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A FORAMINIFERAL FAUNA FROM THE TERTIARY SEDIMENTS OF SOUTHERN MOÇAMBIQUE

By Yvor H. Smitter

Abstract

A group of foraminifera is recorded from beds in Southern Mocambique of probable Upper Miocene age. The species listed are briefly compared with similar forms found elsewhere in the world. Three new species and one new variety are described.

Introduction

In June of 1955, Dr. V. L. Bosazza, while working in Moçambique with the *Servicos de Industria e Geologia*, forwarded to the author for micropaleontological examination several samples of rock material obtained from a borehole located near the village of Palmeira, Southern Moçambique. The samples were found to contain large numbers of foraminifera, and as little is known regarding the Tertiary palaeontology and geology of Southern Moçambique, a brief description of the species encountered would seem worthwhile. In a more general sense, the fauna is of additional interest to workers concerned with the patterns of world distribution of foraminifera, and in this connection it may be noted that the fauna described is characteristic of no single area in particular, but is comprised of forms which were initially described from the Mediterranean, the western Atlantic and Australia. That certain species are characteristic of certain geographic regions is, in some part, an illusory concept created as the result of the intensive investigation of a few rather limited areas and the complete lack of investigation in others.

The age of the fauna is somewhat difficult to establish, but a study of the stratigraphic distribution of the various species in other areas of the world would suggest that the fauna is of Upper Miocene in age. It is hoped that with continued work in the future a more or less complete faunal sequence for the Tertiary of Southern Moçambique may be provided.

Locality

Samples were taken from a depth of sixty feet in a borehole situated six kilometres north of the village of Palmeira, (25°17'S., 33°4'E.), Sul do Save Province, Moçambique. The site is located in an undesignated and, for the most part, unmapped group of Tertiary sediments extending hundreds of miles in a north-south direction through the southern portion of Moçambique.

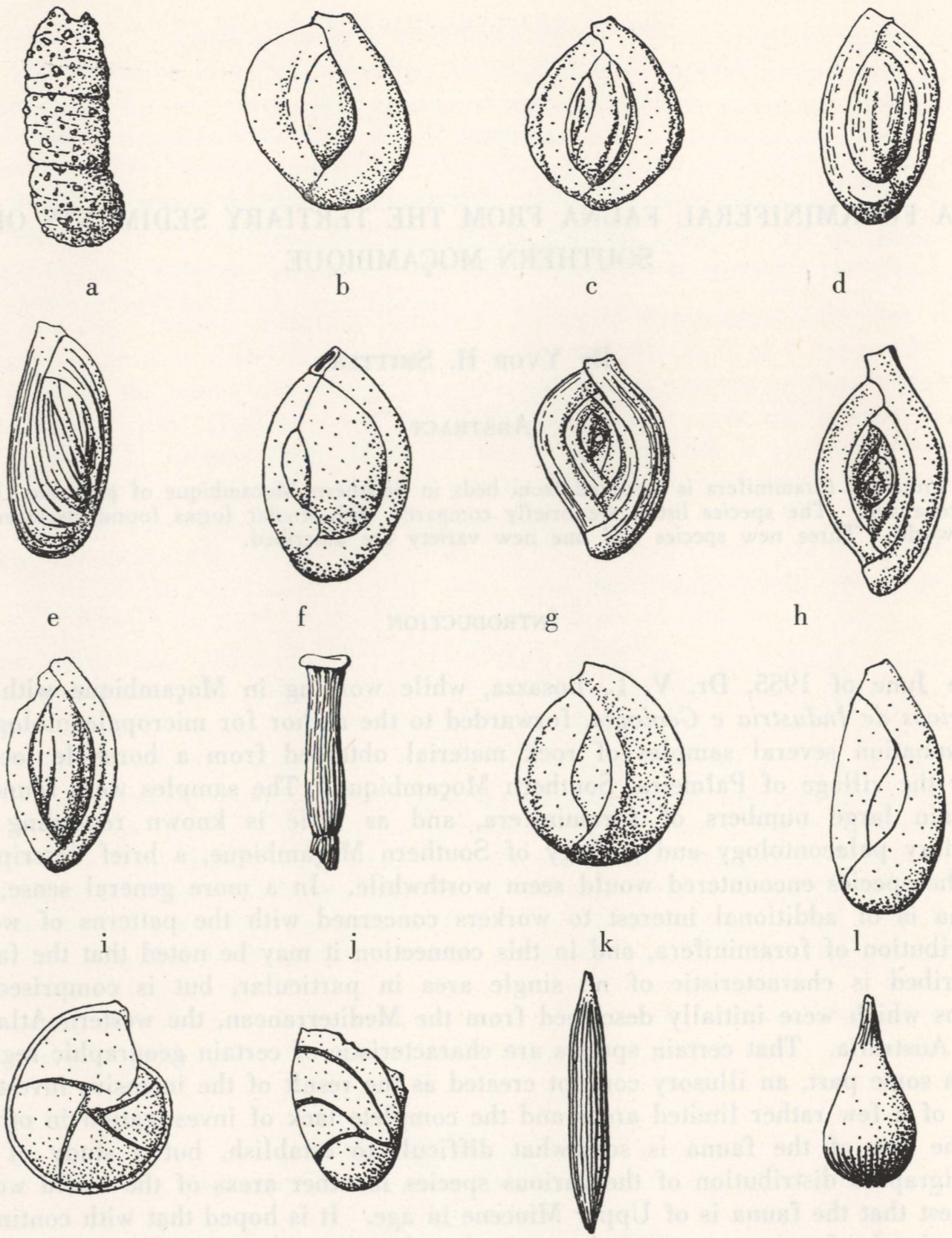


Fig. 39.

(a) *Reophax acosta* Bermudez; x 20.
(b) *Quinqueloculina akneriana* d'Orbigny; x 40.
(c) *Quinqueloculina lamarckiana* d'Orbigny; x 30.
(d) *Quinqueloculina seminulum* (Linne); x 30.
(e) *Quinqueloculina subpoeyana* Cushman;
(f) *Quinqueloculina vulgaris* d'Orbigny; x 30.
(g) *Spiroloculina depressa* d'Orbigny; x 25.
(h) *Spiroloculina elegans* Silvestri; x 20.
(i) *Sigmoilina* cf. *S. tenuis* (Czjzek); x 40.
(j) *Articulina miocenica* Cushman; x 50.
(k) *Triloculina circularis* Bornemann; x 45.
(l) *Triloculina oblonga* (Montagu); x 50.
(m) *Robulus* cf. *R. cibaoensis* Galloway and Heminway; x 40.
(n) *Astacolus sp.*; x 30.
(o) *Lagena distoma* Parker and Jones; x 40.
(p) *Lagena semistriata* Williamson; x 40.

Family REOPHACIDAE

Genus REOPHAX Montfort (1808)

Reophax acosta Bermudez

Figure 39a

1949. Bermudez, P. J., *Cushman Lab. Foram. Res., Special Publ.* No. 25, p. 47, pl. 1, figs. 26, 27.

Several specimens from the Palmeira material compare very closely with the figures and description given by Bermudez of this species which was originally described from the Upper Miocene of the Dominican Republic.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny (1826)

Quinqueloculina akneriana d'Orbigny

Figure 39b

1846. d'Orbigny, A. D., Foram. Foss. Bass. Tert. Vienne, p. 290, pl. 18, figs. 16-21,

The types of this species are from the Miocene of the Vienna Basin. The form has been widely recorded from sediments ranging in age from Miocene to Pleistocene. Specimens from Moçambique are typical of the species, although they are rather rare.

Quinqueloculina lamarckiana d'Orbigny

Figure 39c

1839. d'Orbigny, A., in DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, *Foraminifères*, p. 189, pl. 11, figs 14, 15.
1929. Cushman, J., *U.S. Nat. Mus., Bull.* 104, pt. 6, p. 26, pl. 2, fig. 6,

This variable species is abundant in the Palmeira material. The form was originally described by d'Orbigny from the Recent of the West Indies, but work by Cushman, Stainforth and others has extended the range downward into the Oligocene and possibly the Eocene.

Quinqueloculina seminulum (Linne)

Figure 39d

1785. Linne, C. V., (*Serpula seminulum*) Syst. Nat., ed. 10, p. 786.
1826. d'Orbigny, A. D., *Ann. Sci. Nat.*, vol. vii, p. 303.
1929. Cushman, J., *Contr. Cushman Lab. Foram. Res.*, vol. v, p. 59, pl. 9, figs. 16-18.

A few specimens were found which seem referable to this species. Typically, the surface of the test is smooth and polished, but in several instances specimens were collected which had the surface ornamented with very fine costae. This would suggest Cushman's variety *jugosa*, described from the waters of the New England coast of North America. Cushman's variety, however, is much more strongly costate.

The species has been recorded from many parts of the world, and it ranges from Mid-Tertiary, or earlier, to Recent.

Quinqueloculina subpoeyana Cushman
Figure 39e

1922. Cushman, J., *Carnegie Inst. Washington Publ.* 311, p. 66.
1929. Cushman, J., *U. S. Nat. Mus. Bull.* 104, pt. 6, p. 31, pl. 5, fig. 3.

This is a very distinctive and rather beautiful little form which is particularly common in the Palmeira material. Hitherto, the species was known only to a few localities in North America of Recent, Miocene and Oligocene age.

Quinqueloculina vulgaris d'Orbigny
Figure 39f

1826. d'Orbigny, A. D., *Ann. Sci. Nat.*, vol. 7, p. 302.

A number of specimens of this species were collected from the Moçambique site. Parr has recorded the species from Quaternary terraces on the Natal coast.

The form has a fairly extensive range in time and is certainly one of the most widely recorded species of foraminifera.

Genus SPIROLOCULINA d'Orbigny (1826)
Spiroloculina depressa d'Orbigny
Figure 39g

1826. d'Orbigny, A. D., *Ann. Sci. Nat.*, vol. 7, p. 298,

A few typical specimens were collected from the Palmeira sediments and all specimens showed the characteristic short neck, costate ornamentation, non-projecting base and truncate periphery. The form was originally described from the Pliocene of Italy, but since has been recorded from sediments in the Mediterranean and Northern Europe ranging in age from Miocene to Recent.

Spiroloculina elegans Silvestri
Figure 39h

1896. Silvestri, A., *Mem. Pont. Accad. Nuovi Lincei*, vol. 12, p. 27, pl. 1, fig. 3.

Several specimens were collected which seem to fit Silvestri's original figure and description quite closely. The species is typified by a flattened or slightly concave test, a truncate periphery with angled margins, a blunt but somewhat projecting base, and a smooth wall. The species was initially described from the Lower Pliocene of Italy and, to the author's knowledge, the form has not previously been collected elsewhere.

Genus SIGMOILINA Schlumberger (1887)
Sigmoilina cf. S. *tenuis* (Czjzek)
Figure 39i

Rare specimens from the Palmeira site somewhat resemble the figures and descriptions of this species first recorded from the Miocene of the Vienna Basin.

Genus ARTICULINA d'Orbigny (1826)
Articulina miocenica Cushman and Ponton
Figure 39j

1932. Cushman, J. and Ponton, G. M., (*Articulina sagra* d'Orbigny, var. *miocenica*) *Florida Geol. Surv., Bull.* 9, p. 51, pl. 6, figs. 2-4.

Cushman and Ponton described this fragile species from the Chipola marl of the Florida Miocene in North America. No complete specimens were recovered from the Moçambique material, but this form is a distinctive one and local specimens seem to fit the description of the species rather closely.

Genus TRILOCULINA d'Orbigny (1826)
Triloculina circularis Bornemann
Figure 39k

This variable species is extremely common in the sediments from the Palmeira site. The types of the species are from the Oligocene of Germany, but the form has been recorded throughout all or most of the Tertiary in Europe and America.

Triloculina oblonga (Montagu)
Figure 39l

1884. Brady, H. B., (*Miliolina oblonga*) Rep. Voy. *Challenger*, Zoology, vol. 9, p. 160, pl. 5, fig. 4.

A number of specimens belonging to this species were collected from the Palmeira sediments. There are many records for this species and it has, apparently, a fairly extensive range in the later Tertiary and in the present oceans.

Family LAGENIDAE
Genus ROBULUS Montfort (1808)
Robulus cf. *R. cibaoensis* Galloway and Heminway
Figure 39m

1941. Galloway, J. J. and Heminway, C. E., New York Acad. Sci., Sci. Survey Puerto Rico and Virgin Islands, vol. 3, pt. 4, p. 348, pl. 12, fig. 8.

Several specimens were collected which were found to be somewhat similar in size and configuration to this first described by Galloway and Heminway from the Puerto Rican Oligocene.

Genus ASTACOLUS Montfort (1808)
Astacolus sp.
Figure 39n

Rare fragments of specimens evidently belonging to this genus were found in the Palmeira material.

Genus LAGENA Walker and Jacob (1798)

Lagena distoma Parker and Jones

Figure 39 o

A few incomplete specimens of this species were collected from these sediments. The costae extend over almost the entire length of the test and both basal and apertural ends are much produced. The form is rather widely recorded in Europe and America.

Lagena semistriata Williamson

Figure 39p

Several specimens belonging to this species were found in the Palmeira material. Typically, the test is flank-shaped, the wall hyaline, and the lower portion of the test ornamented with fine costae. All specimens from the Moçambique area show a peculiar twisting of the neck of the test. This species differs from the very similar form, *L. semilineata* Wright, because it lacks the basal spine.

Lagena striata (d'Orbigny)

Figure 40a

1839. d'Orbigny, A. D., (*Oolina striata*) Voy. Amer. Merid., vol. 5, pt. 5, p, 21, pl. 5, fig. 12.

A single well preserved specimen was obtained from the Moçambique samples. The species has a wide geographic distribution and has been reported at occurring in sediments ranging in age from Oligocene to Recent.

Family NONIONIDAE

Genus NONION Montfort (1808)

Nonion advenum (Cushman)

Figure 40b

1922. Cushman, J., (*Nonionina advena*) *U.S. Geol. Survey Prof. Paper* 129, p. 139, pl. 32, fig, 8.
1928. Howe, H. V., *Palaeontology*, vol. 2, p. 175.

Specimens entirely identical to those figured and described by Cushman were collected from the Palmeira sediments. The species was previously known only in the Gulf Coast Oligocene and Eocene of North America.

Nonion tuberculatum (d'Orbigny)

Figure 40c

1846. d'Orbigny, A. D., (*Nonionina tuberculata*) Foram. Foss. Bass. Tert. Vienne, p, 108. pl. 5, figs. 13, 14.

The types of this species are from the Miocene of the Vienna Basin, and specimens have been recorded from the Upper Oligocene, Miocene, and Pliocene of Central and Southern Europe. Forms collected from Moçambique closely resemble those described from Europe, although local specimens seem to evidence a slight reduction in the number of chambers of the outer whorl.

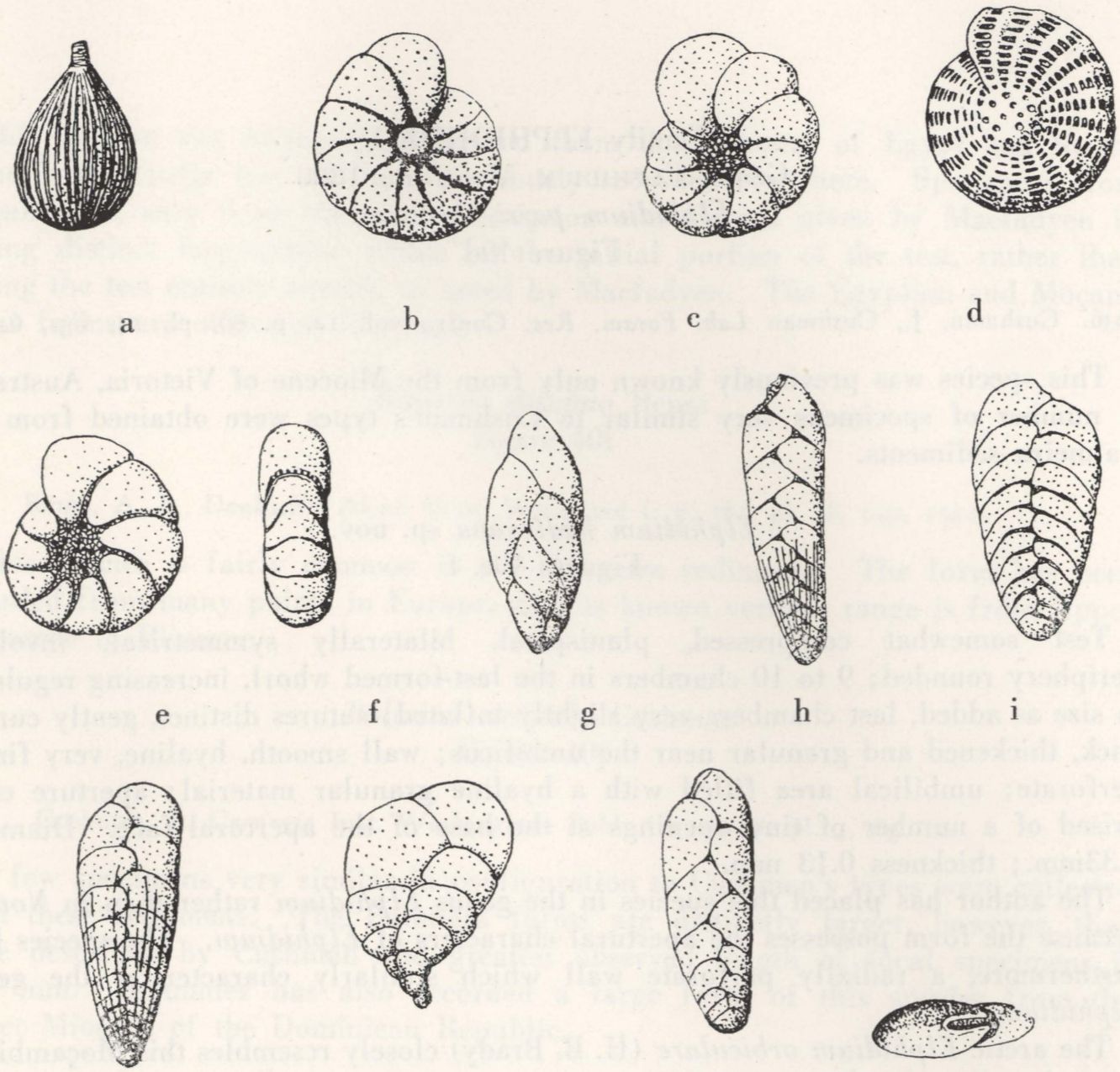


Fig. 40.

(a) *Lagena striata* (d'Orbigny); x 40.
(b) *Nonion advenum* (Cushman); x 45.
(c) *Nonion tuberculatum* (d'Orbigny); x 50.
(d) *Elphidium parri* Cushman; x 30.
(e) *Elphidium hadleyana* sp. nov.; x 60.
(f) *Elphidium hadleyana* sp. nov., edge view; x 60.
(g) *Virgulina schreibersiana* Czjzek; x 55.
(h) *Bolivina arta* Macfadyen var. *striatocola* var. nov.; x 55.
(i) *Bolivina dilatata* Reuss; x 80.
(j) *Bolivina striatula* Cushman; x 45.
(k) *Bolivina tortuosa* H. B. Brady; x 70.
(l) *Bolivina victoriana* Cushman; x 60.
(m) *Bolivina sabiana* sp. nov.; x 80.
(n) *Bolivina sabiana* sp. nov., apertural view; x 80.
(o) *Loxostomum* africanum sp. nov; x 30.
(p) *Gyroidina sp.*; x 30.
(q) *Rotalia beccarii* (Linne) var. *parkinsoniana* (d'Orbigny); x 40.

Family ELPHIDIIDAE
Genus ELPHIDIUM Montfort, 1808
Elphidium parri Cushman
Figure 40d

1936. Cushman, J., *Cushman Lab. Foram. Res. Contr.*, vol. 12, p. 80, pl. 14, figs. 6a, b.

This species was previously known only from the Miocene of Victoria, Australia. A number of specimens very similar to Cushman's types were obtained from the Palmeira sediments.

Elphidium hadleyana sp. nov.
Figures 40e, f

Test somewhat compressed, planispiral, bilaterally symmetrical, involute, periphery rounded; 9 to 10 chambers in the last-formed whorl, increasing regularly in size as added, last chambers very slightly inflated; sutures distinct, gently curved back, thickened and granular near the umbilicus; wall smooth, hyaline, very finely perforate; umbilical area filled with a hyaline granular material; aperture comprised of a number of tiny openings at the base of the apertural face. Diameter 0.33mm.; thickness 0.13 mm.

The author has placed this species in the genus *Elphidium* rather than in *Nonion* because the form possesses the apertural characters of *Elphidium*. The species has, furthermore, a radially perforate wall which similarly characterizes the genus *Elphidium*.

The arctic *Elphidium orbiculare* (H. B. Brady) closely resembles this Moçambique form, but *E. orbiculare* is much larger, possesses more chambers, and is less compressed.

Holotype: Bernard Price Institute for Palaeontological Research, Foraminifera Coll. 5-24.

Family BULIMINIDAE
Genus VIRGULINA d'Orbigny (1826)
Virgulina schreibersiana Czjzek
Figure 40g

1848. Czjzek, J., *Haidinger's Nat. Abhandl.*, vol. 2, p. 11, pl. 13, figs. 18-21.

Rare specimens belonging to this species were collected from the Palmeira sediments. The species was first described from the Miocene of the Vienna Basin, and has since been recorded from beds ranging in age from Upper Oligocene to Recent. The form has a very extensive geographical distribution and is listed as occurring in Europe, North Africa, Australia, and the Philippines.

Genus BOLIVINA *d'Orbigny* (1839)
Bolivina arta Macfadyen var. *striatocola* nov.
Figure 40h

1930. Macfadyen, W. A., Geol. Survey Egypt, p. 58, pl. 4, figs. 21a, b.

This species was originally described from the Miocene of Egypt and to the author's knowledge has not been previously recorded elsewhere. Specimens from Moçambique vary from the type description and figures given by Macfadyen in having distinct longitudinal costae on the initial portion of the test, rather than having the test entirely smooth as noted by Macfadyen. The Egyptian and Moçambique forms are otherwise identical.

Bolivina dilatata Reuss
figure 40i

1850. Reuss, A. E., *Denkschr. Akad. Wiss. Wien*, vol 1, p. 381, pl. 48, figs. 15a-c.

This species is fairly common in the Palmeira sediments. The form has been recorded from many points in Europe, and its known vertical range is from Upper Oligocene to Pliocene.

Bolivina striatula Cushman
Figure 40j

1922. Cushman, J., *Carnegie Inst. Washington, Publ.* 311, p. 27, pl. 3, fig. 10.

A few specimens very similar in configuration to Cushman's types were collected from these sediments. The Palmeira forms are distinctly larger, however, than those described by Cushman and greatest observed length of local specimens is 0.65 mm. Bermudez has also recorded a large form of this species from the Upper Miocene of the Dominican Republic.

Bolivina tortuosa H. B. Brady
Figure 40k

1881. Brady, H. B., *Quart. Micro Soc.*, vol. 21, p. 57.

A number of specimens belonging to this distinctive species were found in the Palmeira samples. The species has been recorded from many parts of the world and has a range in time from Miocene to Recent.

Bolivina victoriana Cushman
Figure 40l

1936. Cushman, J., *Cushman Lab. Foram. Res., Special Publ.* No. 6, p. 55, pl. 8, figs. 2a, b.

Cushman originally described this form from the Miocene of Victoria, Australia, and specimens from Moçambique seem identical in every respect to Cushman's type description and figures of the species.

Bolivina sabiana sp. nov.
Figures 40m, n

Test small, about 1½ times as long as broad, much compressed, periphery rounded; chambers clearly defined in the adult portion of the test, but indistinct

in the earlier portion, slightly inflated, approximately twice as broad as high, increasing rapidly in size as added, chambers few in number; sutures distinct only in the adult two-thirds of the test, conspicuously thickened, slightly depressed, strongly oblique; wall finely perforate, without ornamentation; aperture an elongate slit in the apertural face. Length 0.28 mm.; breadth 0.18 mm.; thickness 0.66 mm.

Holotype: Bernard Price Institute for Palaeontological Research, Foraminifera Coll. 5-30.

Genus LOXOSTOMUM Ehrenberg (1854)

Loxostomum africanum sp. nov.

Figure 40 o

Test elongate, about 4 times as long as broad, not compressed, initial end with a single small spine; chambers fairly distinct, very slightly inflated toward the adult end of the test, increasing greatly in size and relative height as added; sutures clearly visible, slightly if at all depressed, strongly oblique in the more adult portion of the test but less so toward the initial end; wall finely but conspicuously perforate; aperture typically terminal, elongate, with a slight lip. Length 1.05 mm., thickness 0.23 mm.

Specimens very much similar or identical to this form have been noted by R. Said as occurring in core samples from the Red Sea. Said has referred his specimens to the species, *Loxostomum porrectum* (H. B. Brady). The author, however, feels that Said's designation of the species is, in many points, incompatible with the type description and figures of *L. porrectum*. Specimens from Moçambique and also the Red Sea differ markedly from *L. porrectum* in having a basal spine, a greater number of chambers, a relatively short uniserial portion of the test, the sutures much less depressed, and the chambers less inflated.

Holotype: Bernard Price Institute for Palaeontological Research, Foraminifera Coll. 5-22.

Family ROTALIIDAE

Genus GYROIDINA *d'Orbigny* (1826)

Gyroidina sp.

Figure 40p

A single poorly preserved specimen belonging to this genus was obtained from the Palmeira samples. Ventral and apertural portions of the test had been rather badly damaged and no specific identification was found possible.

Genus ROTALIA Lamarck, 1804

Rotalia beccarii (Linne) var. *parkinsoniana* (d'Orbigny)

Figure 40q

Typical specimens of this species are present in great numbers in the Moçambique material. The form is distributed over much of the world and has a known range in time extending from Miocene to Recent.