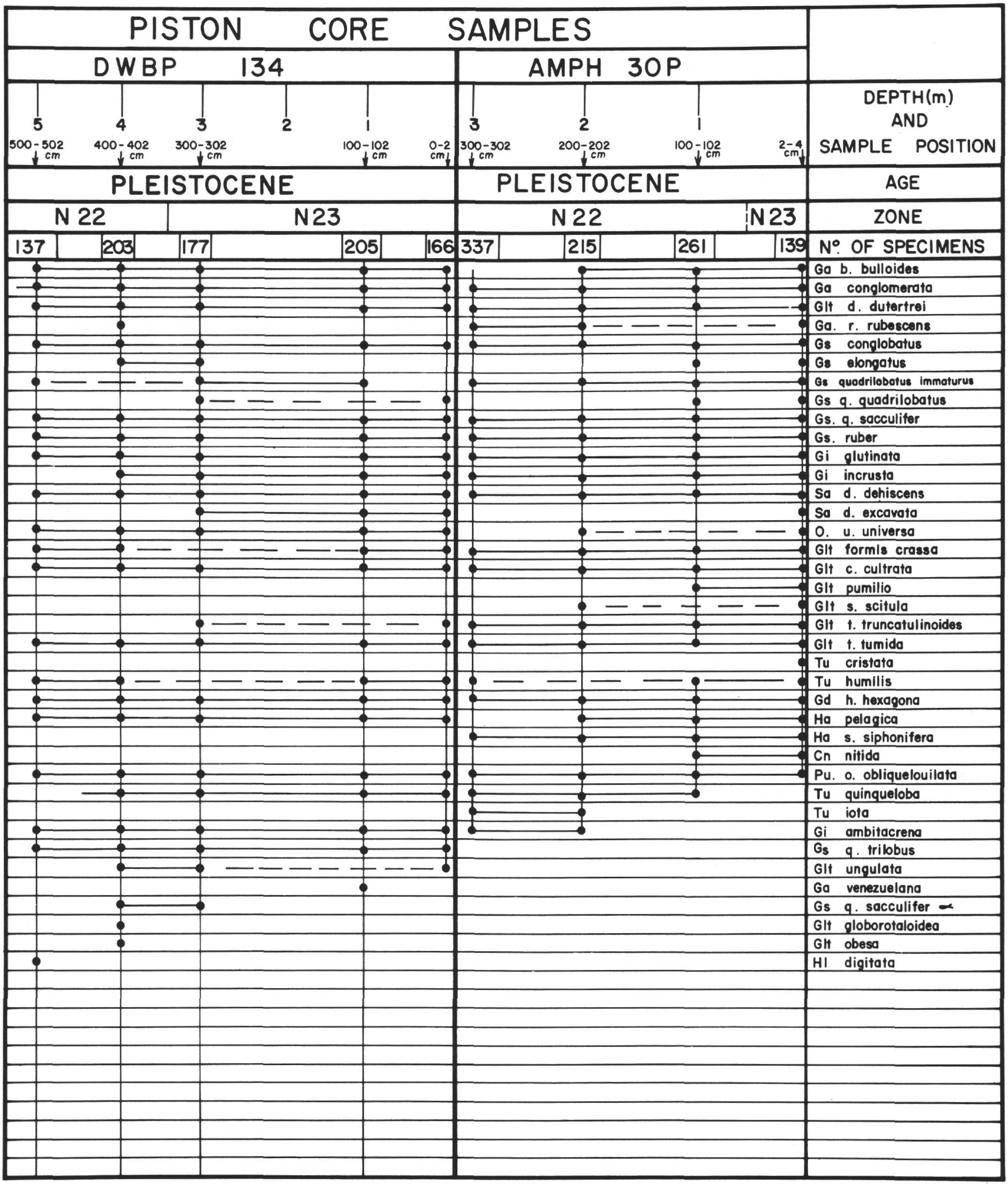

PISTON CORE SAMPLES
DWBP 134
AMPH 30P
5
4
3
2
1
500 - 502 cm
400 - 402 cm
300 - 302 cm
100 - 102 cm
0-2 cm
3
2
1
300 - 302 cm
200 - 202 cm
100 - 102 cm
2-4 cm
DEPTH(m) AND SAMPLE POSITION
PLEISTOCENE
PLEISTOCENE
AGE
N 22
N23
N 22
N 23
ZONE
137
203
177
205
166
337
215
261
139
Nº. OF SPECIMENS
Ga b. bulloides
Ga conglomerata
Glt d. dutertrei
Ga. r. rubescens
Gs conglobatus
Gs elongatus
Gs quadrilobatus immaturus
Gs q. quadrilobatus
Gs. q. sacculifer
Gs. ruber
Gi glutinata
Gi incrusta
Sa d. dehiscens
Sa d. excavata
O. u. universa
Glt formis crassa
Glt c. cultrata
Glt pumilio
Glt s. scitula
Glt t. truncatulinoides
Glt t. tumida
Tu cristata
Tu humilis
Gd h. hexagona
Ha pelagica
Ha s. siphonifera
Cn nitida
Pu. o. obliqueloullata
Tu quinqueloba
Tu iota
Gi ambitacrena
Gs q. trilobus
Glt ungulata
Ga venezuelana
Gs q. sacculifer
Glt globorotaloidea
Glt obesa
Hl digitata

PLATE 1

The abbreviation UWAGD refers to the collections of the Geology Department, University of Western Australia, where all specimens figured here, are held.

Figures 1, 2	*Globigerina ampliapertura* Bolli; UWAGD 74222; ×70; 321-11-3, 60-62 cm.
Figures 3, 4	*G.* cf. *ampliapertura;* UWAGD 74223; ×75; 321-12, CC.
Figures 5, 6	*G. angiporoides* Hornibrook; UWAGD 74224; ×150; 321-9-6, 55-57 cm.
Figures 7, 8	*G. anguliofficinalis* Blow; UWAGD 74225; ×200; 321-8-5, 51-53 cm.
Figures 9, 10	*G. angulisuturalis* Bolli; UWAGD 74226; ×100; 319-5, CC. Reworked.
Figures 11	*G. angulisuturalis;* UWAGD 74227; ×250; 320-1, CC.
Figures 12, 13	*G. angustiumbilicata* Bolli; UWAGD 74229; ×160; 321-8-5, 51-53 cm.
Figures 14, 15	*G. angustiumbilicata;* UWAGD 74228; ×115; 320A-1-2, 51-53 cm.
Figures 16, 17	*G. binaiensis* Koch; UWAGD 74230; ×80, 320-3, CC.
Figures 18, 19	*G.* cf. *brevis* Jenkins; UWAGD 74231; ×130; 321-9-6, 55-57 cm.
Figures 20, 21	*G. bulbosa* LeRoy; UWAGD 74232; ×110; 319-10-1, 92-94 cm.

PLATE 1

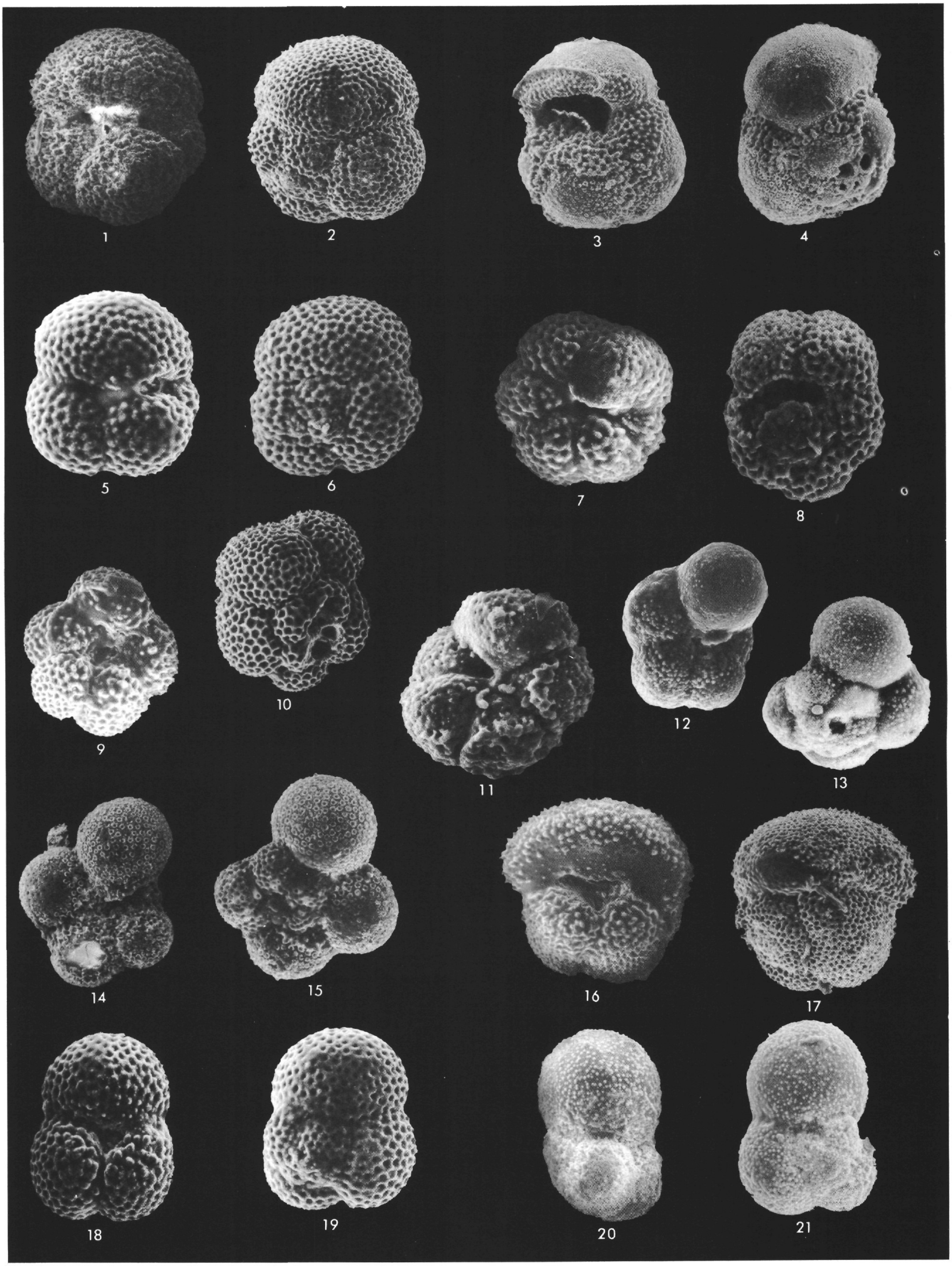


PLATE 2

Figures 1, 2	*G.* cf. *bulbosa*; UWAGD 74233; ×60; 319-5-6, 90-92 cm.
Figures 3, 4	*G. bulloides bulloides* d'Orbigny; UWAGD 74234; ×90; 320-1-0.
Figures 5, 6	*G. b. concinna* Reuss; UWAGD 74235; ×70; 320-1-0.
Figures 7, 8	*G. conglomerata* Schwager; UWAGD 74236; ×40; AMPH 30P, 100-102 cm.
Figures 9, 10	*G. druryi* Akers; UWAGD 74237; ×220; 319-5-5, 90-92 cm.
Figures 11, 12	*G. eamesi* Blow; UWAGD 74238; ×220; 319-5-2, 90-92 cm.
Figures 13, 14	*G. "eamesi"*; UWAGD 74239; ×700; 319-6, CC.
Figures 15, 16	*G. euapertura* Jenkins; ×85; 321-10-2, 60-62 cm. Specimen since lost.
Figures 17, 18	*G. falconensis* Blow; UWAGD 74240; ×110; 319-2-4, 59-61 cm.
Figures 19, 20	*G. foliata* Bolli, UWAGD 74241; ×130; 319-1-4, 100-102 cm.
Figures 21, 22	*G. galavisi* Bermudez; UWAGD 74242; ×105; 321-9-6, 55-57 cm

PLATE 2

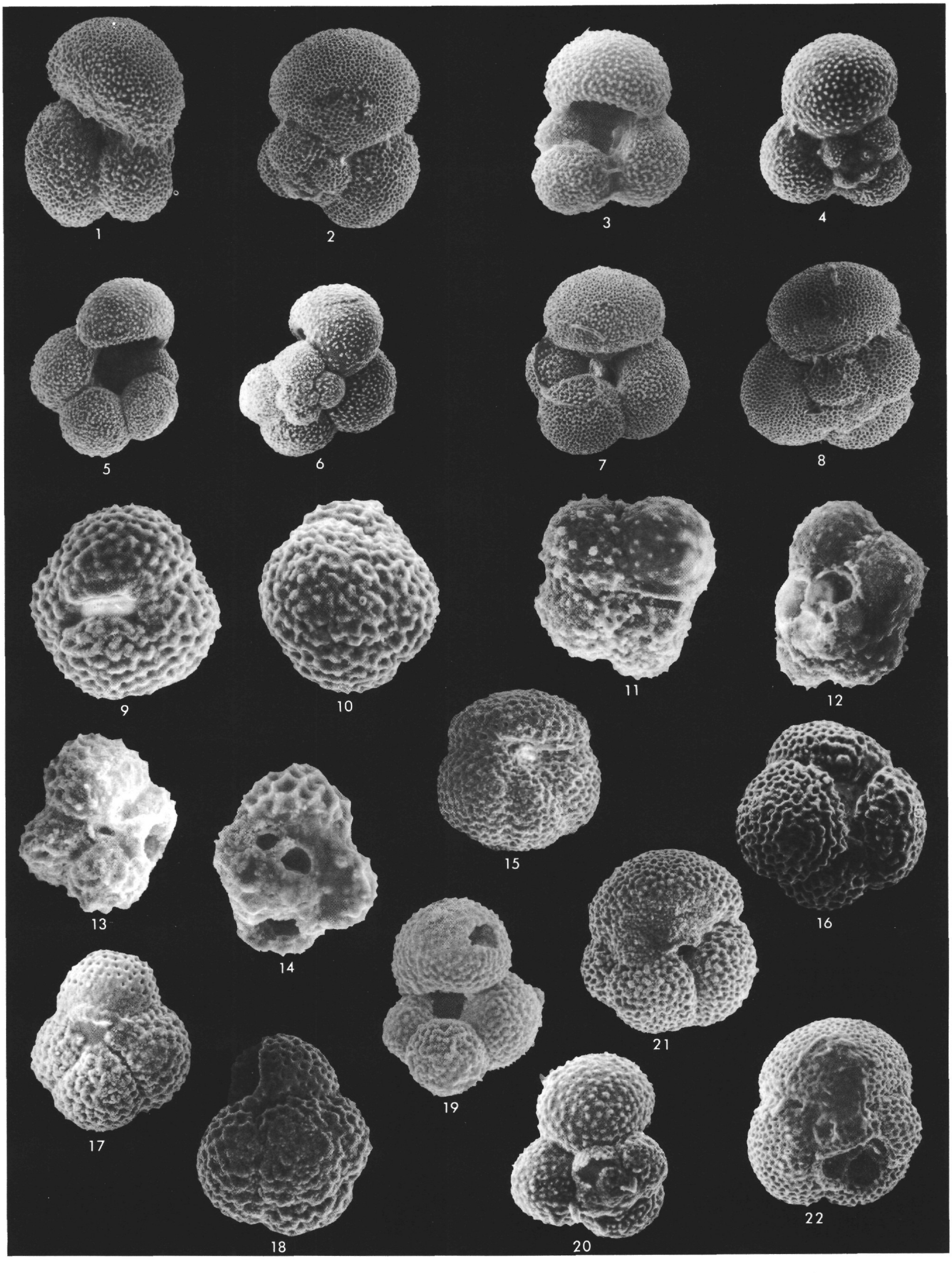


PLATE 3

Figures 1, 2	*Globigerina gortanii gortanii* (Borsetti); UWAGD 74243; ×165; 320B-2-4, 30-32 cm.
Figure 3	*G. nepenthes nepenthes* Todd; UWAGD 74244; ×80; 319-1, CC.
Figures 4, 5	*G. n. nepenthes*; UWAGD 74245, ×120; 319-4-2, 83-85 cm.
Figures 6, 7	*G. nepenthoides* Brönniman and Resig, UWAGD 74246; ×200; 319-7, CC.
Figures 8, 9	*G. officinalis* Subbotina; UWAGD 74247; ×150; 321-11-1, 80-82 cm.
Figure 10	*G. ouachitaensis* group; UWAGD 74248; ×220; 321-8, CC.
Figures 11, 12	*G. pachyderma* (Ehrenberg); UWAGD 74249; ×90; 320-1-1, 84-86 cm.
Figures 13, 14	*G. picassiana* Perconig; UWAGD 74250; ×120; 319-1-5, 42-44 cm.
Figure 15	*G. praebulloides* group; UWAGD 74251; ×240; 319-11-1, 121-124 cm.
Figure 16	*G. praebulloides* group; UWAGD 74252; ×240; 319-4-2, 83-85 cm.
Figures 17, 18	*G. prasaepis* Blow; UWAGD 74253; ×70; 321-9-6, 55-57 cm.
Figures 19, 20	*G. pseudodruryi* Brönnimann and Resig; UWAGD 74254; ×120; 320-3-1, 105-107 cm.
Figures 21, 22	*G.* aff. *pseudodruryi;* UWAGD 74255; ×90; 319-10, CC.

PLATE 3

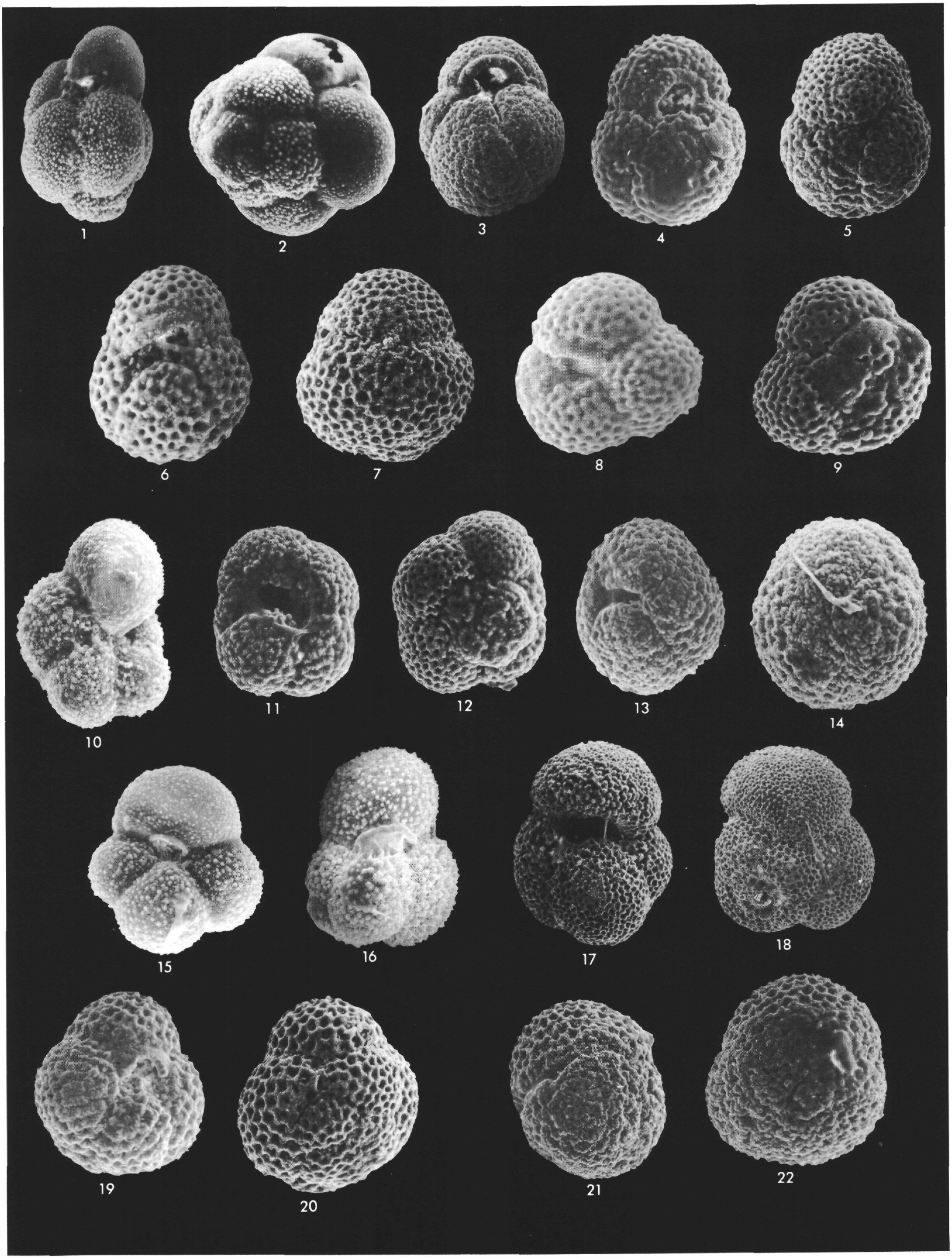


PLATE 4

Figures 1, 2	*Globigerina rubescens decoraperta* Takayanagi and Saito; UWAGD 74256; ×95; 319-4-5, 42-44 cm.
Figures 3, 4	*G. r. rubescens* Hofker; UWAGD 74257; ×200; AMPH 30P, 300-302 cm.
Figures 5, 6	*G. sellii* (Borsetti); UWAGD 74258, ×70; 321-9, CC.
Figures 7, 8	*G. senilis* Bandy; UWAGD 74259; ×95; 321-11-3, 60-62 cm.
Figures 9, 10	*G. tripartita* Koch; UWAGD 74260; ×60; 320-3, CC.
Figures 11, 12	*G. utilisindex* Jenkins and Orr; UWAGD 74261; ×80; 321-11-2, 62-64 cm.
Figures 13, 14	*G. venezuelana* Hedberg; UWAGD 74262; ×50; 319-1-4, 100-102 cm.
Figures 15, 16	*G. winkleri* Bermudez; UWAGD 74263; ×70; 320-3-1, 105-107 cm.
Figures 17, 18	*G.* (?) *winkleri;* UWAGD 74264; ×35; 321-11-4, 68-70 cm.
Figure 19	*G. woodi connecta* Jenkins; UWAGD 74265; ×200; 319-7-2, 104-106 cm.
Figures 20, 21	*G. woodi s.l.;* UWAGD 74266; ×140; 319-3-2, 3-5 cm.

PLATE 4

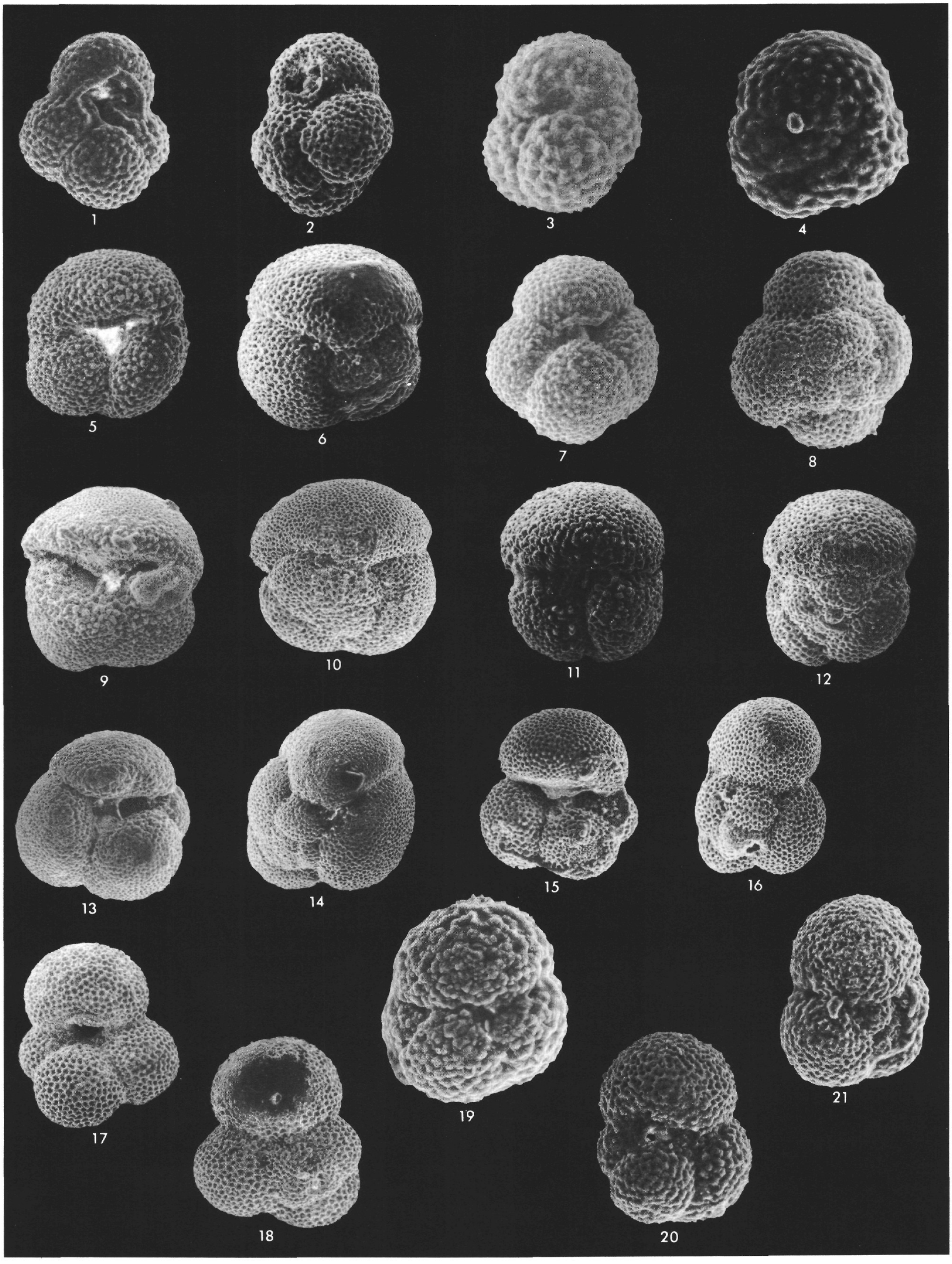


PLATE 5

Figures 1, 2	*Globigerina* sp. 1; UWAGD 74267; ×70; 319-1-4, 100-102 cm.
Figures 3, 4	*G.* sp. 2; UWAGD 74268, ×55; 319-1-4, 100-102 cm.
Figures 5, 6	*G.* sp. 3; UWAGD 74269; ×230; 319-7-4, 85-87 cm.
Figures 7, 8	*G.* sp. 4; UWAGD 74270; ×45; 319-9, CC.
Figures 9, 10	*G.* sp. 5; UWAGD 74271; ×200; 321-9-6, 55-57 cm.
Figures 11, 12	*G.* sp. 6; UWAGD 74272; ×190; 321-9-6, 55-57 cm.
Figures 13, 14	*G.* sp. 7; UWAGD 74273, ×110; 321-9-6, 55-57 cm.
Figures 15, 16	*G.* sp. 8; UWAGD 74274; ×180; 321-12, CC.
Figures 17, 18	*Globigerinoides bollii* Blow; UWAGD 74275; ×150; 319-2-1, 100-102 cm.
Figures 19, 20	*G.* aff. *bollii*; UWAGD 74276; ×165; 319-1-4, 100-102 cm.
Figure 21	Higher magnification of part of Figure 20, ×600.

PLATE 5

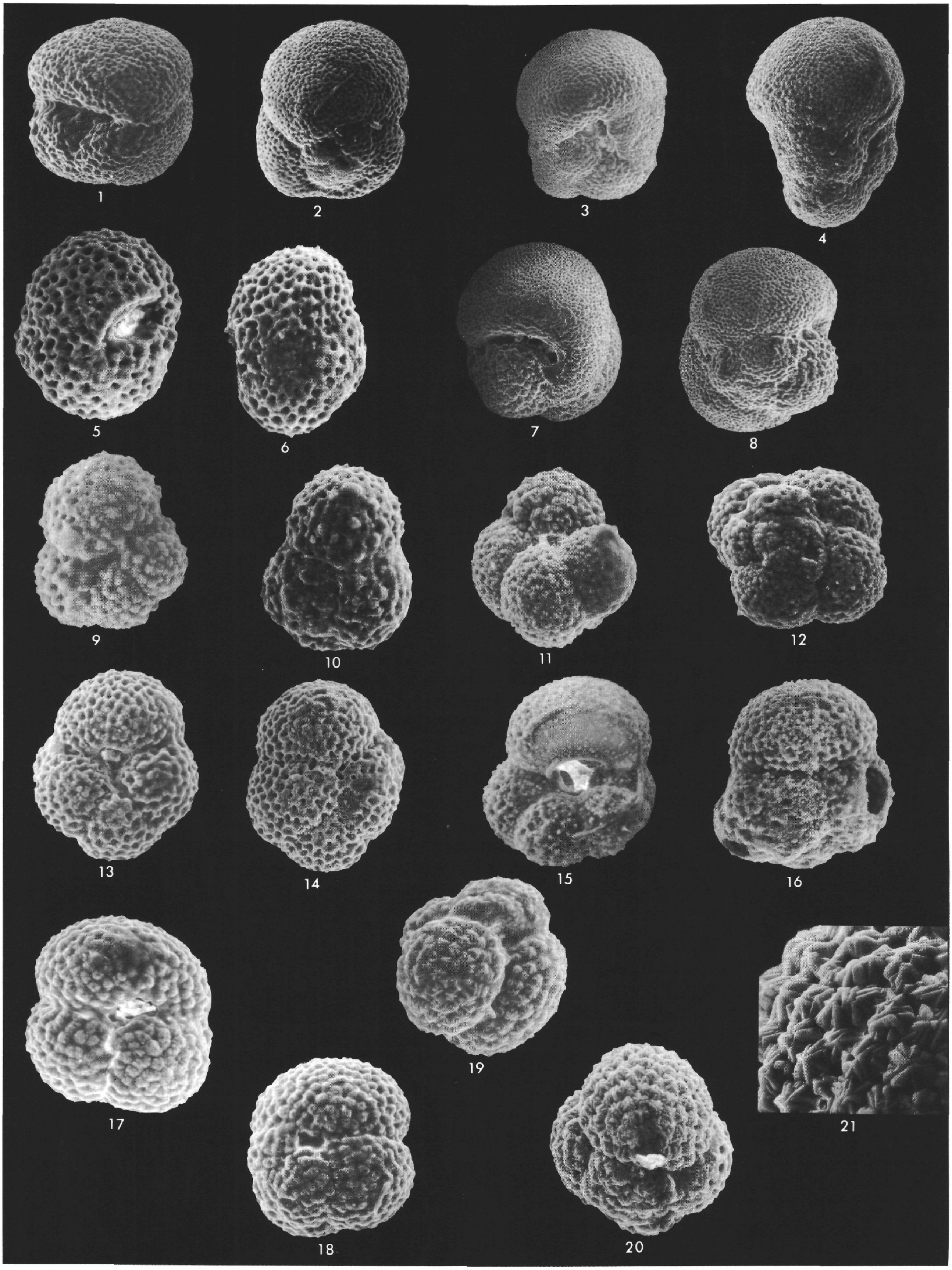


PLATE 6

Figures 1, 2	*Globigerinoides conglobatus* (Brady); UWAGD 74277; ×70; AMPH 30P, 100-102 cm.
Figure 3	*G. diminutus* Bolli; UWAGD 74278; ×150; 319-10-2, 41-43 cm.
Figures 4, 5	*G. elongatus* (d'Orbigny); UWAGD 74279; ×80; DWBP 134, 300-302 cm.
Figures 6, 7	*G. inusitatus* Jenkins; UWAGD 74280; ×90; 320-3, CC.
Figures 8, 9	*G. obliquus extremus* Bolli and Bermudez; UWAGD 74281; ×80; 319-2-1, 100-102 cm.
Figure 10	*G. o. obliquus* Bolli; UWAGD 74282; ×270; 319-2, CC.
Figures 11, 12	*G. quadrilobatus altiaperturus* Bolli; UWAGD 74283; ×80; 320-3, CC.
Figures 13, 14	*G. q. immaturus* LeRoy; UWAGD 74284; ×130, 319-4-6, 100-102 cm.
Figures 15, 16	*G. q. primordius* Blow and Banner; UWAGD 74285; ×110; 320-3-5, 14-16 cm.
Figures 17, 18	*G. q. quadrilobatus* (d'Orbigny); UWAGD 74286; ×60; 319-5, CC.
Figure 19	*G. q. sacculifer* (Brady); UWAGD 74287; ×40; DWBP 134, 500-502 cm.
Figure 20	*G. q. sacculifer;* UWAGD 74288; ×130, 319-5-6, 90-92 cm.
Figure 21	*G. q. sacculifer* form α Blow; UWAGD 74289; ×60; DWBP 134, 300-302 cm.
Figures 22, 23	*G. q. trilobus* (Reuss); UWAGD 74290; ×80; DWBP 134, 400-402 cm.

PLATE 6

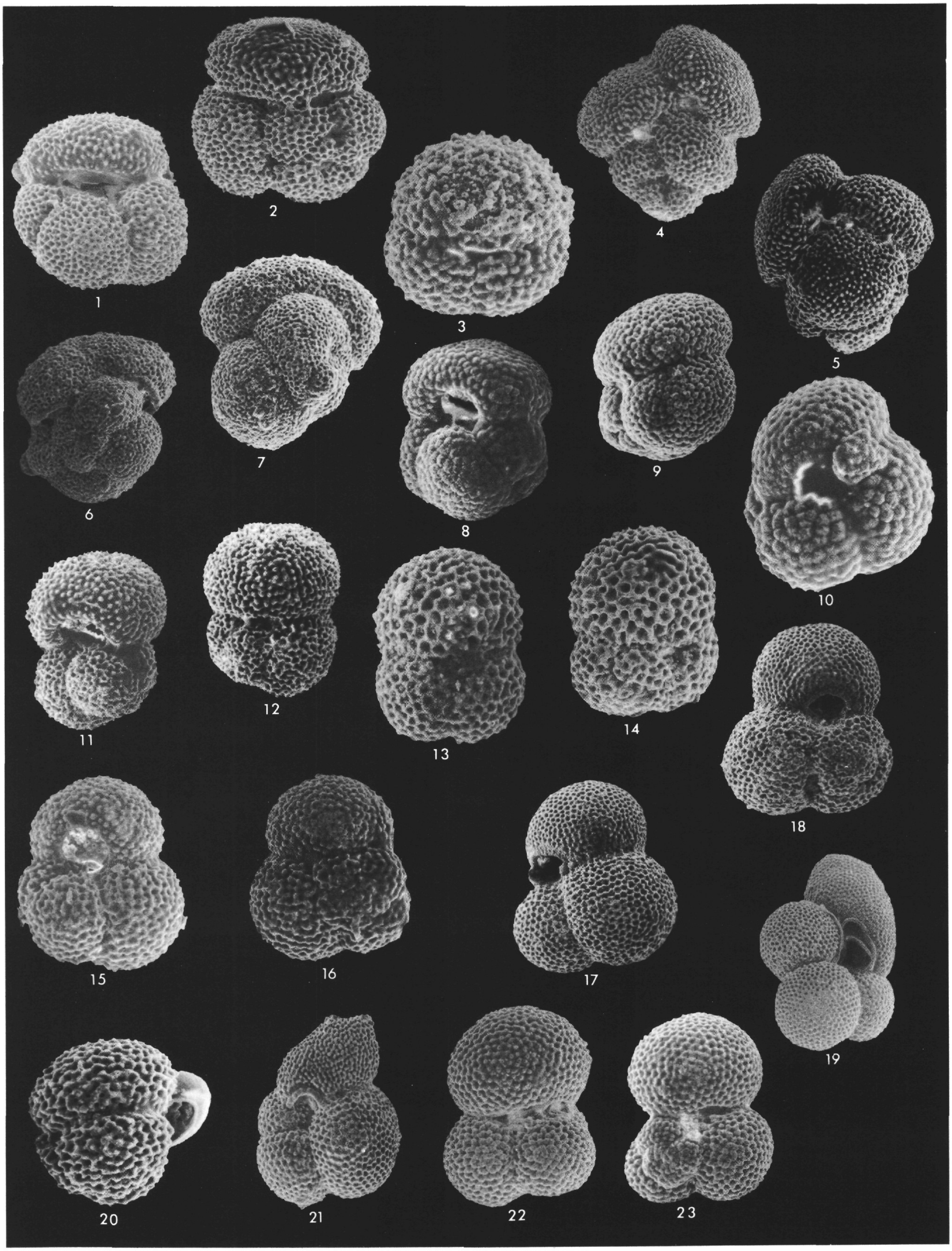


PLATE 7

Figures 1, 2	*Globigerinoides ruber* (d'Orbigny); UWAGD 74291; ×90; AMPH 30P, 100-102 cm.
Figure 3	*G. sicanus* de Stefani; UWAGD 74292; ×200; 319-9-3, 48-50 cm.
Figures 4, 5	*G. sicanus*; UWAGD 74293; ×90; 319-3-3, 83-85 cm.
Figure 6	*G. subquadratus* Brönnimann; UWAGD 74294; ×120; 319-7 CC.
Figures 7, 8	*G. subquadratus;* UWAGD 74295; ×150; 319-12-3, 100-102 cm.
Figures 9, 10	*Catapsydrax boweni* (Brönnimann and Resig); UWAGD 74296; ×80; 319-12, CC.
Figure 11	*C. dissimilis ciperoensis* (Blow and Banner); UWAGD 74297; ×65; 320-3-1, 105-107 cm.
Figures 12, 13	*C. d. dissimilis* (Cushman and Bermudez); UWAGD 74298; ×70; 320-3-1, 105-107 cm.
Figures 14, 15	*C.* aff. *howei* (Blow and Banner); UWAGD 74299; ×80; 321-11-4, 68-70 cm.
Figures 16, 17	*C. martini martini* (Blow and Banner); UWAGD 74300; ×140; 321-10-3, 60-62 cm.
Figure 18	*C. parvulus* Bolli, Loeblich, and Tappan; UWAGD 74301; ×200; 319-6-1, 115-117 cm.
Figure 19	*C. parvulus*; UWAGD 74301; ×200; 319-6-1, 115-117 cm.
Figures 20, 21	*C. pera* (Todd); UWAGD 74302; ×100; 321-10-3, 60-62 cm.
Figure 22	*C. stainforthi stainforthi* Bolli, Loeblich, and Tappan; UWAGD 74303; ×130; 319-8-5, 60-62 cm.
Figure 23	*C. s. stainforthi*; UWAGD 74304; ×100; 319-3-2, 3-5 cm.

PLATE 7

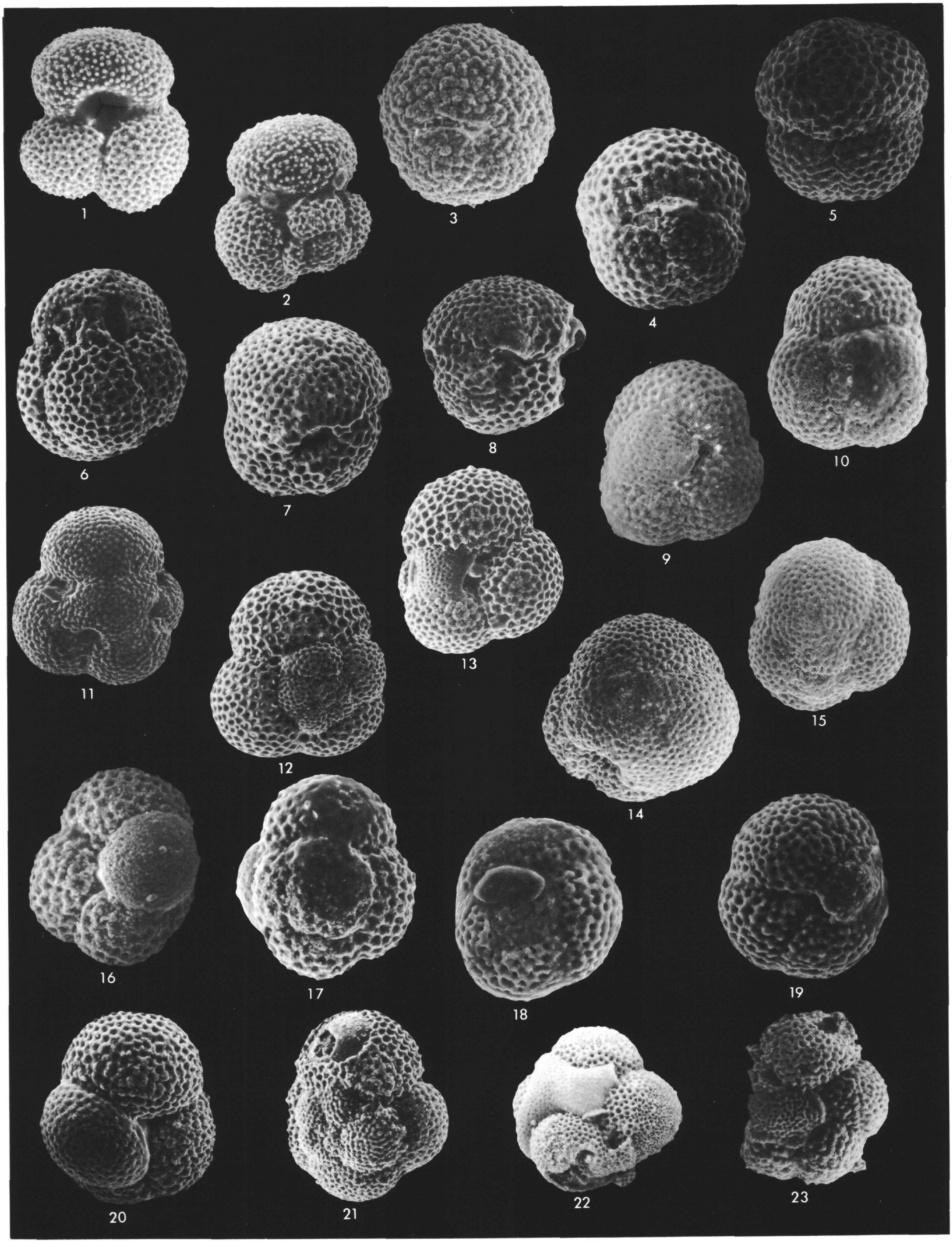


PLATE 8

Figure 1	*Catapsydrax unicava primitiva* (Blow and Banner); ×100; specimen since lost.
Figures 2, 3	*C. u. unicava* Bolli, Loeblich, and Tappan; UWAGD 74305; ×80, 321-9-6, 55-57 cm.
Figure 4	*G. ambitacrena* Loeblich and Tappan; UWAGD 74306; ×110; 319-6-1, 115-117 cm.
Figure 5	*G. ambitacrena*: UWAGD 74307; ×140; 320A-1-2, 51-53 cm.
Figure 6	*G. glutinata* (Egger); UWAGD 74308; ×130; 319-5-6, 90-92 cm.
Figure 7	*G. glutinata;* UWAGD 74309; ×170; 319-12, CC.
Figure 8	*G. glutinata;* UWAGD 74310; ×120; 319-11-1, 122-124 cm.
Figure 9	*G. glutinata;* UWAGD 74311, ×150; 319-10-4, 125-127 cm.
Figures 10, 11	*G. glutinata;* UWAGD 74312; ×120; DWBP 134, 300-302 cm.
Figures 12, 13	*G.* cf. *glutinata;* UWAGD 74313; ×100; 320B-2-4, 30-32 cm.
Figure 14	*G. incrusta* Akers; UWAGD 74314; ×200; 319-8, CC.
Figures 15, 16	*G. incrusta;* UWAGD 74315; ×210; 319-7-2, 104-106 cm.
Figure 17	*G. riveroae* Bermudez; UWAGD 74316, ×200; 321-7, CC.
Figure 18	*G. uvula* (Ehrenberg); UWAGD 74317; ×220; 319-9-3, 48-50 cm.
Figure 19	*G.* sp. 1; UWAGD 74318; ×220; 319-8-1, 61-63 cm.
Figures 20, 21	*G.* sp. 1; UWAGD 74318; ×200; 319-8-1, 61-63 cm.
Figure 22	*Globigerinatella insueta* Cushman and Stainforth, UWAGD 74319; ×100; 319-11-4, 33-35 cm.

PLATE 8

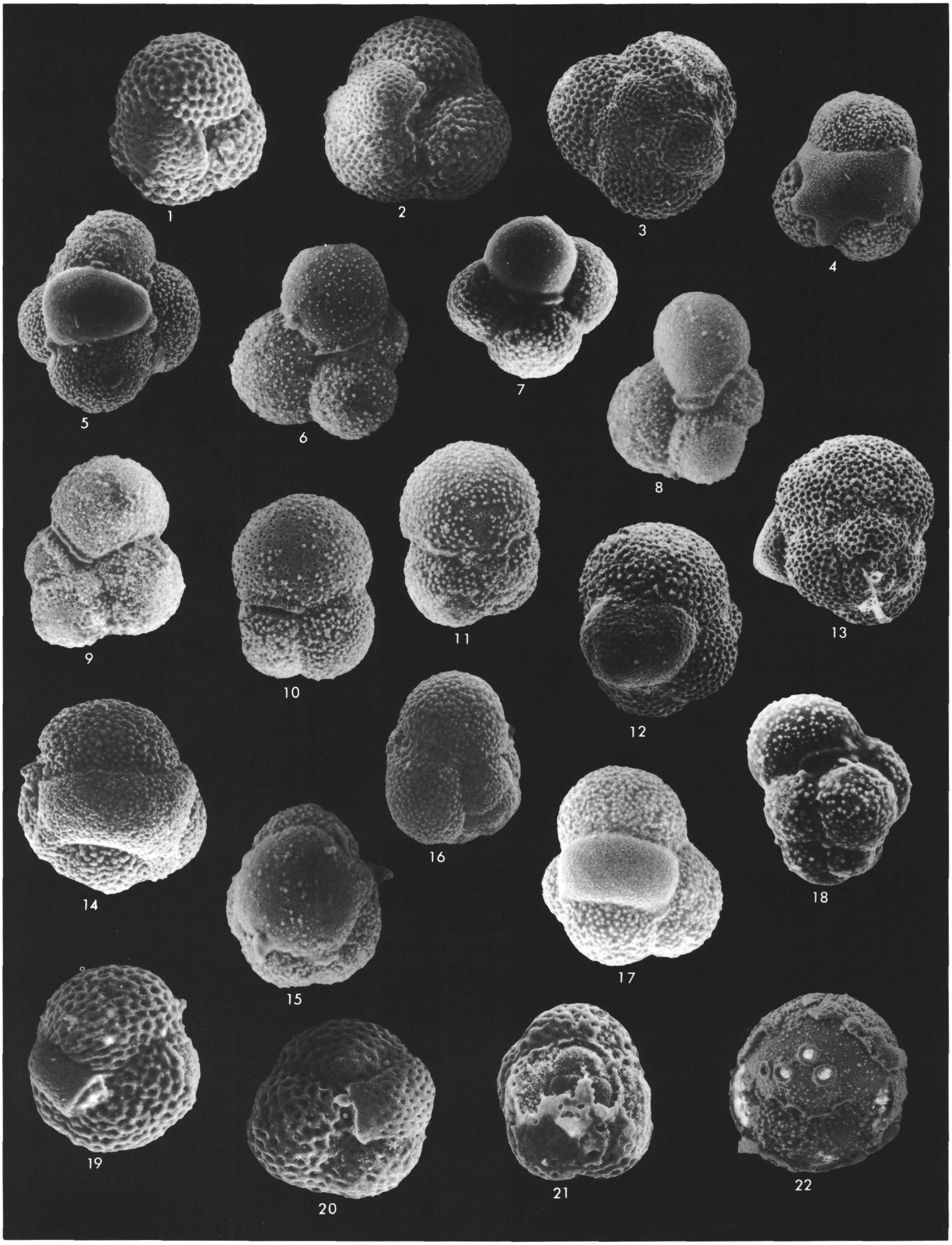


PLATE 9

Figures 1, 2	*Globigerinatella insueta*; UWAGD 74320; ×150; 319-11-6, 66-68 cm.
Figures 3, 4	*Globigerapsis index* (Finlay); UWAGD 74321; ×130; 321-13-3, 88-90 cm.
Figures 5, 6	*G. mexicana* (Cushman); UWAGD 74322; ×110; 321-13-3, 88-90 cm.
Figures 7-9	*G.* sp. UWAGD 74323; ×130; 321-13-3, 88-90 cm.
Figures 10, 11	*Orbulina suturalis* Brönnimann and Resig; UWAGD 74324, ×100; 320A-1-2, 51-53 cm.
Figure 12	*O. universa parkerae* Brönnimann; UWAGD 74325; ×55; 319-1-3, 110-112 cm.
Figure 13	*O. u. universa* d'Orbigny; UWAGD 74326; ×60; specimen since lost, 319-2-4, 59-61 cm.
Figure 14	*Biorbulina bilobata* (d'Orbigny); UWAGD 74327; ×55; specimen since lost, 319-1-5, 40-42 cm.
Figure 15	*Candeina nitida nitida* d'Orbigny; UWAGD 74328; ×65; AMPH 30P, 2-4 cm.
Figures 16, 17	*Sphaeroidinella dehiscens dehiscens* (Parker and Jones); UWAGD 74329; ×40; AMPH 30P, 100-102 cm.
Figures 18, 19	*S. d. excavata* Banner and Blow; UWAGD 74330; ×40; AMPH 30P, 2-4 cm.
Figures 20, 21	*Sphaeroidinellopsis seminulina kochi* (Caudri); UWAGD 74331; ×65; 319-5, CC.
Figure 22	*S. s. kochi*; UWAGD 74332 ×40; 319-6-6, 90-92 cm.

PLATE 9

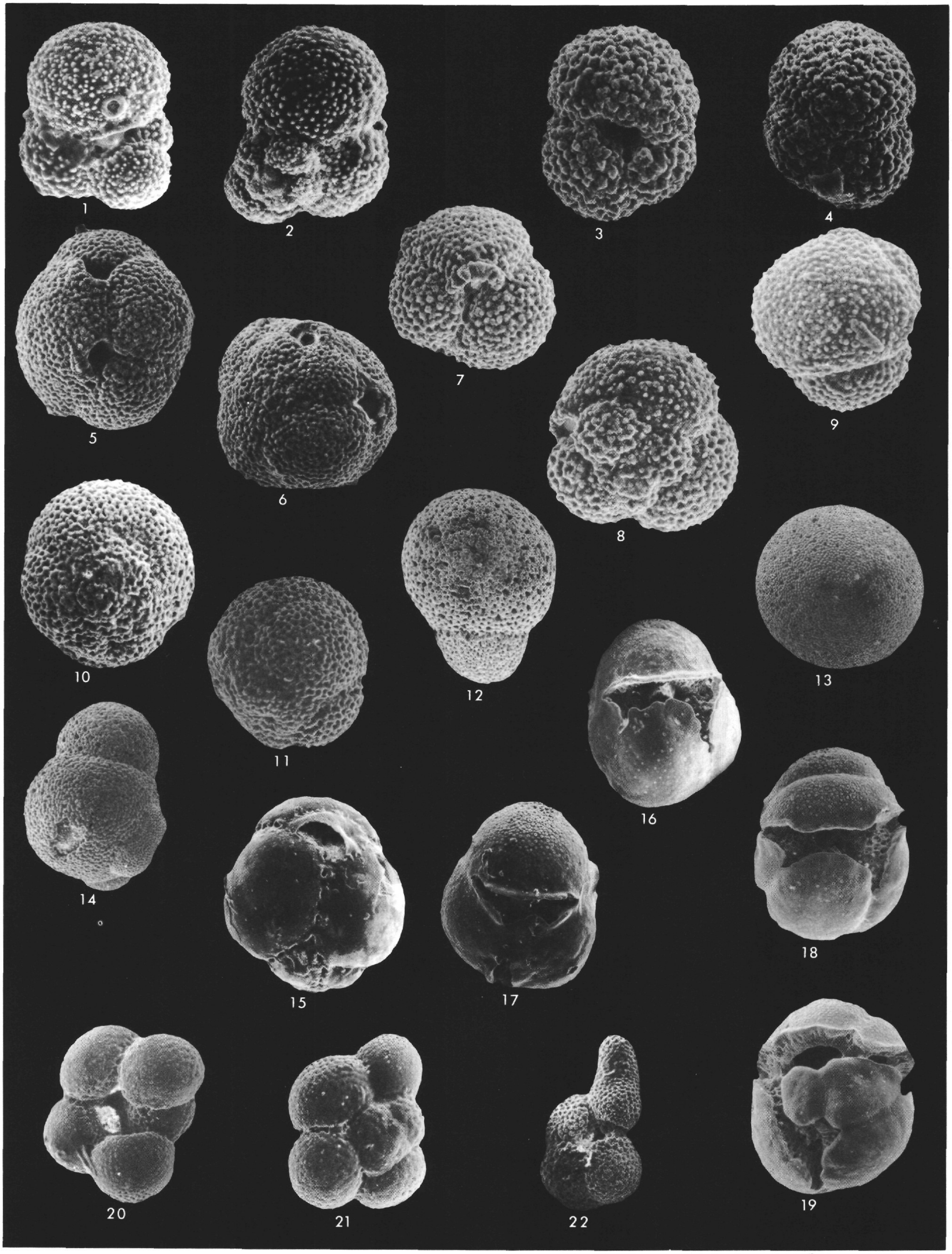


PLATE 10

Figures 1, 2	*Sphaeroidinellopsis seminulina seminulina* (Schwager); UWAGD 74333; ×65; 319-1-3, 110-112 cm.
Figures 3, 4	*S. paenedehiscens* (Blow), UWAGD 74334; ×55; 319-1-3, 110-112 cm.
Figures 5, 6	*S. s. subdehiscens* (Blow); UWAGD 74335; ×85; 319-1-3, 110-112 cm.
Figures 7, 8	*Globoquadrina altispira altispira* (Cushman and Jarvis); UWAGD 74336; ×70; 319-4, CC.
Figures 9, 10	*G. a. globosa* Bolli; UWAGD 74337; ×110; 319-5-4, 90-92 cm.
Figures 11, 12	*G. a. globularis* Bermudez; UWAGD 74338; ×50; 320-3, CC.
Figure 13	*G. baroemoenensis* (LeRoy); UWAGD 74339; ×110; 320B-1-6, 30-32 cm.
Figures 14, 15	*G. dehiscens advena* Bermudez; UWAGD 74340; ×65; 319-4-6, 100-102 cm.
Figures 16, 17	*G. d. dehiscens* form α (Chapman, Parr, and Collins); UWAGD 74341; ×65; 319-7-4, 85-87 cm.
Figures 18, 19	*G. d. d.* form β UWAGD 74342; ×160; 319-6-1, 115-117 cm.
Figures 20, 21	*G. d. praedehiscens* Blow and Banner; UWAGD 74343; ×100, 320-2-1, 80-82 cm.
Figures 22, 23	*G.* aff. *langhiana* Cita and Gelati; UWAGD 74344; 319-5-5, 90-92 cm. 22. ×140. 23. ×130.

PLATE 10

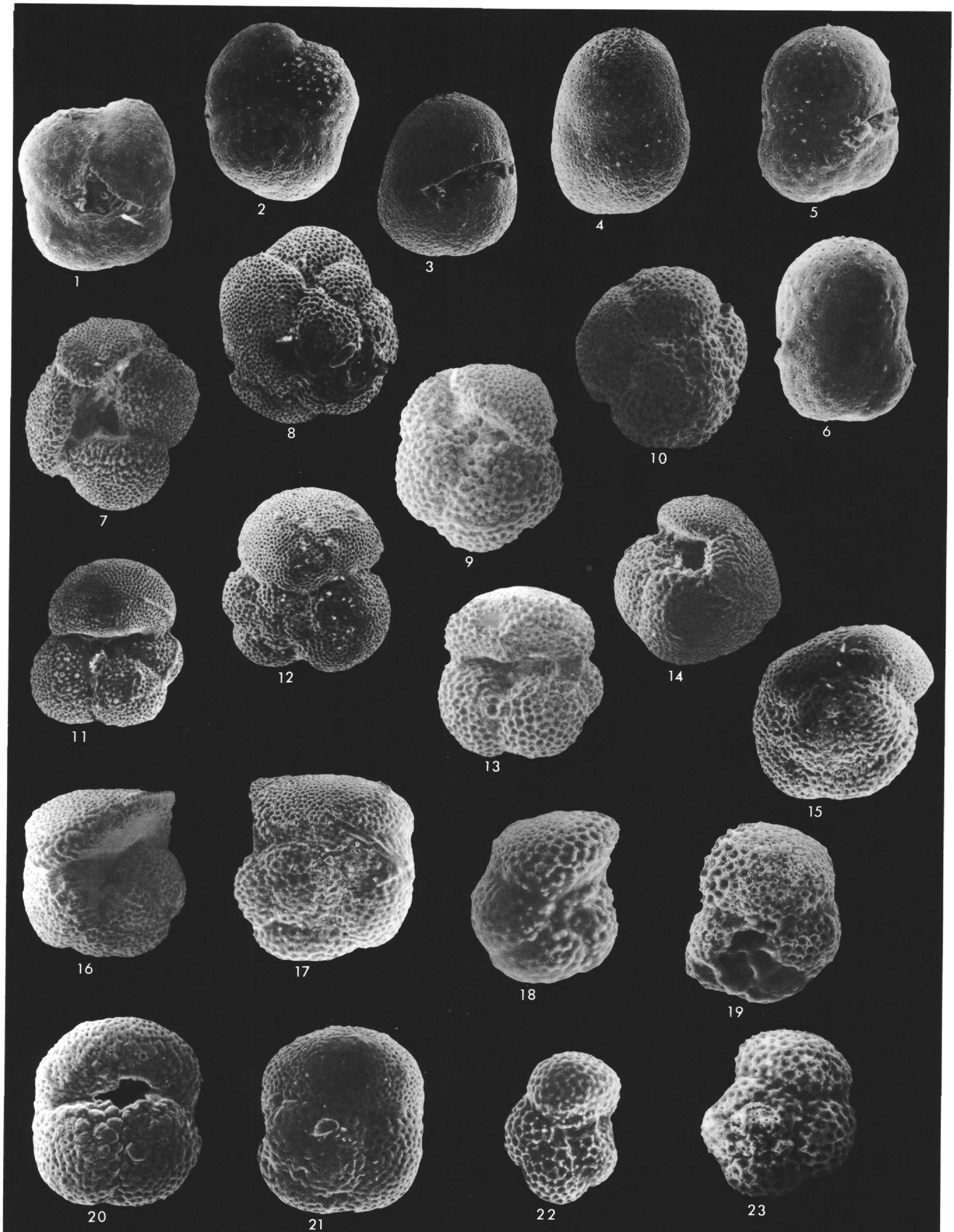


PLATE 11

Figures 1, 2	*Globoquadrina larmeui larmeui* Akers; UWAGD 74345; ×80; 319-7-4, 85-87 cm.
Figures 3, 4	*G. l. obesa* Akers; UWAGD 74346; 319-3, CC. 3. ×60. 4. ×50.
Figures 5, 6	*G.* sp.; UWAGD 74347; ×100; 320-3-4, 6-8 cm.
Figure 7	*Globorotalia (Turborotalia) acostaensis acostaensis* Blow; UWAGD 74348; ×100; 319-3-2, 3-5 cm.
Figure 8	*G. (T.) a. humerosa* Takayanagi and Saito; UWAGD 74349; ×140; 319-1-5, 42-44 cm.
Figures 9, 10	*G. (T.) anfracta* ×20; 319-2-4, 59-60 cm.
Figures 11, 12	*G. (T.) birnageae* Blow; UWAGD 74351; ×110; 319-7, CC.
Figures 13, 14	*G. (T.) clemenciae* Bermudez; UWAGD 74352; ×200; 321-9, CC.
Figures 15, 16	*G. (T.) continuosa* Blow; UWAGD 74353; ×110, 319-5-5, 90-92 cm.
Figures 17, 18	*G. (T.) crassaformis crassaformis* Galloway and Wissler; UWAGD 74354; ×100; DWBP 134, 0-2 cm.
Figures 19, 20	*G. (T.) dutertrei dutertrei* (d'Orbigny); UWAGD 74355; ×60; 320-1-1, 84-86 cm.
Figures 21, 22	*G. (T.) d. dutertrei*; UWAGD 74356; ×70; DWBP 134, 0-2 cm.

PLATE 11

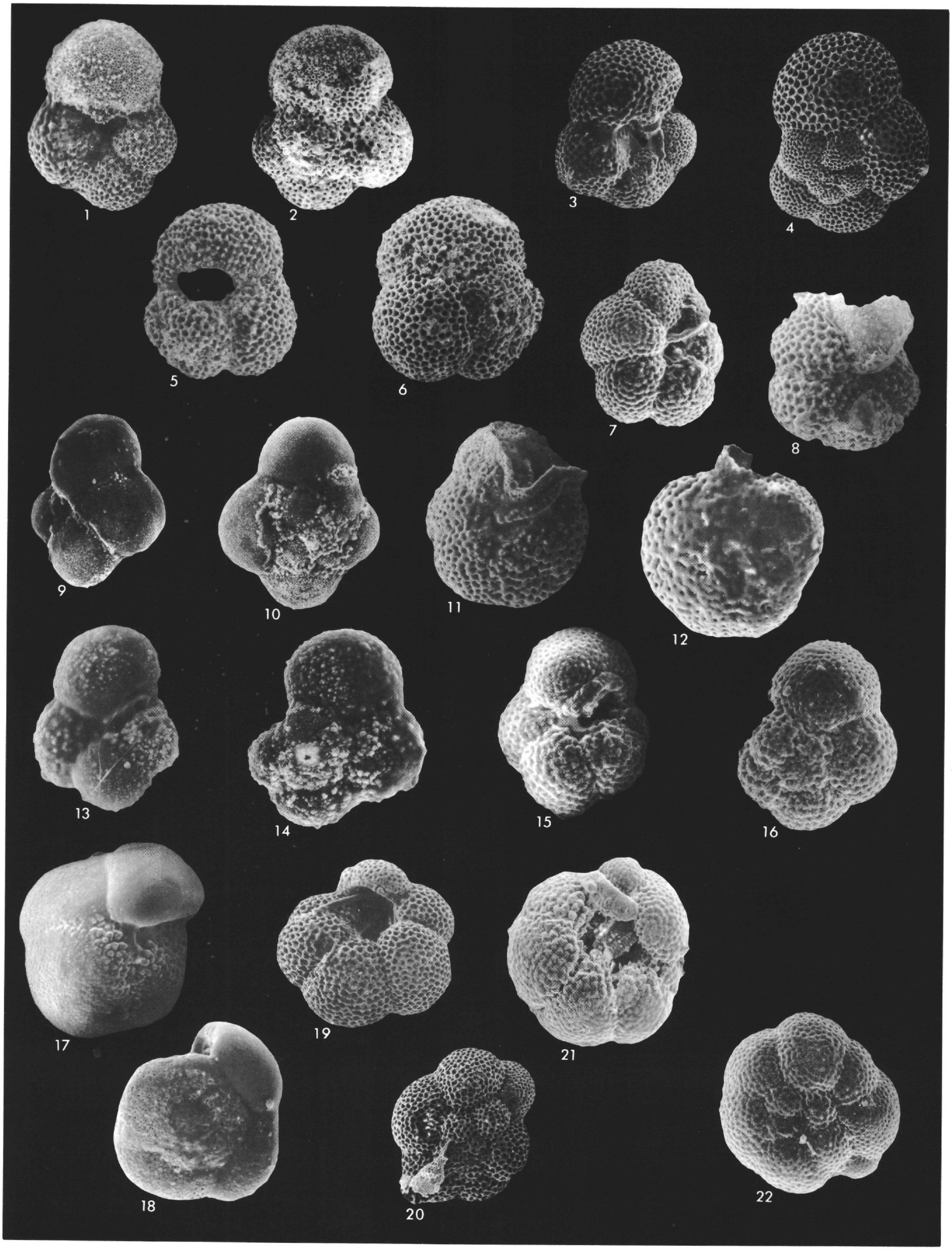


PLATE 12

Figures 1, 2	*Globorotalia (Turborotalia) fohsi lobata* Bermudez, UWAGD 74357; ×65; 319-4-6, 100-102 cm.
Figures 3, 4	*G. (T.) f. peripheroacuta* Blow and Banner; UWAGD 74358; ×140; 319-7, CC.
Figures 5, 6	*G. (T.) f. peripheroronda* Blow and Banner; UWAGD 74359; ×180, 319-4-6, 100-102 cm.
Figure 7	*G. (T.) gemma* Jenkins; UWAGD 74360; ×350; 320B-2-1, 54-56 cm.
Figures 8, 9	*G. (T.) globorotaloidea* (Colom); UWAGD 74361; ×150; DWBP 134, 400-402 cm.
Figure 10	*G. (T.) increbescens* Bandy; UWAGD 74362; ×300; 321-8 CC.
Figures 11, 12	*G. (T.) insolita* Jenkins; UWAGD 74363; ×270; 321-13-3, 88-90 cm.
Figure 13	*G. (T.) insolita*; UWAGD 74364; ×150; 319-9-2, 56-58 cm. Reworked.
Figure 14	*G. (T.)* cf. *insolita*; UWAGD 74365; ×180; 321-8-5, 51-53 cm.
Figures 15, 16	*G. (T.) kugleri* Bolli; UWAGD 74366; ×160; 320-3, CC.
Figures 17, 18	*G. (T.) mayeri* Cushman and Ellisor; UWAGD 74367; ×110, 319-4-3, 96-98 cm.
Figures 19, 20	*G. (T.)* aff. *mayeri;* UWAGD 74368; ×110; 319-5-5, 90-92 cm.
Figures 21, 22	*G. (T.) mendacis* Blow; UWAGD 74369; ×150; 320-3-5, 14-16 cm.

PLATE 12

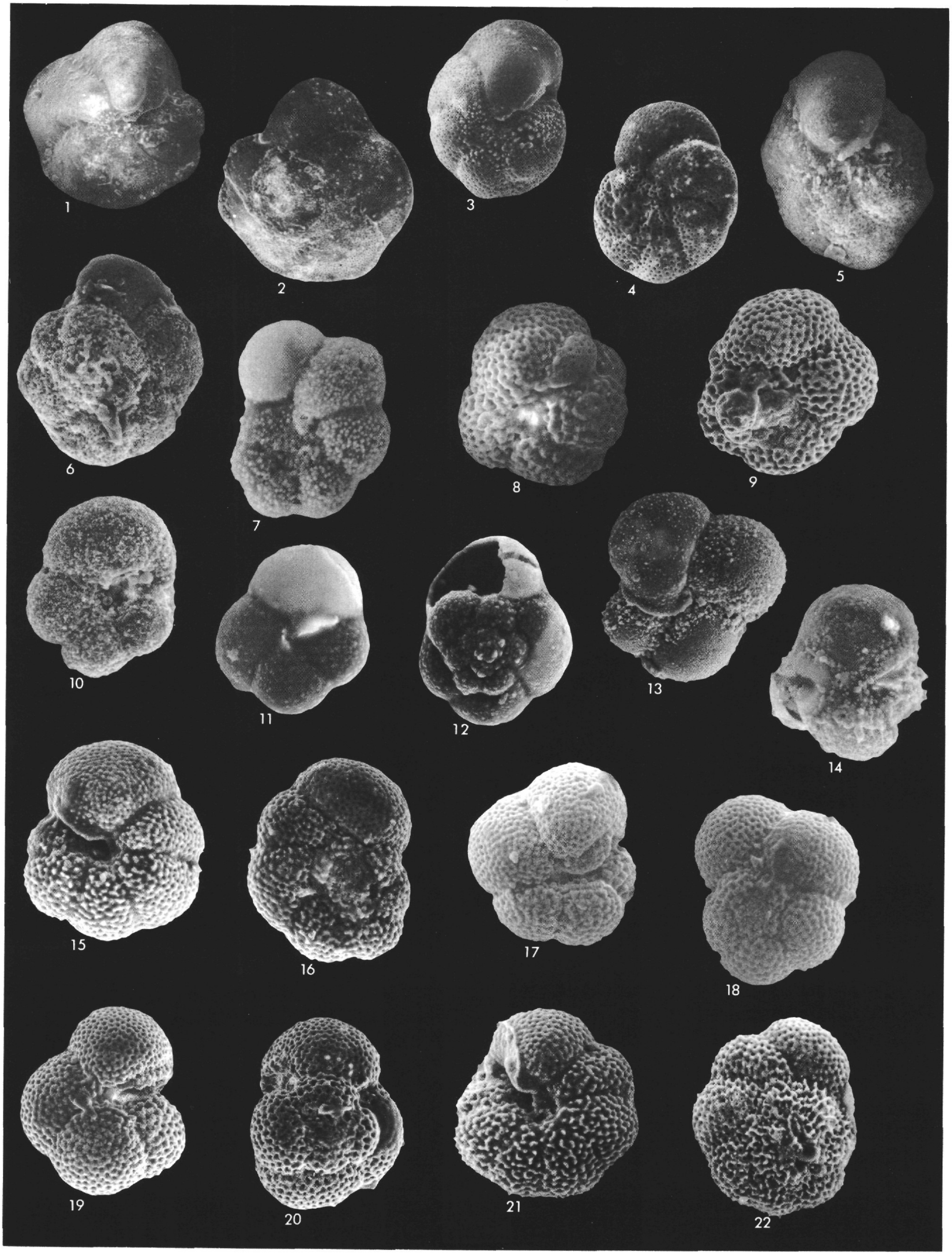


PLATE 13

Figures 1, 2	*Globorotalia (Turborotalia) minima* Akers; UWAGD 74370; ×140; 319-4-6, 100-102 cm.
Figures 3, 4	*G. (T.) minutissima* Bolli; UWAGD 74371; ×200; 319-7, CC.
Figures 5, 6	*G. (T.) obesa* Bolli; UWAGD 74372; ×130; 319-5, CC.
Figure 7	*G. (T.)* aff. *obesa*; UWAGD 74373; ×130; 320-3-1, 105-107 cm.
Figures 8, 9	*G. (T.)* cf. *obesa*; UWAGD 74374; ×110; 319-9, CC.
Figures 10, 11	*G. (T.) opima nana* Bolli; UWAGD 74375; ×180; 320B-2-5, 35-37 cm.
Figures 12, 13	*G. (T.) o. opima* Bolli; UWAGD 74376; ×100; 320B-2, CC.
Figures 14, 15	*G. (T.) permicra* Blow and Banner; UWAGD 74377; ×200; 321-8-2, 89-91 cm.
Figures 16, 17	*G. (T.) pseudokugleri* Blow; UWAGD 74378; ×250; 320-3-2, 27-29 cm.
Figures 18, 19	*G. (T.) pumilio* Parker; UWAGD 74379; ×230; AMPH 30P, 2-4 cm.
Figures 20, 21	*G. (T.) scitula gigantea* Blow; UWAGD 74380; ×60, 319-7-5, 121-123 cm.
Figures 22, 23	*G. (T.) s. praescitula* Blow; UWAGD 74381; ×130; 319-10-5, 41-43 cm.

PLATE 13

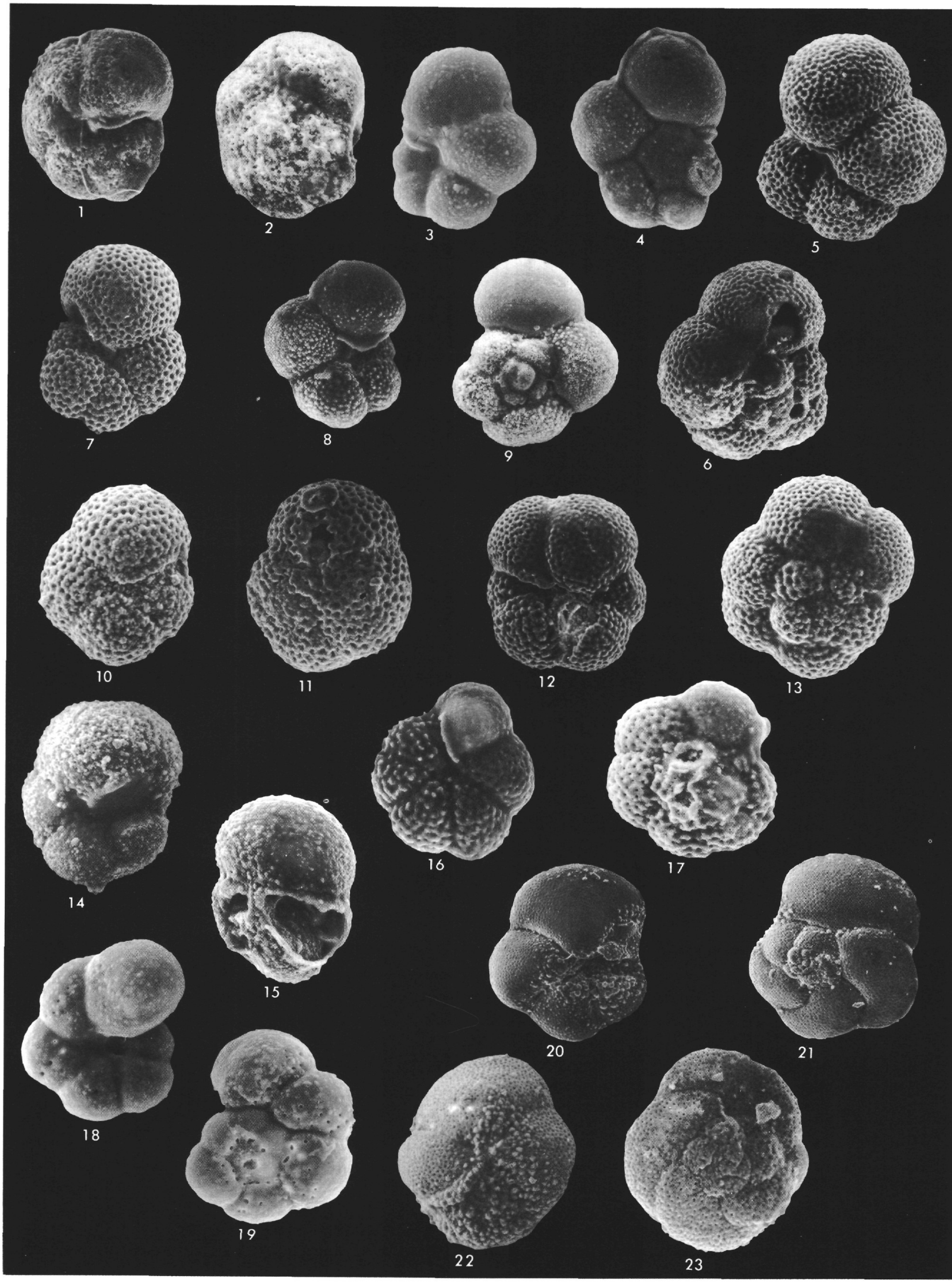


PLATE 14

Figures 1, 2	*Globorotalia (Turborotalia) scitula scitula* (Brady); UWAGD 74382; ×110; 319-11-5, 40-42 cm.
Figures 3, 4	*G. (T.) s.* n. subsp.; UWAGD 74383; ×130; 319-8-5, 60-62 cm.
Figures 5, 6	*G. (T.) siakensis*; UWAGD 74384; ×130; 319-5, CC.
Figures 7, 8	*G. (T.)* "sp. 2"; UWAGD 74385; ×180; 319-5, CC.
Figures 9, 10	*G. (T.) akersi* n. sp.; UWAGD 74386; ×170; 319-4-5, 42-44 cm. Holotype.
Figure 11	*G. (T.) akersi* n. sp.; UWAGD 74386; ×200; 319-4-5, 42-44 cm. Paratype.
Figures 12, 13	*G. (T.) akersi* n. sp.; UWAGD 74386; ×250; 319-4-5, 42-44 cm. Paratype.
Figures 14, 15	*G. (T.) bauerensis* n. sp.; UWAGD 74387; ×200; 319-5-5, 90-92 cm. Holotype.
Figures 16, 17	*G. (T.)* sp. 1, UWAGD 74388; ×150; 319-6-1, 115-117 cm.
Figures 18, 19	*G. (T.)* sp. 2; UWAGD 74389; ×140; 319-7-5, 121-123 cm.
Figures 20-22	*G. (T.)* sp. 3; UWAGD 74390; ×200; 319-9, CC.

PLATE 14

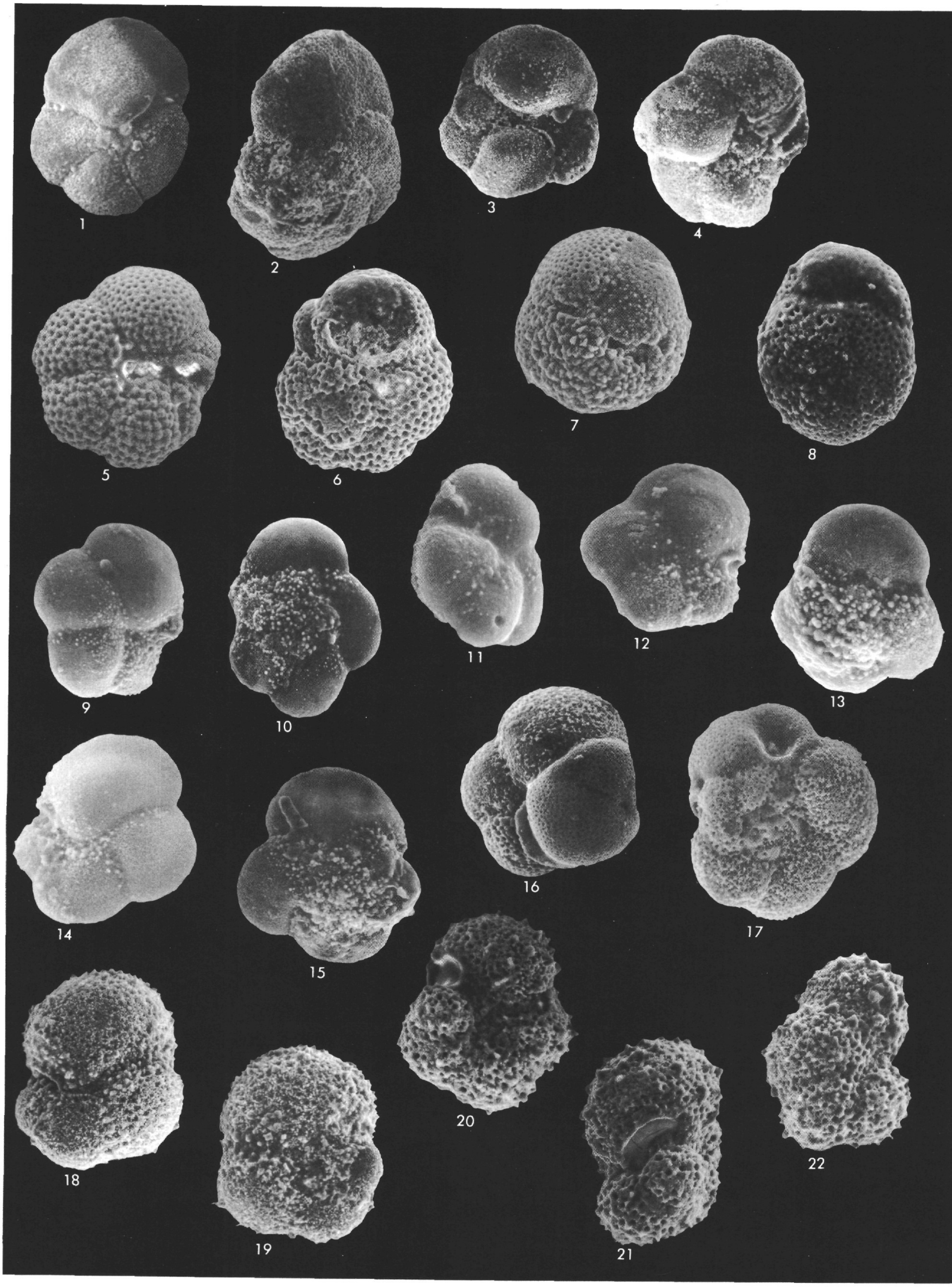


PLATE 15

Figures 1, 2	*Globorotalia (Globorotalia) cultrata cultrata* (d'Orbigny); UWAGD 74391; ×40; 319-1-5, 42-44 cm.
Figure 3	*G. (G.) c.* cf. *limbata* (Fornasini); UWAGD 74392; ×50; 319-1-4, 100-102 cm.
Figures 4, 5	*G. (G.) c.* subsp.; UWAGD 74393; ×90; 319-1-4, 100-102 cm.
Figure 6	*G. (G.) fimbriata* (Brady); ×60; 320-1-1, 84-86 cm. Specimen since lost.
Figures 7, 8	*G. (G.) miozea miozea* Finlay; UWAGD 74394; ×90; 319-4-1, 16-18 cm.
Figures 9, 10	*G. (G.) m. cibaoensis* Bermudez; UWAGD 74395; ×130; 319-2-2, 90-92 cm.
Figures 11, 12	*G. (G.) m.* subsp.; UWAGD 74396; ×55; 319-9, CC.
Figures 13, 14	*G. (G.) praefohsi* Blow and Banner; UWAGD 74397; × 65; 319-5-5, 90-92 cm.
Figures 15, 16	*G. (G.) praemenardii archeomenardii* Bolli; UWAGD 74398; ×120; 319-5-5, 90-92 cm.
Figures 17, 18	*G. (G.) p. praemenardii* Cushman and Stainforth; UWAGD 74399; ×85; 319-5-6, 90-92 cm.
Figures 19, 20	*G. (G.) truncatulinoides truncatulinoides* (d'Orbigny); UWAGD 74400; ×60; AMPH 30P, 100-102 cm.
Figures 21, 22	*G. (G.) tumida flexuosa* (Koch); UWAGD 74401; ×55; 319-1-4, 100-102 cm.

PLATE 15

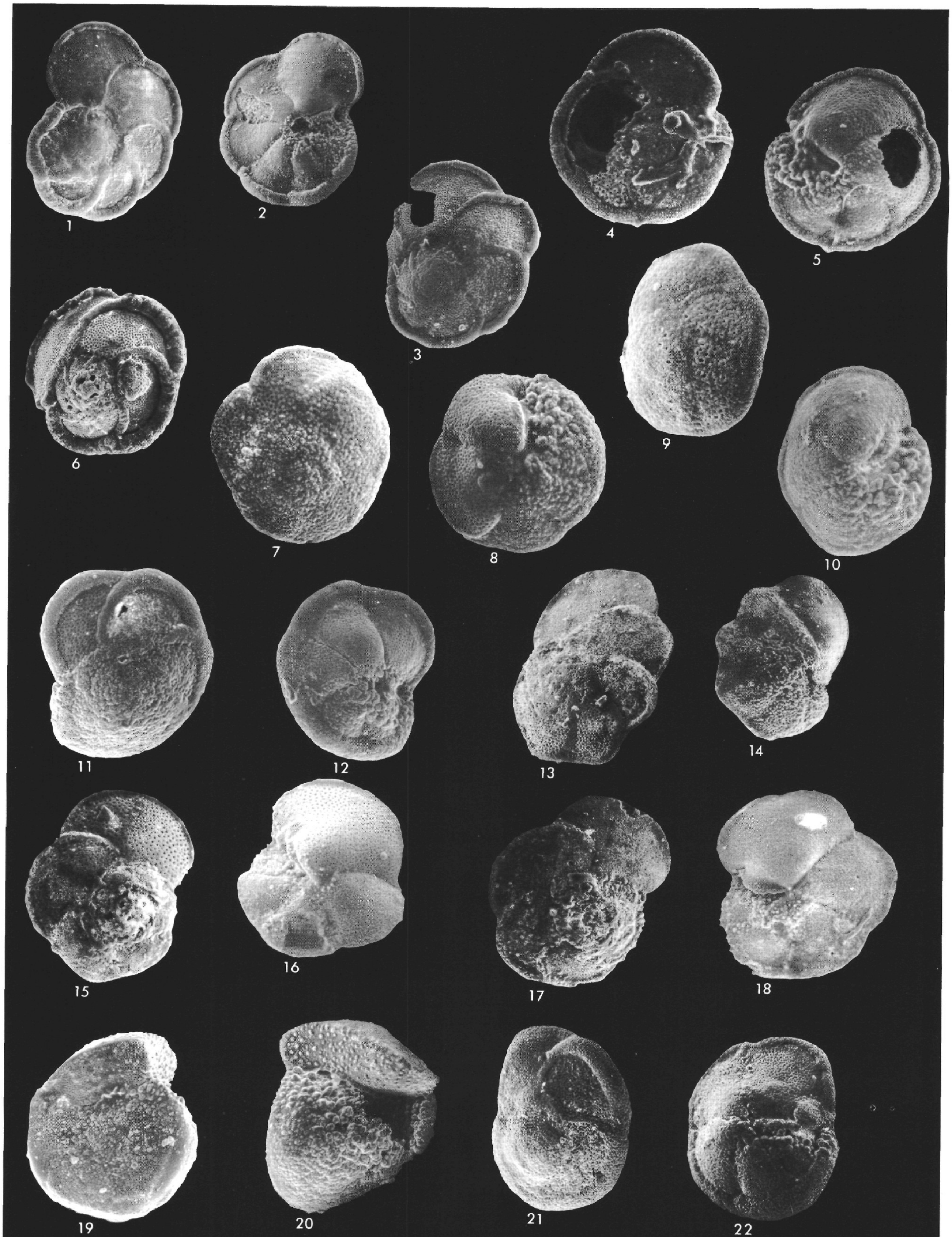


PLATE 16

Figures 1, 2	*Globorotalia (Globorotalia) tumida plesiotumida* Banner and Blow; UWAGD 74402; ×60; 319-2-3, 101-103 cm.
Figures 3, 4	*G. (G.) t. tumida* (Brady); UWAGD 74403; ×30; AMPH 30P, 200-202 cm. Note incipient development of paired keels.
Figure 5	*G. (G.) t.* subsp.; UWAGD 74404; ×80; 320-1-6, 121-123 cm.
Figures 6, 7	*G. (G.) ungulata* Bermudez; UWAGD 74405; ×75; DWBP 134, 300-302 cm.
Figures 8, 9	*Turborotalita cristata* (Heron-Allen and Earland); UWAGD 74406; ×280; AMPH 30P, 2-4 cm.
Figures 10, 11	*T. humilis* (Brady); UWAGD 74407; ×210; AMPH 30P, 100-102 cm.
Figures 12, 13	*T. iota* (Parker); UWAGD 74408; ×220; AMPH 30P, 200-202 cm.
Figure 14	*T. primitiva* Brönnimann and Resig; UWAGD 74409; ×400; 321-7 CC.
Figures 15, 16	*T. quinqueloba* (Natland); ×200; 319-1-4, 100-102 cm. Specimen since lost.
Figures 17, 18	*Globorotaloides hexagona hexagona* (Natland); UWAGD 74410; ×70; 319-2-1, 101-103 cm.
Figures 19, 20	*G. h. variabilis* Bolli; UWAGD 74411; ×120; 319-5-5, 90-92 cm.

PLATE 16

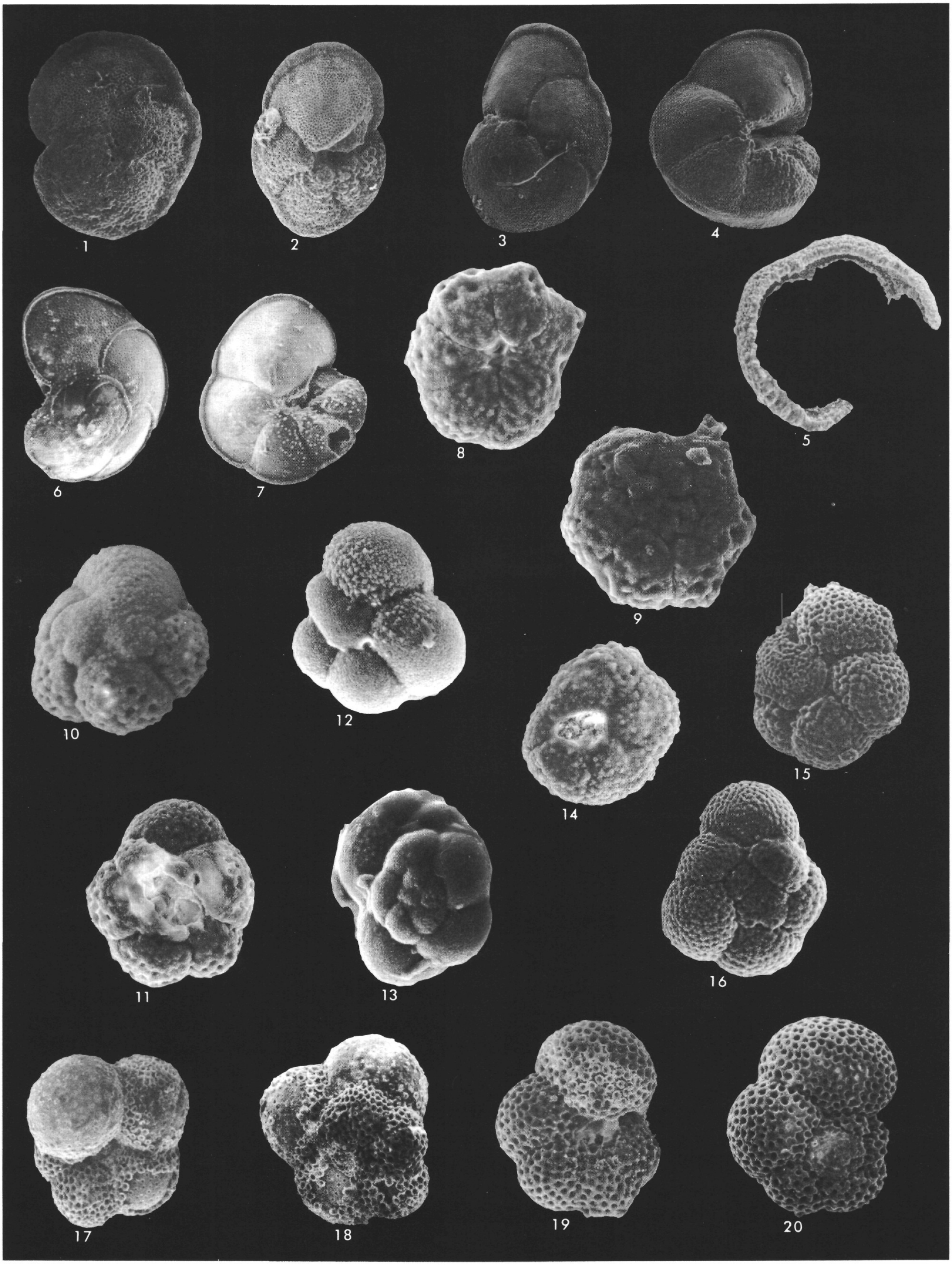


PLATE 17

Figures 1,2	*Globorotaloides suteri* Bolli; UWAGD 74412; ×220; 320B-1-1, 70-72 cm.
Figures 3, 4	*G. suteri;* UWAGD 74413; ×170; 321-10, CC.
Figures 5, 6	*G.* sp.; UWAGD 74414; ×150; 320B-2, CC.
Figures 7, 8	*Hastigerina pelagica* (d'Orbigny); UWAGD 74415; ×75; 319-2, CC.
Figures 9, 10	*H. pelagica;* UWAGD 74416; ×65; 320A-1-2, 51-53 cm.
Figures 11, 12	? *H.* sp.; UWAGD 74417; ×25, 319-5, CC.
Figures 13, 14	*Globigerinopsis aguasayensis* Bolli, UWAGD 74418; ×90; 319-5, CC.
Figures 15, 16	*Clavatorella bermudezi* (Bolli); UWAGD 74419; ×130; 319-11, CC.
Figures 17, 18	*C. bermudezi;* UWAGD 74420; ×55; 319-8-2, 64-66 cm.
Figures 19, 20	*C. bermudezi;* UWAGD 74420; ×55; 319-8-2, 64-66 cm.
Figure 21	*Hastigerinella digitata* (Rhumbler); UWAGD 74421; ×60; DWBP 134, 500-502 cm.

PLATE 17

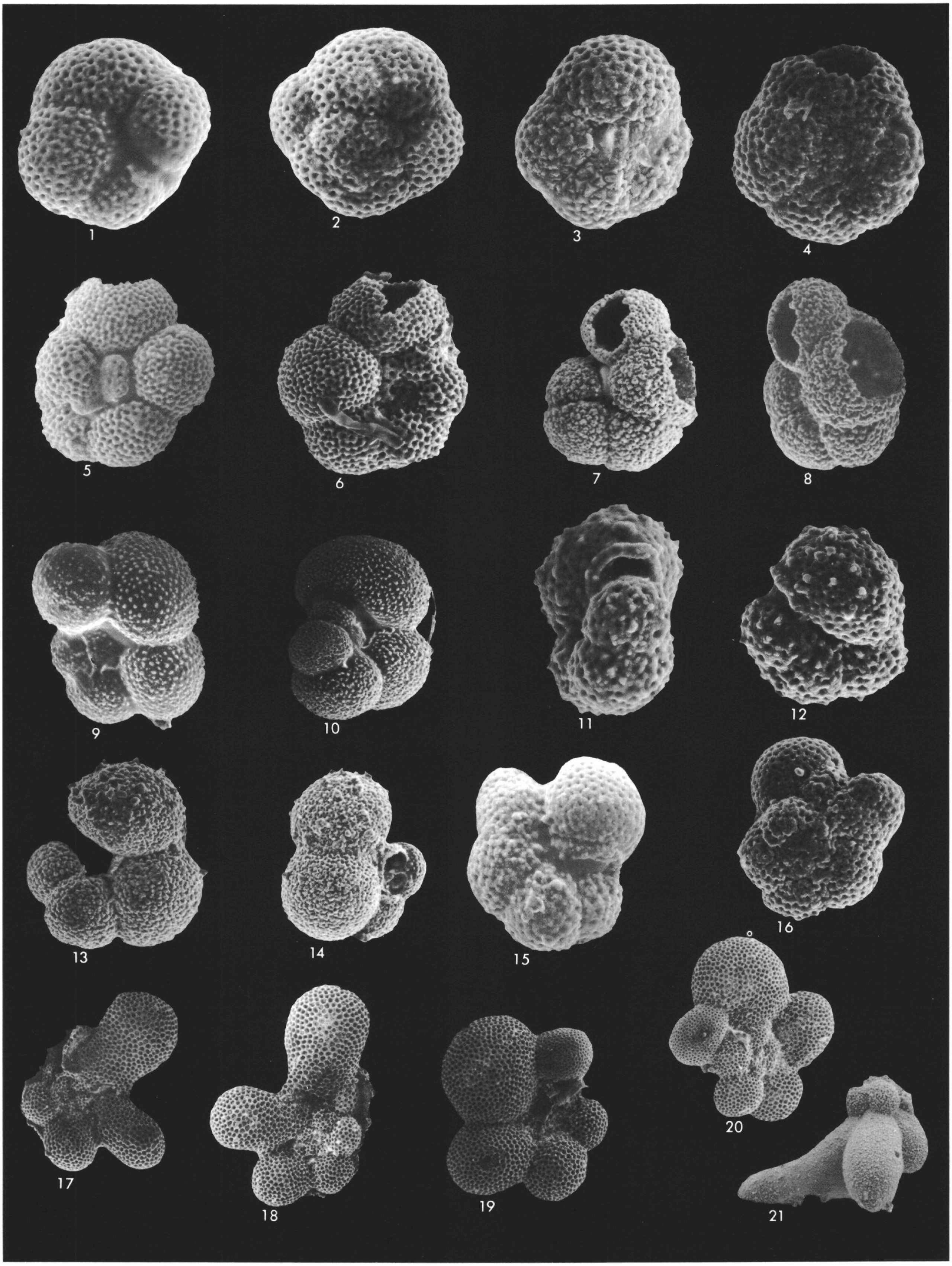


PLATE 18

Figure 1	*Clavigerinella nazcaensis* Quilty n. sp.; UWAGD 74422; ×300, 320B-2, CC. Paratype.
Figure 2	*C. nazcaensis;* UWAGD 74423; ×600; 320B-2, CC. Paratype.
Figure 3	*C. nazcaensis*; UWAGD 74424; ×200; 320B-2, CC. Paratype.
Figure 4	*C. nazcaensis*; UWAGD 74425; ×200; 320B-2, CC. paratype.
Figure 5	*C. nazcaensis*; UWAGD 74426; ×200; 320B-2, CC. Paratype.
Figure 6	*C. nazcaensis* ×300; 320B-2, CC. Paratype.
Figure 7	*C. nazcaensis*; UWAGD 74428; ×130; 320B-2, CC. Paratype.
Figure 8	*C. nazcaensis;* UWAGD 74429; ×160; 320B-2, CC. Holotype.
Figure 9	*C. nuzcaensis;* UWAGD 74430; ×180; 320B-2, CC. Paratype
Fig re 10	*C. nazcaensis*; UWAGD 74431; ×120; 320B-2-2, 10-12 cm. Paratype.
Figure 11	*C. nazcaensis;* UWAGD 74432; ×140; 320B-2-2, 10-12 cm. Paratype.
Figure 12	*C. nazcaensis*; UWAGD 74433; ×23; 320B-2, CC. Paratype.

PLATE 18

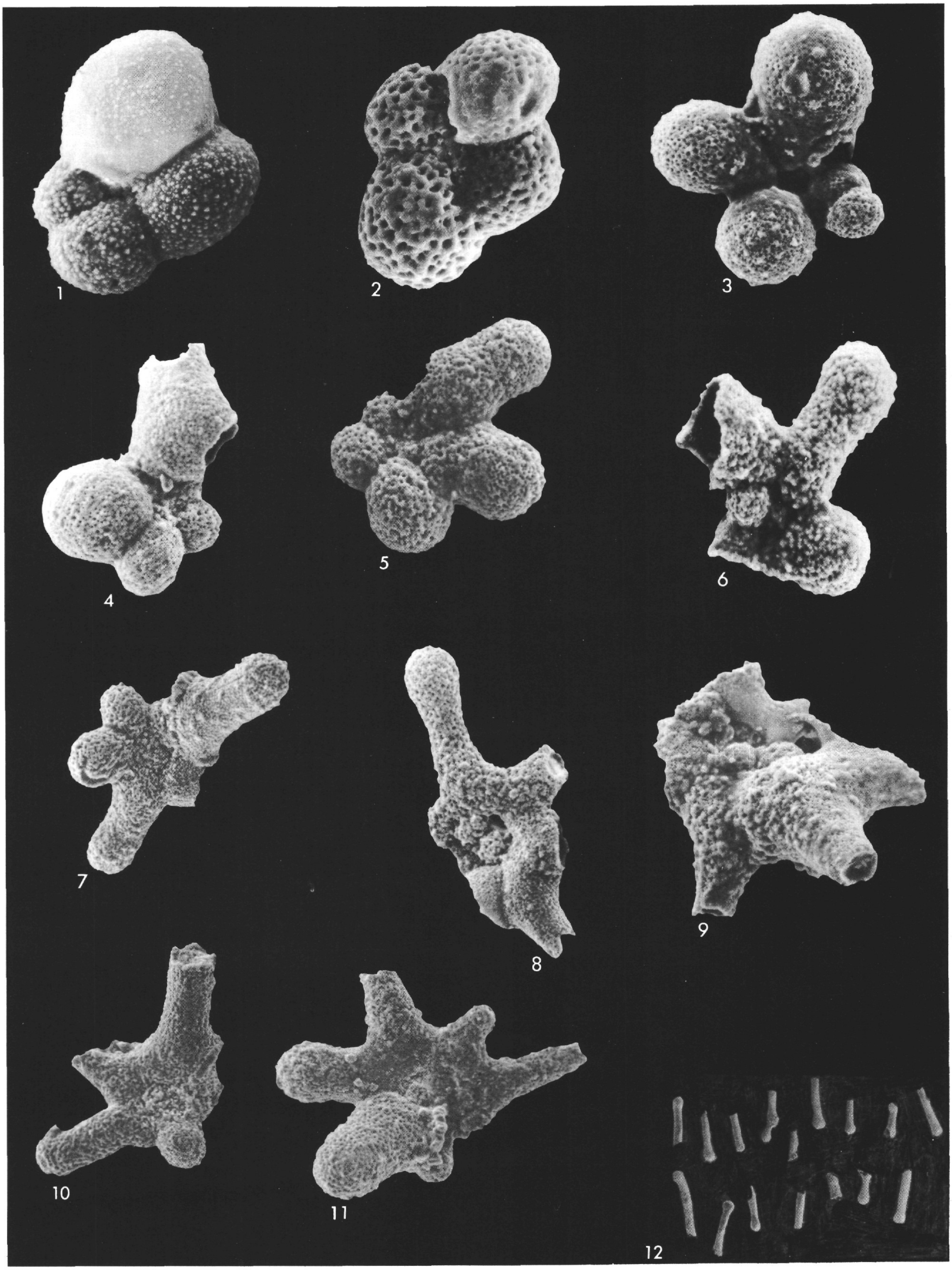


PLATE 19

Figures 1, 2	*Pulleniatina obliqueloculata* (Parker and Jones); UWAGD 74434; ×55; DWBP 134, 300-302 cm.
Figures 3, 4	*P. obliqueloculata*; UWAGD 74435; ×100; 320A-1-2, 51-53 cm.
Figure 5	*Pseudohastigerina barbadoensis* Blow; UWAGD 74436; ×220; 321-8-1, 102-104 cm.
Figure 6	*P. micra* (Cole); UWAGD 74437; ×140; 321-8, CC.
Figure 7	*P. naguewichiensis* (Myatliuk); UWAGD 74438; ×230; 321-13-3, 88-90 cm.
Figure 8	*Hantkenina primitiva* Cushman and Jarvis; UWAGD 74439; ×220; 321-13-3, 88-90 cm.
Figure 9	*H. alabamensis* Cushman; UWAGD 74440; ×230; 321-13-3, 88-90 cm.
Figure 10	*H. alabamensis;* UWAGD 74440; ×120; 321-13-3, 88-90 cm.
Figures 11, 12	*Cassigerinella chipolensis* (Cushman and Ponton); UWAGD 74441; ×230; 321-8-2, 89-91 cm.
Figures 13, 14	*C.* sp.; UWAGD 74442; ×250; 321-8-1, 102-104 cm.
Figure 15	*Chiloguembelina cubensis* (Palmer); UWAGD 74443; ×230; 321-9-6, 67-69 cm.
Figure 16	*C. martini* (Pijpers); UWAGD 74444; ×250; 321-13-3, 88-90 cm.
Figure 17	*Streptochilus pristinum* Brönnimann and Resig; UWAGD 74445; ×200; 319-11-3, 50-52 cm.
Figures 18, 19	Questionable planktonic; UWAGD 74446; ×160; 319-8-2, 64-66 cm.

PLATE 19