33. SPORES AND POLLEN FROM CENOZOIC SEDIMENTS OF THE FALKLAND PLATEAU,
SITE 511, DEEP SEA DRILLING PROJECT LEG 71

Greta M. Bratzeva, Geological Institute of the U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.

ABSTRACT

Cenozoic sediments penetrated by Hole 511 in the southern part of the Atlantic Ocean (Falkland Plateau, Maurice Ewing Bank) were analyzed for palynomorphs. Upper Eocene and lower Oligocene palynoassemblages are characterized and correlated to synchronous palynoassemblages of similar character from South America, Australia, and New Zealand. The lower Oligocene assemblages show a close relationship to those of other Southern Hemisphere continents except Africa. They also contain reworked Permian and Mesozoic species.

The Eocene and early Oligocene climate of the study area was moderately warm and humid, very similar to the southern part of present-day New Zealand; a vertical zonation probably existed.

INTRODUCTION

Samples of Cenozoic sediments from Sites 511 and 512 were analyzed for palynomorphs. At Site 512, all 58 samples of middle Eocene and Miocene carbonate sediments were almost devoid of spores and pollen. In the Cenozoic sediments penetrated by Hole 511, 52 samples were analyzed over the interval from 3 to 185.5 meters. The 10 samples from the uppermost part of the section (Cores 1-3) contained no spores or pollen. In the lower part of the section (Cores 12-21), the spore and pollen content was also insignificant—analysis yielded no more than 50 specimens per sample. Analysis of 17 samples of sediment from the middle part of the section (Cores 4-12) found a relatively large number of spores and pollen, distributed as shown in Table 1.

Preservation of spores and pollen from the Cenozoic sediments at Site 511 is satisfactory, but many specimens are corroded and pitted.

The absence or negligible amounts of spores and pollen in some samples cannot yet be explained. It is clearly not related to lithological composition, which remains the same throughout the interval.

Stratigraphic subdivision of the Cenozoic sediments at Site 511 was accomplished by means of planktonic foraminifers, nannoplankton, radiolarians, and diatoms. The Paleocene–Eocene (Core 21), upper Eocene (Cores 17–20), and lower Oligocene (Cores 2–16) deposits penetrated are composed of diatomaceous oozes and clays.

METHODS

Sediments were treated with 10% HCl to dissolve carbonates, disaggregated by boiling in 10% KOH, elutriated in a pyrophosphate solution (Na2HPO4), separated in a heavy liquid (CdF2 solution (NO32- P2O7)) with specific gravity 2.2, and treated by the acetolysis method. Release from silicates was carried out with cold HF. The residue obtained was covered with glycerine. Stable spores and pollen specimens were prepared from a glycerine emulsion on glycerine gel, numbered, and stored in the collection of the Paleofloristic Laboratory of the Geological Institute of the U.S.S.R. Academy of Sciences, No. GIN 3948.

The study and microphotography were carried out using a Mikroskop D-16 biological microscope, magnification 7×60. Microphotographs of spores and pollen are presented in Plates 1–17.

CHARACTERISTICS AND COMPARISON OF PALYNOASSEMBLAGES OF THE FALKLAND PLATEAU

Only one specimen—a spore of Cyathidites sp. 1—was present in Sample 511-21-1, 40–42 cm (Paleocene–Eocene sediments).

Upper Eocene

Eleven samples were analyzed from upper Eocene sediments (Cores 17–20): 511-20, CC; 511-20-3, 34–36 cm; 511-20-2, 34–36 cm; 511-20-1, 34–36 cm; 511-18, CC; 511-18-2, 34–36 cm; 511-18-1, 34–36 cm; 511-17, CC; 511-17-3, 17–19 cm; 511-17-2, 96–98 cm; 511-17-1, 96–98 cm. The examination showed very small numbers of spores and pollen, from 10 to 40 specimens per sample. Sample 511-18-2, 34–36 cm was the most productive (39 specimens). Despite the small number of isolated microfossils, all samples contain spores of diverse systematic composition: Leiotriletes microadieniensis, Cyathidites minor, Stereisporites antiquasporites, Leptolepidites verrucatus, Giecheniidites senonicus, Cingulatites australis, Lygodidites sp., Cyathidites sp. 1, Deltoideosporites sp., Concavissimisporites sp., Osmundacidites sp., Lycopodiumsporites sp., Trilites sp. 1, and Form sp. 1 (item 61 in the list of species). Equal amounts of gymnosperm and angiosperm plant pollen are present within the assemblage. Gymnosperms are represented by three genera (Podocarpidites marwickii, Dacrydium cupressinum, and Phyllocladidites mawsonii), angiosperms by two (Nothofagidites asperus, N. sp. 2, Tricolpites sp. 3).

Many species of this palynoassemblage, such as G. senonicus, Leiotriletes microadieniensis, Cingulatites australis, Podocarpidites marwickii, Phyllocladidites mawsonii, D. cupressinum, and N. asperus, are representative of Eocene deposits in Argentina (Freile, 1972; Archangelsky, 1972, 1973a; b; Archangelsky and Romero, 1974b; Menendes and Caccavari de Filice, 1975; 1 Ludwig, W. J., Krasheninnikov, V. A., et al., Init. Repts. DSDP, 71: Washington (U.S. Govt. Printing Office).
<table>
<thead>
<tr>
<th>No. Specimensa</th>
<th>Spores (%)</th>
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<tr>
<td>95</td>
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<td>50.0 70.0</td>
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<tr>
<td>100</td>
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**Table 1. Quantitative chart of spores and pollen in lower Oligocene sediment samples from Hole 511.**

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<thead>
<tr>
<th>Spores and Pollen</th>
<th>Core/Section (interval in cm)</th>
<th>11-1, 25-27</th>
<th>11,1, 44-42</th>
<th>42-96</th>
<th>96-92</th>
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<td>1.35</td>
<td>61</td>
<td>73</td>
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<td>100</td>
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<td>78</td>
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<td>52.0</td>
<td>49.0</td>
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<tr>
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<td>15.0</td>
<td>30.0</td>
<td>10.0</td>
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<tr>
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<tr>
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<td>16.0</td>
<td>19.0</td>
<td>19.0</td>
<td>22.5</td>
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</tbody>
</table>

**Note:** + indicates that content is <0.5%.

a Where total N is < 100, column entries specify no. specimens found; for a total N > 100, column entries are percentages.
Romero, 1977), Chile (Takahashi, 1977), New Zealand (Couper, 1953, 1960), and Australia (Cookson, 1964). The rest of the forms, mainly spores, are widely distributed in both the Mesozoic and the Cenozoic deposits of the Southern Hemisphere. Archangelsky (1973b) showed that in Eocene palynoassemblages from Argentina Nothofagidites and gymnosperm pollen (Podocarpidites, Dacrydiumites, and Phyllocladidites) were predominant. He noted that some Eocene horizons were rich in spores. The Eocene climate in the region of Argentina was moderate and humid. The composition of upper Eocene palynoassemblages at Site 511 testifies to a relatively humid, warm, temperate climate.

Palynological data do not show an abrupt change at the upper Eocene/lower Oligocene boundary, but appreciable change is apparent somewhat higher at 108.5 meters, in lower Oligocene sediments. It is difficult to locate this change precisely, because no samples from 109.5–128.5 meters (Cores 13–14) were available for study (core recovery 3.3% and 0.5%, respectively).

Oligocene

Over the interval from 3 to 147.5 meters (Cores 511-1-16), Hole 511 sediments belong to the lower Oligocene. In this interval, 37 samples were analyzed: 7 proved barren, 13 contained small amounts of pollen
and spores (up to 50 specimens), and 17 had from 50 to 215 specimens.

Four samples (511-16, CC; 511-16-2, 33-35 cm; 511-16-1, 33-35 cm; 511-15-1, 28-30 cm) were analyzed at the base of the lower Oligocene section, from 128.5 to 147.5 meters (Cores 15-16).

The numbers of spores and pollen in the samples were very small; they are most abundant in Sample 511-16-2, 33-35 cm. As in the previous palynoassemblage, spores predominate: Cyathidites patagonicus, C. minor, Gleichenidites senonicus, Cingutriletes australis, Stereosporites antiquaspais, Leptopectides sp., Osmunda sp., and Polyopodiidites sp. Gymnosperm pollen was few (Pinuspollenites, Podocarpus sp., Dacrydium cupressinum, Phyllocladidites mawsonii). Numbers and diversity of angiosperm plants increase somewhat: Nothofagidites diminuta, N. sp. 2, Proteacidites sp., Casuarinidites sp., Chenopodiaceae, Tricolpites cf. brevicolpus, T. fissilis, T. sp. 3.

In the superjacent sediments, beginning at Sample 511-12-2, 25-27 cm and representing the interval from 6-108.5 meters, the ratio of the major groups in the palynoassemblage (spores, gymnosperms, and angiosperms) changes sharply. Pollens of gymnosperm plants are most abundant (35-60%), spores are second (21-50%), and then pollen of angiosperm plants (10-31%). This ratio remains the same throughout the rest of the lower Oligocene section (see Table 1).

Spores were the most diverse taxonomically, with 27 genera and 64 species identified. These consisted primarily of Leiotriletes microadiennis, cf. Lygodium? labrum, Cyathidites patagonicus, Deltoideospora cf. delicata, Stereosporites conceptionensis, Verrucatosporites transdanubicus, Lycopodiumsporites cf. euminus, Neoraistrickia sp., Trilites cf. paravallatus, Cingutriletes australis, and Polyopodiidites speciosus. These have all been described from Cenozoic deposits, mostly of Paleogene age, in Argentina (Archangelsky, 1972), Chile (Takehashi, 1977), Western Europe (Kruttsch, 1959; Kedves, 1973), North America (Frederiksen, 1975) and from the Neogene of Africa (Sah, 1967). The spores Cyathidites minor, C. australis, S. antiquaspais, and Leptopectides verrucatus are distributed worldwide in Mesozoic and Cenozoic sediments. Some species, such as Gleichenidites senonicus and Clavifera triplex, are present both in Paleogene (Archangelsky, 1972, 1973a) and Cretaceous sediments (Dettmann and Playford, 1969; Burger, 1976). Dicksonia aff. squarrosa is distributed in New Zealand from Maestrichtian to Recent times (Couper, 1960). The majority of species (Concavissimiraporites punctatus, C. granulatus, Osmundaciti des wellmanii, Foveosporites canalis, Klukisporites pseudoreticulatus, Cicatricosporites australis, Gleichenidites cf. G. trigutus, Foraminisporites wonghaghiensis, F. dailyi, Cingutriletes clausus, Trilobosporites pururgerulosus, and Lycopodiumsporites rosewoodensis) are characteristic of the Cretaceous of Australia (Dettmann, 1963; Burger, 1974, 1976; Playford et al., 1975; Dettmann and Playford, 1969), New Zealand (Couper, 1960), England (Stover, 1964; Playford, 1971), and Canada (Pocock, 1964; Vagvolgyi and Hills, 1969).

The presence, in the lower Oligocene palynoassemblage, of spores that, judging by the data in the literature, are not peculiar to Cenozoic deposits can be explained in one of two ways: either the plants to which these spores belonged existed in the flora of the Southern Hemisphere longer than previously recognized, or the spores have been reworked from older deposits. In the samples from the lower Oligocene, the spores have been redeposited from older deposits. In the samples from the upper Oligocene, the pollen composition of angiosperm plants is similar and is close to that of the gymnosperm pollen from the underlying Oligocene and upper Eocene sediments. In addition, the palynoassemblage in this upper interval is more diverse taxonomically; it contains 10 genera and 18 species of gymnosperm plant pollen. Predominant are Podocarpidites marwickii, P. microteculoidata, Dacrydium cupressinum, D. aff. cupressinum, Phyllocladidites mawsonii, P. mawsonii cf. verrucatus, and Microcachrydites antarcticus. There are small amounts of M. parvus, Triscaccharalis microsaccatus, Pinuspollenites, and Ephedra sp., and single grains of Tsugaepollenites and Araucariates. All the above species, except M. parvus, are representative of the Cretaceous and Tertiary of the Southern Hemisphere. M. parvus is distributed in Oligocene, Neogene, and Pleistocene deposits of New Zealand (Couper, 1960).

The pollen composition of gymnosperm plants in the palynoassemblage is relatively diverse—24 genera, 57 species. Nothofagidites pollens belonging to three groups (menziesii, brassi, and fusca) are predominant. Among them are: N. asperus, N. diminuta, N. crannwellae, N. spinosus, N. brachispinulosa, N. cincta. These are widespread in Cenozoic sediments of New Zealand (Couper, 1960), Australia (Cookson, 1958), Argentina (Archangelsky and Romero, 1974a,b; Menendes and Cacavari de Filice, 1975; Romero, 1977), and the Antarctic (Cranwell, 1964). In the recent flora of New Zealand, Australia, and South America, there are no representatives of the genus Nothofagidites of the menziesii and brassi groups, which are known only in the flora of New Guinea and New Caledonia. The predominance of Nothofagidites is peculiar to Tertiary deposits of New Zealand and Australia (Couper, 1960). Almost all samples contain pollen of the genera Casuarinidites, Psialticolporites, Rhoipites, Tricolporopollenites, and Tricolpites. Pollen of the genera Proteacidites, Myrtaceidites, and Rhizophora occur in much smaller amounts. Very typical pollens of Paraspididites cf. psilatus, Ilex, Alnus, Polygonum, and Chenopodiaceae were observed in some of the samples. Pollens of the angiosperms from the lower Oligocene sediments at Site 511 are, therefore, peculiar to Paleogene deposits of New Zealand (Couper, 1953, 1960), Australia (Cookson, 1958, 1964), and South America (Archangelsky, 1973a, b; Romero, 1977; Takehashi, 1977).
Thus, the lower Oligocene palynoassemblage of Site 511 is very similar to the palynoassemblages from Paleogene deposits of all Southern Hemisphere continents except Africa, and to the palynoassemblage found in Oligocene and lower Miocene sediments penetrated by Hole 270, DSDP Leg 28 (Kemp, 1974).

CONCLUSIONS

The composition of the palynoassemblages suggests that during the accumulation of Paleogene sediments on the Falkland Plateau, the nearest continent (or islands) was covered by forest vegetation similar in composition to the Recent vegetation of New Zealand, and especially of its southern island. In the northern part of this island there are at present subtropical forests consisting of conifers (Podocarpus, Dacridium) and broad-leaved plants, and in the southern part subantarctic forests with various types of Nothofagus (Campbell, 1948). The wide distribution of Nothofagus indicates that the Eocene and Oligocene climate in the area of the Falkland Plateau was moderately warm and humid. It is likely that vertical zonality existed as well.

During the Paleogene, Argentina (Romero, 1977) and Australia (Cranwell, 1964) also supported forest vegetation similar to that existing today in New Zealand. This study of the composition of the late Eocene-lower Oligocene palynoassemblages of Site 511 in conjunction with the data of other researchers (Cranwell, 1964; Romero, 1977) has enabled us to establish a close relationship among floras of the southern parts of South America, New Zealand, Antarctica, and Australia for the Paleogene period. The connection between South America and New Zealand was made via Antarctica and Australia (Cranwell, 1964) also supported forest vegetation similar in composition to the Recent vegetation of New Zealand, and especially of its southern island. Such a relationship is evidenced by the present-day forests in which Nothofagus is present and which cover the southern margins of Argentina, Chile, Australia, and New Zealand. On the Antarctic continent, they have been destroyed by glaciation.

TAXONOMIC LIST

In the numbered list of taxa that follows, the geological distribution of previously defined species is given. The distribution of the taxa is presented in Table 1.

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<td>cf. Lygodium labratus</td>
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<td>28.</td>
<td>Verrucatosporites</td>
<td>sp. 1 (Plate 4, Fig. 2)</td>
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<td>29.</td>
<td>cf. Verrucatosporites</td>
<td>sp. 2 (Plate 4, Fig. 4)</td>
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<td>Genus</td>
<td>CONCAVISPORITES</td>
<td>Pflug, 1952, Delcourt and Sprumont, 1955</td>
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<td>30.</td>
<td>Concavisporites</td>
<td>sp. (Plate 4, Fig. 5)</td>
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</table>
Genus **FOVEOSPORITES**
31. Foveosporites canalis Balme, 1957 (Plate 4, Fig. 3). Mid-Cretaceous of Australia (Playford et al., 1975).

Infraturma **MURORNATI** R. Potonié and Kremp, 1954

Genus **LYCOPODIUMSPORITES** Thiégart ex Delcourt and Sprumont, 1955
33. Lycopodiumsporites rosewoodensis (de Jersey) (Plate 4, Fig. 10). Lower Cretaceous of Australia (Burger, 1974).
34. Lycopodiumsporites sp. (Plate 4, Figs. 8–9).

Genus **KLUKISPORITES** Couper, 1958
35. Klukisporites pseudoreticulatus Couper, 1958 (Plate 4, Fig. 11). Cretaceous sediments of England (Playford, 1971).

Genus **CICATRICOSISPORITES** Potonié and Gelletich, 1933
36. Cicatricosisporites australiensis (Cookson), Potonié, 1956 (Plate 4, Fig. 12). Neocomian–Cenomanian of Australia (Hill et al., 1969), and England (Playford, 1971); Neocomian of Australia (Burger, 1975, 1973, 1974).
37. Cicatricosisporites sp. (Plate 4, Fig. 13).

Infraturma **TRICRASSATI** Dettmann, 1963

Genus **GLEICHENIDITES** (Ross ex Delcourt and Sprumont), Dettmann, 1963
38. Gleichenidites senonicus Ross, 1949 (Plate 5, Figs. 1–2). Eocene of Argentina (Archangelsky, 1972); Cretaceous deposits of the eastern to north Atlantic Ocean (Kotova, 1978).
39. Gleichenidites circinidites (Cookson), Burger, 1976 (Plate 5, Fig. 5). Cenomanian of Australia (Burger, 1976).

Genus **CLAVIFERA** Bolkhovitina, 1966
41. Clavifera tripex (Bolkhovitina), Bolkhovitina, 1966 (Plate 5, Fig. 13). Cretaceous of Australia (Dettmann and Playford, 1969); Paleocene of Argentina (Archangelsky, 1973); Cenomanian of Australia (Burger, 1976).

Genus **NEORAISTRICKIA** Potonié
42. Neoraistrickia sp. (Plate 5, Fig. 8). Paleocene of Argentina (Archangelsky, 1973).

Infraturma **AURICULATI** Schopf, emend. Dettmann, 1963

Genus **TRILOBOSPORITES** Pant ex Potonié, 1956
43. Trilobosporites purverulentus (Verbitskaya), Dettmann, 1963 (Plate 5, Fig. 6). Lower Cretaceous of Canada (Playford, 1971).
44. Trilobosporites sp.? (Plate 5, Fig. 7).

Genus **TRILITES** Erdtman ex Couper, emend. Dettmann, 1963
46. cf. Trilites sp. 1 (Plate 5, Figs. 11–12).
47. cf. Trilites sp. 2 (Plate 6, Figs. 1–2).

Genus **DICKSONIA** L’Hartier
48. Dicksonia aff. *squamerosa* Swartz (Plate 6, Figs. 3–4). Maestrichtian to present-day New Zealand (Couper, 1960); bottom sediments in the western part of the Pacific Ocean (Korennev, 1964).
49. Dicksonia sp. (Plate 6, Figs. 5–6).

Infraturma **CINGULATI** R. Potonié and Klaus, emend. Dettmann, 1963

Genus **FORAMINISPORIS** Krutzsch, 1959
50. Foraminisporis *dailyi* (Cookson and Dettmann), Dettmann, 1963 (Plate 6, Fig. 7). Cretaceous sediments of Australia (Hill et al., 1968) and Canada (Playford, 1971).
51. Foraminisporis sp. (Plate 6, Fig. 9).
52. Foraminisporis *wanthagicensis* (Cookson and Dettmann), Dettmann, 1963 (Plate 6, Fig. 8). Aptian–Albian of Australia (Dettmann, 1963); Cretaceous sediments of Australia (Hill et al., 1968); Mid-Cretaceous of North America (Norris, 1967; Singh, 1971); Cenomanian of Australia (Burger, 1976).

Genus **CYATHEACIDITES** (Cookson), Potonié, 1956
53. Cyatheacidites sp. 1 (Plate 7, Figs. 1–2).
54. Cyatheacidites sp. 2 (Plate 7, Figs. 3–4).

Genus **CINGUTRILETES** Pierce, emend. Dettmann, 1963
55. Cingutriletes *australis* (Cookson) Archangelsky, 1972 (Plate 7, Fig. 5). Eocene of Argentina (Archangelsky, 1972).
56. Cingutriletes *clavus* (Balme), Dettmann, 1963 (Plate 7, Fig. 6). Lower Cretaceous of Australia (Burger, 1974) and Canada (Vagvolgyi and Hills, 1969).

Infraturma **SCULPTATOMONOLETI**

Genus **POLYPODIIDITES** Ross, 1949, emend. Potonié, 1966
57. Polypodiidites *speciosus* (Harris), Archangelsky, 1972 (Plate 7, Fig. 9). Eocene of Argentina (Archangelsky, 1972).
58. Polypodiidites sp. (Plate 7, Figs. 7–8).

Turma **HILATES** Dettmann, 1963
Genus **AEQUITRIRADITES**
59. Aequitriradites sp. (Plate 8, Fig. 8).

Incertae sedis
60. Trilites sp. E; Koreneva, 1964 (Plate 8, Fig. 1). Bottom sediments in the western part of the Pacific Ocean (Korennev, 1964).
61. Form sp. 1 (Plate 8, Figs. 2–3).
62. Form sp. 2 (Plate 8, Figs. 4–5).
63. Form sp. 3 (Plate 8, Fig. 6).
64. Form sp. 4 (Plate 8, Fig. 7).

Anteturma **POLLENITES** Potonié, 1931
Infraturma **SACCIZONATI** Bhardwaj, 1957

Genus **TSUGAEPOLLENITES** Potonié and Venitz, emend. Potonié, 1958
65. Tsugaepollenites sp. (Plate 9, Fig. 1).

Subturma **DISACCITES** Cookson, 1947

Genus **PINUSPOLLENITES** Raatz, 1937
66. Pinuspollenites sp. (Plate 9, Fig. 2).

Genus **PODOCARPIDITES** Cookson ex Couper, 1953
67. Podocarpidites *marwickii* Couper, 1953 (Plate 9, Fig. 3). Lower Cretaceous to lower Oligocene of New Zealand (Couper, 1953); Albian to upper Eocene of New Zealand (Couper, 1960); Maestrichtian–Paleocene of Argentina (Freile, 1972); Upper Cretaceous–Paleocene of Patagonia (Archangelsky and Romero, 1974a); Eocene of Argentina (Romero, 1977).
69. Podocarpidites *microreticuloidata* Cookson, 1947 (Plate 9, Fig. 6). Upper Cretaceous–Paleocene of Patagonia (Archangelsky and Romero, 1974a); Eocene of Argentina (Romero, 1977).
70. Podocarpidites sp. (Plate 9, Fig. 11).
Genus **DACRYDIUMITES** (Cookson and Pike), Harris, 1965

71. *Dacrydiumites* sp. (Plate 9, Fig. 7).

Genus **DACRYDIUM** Soland.

72. *Dacrydium cupressinum* Soland. ex Forst. (Plate 9, Figs. 8–9). Lower Oligocene to Recent of New Zealand (Couper, 1953); bottom sediments in the western part of the Pacific Ocean (Koreneva, 1964); Maastrichtian–Paleocene–Eocene of Patagonia (Archangelsky and Romero, 1974a, b); Upper Cretaceous–Paleogene of Argentina (Romero, 1977).

73. *Dacrydium* aff. *capitis* Soland. ex Forst. (Plate 9, Fig. 10). Maestrichtian to present-day New Zealand (Couper, 1960); bottom sediments in the western Pacific Ocean (Koreneva, 1964).

Genus **PHYLLIOCLODIDITES** Cookson, 1947

74. *Phyllocladidites mawsonii* Cookson, 1947 (Plate 10, Fig. 1). Lower Cretaceous–lower Oligocene of New Zealand (Couper, 1953); Cretaceous–Tertiary of Patagonia (Archangelsky and Romero, 1974a, b); Lower Cretaceous–Pliocene of Argentina (Romero, 1977).

75. *Phyllocladidites mawsonii f. verrucosa* Cookson, 1947 (Plate 10, Fig. 2). Paleocene–Eocene of Argentina (Romero, 1977).

76. *Phyllocladidites* sp. (Plate 10, Figs. 3–4).

Genus **TRISACCITES** (Cookson), Menendez, 1968

77. *Trisaccites microsaccatus* (Couper) Couper, 1960 (Plate 10, Fig. 8). Maastrichtian–Paleocene–Eocene of Patagonia (Archangelsky and Romero, 1974a, b).

78. *Trisaccites* sp. (Plate 10, Fig. 9).

Subturmata **AZONALETES** Luber, emend. R. Potonié and Kremp, 1954

79. *Araucariacites* sp. (Plate 10, Fig. 10). Maestrichtian to present-day New Zealand (Couper, 1960); bottom sediments in the western part of the Pacific Ocean (Koreneva, 1964).

Genus **ARAUCARIACITES** Cookson, 1947

80. *Araucariacites* sp. (Plate 10, Fig. 9).

Genus **MONOCOLPITES** Iversen and Pflug, 1953

81. *Liliacidites* sp. (Plate 9, Fig. 7). Paleocene–Oligocene of Australia (Cookson, 1950); middle Oligocene to Miocene of New Zealand (Couper, 1960).

82. *Ephedra* sp. (Plate 10, Figs. 11–12).

Subturmata **MONOCOLPATES** Iversen and Treoels-Smith, 1950

83. *Monosulcites* sp. (Plate 10, Fig. 13).

Genus **MONOSULCITES** Cookson ex Couper, 1958

84. *Liliacidites* sp. (Plate 9, Fig. 10).

Subturmata **TRIPTYCHES** Naumova, 1939, emend. R. Potonié, 1960


86. *Tricorpites* alveolatus Couper, 1953 (Plate 10, Fig. 16). Lower Eocene to Miocene of New Zealand (Couper, 1953).


89. *Tricorpites fissilis* Couper, 1960 (Plate 11, Fig. 5). Upper Senonian of New Zealand (Couper, 1960).


91. *Tricorpites* sp. 1 (Plate 11, Figs. 9–10).

92. *Tricorpites* sp. 2 (Plate 11, Figs. 11–12).

93. *Tricorpites* sp. 3 (Plate 11, Figs. 13–16).

94. *Tricorpites* sp. 4 (Plate 11, Fig. 17). 

95. *Tricorpites* sp. 5 (Plate 11, Figs. 18–19).

Genus **TRICOLPOROPOLLENITES** Thomson and Pflug, 1953

96. *Tricorporellites* sp. 1 (Plate 12, Fig. 1).

97. *Tricorporellites* sp. 2 (Plate 12, Fig. 2).

98. *Tricorporellites* sp. 3 (Plate 12, Figs. 3–4).

99. *Tricorporellites* sp. 4 (Plate 12, Fig. 5).

Genus **TRICOLPORITES**

100. *Tricorpites* scabrustris Harris, 1965 (Plate 12, Figs. 6–8). Paleocene–Eocene of Australia (Harris, 1965).

Genus **PSILATRICOLPORITES** (van der Hammen), Pierce, 1961

101. *Psilatricorpololites* sp. (Plate 12, Figs. 9–10).

Genus **RHOPITITES** Wodehouse, 1933


105. *Rhopites* sp. (Plate 12, Figs. 17–18).

Genus **SENIPITES** Srivastava


Genus **TETRACOLPORITES** Couper, 1953

107. *Tetracolporites* sp. (Plate 12, Figs. 22–23).

Genus **POROSSES** Naumova, emend. R. Potonié, 1960


Subturmata **TRICOLPORITES** Couper, 1953


110. *Casuarinidites* sp. (Plate 13, Figs. 5–7).

Genus **PROTEACIDITES** Cookson ex Couper 1954

111. *Proteacidites minimus* Couper, 1954 (Plate 13, Figs. 8–9). Upper Oligocene to lower Pleistocene of New Zealand (Couper, 1960).


114. *Proteacidites* sp. (Plate 13, Figs. 12–13).

Genus **MYRTACEIDITES** Cookson and Pike, 1954

115. *Myrtaceidites* sp. (Plate 13, Figs. 16–17).

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REFERENCES


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Plate 7. (All specimens magnified ×1000.) 1-2. Cyatheacidites sp. 1, Sample 511-6-2, 40-42 cm. 3-4. Cyatheacidites sp. 2, Sample 511-4-3, 25-27 cm. 5. Cingutriletes australis (Cookson), Archangelsky, 1972, Sample 511-12-1, 25-27 cm. 6. Cingutriletes clavus (Balme), Dettmann, 1963, Sample 511-12-1, 25-27 cm. 7-8. Polypodiidites sp., Sample 511-5-1, 20-22 cm. 9. Polypodiites speciosus (Harris), Archangelsky, 1972, Sample 511-12-1, 25-27 cm.
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Plate 15. (All specimens magnified ×1000.)

1-5. Parsonsidites cf. psilatus Couper, 1960 (1-2) Sample 511-5-1, 20-22 cm. (3-5) Sample 511-6-3, 40-42 cm.


8-9. Rhizophora sp. 1, Sample 511-9-3, 92-96 cm.

10-11. Rhizophora sp. 2, Sample 511-5-1, 20-22 cm.

12. Alnus sp., Sample 511-12-1, 25-27 cm.

13. Ilex sp., Sample 511-5-1, 20-22 cm.

14-16. Chenopodiaceae, Sample 511-5, CC.

Plate 16. (All specimens magnified × 1000.) 1-3. Form sp. 1, Sample 511-6-2, 40-42 cm. 4-5. Form sp. 2, Sample 511-9-7, 42-46 cm. 6. Form sp. 3, Sample 511-9-4, 92-96 cm. 7-8. Form sp. 4, Sample 511-5-4, 20-22 cm. 9. Form sp. 5, Sample 511-9-7, 42-46 cm.