

THE PALEOCENE AND LOWER EOCENE POLLEN FLORA OF GUYANA

BY

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ABSTRACT

A description is given of a Paleocene and Lower Eocene pollen flora of two bore-holes in Guana. Some new species are described and some remarks are made on their stratigraphical significance. Pollen diagrams are presented, one probably representing the entire Paleocene and a part of the Eocene.

INTRODUCTION

Shelter Belt no. 3 well (fig. 1) was drilled not far from Georgetown in 1959. In the interval 820—1240 feet, a sequence of clays and lignites was encountered and these have been examined on their pollen content; it is the purpose of this article to give a description of the pollen flora encountered in this interval. We also analyzed a well from Mombaka (fig. 3, diagram),

situated in the bauxite area of Reynolds Metals Cy and a few samples from the Rose Hall test well. In this way it was possible to get a reasonable insight in the composition and development of the Paleocene flora in Guyana.

A discussion of the stratigraphical relations and pollen stratigraphy in the Guiana Basin is given in van der Hammen & Wijmstra (1964).

This publication also includes some of the results of the present study. It seems therefore to be sufficient to make only a few additional remarks. The samples from the interval 820—950 feet have pollen associations which resemble those from the Lower Eocene of Colombia; there are a number of species in common (see zones C and D in van der Hammen & Wijmstra, 1964, van der Hammen, 1957a, and Gonzalez, 1966, in print). In the lower part, 1180—1240 feet, several species of the Maastrichtian of Colombia (van der Hammen, 1954) are present, but also a few species of Paleocene age. It is possible that these Paleocene species are the result of a contamination by drilling mud; another possibility is that there were already a few „Paleocene” species present in the upper part of the Maastrichtian of Guyana. It is not yet possible to choose between these two possibilities.

An important argument in favour of the indicated position of the Maastrichtian-Paleocene boundary is the fact that the pollen diagram is very similar to the diagram of the Maastrichtian-Paleocene interval in Colombia (van der Hammen, 1957a and b; van der Hammen & Wijmstra, 1964).

The drill-hole in Mombaka was made in the Kwakwani area by Reynolds Metals Cy. It is one of the most important sections in the bauxite area, because it represents the only place in Guyana where datable sediments have been found below the bauxite. The pollen bearing sediments are situated at 85—90 feet below the bauxite level, intercalated in sands and kaolinitic clays. The pollen content shows a close connection with the interval of 1140—1195 feet in the Shelter Belt no. 3 well.

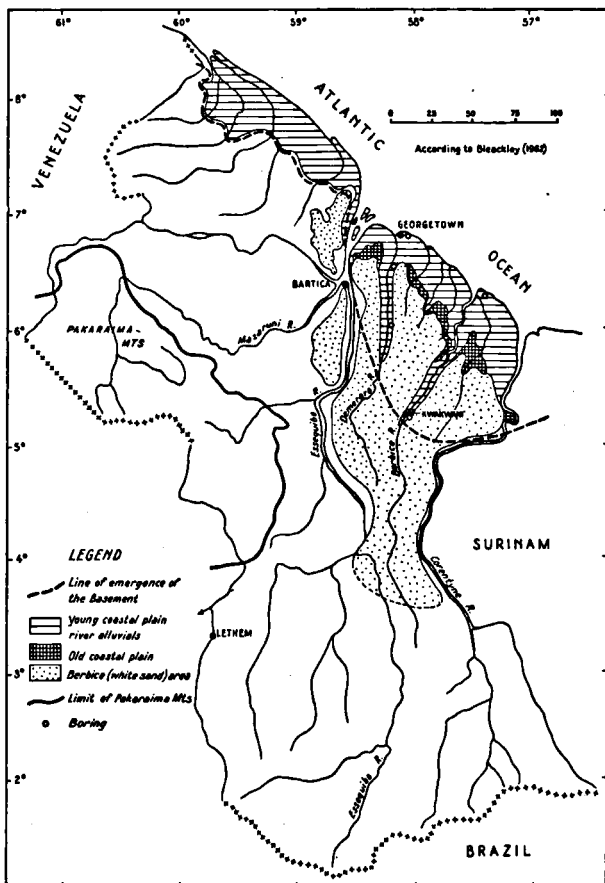


Fig. 1. General map of Guyana with drilling locations.

ACKNOWLEDGEMENTS

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WORKING METHODS

All the samples were treated with KOH; thereafter acetolysis and Bromoform separation followed; if a sample contained some lime it was submitted to a preliminary HCl treatment. For the construction of the diagrams the method introduced by van der Hammen (1957a) was used. For these PAF diagrams a total of 200 pollen grains was always counted. The following groups were analyzed.

- 1) *Psilamoncolpites medius*
- 2) *Mauritiidites franciscoi*
- 3) *Longapertites proxapertitoides*
- 4) *Proxapertites operculatus*
- 5) Angiospermae
- 6) Spores

The zonation used in these diagrams is the same as in van der Hammen & Wijmstra (1964); for a

discussion we may refer to this publication. It is the purpose of this article to give a rather extensive review of species encountered in Guyana.

For the nomenclature of the species, the system introduced by van der Hammen (1956a and b) is used, with the exception that to the subgenera generic rank has been given, following the suggestion of Pierce (1961). The terms used in this description are according to the definitions given by Iversen and Troels Smith (1950).

All the holotypes are preserved in the collection of the Palynological Department of the Rijksmuseum van Geologie en Mineralogie in Leiden, The Netherlands. All coordinates of grains refer to microscope Po 16 of the Palynological Department.

A SHORT DISCUSSION OF THE POLLEN DIAGRAMS

1) *The pollen diagram of Shelter Belt 3*

In the diagram (fig. 2) the following sequence of events can be noticed. In the lower part of the diagram, zone B₁, in the interval 1180—1240', the samples contain several species from the Maastrichtian of Colombia; also some Paleocene species are already present; some of the samples mentioned here are

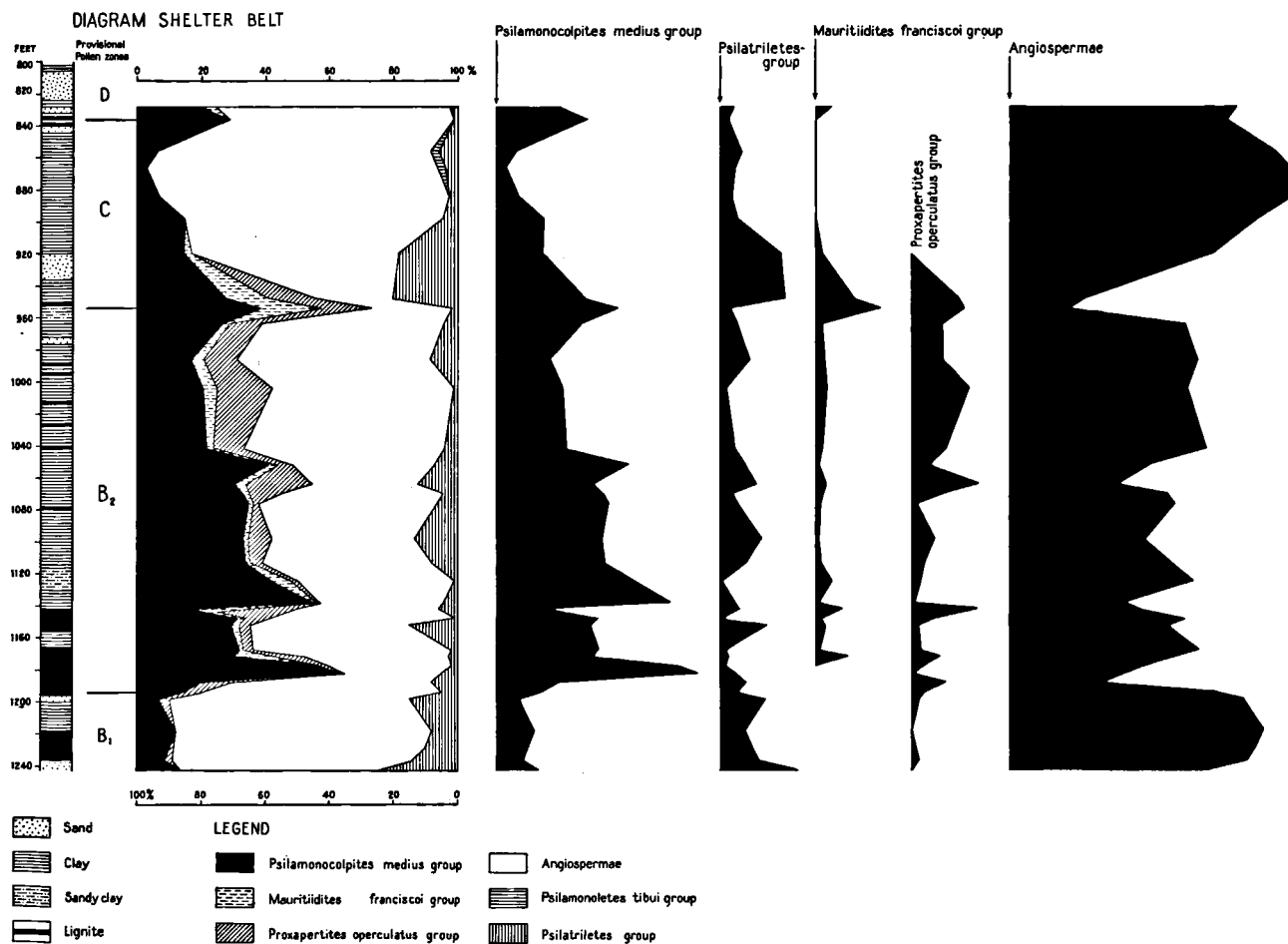


Fig. 2. Pollen diagram of the Shelter Belt no. 3 well, 820'/1260' interval.

contaminated with drilling mud, so that a definite interpretation of this interval is difficult (for further discussion see van der Hammen & Wijmstra, 1964). Pollen zone B₂ starts with a very high peak of the *Psilamonocolpites medius* group, the highest peak encountered in the whole diagram. In this zone we see the first appearance of *Mauritiidites franciscoi* and besides several new Angiosperm species.

Among these species can be mentioned *Bombacacidites annaeoides*, *Verrutricolpites isolatus*, *Gemmatricolporites divaricatus*, *Clavatricolporites leticiae*, *Ephedripites vanegensis*, etc. According to the maxima of the *Psilamonocolpites medius* group, several subzones can be noticed, which correspond very well with the subdivision of the Paleocene made by van der Hammen in Colombia (van der Hammen, 1957a & b).

Pollen zone C also starts with a high peak of the *Psilamonocolpites medius* group and also the *Mauritiidites franciscoi* group reaches a maximum, while the *Proxapertites operculatus* group has almost disappeared. In the course of this zone *Mauritiidites franciscoi* and *Proxapertites operculatus* disappear temporarily. They regain their place in the pollen spectrum at the beginning of zone D. In zone C several new species appear: *Cricotriporites guianensis*, *Retitricolporites mariposus*. Several of these species are known from the Eocene of Colombia (van der Hammen, 1957a, and Gonzalez, 1966, in print).

Zone D starts with a maximum of the *Psilamonocolpites medius* curve. For a discussion of this zone see van der Hammen & Wijmstra (1964).

2) The pollen diagram of Mombaka

The investigated section (fig. 3) gives three maxima of the *Psilamonocolpites medius* group: a lowermost top of 62 %, followed by two maxima of 53 %. The *Mauritiidites franciscoi* group is represented here with more or

less equal values as in the Shelter Belt 3 diagram. Again the percentage of *Proxapertites operculatus* (max. 2 %) is very low, but *Longapertites proxapertitoides* reaches a value of 25 %. Next to the already known groups from Shelter Belt, we see here for the first time a new group represented by *Curvimonocolpites inornatus*. This group consists of pollen grains with a proximal aperture, that is longer than the greatest length of the grain; sculpture type psilate (see Plate I, 1).

It is possible to correlate this section with that from Shelter Belt, both on lithological as well as on palynological grounds. Lithologically it should be correlated then with the interval of 1130—1200 feet of the Shelter Belt, where relatively thick lignite layers occur. The section from Mombaka shows that the sedimentation was less important here than in the North.

Comparing now the Mombaka pollen content and that from Shelter Belt 3, the former most closely resembles the interval of 1130—1165 feet of the latter. The curve of *Mauritiidites franciscoi* remains low, although *Proxapertites operculatus* represents only a very small part of the total pollen content. *Longapertites proxapertitoides* reaches here a yet unknown high percentage; *Curvimonocolpites inornatus* is also well represented. The latter is new in the diagram and up till now still unknown in the Shelter Belt section.

There is also an agreement between the Angiosperm flora of Shelter Belt and that of Mombaka; for instance here too were represented grains of *Retitricolpites cecryphalium*, *Gemmatricolpites vigdisae*, *Retistephanocolpites angeli* and *Bombacacidites cf. annaeoides* van der Hammen; furthermore *Retidiporites botulus* and *Ephedripites vanegensis* are also found.

It can thus be concluded that we are dealing here with pollen zone B₂.

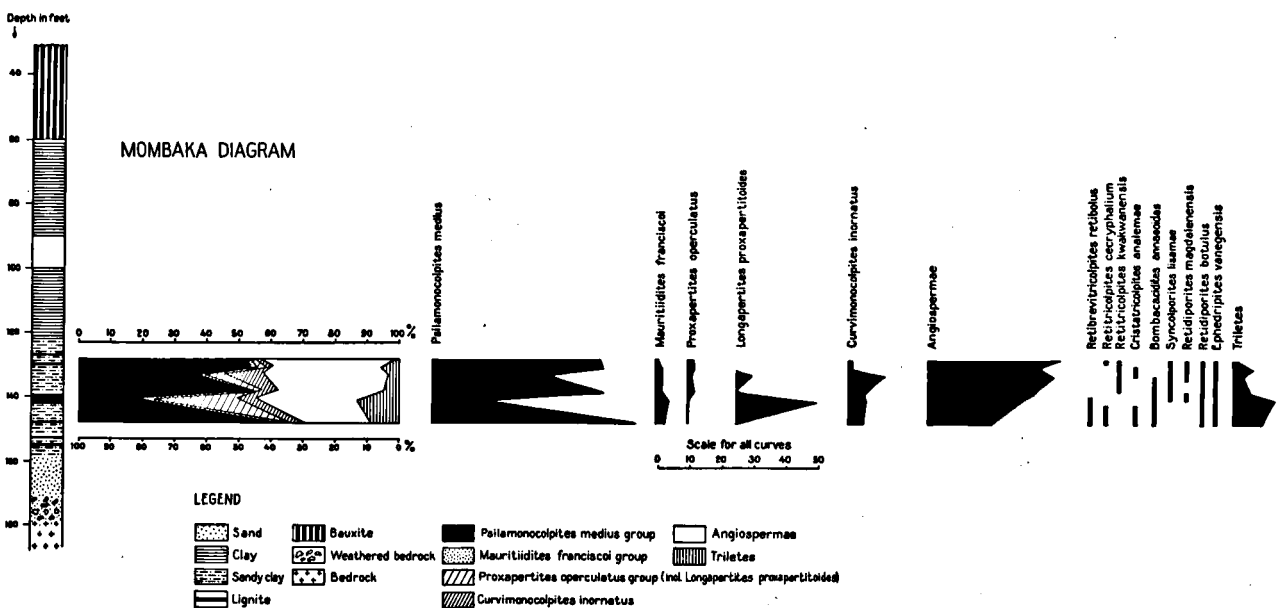


Fig. 3. Pollen diagram Mombaka.

SYSTEMATICAL PART

MONOCOLPATES

Curvimonocolpites nov.gen.

Diagnosis: Monocolpate pollen grains with a psilate sculpture. Aperture along concave side of the grain, and longer than largest size of the grain.

Genotype: *Curvimonocolpites inornatus* nov.sp.

Curvimonocolpites inornatus nov.sp. Plate I, 1.

Holotype: Slide Mombaka, Guiana, DH 18—561A, 131—135A, loc. 40.3 × 105.6 (Po 16).

Pollen grain monocolpate, sculpture type psilate (to finely scabrate). The grain has a concave and a convex side. The furrow is found at the side with the smallest radius. The thickness of the exine is 1.5 μ; tectate. Size: variation length 30—42 μ; variation width 16.5—25 μ.

Age and locality: Pollen zone B, Guiana.

TRICOLPATES

Psilatricolpites van der Hammen 1956a; van der Hammen & Wijmstra 1964.

Psilatricolpites solus nov.sp. Plate I, 4.

Holotype: Slide Shelter Belt 3, Guiana, 955—960Aa, loc. 45.3 × 102.3 (Po 16).

Pollen grain tricolpate with three short colpi, distance between ends of the colpi about 12 μ, sculpture type psilate. The thickness of the exine is 1 μ; tectate. The size of the grain is about 24 μ.

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Psilatricolpites undamarginis nov.sp. Plate I, 3.

Holotype: Slide Shelter Belt 3, Guiana, 1145—1150A, loc. 25.5 × 99.2 (Po 16).

Pollen grain tricolpate, sculpture type psilate, and with a triangular shape in polar view; the polar area is rather large. The colpi are provided with a margo. The fine perforations (< 1 μ) give an undulating aspect to the exine. The distance between the ends of the colpi is about 8.5 μ. The thickness of the exine is 3.5 μ; perforate tectate. The size of the grain is 24 μ.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Cristatricolpites nov.gen.

Diagnosis: Tricolpate pollen grains with a psilate sculpture. The grain has crestlike ridges, parallel to the colpi, and uniting around the poles.

Genotype: *Cristatricolpites analemae* nov.sp.

Cristatricolpites analemae nov.sp. Plate I, 5.

Holotype: Slide Shelter Belt 3, Guiana, 1135—1140 C, loc. 35.2 × 101.3 (Po 16).

Pollen grain tricolpate with generally indistinct delimitations of the colpi, sculpture type psilate. The

ektexine between the colpi is distinctly thicker at the equatorial belt than everywhere else. In the polar area the exine bends slightly inwards. The thickness of the exine is about 2 μ; the tectum is not wholly developed, the pila are sometimes connected at the top, sometimes not. The size of the grain varies from 33—38 μ. The distance between the ends of the colpi is about 18 μ.

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

Natural relationship: This species possibly belongs to the family of the Ctenolophonaceae.

Retitricolpites van der Hammen 1956a; van der Hammen & Wijmstra 1964.

Retitricolpites kwakwanensis nov.sp. Plate I, 7.

Holotype: Slide Mombaka, Guiana, DH 18—561A, 126—130A, loc. 34.7 × 95.9 (Po 16).

Pollen grain tricolpate with three narrow colpi, globular shaped, sculpture type coarsely reticulate (to foveolate), muri rather high: about 5 μ; diameter of elements of the muri at the base about 2 μ and at the top appr. 1 μ. The thickness of the exine is about 6 μ. The size of the grain is 40 μ. Distance between ends of the colpi about 12 μ.

Age and locality: Pollen zone B₂, Guiana.

Retitricolpites agricaulis nov.sp. Plate II, 1.

Holotype: Slide Shelter Belt 3, Guiana, 945—950 B α, loc. 42 × 104.7 (Po 16).

Pollen grain tricolpate and with a more or less triangular shape in polar view, sculpture type reticulate; the reticulum is undulating, with high muri; height of muri about 2 μ, width 0.2—0.3 μ. The lumina are very unequal, 1—2.5 μ. Distance between ends of the colpi 9.5 μ. The thickness of the exine is about 3 μ. The size of the grain varies from 31—33.5 μ. Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Retitricolpites retiaphelis nov.sp. Plate I, 2.

Holotype: Slide Shelter Belt 3, Guiana, 940—945Aa, loc. 30.3 × 104.3 (Po 16).

Pollen grain tricolpate, sculpture type reticulate, lumina small and circular shaped, muri about 1 μ high. Distance between ends of the colpi about 14.5 μ; because the colpi are usually torn open, their limits are indistinct. The thickness of the exine is about 1.5 μ; intectate. The size of the grain is 53 μ.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Retitricolpites cecryphalum nov.sp. Plate I, 6.

Holotype: Slide Shelter Belt 3, Guiana, 1115—1120Bb, loc. 49.8 × 112.7 (Po 16).

Pollen grain tricolpate, circular shaped in polar view, sculpture type coarsely reticulate to foveolate; diameter of lumina varies from 1 to 4 μ; diameter of muri at the top about 1 μ, at the base 1.5 μ. Colpi without a distinct margo; distance between ends of the colpi relatively small, about 15 μ. The thickness

of the exine is about 3μ . The size of the grain varies from $48-50\mu$.

Age and locality: Pollen zone BC, Shelter Belt 3, Guiana.

Retibrevitricolpites van Hoeken-Klinkenberg 1966.

Retibrevitricolpites retibolus nov.sp. Plate II, 4.

Holotype: Slide Mombaka, Guiana, DH 18—561A, 140—141A, loc. 43.9×107.8 (Po 16).

Pollen grain tricolpate (to tricolporate) with very short colpi and transversal furrow; almost completely spheroidal, sculpture type reticulate; diameter of lumina about 0.5μ . The thickness of the exine is about 1μ . The size of the grain is about 17μ .

Age and locality: Pollen zone B₂, Shelter Belt 3 & Mombaka, Guiana.

Verrutricolpites Pierce 1961.

Verrutricolpites isolatus nov.sp. Plate II, 5.

Holotype: Slide Shelter Belt 3, Guiana, 1135—1140C, loc. 42.3×98.9 (Po 16).

Pollen grain tricolpate with very long colpi which nearly touch each other at the poles, sculpture type verrucate; height of verrucae $3-3.5\mu$, diameter about 4.5μ . The thickness of the exine is $3.5-4\mu$; tectate, with fine columellae. The size of the grain varies from $26-30\mu$. In the slide the grains appear with a relatively dark brown colour.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Verrutricolpites verrubolus nov.sp. Plate II, 7.

Holotype: Slide Shelter Belt 3, Guiana, 930—935Aa, loc. 32×98.6 (Po 16).

Pollen grain tricolpate and globular, sculpture type verrucate. The colpi are difficult to distinguish because of the verrucae. Height of the verrucae about 4μ , diameter about 6μ . The thickness of the exine varies between 5.5 and 6μ ; tectate, columellae about 0.5μ long. The size of the grain is 41μ . In the slide the grain has a rather dark colour.

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Verrutricolpites giokiniae nov.sp. Plate II, 2.

Holotype: Slide Shelter Belt 3, Guiana, 1160—1165Ac, loc. 35.6×113 (Po 16).

Pollen grain tricolpate, sculpture type verrucate. The colpi are short and narrow and provided with thick costae. Diameter of verrucae about 1μ . Distance between ends of the colpi about 17μ . The thickness of the exine is about 3.5μ . The size of the grain (in polar view) is about 29μ . The grains have a rather irregular appearance.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Crototricolpites nov.gen.

Diagnosis: Tricolpate clavate pollen grains with a distinct „croton” pattern.

Genotype: *Crototricolpites annemariae* nov.sp.

Crototricolpites annemariae nov.sp. Plate II, 6.

Holotype: Slide Shelter Belt 3, Guiana, 955—960Aa, loc. 48.4×111 (Po 16).

Pollen grain tricolpate, nearly circular shape in polar view, sculpture type clavate (to baculate and gemmate); height of clavae about 3μ , diameter of clavae varies between $1.5-2\mu$. A particularity is the very distinct „croton” pattern, visible by moving the tube of the microscope up and down. Distance between ends of the colpi about 15μ . The thickness of the exine is about 4μ ; tectate. The size of the grain is about 48μ .

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Gemmatricolpites Pierce 1961.

Gemmatricolpites vigdisae nov.sp. Plate II, 3.

Holotype: Slide Shelter Belt 3, Guiana, 1145—1150A, loc. 27.3×104.4 (Po 16).

Pollen grain tricolpate, sculpture type gemmate (to clavate). The colpi are short and with thick costae. Gemmae about 1.5μ high. Distance between ends of the colpi about 14.5μ . The thickness of the exine is about 1μ ; intectate. The size of the grain is about $37-38\mu$.

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

STEPHANOCOLPATES

Psilastephanocolpites nov.gen.

Diagnosis: Stephanocolpate pollen grains with a psilate sculpture.

Genotype: *Psilastephanocolpites maia* nov.sp.

Psilastephanocolpites maia nov.sp. Plate III, 1.

Holotype: Slide Shelter Belt 3, 875—880Aa, loc. 35.5×104.8 (Po 16).

Pollen grain stephanocolpate with four colpi, sculpture type psilate; the polar area is relatively small; in polar view the grain gives the impression of a „cross”. The thickness of the exine is about 2μ . The size of the grain is about 25μ .

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Retistephanocolpites nov.gen.

Diagnosis: Stephanocolpate pollen grains with a reticulate sculpture. They differ from *Stephanocolpites* van der Hammen 1954 by the absence of aequatorial costae.

Genotype: *Retistephanocolpites angeli* nov.sp.

Retistephanocolpites angeli nov.sp. Plate III, 3.

Holotype: Slide Shelter Belt 3, Guiana, 1165—1170 Bd, loc. 47.3×109.1 (Po 16).

Pollen grain stephanocolpate with four or five short colpi and circular in polar view; sculpture type reti-

culate; the muri are about 2.5μ high, the diameter of the lumina is about 1μ . The distance between the ends of adjacent colpi is about 18μ ; the polar area measures about 30μ . The thickness of the exine is appr. 3.5μ ; tectate. The size of the grain is about 45.5μ (varies between about 35 and 50μ).

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Foveostephanocolpites nov.gen.

Diagnosis: Stephanocolpate pollen grains with a foveolate sculpture.

Genotype: *Foveostephanocolpites typicus* nov.sp.

Foveostephanocolpites typicus nov.sp. Plate III, 2.

Holotype: Slide Shelter Belt 3, Guiana, 945—950 B α , loc. 41.5×104 (Po 16).

Pollen grain stephanocolpate probably with seven colpi (usually difficult to distinguish), provided with costae; globular shaped, sculpture type finely foveolate. The thickness of the exine is about 4μ ; tectate. The size of the grain is about 25μ .

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Foveostephanocolpites perfectus nov.sp. Plate III, 4.

Holotype: Slide Shelter Belt 3, Guiana, 1115—1120Bb, loc. 38.2×113.2 (Po 16).

Pollen grain stephanocolpate with six colpi, shape circular in polar view, sculpture type foveolate. The grain has a thick margo bordering the colpi. Polar area about 14μ . The thickness of the exine is about 3.5μ . The size of the grain is about 29μ .

Age and locality: Pollen zone B_{1, 2}, and C, Shelter Belt 3, Guiana.

Gemmastephanocolpites van der Hammen & Garcia 1965.

Gemmastephanocolpites asteroformis nov.sp. Plate III, 5.

Holotype: Slide Shelter Belt 3, Guiana, 1195—1200B, loc. 32×110.1 (Po 16).

Pollen grain stephanocolpate with six colpi, sculpture type gemmate to clavate.

Shape circular in polar view; a narrow margo is present. The gemmae are 1 — 1.5μ high; some grains have very thin and small gemmae, sometimes resembling scabrae. The polar area measures about 10μ . The thickness of the exine varies between 2 — 3μ ; probably intectate. The size of the grain varies from 34 — 40μ .

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

DIPORATES

Retidiporites Varma & Rawat 1963.

Retidiporites botulus nov.sp. Plate III, 8.

Holotype: Slide Shelter Belt 3, Guiana, 1165—1170Bd, loc. 44×100.5 (Po 16).

Pollen grain diporate, bean-shaped, pores usually not clearly visible, sculpture type reticulate; diameter of lumina up to max. about 2.5μ . The exine is thin;

intectate. The size of the type specimen is about $20.5 \times 11 \mu$.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

TRIPORATES

Cricotriporites nov.gen.

Diagnosis: Triporate pollen grains with a psilate sculpture and with a circular circumference. The grains are provided with distinct circular to oval pores with annulus and/or costae pori.

Genotype: *Cricotriporites guianensis* nov.sp.

Cricotriporites guianensis nov.sp. Plate IV, 4.

Holotype: Slide Shelter Belt 3, Guiana, 890—895Aa, loc. 42.5×102.8 (Po 16).

Pollen grain triporate, shape globular to oblate, sculpture type psilate, sometimes finely scabrate. Pores ovally shaped and provided with an annulus and costae pori; exceptionally an operculum is present, size of pore opening (without operculum) is about 2.5μ long and 2μ wide, thickness of annulus about 1μ . The thickness of the exine is 1 — 2μ . The size of the grain is 16 — 25μ .

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Echitriporites van der Hammen 1956a; van Hoeken-Klinkenberg 1964.

Echitriporites guianensis nov. sp. Plate III, 7.

Holotype: Slide Shelter Belt 3, Guiana, 1275—1295Cb, loc. 28.5×95.4 (Po 16).

Echitriporites guianensis obviously is closely related to a species from the Upper Cretaceous of Nigeria, *Echitriporites trianguliformis*, which was described earlier by Mrs. van Hoeken-Klinkenberg (1964). Although *Echitriporites guianensis* is very similar to the Nigerian species, it differs in magnitude.

The size of *Echitriporites guianensis* in polar view is about 24 — 26μ . The size of *Echitriporites trianguliformis* in polar view is about 32 — 35μ . The sculpture type of both *Echitriporites guianensis* and *Echitriporites trianguliformis* is echinate; the number of echinae of the species described here is less than that of the Nigerian species; their length is 1.5μ . The three pores have a vestibulum. In polar view the exine is often folded in the direction from pore to pore, thus accentuating the triangular shape of the grain. The thickness of the exine is about 1μ .

Age and locality: Pollen zone BC, Shelter Belt 3, Guiana.

STEPHANOPORATES

Echistephanoporites nov.gen.

Diagnosis: Stephanoporate pollen grains with an echinate sculpture, and circular pores provided with an annulus.

Genotype: *Echistephanoporites alfonsi* nov.sp.

Echistephanoporites alfonsi nov.sp. Plate V, 4.

Holotype: Slide Shelter Belt 3, Guiana, 955—960Aa, loc. 38.2 × 101.6 (Po 16).

Pollen grain stephanoporate with four pores provided with an annulus, sculpture type echinate; diameter of pore (without annulus) about 2.5 μ; the annulus is about 2.5 μ broad. The thickness of the exine is about 1 μ; tectate. The size of the grain varies from 18—19 μ.

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Verrustephanoporites nov.gen.

Diagnosis: Stephanoporate pollen grains with a verrucate sculpture (and therefore different from *Ulmipollenites* Wolff 1934).

Genotype: *Verrustephanoporites simplex* nov.sp.

Verrustephanoporites simplex nov.sp. Plate IV, 2 and III, 10.

Holotype: Slide Shelter Belt 3, Guiana, 1255—1260Aa, loc. 40 × 101.4 (Po 16).

Pollen grain stephanoporate with four pores; sculpture type verrucate. In polar view almost square-shaped, with the pores in the corners; pores provided with thick costae pori; diameter of the pore opening about 2 μ. Verrucae 2—2.5 μ in diameter and about 0.5—1 μ high. The thickness of the exine is about 1.5 μ. The size of the grain varies between about 22 and 28 μ.

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

TRICOLPORATES

Retitricolporites van der Hammen 1956a; van der Hammen & Wijmstra 1964.

Retitricolporites costatus nov.sp. Plate III, 9.

Holotype: Slide Shelter Belt 3, Guiana, 1185—1190Ab, loc. 42.8 × 107.1 (Po 16).

Pollen grain tricolporate, prolate, with three pores in the equatorial plane and three very short and almost indistinguishable colpi; sculpture type micro-reticulate. Costae pori are present; diameter of pore opening about 2.5 μ. The thickness of the thin exine is about 0.5 μ; columellae very fine. The size of the grain is long 25 μ × lat. 17 μ.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Retitricolporites mariposus nov.sp. Plate V, 5.

Holotype: Slide Shelter Belt 3, Guiana, 940—945Aa, loc. 32.2 × 102 (Po 16).

Pollen grain tricolporate, subtriangular shape with convex sides in polar view, sculpture type reticulate to foveolate. Often the colpi are split open and then no pores can be seen. The thickness of the exine varies from 1.5—2 μ; semitectate, length of columellae

about 1 μ. Distance between ends of the colpi about 5 μ. The size of the grain is 25—30 μ.

Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Bombacidites Couper 1960.

The grains described as *Retitricolporites annae* (van der Hammen 1954) van der Hammen & Garcia 1965 and as *Retitricolporites annaeoides* van der Hammen & Garcia 1965, are transferred here to the genus *Bombacidites* Couper 1960.

A genus *Bombacites* for these grains, as proposed provisionally by van der Hammen and Garcia (1965), seems not to be necessary, as they fit in the existing genus of Couper.

Bombacidites annaeoides (van der Hammen & Garcia 1965) emend. Plate IV, 1.

For a description of this grain see van der Hammen & Garcia 1965.

Clavatricolporites nov.gen.

Diagnosis: Tricolporate pollen grains with a clavate sculpture.

It differs from *Ilex pollenites* in having a layer of smaller sculpture elements of two separate size classes.

Genotype: *Clavatricolporites leticiae* nov.sp.

Clavatricolporites leticiae nov.sp. Plate IV, 3.

Holotype: Slide Shelter Belt 3, Guiana, 1135—1140C, loc. 49.4 × 99.0 (Po 16).

Pollen grain tricolporate, although only in a few cases the pores are well perceivable; sculpture type clavate and baculate to gemmate; the base of the large clavae is not visible because of the many small baculae; diameter of clavae varies from 2—2.5 μ, the length varies between 2 and 2.5 μ. The polar area measures about 9 to 11 μ. The thickness of the exine is about 4 μ; tectate. The size of the grain is about 37—40 μ.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Gemmatricolporites nov.gen.

Diagnosis: Tricolporate pollen grains with a gemmate sculpture.

Genotype: *Gemmatricolporites berbicensis* nov.sp.

Gemmatricolporites berbicensis nov.sp. Plate IV, 5.

Holotype: Slide Shelter Belt 3, Guiana, 1135—1140C, loc. 31.4 × 111 (Po 16).

Pollen grain tricolporate, subspheroidal, sculpture type gemmate; the gemmae are approximately 3.5 μ high and have a diameter of about 2.5 μ.

The thickness of the exine is about 5 μ; intectate. The size of the grain is: long about 40 μ, lat. about 31 μ. The grains appear dark coloured in the slides.

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

Gemmatricolporites divaricatus nov.sp. Plate IV, 6.

Holotype: Slide Shelter Belt 3, Guiana, 1185—1190Ab, loc. 35.5 × 107 (Po 16).

Pollen grain tricolporate, sculpture type gemmate; the gemmae are scattered and have a diameter of about 2.5 μ. The thickness of the exine is about 5 μ. The size of the grain varies from 25—35 μ.

Age and locality: Pollen zone B_{1, 2}, Shelter Belt 3, Guiana.

Striatricolporites van der Hammen 1956a.

Diagnosis: Tricolporate pollen grains with a striate sculpture.

The genotype is a species based on a recent pollen grain.

Potonié thinks that this is not advisable. In the case that the foundation on a recent species should be proved not to be correct, we would hold *Striatricolporites pimulis* as lectogenotype.

Striatricolporites pimulis nov.sp. Plate IV, 7.

Holotype: Slide Shelter Belt 3, Guiana, 1275—1294Cb, loc. 42.3 × 95 (Po 16).

Pollen grain tricolporate, sculpture type striate. Intercolpia in aequatorial limb more or less flattened. The thickness of the exine is about 1.5 μ; tectate; the thickness of the ectexine is about 0.5 μ. The size of the grain varies from 18—19 μ.

Age and locality: Pollen zone (B₁?) B₂, Shelter Belt 3, Guiana.

STEPHANOCOLPORATES

Psilastephanocolporites nov.gen.

Diagnosis: Stephanocolporate pollen grains with a psilate sculpture.

Genotype: *Psilastephanocolporites fissilis* nov.sp.

Psilastephanocolporites fissilis nov.sp. Plate V, 3.

Holotype: Slide Shelter Belt 3, Guiana, 875—880Aa, loc. 37.4 × 103.0 (Po 16).

Pollen grain stephanocolporate with 8—10 furrows and pores, sculpture type psilate; the equatorial furrow is about 3.5 μ wide, the polar area is small. The thickness of the exine is about 2.5 μ; intectate. The size of the grain is about 53 μ long and lat. appr. 30 μ. Age and locality: Pollen zone C, Shelter Belt 3, Guiana.

Clavastephanocolporites nov.gen.

Diagnosis: Stephanocolporate pollen grains with a clavate sculpture.

Genotype: *Clavastephanocolporites ambigens* nov.sp.

Clavastephanocolporites ambigens nov.sp. Plate III, 6.

Holotype: Slide Shelter Belt 3, Guiana, 1145—1150A, loc. 36.7 × 104 (Po 16).

Pollen grain stephanocolporate with 5 or 6 colpi, sculpture type clavate. The colpi are perpendicularly cut by an equatorial furrow, with costae aequato-

riales, in the endexine; the ectexine of the equatorial furrow arches up; the clavae of the ectexine sometimes fuse near the apertures; the endexine is rather thin. The thickness of the exine is about 2.5 μ. The size of the grain is about 28 μ. Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

Foveostephanocolporites nov.gen.

Diagnosis: Stephanocolporate pollen grains with a foveolate sculpture resp. lacunae.

Genotype: *Foveostephanocolporites liracostatus* nov.sp.

Foveostephanocolporites liracostatus nov.sp. Plate V, 1.

Holotype: Slide Shelter Belt 3, Guiana, 1115—1120Bc, loc. 30.5 × 110.8 (Po 16).

Pollen grain stephanocolporate with ten colpi, sculpture type foveolate or with lacunae. The width of the intercolpia at the equator of the grain is about 9.5 μ. An equatorial furrow is present; the exine bordering the equatorial furrow bulges out. The polar area is small. The thickness of the exine is about 3.5 μ. The size of the grain is about 51 μ.

Age and locality: Pollen zone B₂, Shelter Belt 3, Guiana.

SYNCOLPORATES

Syncolporites van der Hammen 1954; van der Hammen & Garcia 1965.

Syncolporites lisamae van der Hammen 1954. Plate V, 2. For a description see van der Hammen & Garcia 1965.

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PLATES

Curvimonocolpites inornatus I,1

Retitricolpites retiaphelis I,2

Psilatricolpites undamarginis I,3

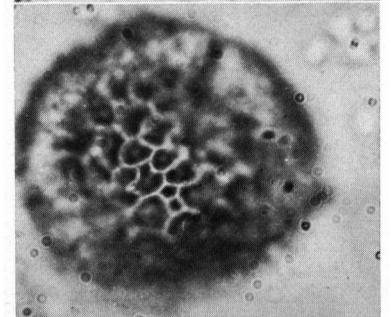
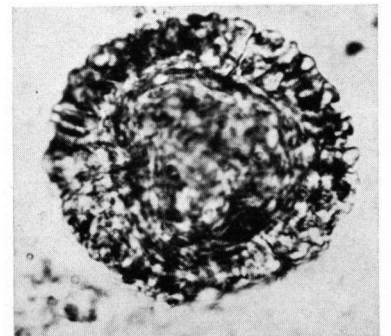
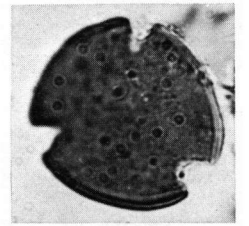
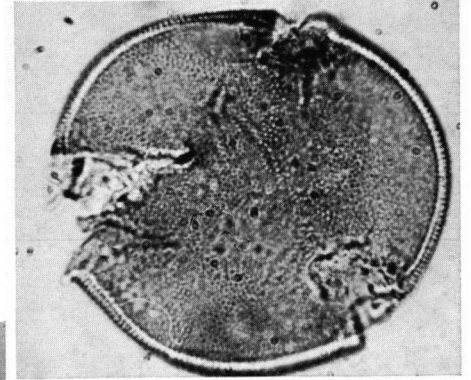
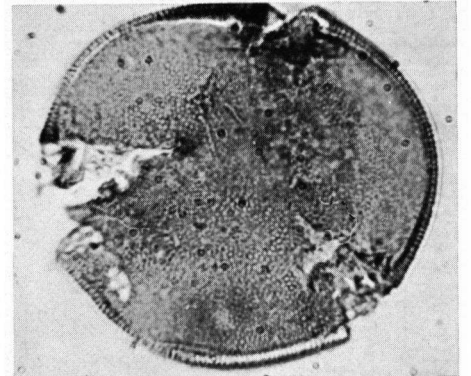
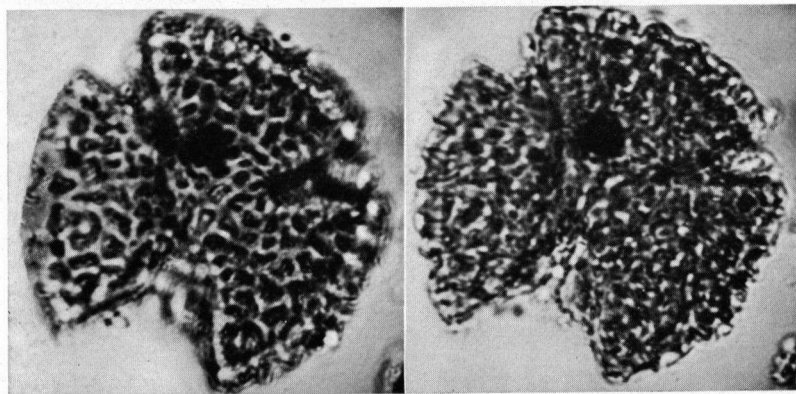
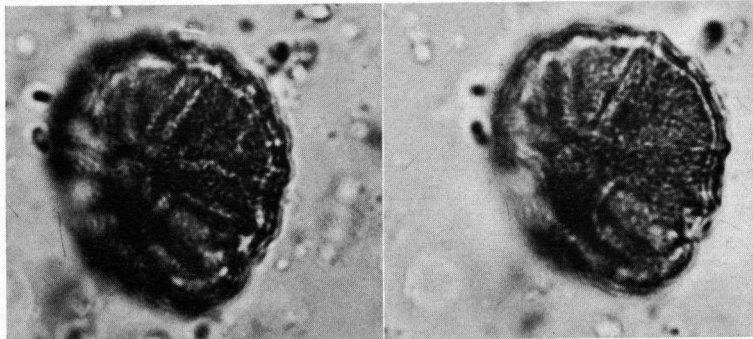
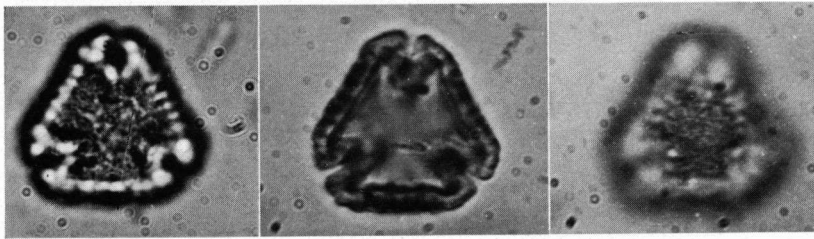
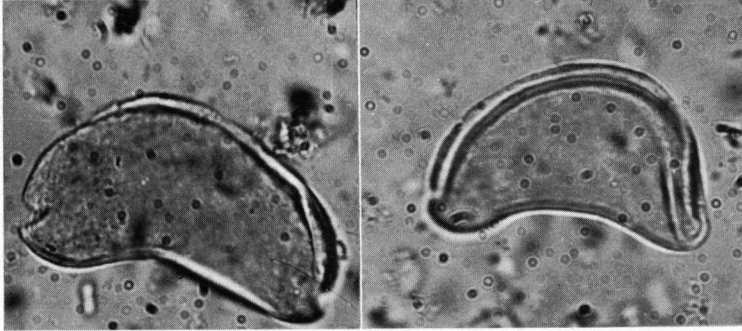
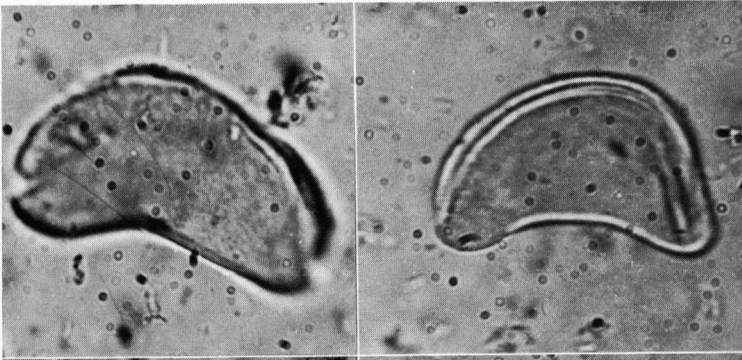
Psilatricolpites solus I,4

Cristatricolpites analemae I,5

Retitricolpites kwakwanensis I,7

Retitricolpites cecryphalium I,6

PLATE I



Retitricolpites agricaulis II,1

Verrutricolpites
giokinae II,2

Gemmatricolpites vigdisae II,3

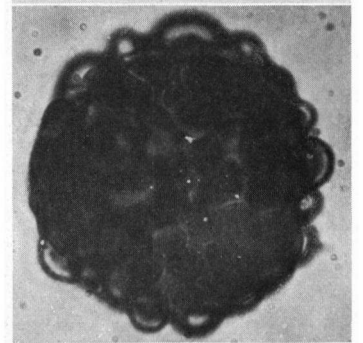
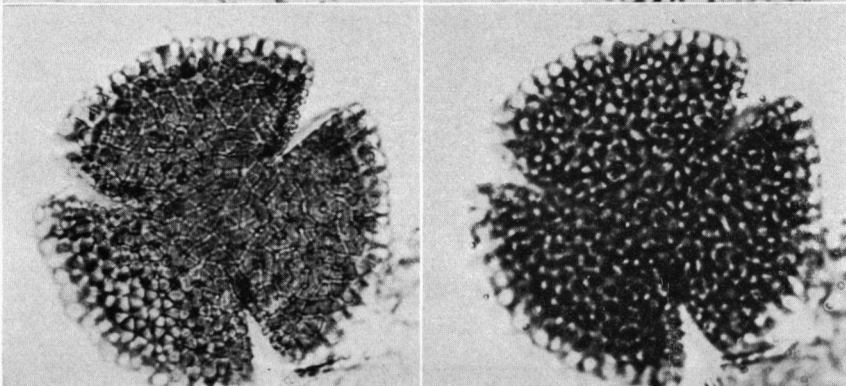
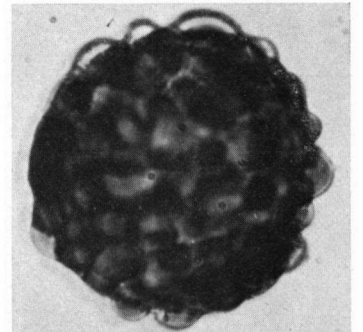
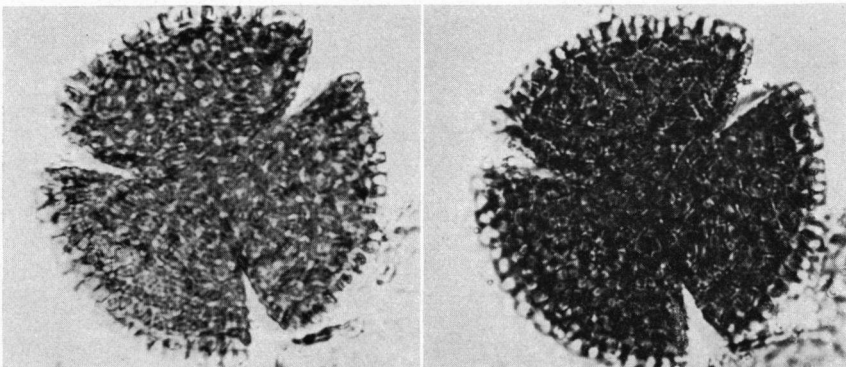
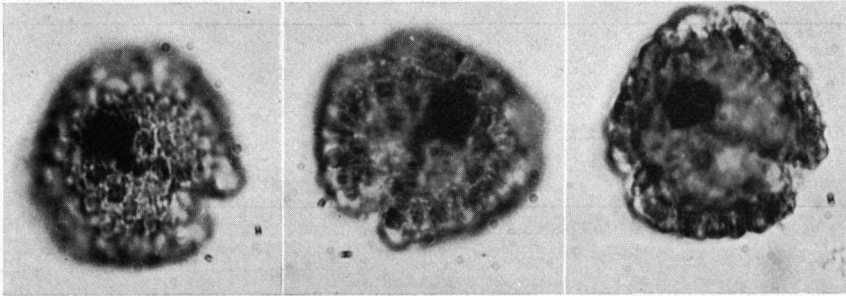
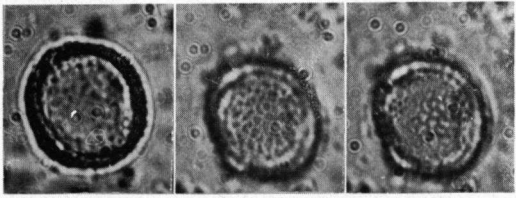
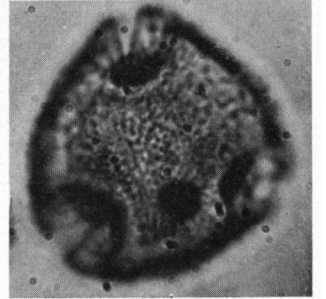
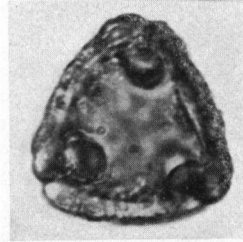
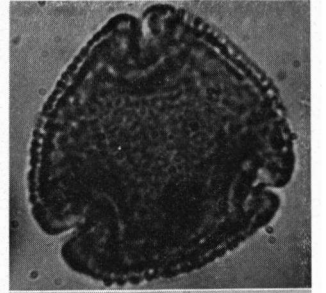
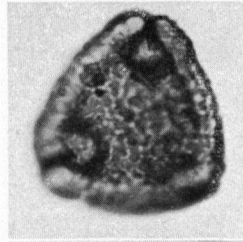
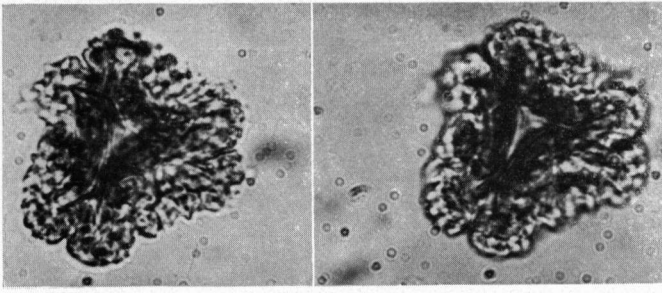
Retibrevitricolpites retibolus II,4

Verrutricolpites isolatus II,5

Crototricolpites annemariae II,6

Verrutricolpites verrubolus II,7

PLATE II



Psilastephanocolpites maia III,1

Foveostephanocolpites typicus III,2

Retistephanocolpites angeli III,3

Foveostephanocolpites perfectus III,4

Gemmastephanocolpites asteroformis III,5

Clavastephanocolporites ambigens III,6

Echitriporites guianensis III,7

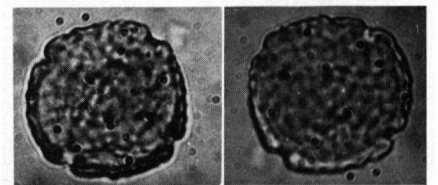
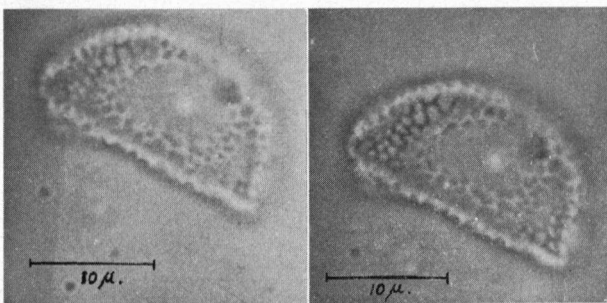
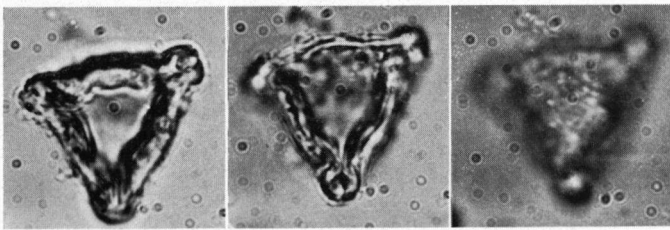
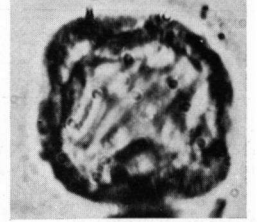
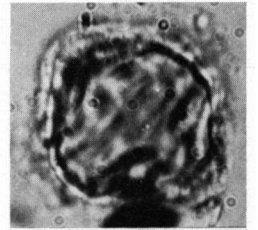
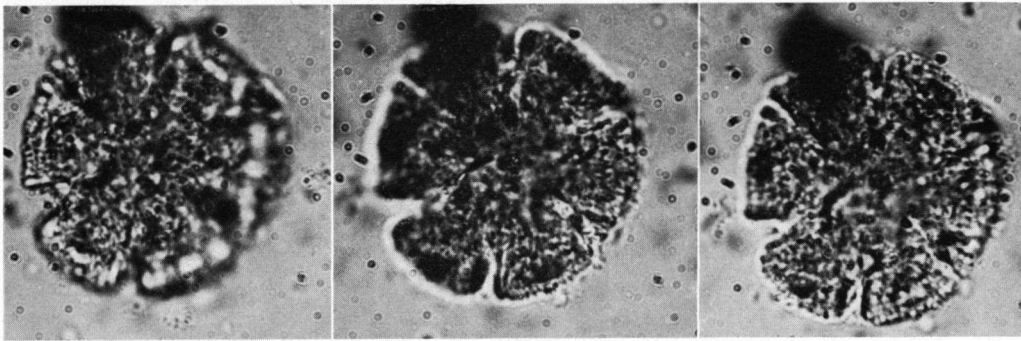
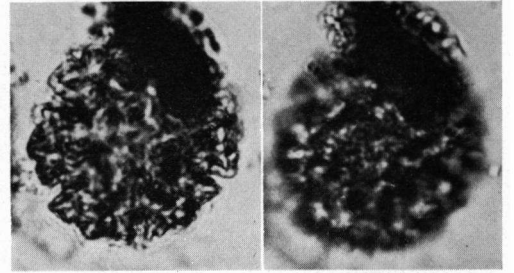
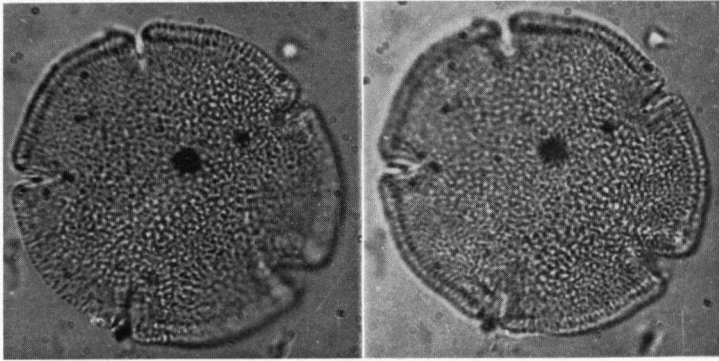
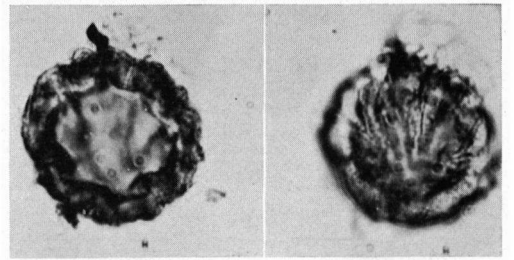
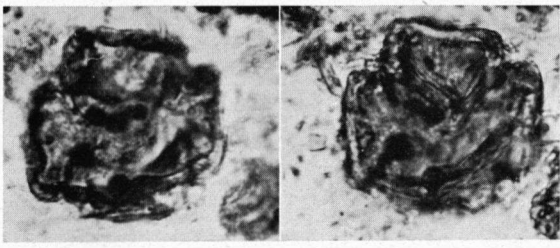
Retitricolporites costatus III,9

Retidiporites botulus III,8

Verrustephanoporites simplex III, 10

1000 x (with the exception of photo 8)

PLATE III



Bombacacidites annaeoides IV,1

Verrustephanoporites simplex IV,2

Clavatricolporites leticiae IV,3

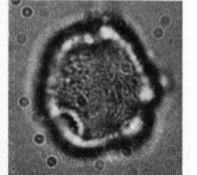
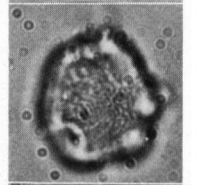
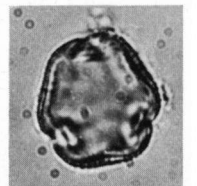
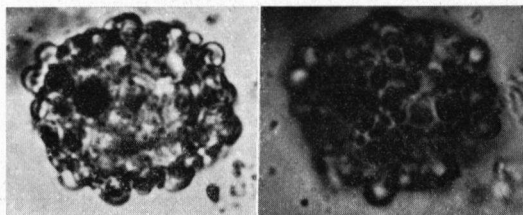
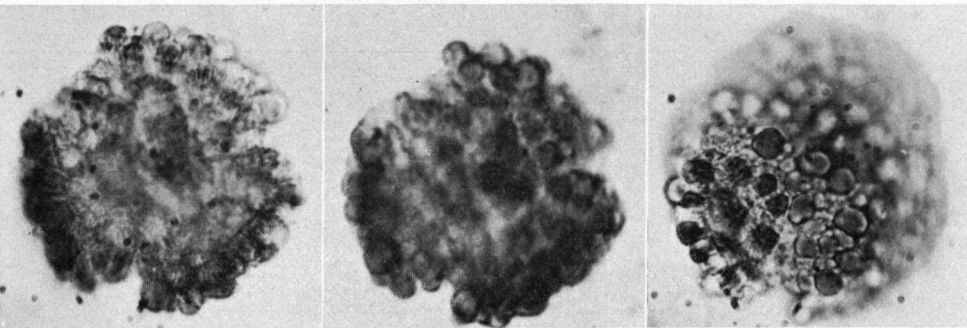
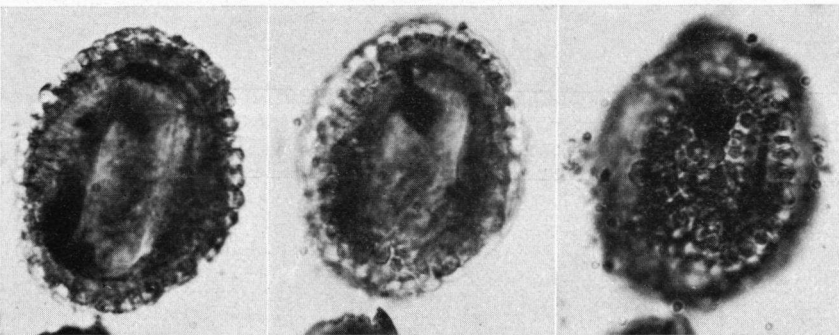
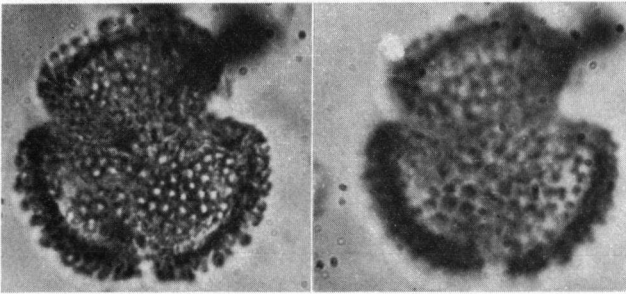
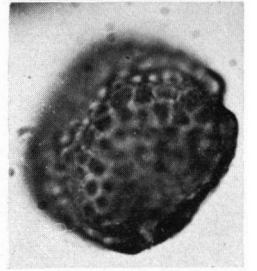
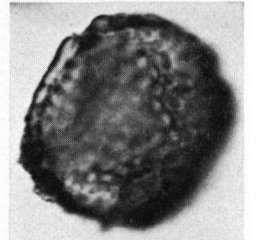
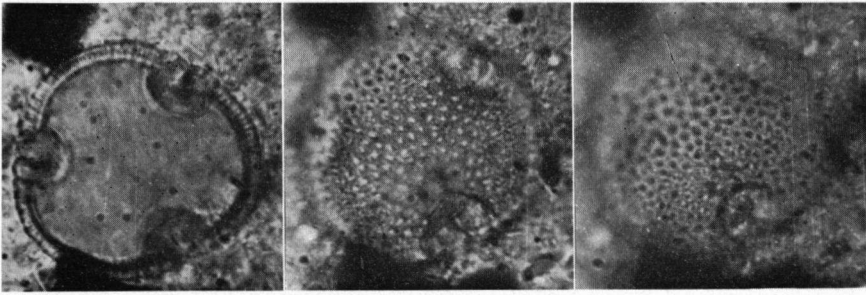
Cricotriporites guianensis IV,4

Gemmatricolporites berbicensis IV,5

Gemmatricolporites divaricatus IV,6

Striatricolporites pimulis IV,7

PLATE IV



Foveostephanocolporites liracostatus V,1

Syncolporites lisamae V,2

Psilastephanocolporites fissilis V,3

Echistephanoporites alfonsi V,4

Retitricolporites mariposus V,5

PLATE V

