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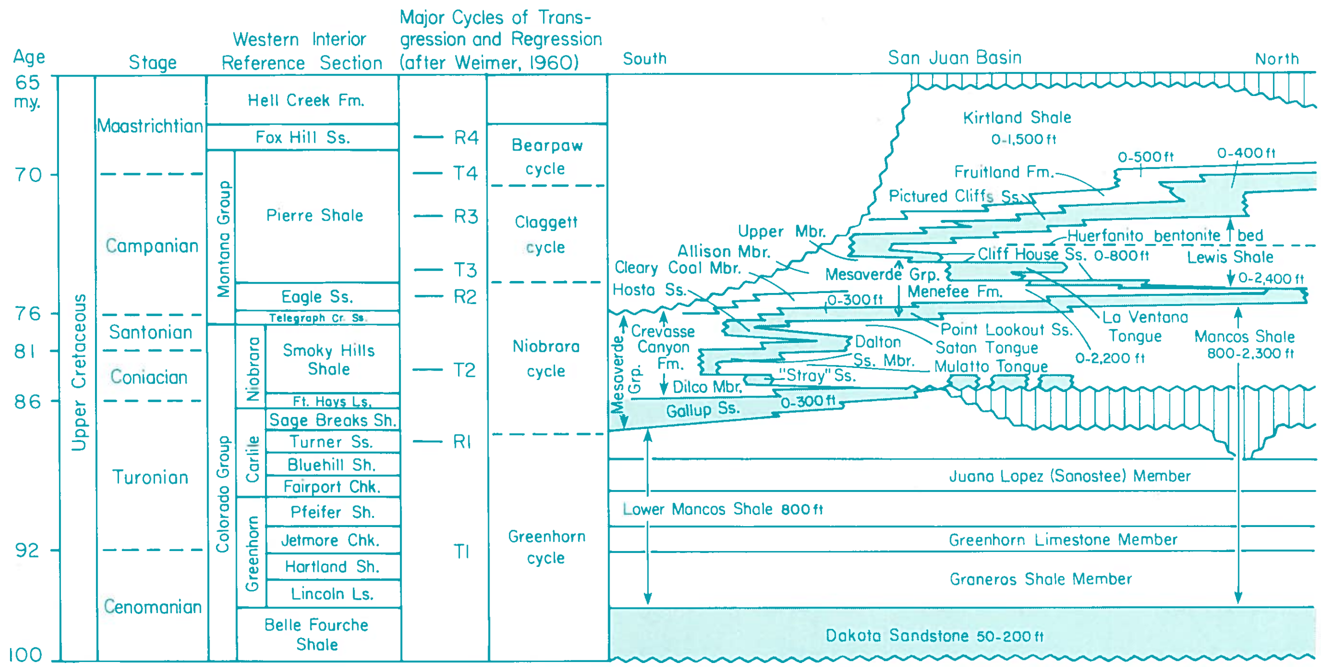
by Abolfazl Jameossanaie



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Abstract

Ninety-four samples from four core sections in the South Hospah coal-bearing deposits, McKinley County, New Mexico, yielded a rich palynomorph assemblage. One hundred and seventy-two species assigned to 91 form genera of spores, gymnospermous pollen, and angiospermous pollen are described in this paper. Two new genera, eight new species, nine new combinations, and two new ranks are proposed. One hundred and fourteen of the described palynomorphs are either stratigraphically restricted to the Cretaceous System, or their oldest reported occurrence is in the Cretaceous. The palynomorph assemblages indicate a Late Cretaceous (early Campanian) age for the South Hospah deposits. Assignment of these strata to the Menefee Formation is appropriate according to palynological evidence. The source of some of the clastic material in the South Hospah deposits can be interpreted based on the occurrence of palynomorphs recycled from older strata.

Introduction

Previous studies

Most of the palynological studies pertinent to the Upper Cretaceous strata of western North America have been summarized in Table 1; Fig. 1 shows their geographic locations.

Only a few palynological studies have been published on the Cretaceous rocks of New Mexico (Fig. 2). Anderson (1960) studied pollen, spores, and a few dinoflagellates from some outcrops of the Lewis Shale and the Kirtland, Ojo Alamo, and Nacimiento Formations in the vicinity of Cuba, San Juan County, New Mexico. Sargeant and Anderson (1969) restudied some of the dinoflagellate cysts from the uppermost Lewis Shale of New Mexico.

R. H. Tschudy (1973) made a palynological analysis of a core from Rio Arriba County, New Mexico. The core was cut through the Nacimiento and Ojo Alamo Formations (Paleocene); Fruitland Formation, Pictured Cliffs Sandstone, and Lewis Shale (all of late Campanian age) were also penetrated.

R. H. Tschudy (1976a) studied nine outcrop samples from the Dilco and Gibson Coal Members of the Crevasse Canyon Formation near Hosta Butte and Crownpoint, McKinley County, and one sample from the lowest coal in the Menefee Formation west of Farmington, San Juan County, New Mexico.

Zavada (1976) studied the palynology of part of the Fruitland Formation in New Mexico for his M.S. thesis at Arizona State University.

FIGURE 1—Geographic location of previous palynological studies pertinent to the Upper Cretaceous strata of western North America.

TABLE 1—Major palynological studies on the Upper Cretaceous strata of western North America. From Jameossanaie (1983), revised. Cen = Cenomanian, Tur = Turonian, Con = Coniacian, San = Santonian, Cmp = Campanian, Maa = Maastrichtian.

Code	Author(s)	Year	Location	Comments
1	Radforth & Rouse	1954	British Columbia	
2	Rouse	1956	British Columbia	thesis
3	Tschudy, R. H.	1961	Colorado, Wyoming	
4	Newman	1961	Colorado	thesis
5	Newman	1964	Colorado	
6	Srivastava	1967	general	review
7	Hall*	1969a	general	megaspores
8	Nicols & Jacobson	1982	Utah, Wyoming	
9	Penny	1969	general	
10	Ryder & Ames	1970	Idaho, Montana	
11	Bergad	1972	general	megaspores
12	May	1972a	Utah	
13	Newman	1972	Montana	review, range chart
14	Hall	1974	general	megaspores
15	Norris et al.	1975	western Canada	
16	Singh	1975	western Canada	review
17	Tschudy, R. H.	1975	Mississippi Embay.	Normapolles
18	Tschudy, R. H.	1976b	general	Minerisporites
19	Tschudy, R. H.	1981	general	Normapolles
20	Melchoir	1965	Montana	thesis; ?age
21	Pierce	1961	Minnesota	
22	Hall	1963	Iowa	mega- and microspores
23	Hedlund	1963	Oklahoma	thesis
24	Ellis & Tschudy	1964	Colorado	Arcellites
25	Hedlund	1966	Oklahoma	
26	Panella	1966	Colorado	thesis
27	Agasie & Kremp	1967	Arizona	
28	Norris	1967	Alberta	
29	Stanley	1967	Alaska	
30	Hall & Peake	1968	Minnesota	megaspores
31	Hedlund	1968	Oklahoma	
32	Agasie	1969	Arizona	
33	Griggs	1970	Wyoming	thesis
34	Hall	1971	Minnesota	megaspores
35	Romans	1972	Arizona	
36	May & Traverse	1973	Utah	
37	Hall	1975	general	megaspores
38	May	1972b	Utah, Arizona	
39	Singh	1983	Alberta	
40	Brown & Pierce	1962	Texas	
41	Burgess	1971	Wyoming	
42	Romans	1975	Arizona	
43	Sarmiento	1957	Utah	age cf. Tschudy(81)
44	Upshaw	1964	Wyoming	zonation
45	Sulkoske	1975	Wyoming	thesis
46	Bergad	1973	western N. America	megaspores
47	Griesbach	1956	Wyoming	thesis
48	Upshaw	1959	Wyoming	thesis
49	Upshaw	1963	Wyoming	Aequitriradites
50	Stone	1967	Texas	
51	Hall	1967	Montana	megaspores
52	Orlansky	1971	Utah	
53	Thompson	1969	Colorado	thesis
54	Tschudy, R. H.	1980	Rockies	Normapolles
55	Tschudy, R. H.	1976a	New Mexico	
56	Rouse et al.	1971	British Columbia	
57	McIntyre	1974	NW Territories	
58	Wall & Singh	1975	Alberta	
59	Ames	1951	Colorado	thesis
60	Hills & Jensen	1966	Alberta	megaspores
61	Morgan	1967	Oklahoma	dinoflagellates
62	Hall	1969b	Montana	Aquilapollenites
63	Sarjeant & Anderson	1969	New Mexico	age cf. Tschudy(81)
64	Tschudy, B.	1969	Alaska	
65	Lohrengel	1970	Utah	thesis
66	Tschudy, B.	1971b	Montana	
67	Stone	1971	Wyoming	
68	Tschudy, B.	1973	Montana	
69	Stone	1973	Wyoming	
70	Zavada	1976	New Mexico	
71	Delfel	1979	New Mexico	thesis
72	Manfrino	1984	Colorado	
73	Martinez-Hernandez	ms.	Colorado	thesis
74	Anderson	1960	New Mexico	
75	Leopold & Tschudy	1965	Wyoming	
76	Newman	1965	Colorado	thesis
77	Hall	1968	Montana	megaspores
78	Lamons	1969	Kansas	thesis
79	McLeroy	1970	California	thesis
80	Tschudy, B.	1970a	Rockies	Aquilapollenites
81	Tschudy & Leopold	1971	Rockies	Aquilapollenites
82	Kidson	1971	Colorado	thesis
83	Gies	1972	Colorado	thesis
84	Gunther & May	1972	Alberta	megaspores & seeds
85	Chmura	1973	California	
86	Tschudy, R. H.	1973	New Mexico	
87	Johnson & May	1980	Colorado	K-T boundary
88	Howell	1954	Colorado	
89	Stanley	1960	South Dakota	thesis
90	Funkhouser	1961	South Dakota	Aquilapollenites
91	Stanley	1961a	South Dakota	
92	Stanley	1961b	South Dakota	
93	Rouse	1962	British Columbia	
94	Clarke	1963	Colorado	thesis
95	Norton	1963	Montana	fungal spores
96	Clarke	1965	Colorado	Azolla
97	Hills & Weiner	1965	British Columbia	Aquilapollenites
98	Norton	1965	Montana	thesis
99	Srivastava	1965	Alberta	
100	Stanley	1965	South Dakota	
101	Srivastava	1966	Alberta	
102	Drugg	1967	California	
103	Hall & Norton	1967	Montana	
104	Srivastava	1967	Alberta	
105	Zaitzeff	1967	Texas	
106	Zaklinskaya	1967	general	review
107	Binda & Srivastava	1968	Alberta	megaspores
108	Hall & Swanson	1968	Minnesota	megaspores
109	Srivastava	1968a	Alberta	fungal spores
110	Srivastava	1968b	Alberta	ephedralean pollen
111	Norton & Hall	1969	Montana	
112	Oltz	1969	Montana	numerical analysis
113	Snead	1969	Alberta	
114	Srivastava	1969	Alberta	
115	Srivastava & Binda	1969	Alberta	Balmeisporites
116	Griggs	1971	Washington	
117	Srivastava	1970	Alberta	
118	Zaitzeff & Cross	1971	Texas	dinoflagellates
119	Bergad & Hall	1971	North Dakota	megaspores
120	Leffingwell	1971	Wyoming	K-T boundary
121	Oltz	1971	Montana	cluster analysis
122	Srivastava	1971a	Alberta	
123	Tschudy, R. H.	1971	Rockies	K-T boundary
124	Rouse & Srivastava	1972	NE Yukon	
125	Srivastava	1972a	Alberta	
126	Robertson	1973	Montana	Marsypiletes
127	Artzner	1974	North Dakota	thesis
128	Tschudy, R. H.	1976c	Wyoming	K-T boundary
129	Lerbekomo et al.	1979	Alberta	
130	Farabee	1981	Wyoming	thesis
131	Farabee et al.	1984	WY, NM, CO	
132	Kumar	ms.	Texas	thesis

FIGURE 2—Geographic location of this study and of previous palynological studies on the Upper Cretaceous rocks of New Mexico. **1,** Anderson (1960); Sarjeant and Anderson (1969); **2,** Tschudy, R. H. (1973a); **3, 4,** Tschudy, R. H. (1976a); **5,** Zavada (1976); **6,** Delfel (1979); **7,** this study.

Delfel (1979) studied the palynology of a portion of the La Ventana Sandstone section for her M.S. thesis at Pennsylvania State University. The study concerns a tongue in the Cliff House Sandstone which was deposited over the Menefee Formation as the sea re-advanced in the San Juan Basin in the vicinity of La Ventana, Sandoval County, New Mexico.

Stratigraphic setting

The oldest coal-bearing terrestrial unit in the San Juan Basin, New Mexico, is known as the Mesaverde Group. It consists, in ascending order, of the Crevasse Canyon Formation with two coal-bearing members (Dilco and Gibson), and the Menefee Formation with a lower coal-bearing member (Cleary Coal) and an upper, unnamed, coal-bearing member (Fig. 3). The most economically significant coal in the basin is found in the stratigraphically higher Fruitland Formation (Beaumont, 1968).

Location of study area

The study area is located on the South Hospah lease, about 19 road miles northeast of Crownpoint, adjacent to, and on the western side of, the Continental Divide, in the east-central part of McKinley County, New Mexico. It includes sec. 1 of T16N, R1OW and secs. 25-27 and 34-36 of T17N, R1OW in Orphan Annie Rock and Laguna Castilla quadrangles. The area encompasses 107°50'-107°54' west longitude and 35°52'-35°40' north latitude (Fig. 4).

The exposed rocks consist mainly of shale beds and crossbedded sandstones. These deposits have been assigned to the Cleary Coal Member of the Menefee Formation by both petroleum geologists and the coal geologists mapping the South Hospah lease area. The strata dip about 2-3° NNE towards the center of the San Juan Basin. Coal seams are exposed locally at the surface.

Material and methods

Four core sections (Figs. 4, 5) with the following positions were sampled:

EC-75: Central point of 5E1/4 NE1/4 sec. 35, T17N, R1OW, E 492,000 ft, N 1,697,737 ft; elevation 6,884 ft. Total cored section 107 ft 4 in.

EC-100: West-central corner of NW1/4 NE1/4 sec. 36, T17N, R1OW, E 493,900 ft, N 1,697,612 ft; elevation 6,893 ft. Total cored section 105 ft.

EC-150: East-central point of SE1/4 SE1/4 sec. 36, T17N, R1OW, E 497,000 ft, N 1,693,600 ft; elevation 7,008 ft. Total cored section 159 ft 9 in.

EC-50: North-central corner of SW1/4 NE1/4 sec. 1, T16N, R1OW, E 495,613 ft, N 1,691,513 ft; elevation 6,996 ft. Total cored section 53 ft 11 in.

The cored sections include a total of 233 ft of subsurface strata (Fig. 5). The coal and some of these strata are exposed locally.

One hundred and seventy-six samples of coal and associated deposits were prepared for palynological analysis; 94 of them yielded rich assemblages. Samples were treated with hydrofluoric acid to remove silica and to partially dissolve clay material. The residues were then bleached by cold sodium hypochlorite (trade name Clorox) and stained red with 0.1% Safranin-O for microscopic study. The coal samples that did not respond to the Clorox treatment were treated with a standard Schulze's solution (one part saturated potassium chlorate and nine parts commercial-strength nitric acid) on a steam table for 15 minutes and then quickly washed in 5% potassium hydroxide.

Cuts of core specimens, maceration residues, and microscopic preparations are deposited in the Palynology Laboratory, Department of Geological Sciences, Michigan State University. Described specimens are identified by maceration number, slide number, x—y coordinates in the slide, photographic-negativeroll number, and frame number in each roll. For instance, Pb12533-3 (122.4 x 39.5), Roll 57-9 indicates a palynomorph specimen extracted from maceration residue number Pb12533 (Pb designates paleobotanical samples), in microscopic slide number 3 made

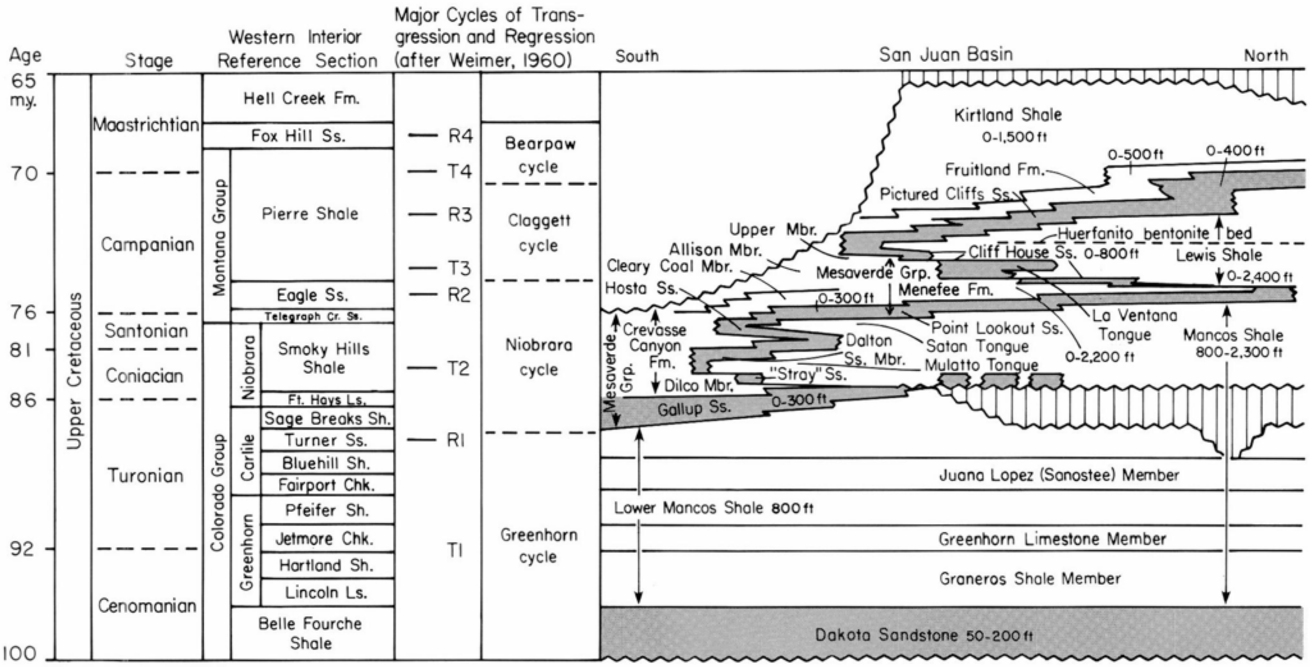

FIGURE 3—Stratigraphic setting of the Upper Cretaceous rock units in the San Juan Basin. From McGookey et al. (1972) and Molenaar (1977), with modifications.

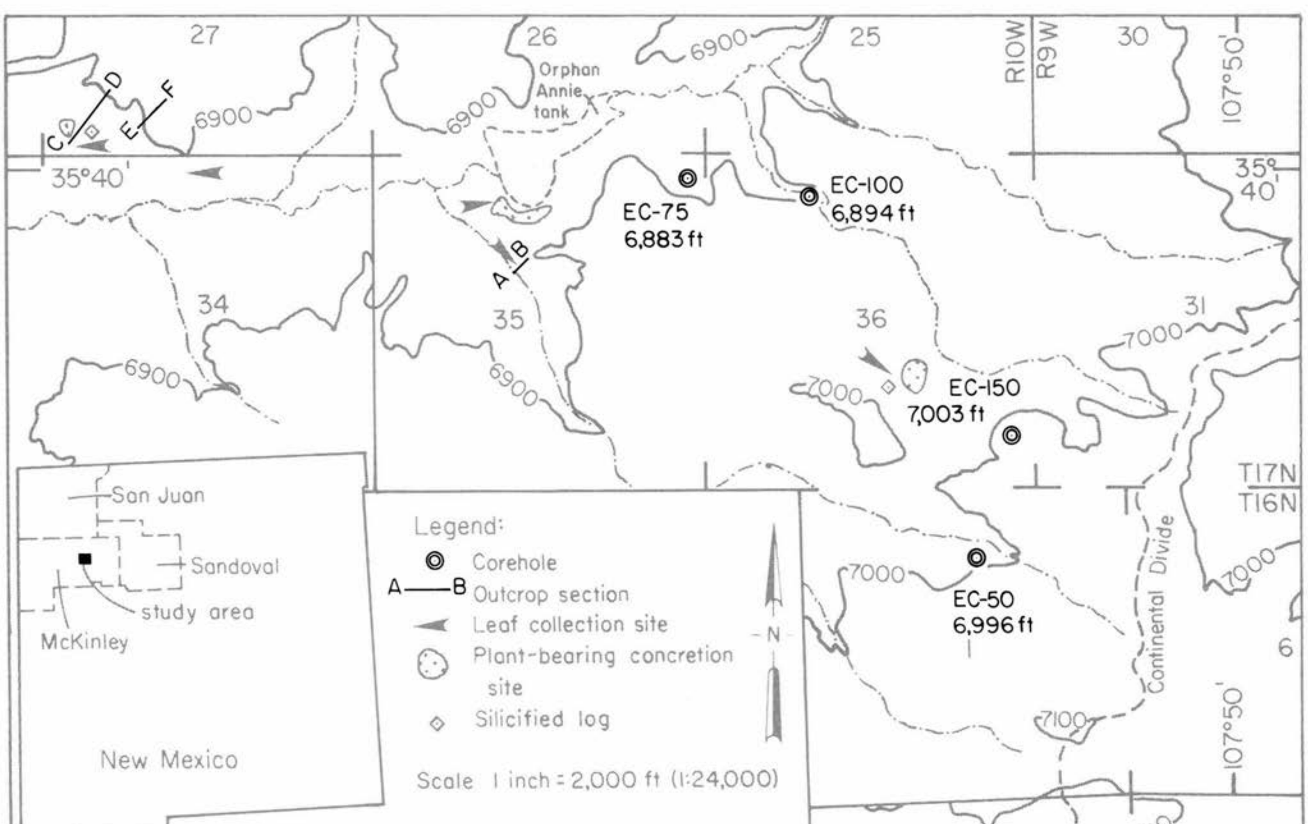

FIGURE 4—Location map of the study area in South Hospah, McKinley County, New Mexico.

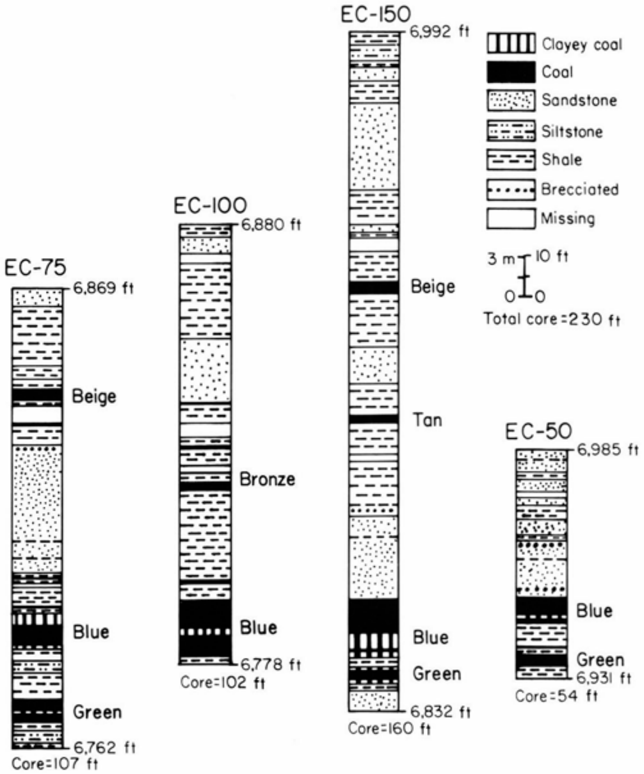

FIGURE 5—Stratigraphic profile of the four South Hospah core sections. Sampling points have been shown by tick marks on the left side of each section. The sequential numbers correspond to the following sample codes used in this study.

EC-150: 1 = Pb12374, 2 = Pb12375, 3 = Pb12378, 4 = Pb12379, 5 = Pb12382, 6 = Pb12384, 7 = Pb12385, 8 = Pb12386, 9 = Pb13241, 10 = Pb12387, 11 = Pb12394, 12 = Pb12400, 13 = Pb12401, 14 = Pb12402, 15 = Pb12403, 16 = Pb12404, 17 = Pb12408, 18 = Pb12411, 19 = Pb12413, 20 = Pb12414, 21 = Pb12415, 22 = Pb12416, 23 = Pb12417, 24 = Pb12428, 25 = Pb12430, 26 = Pb12432, 27 = Pb12435, 28 = Pb12439, 29 = Pb12442, 30 = Pb12445, 31 = Pb12449.

EC-75: 32 = Pb12453, 33 = Pb12454, 34 = Pb12455, 35 = Pb12456, 36 = Pb12457, 37 = Pb12458, 38 = Pb12459, 39 = Pb12460, 40 = Pb12461, 41 = Pb12462, 42 = Pb12463, 43 = Pb12464, 44 = Pb12465, 45 = Pb12466, 46 = Pb12467, 47 = Pb12470, 48 = Pb12471, 49 = Pb12472, 50 = Pb12473, 51 = Pb12474, 52 = Pb13238, 53 = Pb12476, 54 = Pb12478, 55 = Pb12483, 56 = Pb12484, 57 = Pb12485, 58 = Pb12486, 59 = Pb12487.

EC-50: 60 = Pb12492, 61 = Pb12494, 62 = Pb13210, 63 = Pb13211, 64 = Pb13212, 65 = Pb12496, 66 = Pb12498, 67 = Pb13215, 68 = Pb13216, 69 = Pb12500, 70 = Pb12501.

EC-100: 71 = Pb12504, 72 = Pb12505, 73 = Pb12506, 74 = Pb12508, 75 = Pb12511, 76 = Pb12512, 77 = Pb12513, 78 = Pb12514, 79 = Pb12515, 80 = Pb12516, 81 = Pb12517, 82 = Pb12518, 83 = Pb12519, 84 = Pb12520, 85 = Pb12521, 86 = Pb12522, 87 = Pb12523, 88 = Pb12524, 89 = Pb12525, 90 = Pb12527, 91 = Pb12529, 92 = Pb12530, 93 = Pb12533, 94 = Pb12534.

from that residue, located in the x—y coordinate 122.4 x 39.5 (measured on the mechanical stage of the Leitz microscope number 591962 with the label to the left of the observer), photographed in negative-roll number 57, frame number 9.

Acknowledgments

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Systematic descriptions

The palynomorphs recovered from the South Hospah samples have been assigned to form genera and form species and placed in higher taxa according to their inferred affinity. The genera and species described under each major taxonomic heading have been arranged alphabetically. The forms with unknown affinity have been treated as incertae sedis and arranged morphologically where applicable. Morphological categories, i.e. tricolpate, tetracolpate, tricolporate, triporate, and polyad have been used for the dicot angiospermous pollen. The frequencies of palynomorphs in productive samples have been expressed by qualifiers such as abundant (found in all samples in a frequency higher than 10%), common (found in more than 50% of the samples in a frequency higher than 5%), and rare (found in less than 50% of the samples in a frequency of less than 5%).

Division CHLOROPHYTA (green algae)
Genus *PALAMBAGES* Wetzel, 1961

PALAMBAGES CANADIANA Srivastava, 1968a
Fig. 6/1

Description-See Srivastava, 1968a, p. 1117, fig. 11.

Occurrence-Albian and Upper Cretaceous: Menefee Formation of New Mexico (rare to common); Campanian-Maastrichtian of northwest Colorado; upper Albian of Alberta, Canada (Singh, 1971); Maastrichtian of Alberta, Canada (Srivastava, 1968a); Maastrichtian of southwest Texas (Zaitzeff, 1967).

Measurements-67 µm (one specimen measured).

PALAMBAGES sp.
Fig. 6/2

Description-Colony irregular; individual cells spheroidal, inaperturate, very thin-walled, psilate, folded.

Comments-Palambages cf. *deflandrei* (Thompson, 1969, p. 46, pl. 12, fig. 3), *Palambages* forma A (Stone, 1973, p. 49, pl. 1, fig. 3), and *Palambages* sp. 1 (Gies, 1972, p. 231, pl. 16, figs. 12, 13) appear to be comparable to the form described here. *Palambages* sp. differs from *P. canadiana* in having lower number of cells in the colony and much thinner wall membrane in individual cells.

Occurrence-Turonian-Maastrichtian: Menefee Formation of New Mexico (rare); upper Campian of Wyoming (Stone, 1973); upper Campanian-Maastrichtian of northwest Colorado (Gies, 1972); Turonian-Santonian of southwest Colorado (Thompson, 1969).

Measurements-40 x 55 µm (one specimen measured).

RHOMBOSPORITES, new genus

Etymology-From *rhombos* (Greek) = rhombus or diamond, referring to the shape of the palynomorph.

Type *species-Rhombosporites* *tetrangulus* n. sp.

Diagnosis-Palynomorph diamond-shaped (bipyramid with triangular base); flattened specimens invariably show a triangular, diagonal fold covering one-half of one surface; the wall thicker at the two polar apices of the grain, subtended by a narrow zone of thin-walled area forming a ring.

Comments-The form genus *Tetraporina* is tetragonal in outline, but is distinguishable from the new genus by the lack of a persistent diagonal fold and the presence of four distinct pores at the four corners of the grain.

RHOMBOSPORITES TETRANGULUS, new species
Fig. 6/3-7

1964. Cf. *Tetraporina* Naumova *in* Leopold and Pakiser, pl. 9, figs. 2, 3.

Etymology-From *tetra* (Greek) = four, and *angulus* (Latin) = angle, referring to the outline of the flattened specimens.

Holotype-Pb 12457-1 (120.7 x 42.9), Figs. 6/3, 4.

Diagnosis-Palynomorph small; shape bipyramidal with triangular base, flattened specimens rhomboid in outline, with a triangular, diagonal fold covering one-half of one surface; wall thickness less than 0.5 µm, differentially thickened at the bipolar apex areas of the grain; the apex areas subtended by a narrow, circular furrow or thin zone; wall very thin, surface smooth or finely scabrate.

Comments-"Cf. *Tetraporina* Naumova" reported by Leopold and Pakiser (1964, pl. 9, figs. 2, 3) from the Cenomanian-Turonian of Alabama shows the same features as *R. tetrangulus* n.sp. The genus *Tetraporina* and its modern counterpart, *Mougeotia,* have four distinct depressions or pore-like structures at all four corners of their tetragonal bodies. Nevertheless, *R. tetrangulus* may have affinity with spores of some chlorophytan algae.

Occurrence-Upper Cretaceous: Menefee Formation of New Mexico (common); Cenomanian-Turonian of western Alabama (Leopold and Pakiser, 1964).

Measurements-17-20 m (this study, 10 specimens measured); 18-20 µm (Leopold and Pakiser, 1964).

Genus *SCHIZOSPORIS* Cookson and Dettmann, 1959

SCHIZOSPORIS COOKSONI Pocock, 1962
Fig. 6/8

Description-See Pocock, 1962, p. 76, pl. 13, figs. 197, 198.

Comments-This form is similar to *Schizosporis parvus,* but has a thinner wall and a smooth surface.

Occurrence-Upper Jurassic-Campanian: Menefee Formation of New Mexico (common).

Measurements-Longest dimension 30 and 40 m (two specimens measured).

SCHIZOSPORIS PARVUS Cookson and Dettmann, 1959
Fig. 6/9

Description-See Cookson and Dettmann, 1959, p. 216, pl. **1,** figs. 15-20; Dettmann, 1963, p. 108, pl. 26, figs. 18, 19.

Comments—S. *parvus* has an affinity with the zygospores and aplanospores of some *Spirogyra* spp. (Chlorophyta, family Zygnemataceae) (see van Geel and van der Hammen, 1978).

Occurrence—Barremian–Recent: Menefee Formation of New Mexico (rare).

Measurements-30 x 19 µm (one specimen measured).

SCHIZOSPORIS SCABRATUS Stanley, 1965
Fig. 6/10-14

Description—See Stanley, 1965, p. 269, pl. 35, figs. 10-17.

Comments—S. *scabratus* is characterized by its spherical shape, thick wall, small size, and scabrate surface.

Occurrence—Campanian–Maastrichtian: Menefee Formation of New Mexico (rare, but abundant in sample Pb12387, Beige Coal, core EC-150); upper Campanian of southwest Colorado (Gies, 1973); Maastrichtian of northwest South Dakota (Stanley, 1965).

Measurements-15 (23) 25 m (this study, 10 specimens measured); 15-40 µm (Stanley, 1965).

Division BRYOPHYTA
Class Musa (mosses)
Genus *CINGLITRILETES* Pierce, 1961, emend. Dettmann, 1963

Pierce (1961) proposed this genus to incorporate cingulate or zonate spores with an equatorial flange rather than a cingulum. However, he also included interradially crassate forms. Dettmann (1963) emended the genus to include only cingulate, smooth forms, but included *Cingulatisporites clavus* which has a distinct distal circular thickening at the polar area. Here, the genus *Cingutriletes* is treated in the sense of Dettmann (1963), i.e. as comprising only forms with a distinct cingulum.

CINGUTRILETES CONGRUENS Pierce, 1961
Fig. 6/15

1963b. *Stereisporites congruens* (Pierce): Krutzsch, p. 17.

Comments—Cingulatisporites cf. *levispeciosus* of Hedlund (1966, pl. 1, fig. 6) and Clarke (1963, pl. 4, fig. 6), and *Triletes* sp. 7 in Martinez-Hernandez (ms., pl. 16, fig. 18) belong here.

Occurrence—Upper Cretaceous: Menefee Formation of New Mexico (common); Cenomanian of Oklahoma (Hedlund, 1966); Vermejo Formation of Colorado (Clarke, 1963); Campanian of northwest Colorado (Martinez-Hernandez, ms.).

Measurements-43 m (three specimens measured).

Genus *DISTANCORISPORIS* Srivastava ex Srivastava, 1973

1963b. *Stereisporites (Distancoraesporis)* Krutzsch, p. 62.

Srivastava (1972a) elevated the subgenus *Stereisporites (Distancoraesporis)* to generic rank to incorporate cingulate trilete spores having a distal triradiate boss. The type of the genus, *Distancorisporis germanicus* (Krutzsch) Srivastava, was inadvertently omitted in the original publication, but this was corrected in an erratum published later (Srivastava, 1973).

DISTANOCORISPORIS DAKOTAENSIS, new combination
Fig. 6/16, 17

1965. *Cingulatisporites dakotaensis* Stanley, p. 243, pl. 30, figs. 1-8.
1974. *Stereisporites dakotaensis* (Stanley): Waanders, p. 32, pl. 1, figs. 10-12.

Description—See Stanely, 1965, p. 244.

Comments—D. *dakotaensis* has a subtriangular to subcircular outline, prominent Y-shaped distal thickening, and a thick cingulum. The specimens included by Srivastava (1972a, pl. 6, figs. 8, 9) in *Cingutriletes clavus* are *Distancorisporis dakotaensis.*

Occurrence—Campanian–Maastrichtian: Menefee Formation of New Mexico (rare); Campanian of northwest Colorado (Martinez-Hernandez ms.); Campanian–Maastrichtian of northwest Colorado (Gies, 1972); Maastrichtian of Texas (Kumar, ms.), New Jersey (Waanders, 1974), South Dakota (Stanley, 1965), and Alberta, Canada (Snead, 1969; Srivastava, 1972a).

Measurements-25-30 µm (five specimens measured).

Genus *DISTVERRUSPORIS,* new rank

1963b. *Stereisporites (Distverrusporis)* Krutzsch, Atlas, pt. III, p. 14.

Diagnosis—Sphagnoid, cingulate or acingulate trilete spores with a distinct circular or irregularly circular polar thickening at distal polar area; surface smooth or scabrate, irregularly granulose, or with scattered weak, low verrucae.

Comments—The subgenus *Distverrusporis* Krutzsch is here raised to the generic rank. This genus is distinguishable from *Stereisporites* Pflug and *Cingutriletes* Pierce emend. Dettmann in having a circular or irregularly circular thickening at distal polar area.

DISTVERRUSPORIS ANTIQUASPORITES, new combination
Fig. 6/18, 19

1946. *Sphagnum antiquasporites* Wilson and Webster, p. 273, fig. 2.
1956. *Sphagnumsporites antiquasporites* (Wilson and Webster): Potonié, p. 17.
1963. *Stereisporites antiquasporites* (Wilson and Webster): Dettmann, p. 25.

Description—See Dettmann, 1963, p. 25.

Comments—This form is very distinct in having a distal boss, small size, and a relatively thin exine with no conspicuous cingulum. The distal boss may appear as a linear thickening around the laesurae in some specimens (Fig. 6/19).

Occurrence—Jurassic–Tertiary: Menefee Formation of New Mexico (common); widely distributed in various parts of the world.

Measurements-20-23 m (this study, three specimens measured); 20 (27) 36 µm (Dettmann, 1963).

DISTVERRUSPORIS POCOCKII, new combination
Fig. 6/20-23

1980. *Stereisporites pocockii* Burger, p. 58, pl. 12, figs. 14-17.

Comments—Stereisporites pocockii was described by Burger (1980) to have a weak thickening in a small, circular to triangular area at or near distal pole, and a smooth or radially lineated cingulum. The presence of the distal thickening places this form in the genus *Distverrusporis* as defined in this paper.

Occurrence—Aptain-Cenomanian: Menefee Formation of New Mexico (rare, recycled?). Aptain-middle Albian of Australia (Burger, 1980); Cenomanian of Oklahoma (Hedlund, 1966).

Measurements-26-35 µm (three specimens measured).

DISTVERRUSPORIS sp.
Fig. 6/24

Description—Cingulate trilete spore with a circular thickening at distal polar area; trilete mark faint, laesurae long, extended to the cingulum; distal thickening about 5µm; cingulum 2 m at radial equatorial areas, decreasing in thickness to 1.5 m towards the interradial areas.

Comments—This form is distinct in having arcuate thickenings at the radial equatorial areas, and in having long trilete marks and deltoid amb.

Occurrence-Menefee Formation of New Mexico (rare).

Measurement-31 m (one specimen measured).

Genus STEREISPORITES Pflug, 1953

1953. *Stereisporites* Pflug *in* Thomson and Pflug, p. 53. (March) 1953. *Sphagnites* Cookson, p. 463. (November)
1956. *Sphagnumsporites* Raatz (1937) 1938 ex Potonié, p. 17.
1966. *Sphagnumisporites* Levet-Carette, p. 154.

The genus *Stereisporites* was proposed for sphagnoid, smooth, nonhyaline, trilete spores. Forms with cingulum and other exinal modifications should be removed from this genus.

STEREISPORITES STEREOIDES (Potonié and Venitz) Pflug, 1953
Fig. 6/25

1934. *Sporites stereoides* Potonié and Venitz, p. 11, pl. 1, fig. 4. 1953. *Stereisporites stereoides* (Potonié and Venitz): Pflug *in* Thomson and Pflug, p. 53.

Occurrence—Mesozoic and Cenozoic: Menefee Formation of New Mexico (common).

Measurements-23 m (this study, one specimen measured); 24-25 **m** (Potonié and Venitz, 1934).

STEREISPORITES sp. 1
Fig. 6/26

Description—Trilete spore; amb strongly obliquely-triangular to semicircular; trilete mark inconspicuous, open, differentiated by a slight thinning of the exine; exine less than 0.5 µm, slightly thickened at radial corners; surface scabrate.

Comments—This form is distinguished by its very small size and a faint trilete mark.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-12, 13 m (two specimens measured).

STEREISPORITES sp. 2 Figs. 6/27-29, 7/1-3

Description—Azonotrilete spore, amb subtriangular, sides convex, apices rounded; laesurae short, simple, without lips, length less than half the radius, one of the laesurae often gaping and folded back; exine up to 0.5 µm thick; surface granulose, granules scattered and low.

Comments—This form is distinct in having granulose ornamentation. The palynomorph illustrated by Waanders (1974, pl. 1, fig. 14) as *Stereisporites* sp. **1** appears to be a similar form.

Occurrence—Campanian-Maastrichtian: Menefee Formation of New Mexico (common); Maastrichtian of New Jersey (Waanders, 1974).

Measurements-20-23 m (four specimens measured).

Genus TRIPUNCTISPORIS, new rank

1966. *Stereisporites (Tripunctisporis)* Krutzsch *in* Daring et al., p. 73.

Diagnosis—See Doring, et al., 1966, p. 75.

Comments—The subgenus *Stereisporites (Tripunctisporis)* Krutzsch, 1966, is here elevated to the generic rank. The genus *Tripunctisporis* is easily distinguishable by a distinct circular or irregular thickening at distal polar area, with three circular areas of thinner exine. The three thin areas are opposite or approximately opposite the laesurae. One of the depressions may be obscure in some specimens. The distal thickening may be irregular, but it is distinct from the triradiate thickening in the genus *Distancorisporis.*

TRIPUNCTISPORIS sp.
Fig. 7/4-6

Description—Trilete spore; outline triangular, sides convex, radial apices rounded or pointed; cingulate, cingulum 2-4 µm thick, laesurae obscure, small, about one-third the radius, subtended by three distal, unequally thin areas, one of which may be obscure; distal thickening distinct to indistinct, up to 12 m, thinning near its outer margin; exine covered by low verrucae.

Comments—This form is comparable to *Stereisporites cristalloides* described by Kumar (ms.) from the Maastrichtian of Texas and by Waanders (1974, pl. 1, figs. 7-9) from the Maastrichtian of New Jersey.

Occurrence—Campanian-Maastrichtian: Menefee Formation of New Mexico (rare); Maastrichtian of Texas (Kumar, ms.) and New Jersey (Waanders, 1974).

Measurements-25 (27) 32 m (six specimens measured).

Class HEPATICAE (liverworts)
Genus AEQUITRIRADITES Delcourt and Sprumont, 1955, emend. Cookson and Dettmann, 1961

AEQUITRIRADITES ORNATUS Upshaw, 1963
Fig. 7/7

Description—See Upshaw, 1963, p. 428, pl. 1, figs. 1-6, 9-14.

Occurrence—Late Albian-Maastrichtian: Menefee Formation of New Mexico (rare); Cenomanian of Alberta, Canada (Singh, 1983); late Albian of southern Oklahoma (Wingate, 1980); Maastrichtian of Alberta, Canada (Srivastava, 1972a); Cenomanian of Wyoming (Griggs, 1970b); Cenomanian, Turonian, and Campanian of Wyoming, and Cenomanian of Montana (Upshaw, 1963); Maastrichtian of Texas (Kumar, ms.); Campanian of northwest Colorado (Martinez-Hernandez, ms.).

Measurement-52 m (body; one specimen measured).

AEQUITRIRADITES SPINULOSUS (Cookson and Dettmann, 1959) Cookson and Dettmann, 1961
Fig. 7/8

Description—See Dettmann, 1963, p. 93.
Occurrence—Cretaceous, widespread: Menefee Formation of New Mexico (rare).
Measurement-55 m (one specimen measured).

Genus TTIPOROLETES Mtchedlishvili, 1960, emend. Playford, 1971

For synonymy see Srivastava, 1975b, p. 67.

TRIPOROLETES NOVOMEXICANUS (Anderson) Srivastava, 1975b
Fig. 7/9

1960. *Lycopodium novomexicanum* Anderson, p. 14, pl. 1, fig. 2, pl. 8, fig. 1.

Comments—Retitriletes *cenomanicus* described by Gies (1972, pp. 52, 53) and Martinez-Hernandez (ms.) conforms with this species. Gies (1972) noted the similarity of his form with Anderson's species. The thin, peripheral zona may readily detach from the grain.

Occurrence—Campanian–Paleocene: Menefee Formation of New Mexico (rare to common); Campanian of northwest Colorado (Martinez-Hernandez, ms.); Campanian–Maastrichtian of northwest Colorado (Gies, 1972); Maastrichtian–Paleocene of Wyoming (Leffingwell, 1971); Campanian–Maastrichtian of San Juan Basin, New Mexico (Anderson, 1960).

Measurements-46-52 m (this study, body only; four specimens measured); 42-60 m (Anderson, 1960).

Division LYCOPHYTA (club mosses)
Genus CAMAROZONOSPORITES Pant ex Potonié, 1956, emend. Klaus, 1960

CAMAROZONOSPORITES HAMMENII van Amerom, 1965
Fig. 7/10, 11

Description—See van Amerom, 1965, p. 116, pl. 4, fig. 2, pl. 8, figs. 1, 2.

Comments—Camarozonosporites *rudis* (Leschik) Klaus has prominent, lipped laesurae reaching the equator. *C. insignis* Norris is distinct from *C. hammenii* in being larger (30-55 m), proximally sculptured, and having relatively coarser distal rugulae. *C. imberbis* van Amerom has much finer rugulae.

Occurrence—Upper Cretaceous: Menefee Formation of New Mexico (common); north Spain (van Amerom, 1965).

Measurements-27-29 µm (five specimens measured).

Genus ECHINATISPORIS Krutzch, 1959

This genus includes azonate trilete spores with echinate exine on distal and proximal surfaces.

ECHINATISPORIS VARISPINOSUS (Pocock) Srivastava, 1975b
Fig. 7/12

1962. *Acanthotriletes varispinosus* Pocock, p. 36, pl. 1, figs. 8-20.
1972a. *Ceratosporites pocockii* Srivastava, p. 8, pl. 4, fig. 7.

Occurrence—Aptain–Maastrichtian: Menefee Formation of New Mexico (rare); Aptain–Maastrichtian of Alberta, Canada (Pocock, 1962; Singh, 1964; Srivastava, 1972a); upper Albian of Texas (Srivastava, 1975b).

Measurements-18-38 m (this study, eight specimens measured). 20-38 m (Srivastava, 1972a).

Genus HAMULATISPORIS Krutzsch, 1959, emend. Srivastava, 1972a

1963a. *Camarozonosporites* subg. *Hamulatisporis* Krutzsch, p. 23.
1966. *Hamulatisporites* Nakoman, p. 77.

Srivastava (1972a) emended this genus to include rugulate azonotrilete spores without interradial crassitudes. *Hamulatisporites* Nakoman, 1966, is an obligate junior synonym of *Hamulatisporis.*

HAMULATISPORIS RUGULATUS (Couper) Srivastava, 1972a
Fig. 7/13

1958. *Perotrilites rugulatus* Couper, p. 147, p1. 25, figs. 7-8.

Occurrence—Upper Triassic–Paleocene (fide Srivastava, 1972a): Menefee Formation of New Mexico (rare).

Measurements-49-66 m (three specimens measured).

Genus NEORAISTRICKIA Potonié, 1956

This genus was instituted by Potonié (1956) to accommodate Mesozoic azonotrilete, baculate microspores with subtriangular amb. The Paleozoic genus *Raistrickia* includes forms with additional spinules and coni. *Baculatisporites* has a circular amb. *Ceratosporites* has a smooth proximal face.

NEORAISTRICKIA cf. SPECIOSA Srivastava, 1972a
Fig. 7/14

Comments—This form is smaller but otherwise similar to *Neoraistrickia speciosa.*

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-23, 27 m (two specimens measured); 33-38 m (Srivastava, 1972a).

Genus PEROMONOLITES Couper, 1953

PEROMONOLITES SUBENGELMANNI, new combination
Fig. 7/15, 16

1968a. *Isoetes subengelmanni* Elsik, p. 288, pl. 5, figs. 5-7.-

Description—Spore perinate monolete; outline elliptical; laesura usually obscure; exine very thin, granulose, covered by a thin, delicate, granulose perine; perine usually folded, may readily detach from the body.

Comments—The spores of the modern species *Isoetes savatieri* from Chile (Heusser, 1971, pl. 2, fig. 12) are comparable to the forms described here from New Mexico.

Occurrence—Cenomanian-Paleocene: Menefee Formation of New Mexico (rare to common); abundant in organic-shale samples Pb12455, Pb12457, Pb12458 (section EC-75) and Pb12533 (section EC-100). Cenomanian of Wyoming (Griggs, 1970b); Paleocene of Texas (Elsik, 1968a).

Measurements—Body 19-25 x 12-18 µm; body and perine 32-41 x 20-27 m (this study, six specimens measured); body 20-24 x 11-15 µm; body and perine 26-33 x 18-23 m (Elsik, 1968a).

Genus PEROTRILITES Couper, 1953

PEROTRILITES sp. 1
Fig. 7/17

Description—Zonotrilete spore; amb triangular, sides convex, apices pointed; surrounded by a thin, hyaline, psilate perispore; exine psilate or with scattered granules; laesurae short, about one-third to one-half the radius, simple without lips, extending to the periphery; zona may be folded around the exine and give a thickened appearance to the wall.

Comments—This form is distinct from *P. granulatus* Couper, 1953, in having psilate endexine and ektexine. Rouse (1957, pl. 1, figs. 51-54) reported similar forms from the Campanian of western Canada as *P. granulatus.*

Occurrence—Campanian: Menefee Formation of New Mexico (rare); Campanian of western Canada (Rouse, 1957).

Measurements-38-50 µm; wall thickness up to 3.5 perine 4-10 m (four specimens measured).

PEROTRILITES sp. 2
Fig. 7/18, 19

Description—Perinate trilete spore; amb rounded triangular; perine reticulate, may be stripped off the spore body, cavate, cavity 4 m wide.

Comments—P. sp. 2 is comparable to the forms described from the Campanian-Maastrichtian of Colorado (Gies, 1972, pl. 2, figs. 5, 6).

Occurrence—Campanian-Maastrichtian: Menefee Formation of New Mexico (only two grains recognized); Campanian-Maastrichtian of southwest Colorado (Gies, 1972).

Measurements-28, 30 m; lumina of reticulum about **1** m (two specimens measured).

Genus SESTROSPORITES Dettmann, 1963

The genus *Sestrosporites* is a foveolate, zonate or azonate, trilete microspore characterized by development of an interradial crassitude, which distinguishes it from *Foveotriletes* Potonié, *Foveosporites* Balme, and *Microreticulatisporites* Knox. *Vallizonosporites* airing has additional apiculate sculptural elements such as spinae, coni, bacula, etc.

SESTROSPORITES PSEUDOALVEOLATUS (Couper) Dettmann, 1963
Fig. 7/20

1958. *Cingulatisporites pseudoalveolatus* Couper, p. 147, pl. 25, figs. 5, 6.
1964. *Hymenzonotriletes pseudoalveolatus* (Couper): Singh, p. 83, pl. 10, figs. 1-3.
1965. *Vallizonosporites pseudoalveolatus* (Couper): boring, p. 60.

Occurrence—Middle Jurassic-Cretaceous: Menefee Formation of New Mexico (rare); Middle Jurassic-Lower Cretaceous of Europe (Couper, 1958; Burger, 1966; Baltes, 1967); Lower Cretaceous of Canada (Brideaux and McIntyre, 1975; Singh, 1964, 1971; Norris, 1967); Lower Cretaceous of Australia (Dettmann, 1963; Norvick and Burger, 1976); and Albian-Maastrichtian of the United States (Stanley, 1965; Panella, 1966; Davis, 1963; Kidson, 1971; Gies, 1972; Waanders, 1974; Kumar, ms.; Martinez-Hernandez, ms.). Post-Cenomanian occurrences in the United States may be recycled specimens.

Measurements-45, 46 m (two specimens measured); 37-68 m (cf. the above references).

Division PTEROPHYTA (ferns)
Order FILICALES
Family OSMUNDACEAE
Genus TODISPORITES Couper, 1958

TODISPORITES MINOR Couper, 1958
Fig. 8/1, 2

Occurrence—Bajocian-Cenomanian: Menefee Formation of New Mexico (single grain, sample Pb 12387, section EC-150, Beige Coal; interpreted here as being recylced).

Measurement-32 m (one specimen measured).

Family SCHIZAEACEAE
Genus APPENDICISPORITES Weyland and Krieger, 1953

APPENDICISPORITES CRISTATUS (Markova) Pocock, 1965
Fig. 8/3-6

1961. *Anemia cristata* Markova *in* Samoilovich, p. 78, pl. 20, figs. la, b.

Comments—Anemia *cristata* has bulbous or attenuated appendices formed by fusing of adjacent ribs at radial apices.

Occurrence—Middle Albian-Paleocene: Menefee Formation of New Mexico (rare); middle Albian of Saskatchewan, Canada (Pocock, 1965); Late Cretaceous-Paleocene of northeast Yukon, Canada (Rouse and Srivastava, 1972); Cenomanian of Bathurst Island, Australia (Norvick and Burger, 1976).

Measurements-50-65 m (three specimens measured).

APPENDICISPORITES POTOMACENSIS Brenner, 1963
Fig. 8/7

Occurrence—Barremain-Cenomanian: Menefee Formation of New Mexico (rare, found in the shale samples; interpreted here as being recycled).

Measurements-51, 54 m (two specimens measured).

APPENDICISPORITES UNICUS (Markova) Singh, 1964
Fig. 8/8

1961. *Anemia unica* Markova *in* Samoilovitch, p. 79, pl. 20, figs. 3a, b.

Comments—This form is characterized by relatively long appendices and few ribs which are parallel to the sides.

Occurrence—Middle Albian–Cenomanian: Menefee Formation of New Mexico (two specimens in sample Pb 12401, shale; interpreted here as being recycled).

Measurements-66 µm (including the appendices, two specimens measured).

Genus *CICATRICOSISPORITES* Potonié and Gelletich, 1933

CICATRICOSISPORITES AUSTRALIENSIS (Cookson) Potonié, 1956
Fig. 8/9

1953. *Mohrioisporites australiensis* Cookson, p. 470, pl. 2, figs. 29-34.

Occurrence—Cretaceous, widespread: Menefee Formation of New Mexico (rare).

Measurements-34-40 m (three specimens measured).

CICATRICOSISPORITES CUNEIFORMIS Pocock, 1965
Fig. 8/10

Occurrence—Middle Albian–Cenomanian: Menefee Formation of New Mexico (rare, found in Pb 12401 and Pb 12402, both shale samples, section EC-150; interpreted here as being recycled); middle Albian of Saskatchewan, Canada (Pocock, 1965); late Albian and Cenomanian of eastern Australia (Dettmann and Playford, 1968); Cenomanian of Australia (Norvick and Burger, 1976).

Measurements-36, 50 m (two specimens measured); 40-51 µm (Norvick and Burger, 1976). Size range was not given by Pocock (1965).

Genus *CHOMOTRILETES* Naumova, 1953

CHOMOTRILETES MINOR (Kedves) Pocock, 1970
Fig. 8/11, 12

1961. *Schizaeoisporites minor* Kedves, p. 129, pl. 6, figs. 11-16.
1962. *Chomotriletes fragilis* Pocock, p. 39, pl. 2, figs. 30-32.

Occurrence—Upper Jurassic–Eocene: Menefee Formation of New Mexico (rare); widespread in North America and Europe.

Measurements-28-35 µm (four specimens measured).

Genus *RETICULOSPORIS* Krutzsch, 1959

1954. *Foveomonoletes* van der Hammen, p. 14. (nomen nudum)
1961. *Retimonoletes* Pierce, p. 33.
1963. *Cuddaloria* Thiergart and Frantz, p. 43.

See Singh (1983, pp. 47-50) for comparison of sculptured monolete spores.

RETICULOSPORIS FOVEOLATUS (Pierce) Skarby, 1978
Fig. 9/1

1961. *Retimonoletes foveolatus* Pierce, p. 33, p1. 1, fig. 32.
1966. *Microfoveolatosporis foveolatus* (Pierce): Potonié, pl. 9, fig. 107.

Occurrence—Cenomanian–Senonian: Menefee Formation of New Mexico (rare). See Singh (1983, p. 50) for stratigraphic and geographic distribution of this species.

Measurements—Breadth 60 (70) 75 µm, length 86 (97) 116 m (four specimens measured).

RETICULOSPORIS RETICULATUS, new combination
Fig. 9/2

1957. *Schizaea reticulata* Cookson, p. 42, pl. 8, figs. 1, 2.

Description—Reticulate monolete spore; outline ellipsoidal, laesura closed, slightly lipped, 38 µm long; exine 3-4 m thick, two-layered, endexine very thin (about 0.3 m), ektexine without internal structure; muri 1.5-2.5 m thick, rounded in cross section; lumina 2-7 µm thick, hexagonal to pentagonal with unequal sides, decreasing in size toward the laesura.

Comments—Reticuloidosporites sp. of McIntyre (1974, pl. 14, fig. 32) is comparable to *Reticulosporis reticulatus.*

Occurrence—Campanian–Paleocene: Menefee Formation of New Mexico (rare); Paleocene of Australia (Cookson, 1957); Maastrichtian of Arctic Canada (Felix and Burbridge 1973); Campanian–Maastrichtian of District of Mackenzie, Canada (McIntyre, 1974).

Measurements-53 x 68 µm (this study, two specimens measured); 75 x 60 m (Cookson, 1957), 54 x 72 m (Felix and Burbridge, 1973).

Genus *MICRORETICULATISPORITES* Knox, 1950, emend. Bharadwaj, 1956

MICRORETICULATISPORITES UNIFORMIS Singh, 1964
Fig. 9/3

Comments—Lycopodiumsporites sp. A described by Clarke (1963, p. 42, pl. 3, fig. 7) and *Microreticulatisporites* spp. described by Elsik (1968a, p. 306, pl. 12, figs. 1-8) are comparable to M. *uniformis.*

Occurrence—Aptian–Paleocene: Menefee Formation of New Mexico (rare); Aptian–Albian of District of Mackenzie, Canada (Brideaux and McIntyre, 1975); Aptian–lower Cenomanian of Alberta, Canada (Singh, 1971); Aptian–lower Cenomanian of Colorado and Nebraska (Panella, 1966); Maastrichtian of central Colorado (Clarke, 1963); Maastrichtian–Danian of California, U.S.A. (Drugg, 1967); Paleocene of Texas (Elsik, 1968a).

Measurements-44 m (this study, one specimen measured); 44-48 m (Singh, 1964); 45-53 m (Drugg, 1967).

Family GLEICHENIACEAE
Genus *FOVEOGLEICHENIIDITES* Burger, 1976

FOVEOGLEICHENIIDITES CONFOSSUS (Hedlund) Burger, 1976
Fig. 9/4

1966. *Gleicheniidites confossus* Hedlund, p. 17, pl. 1, fig. 8a—c.

Comments—Specimens described by Kimyai (1966, p. 127, pl. 22, figs. 20-22) as *Foveogleicheniidites orientalis* Bolkhovitina belong to *F.confossus* according to Burger (Norvick and Burger, 1976).

Occurrence—Albian-Cenomanian: Menefee Formation of New Mexico (one specimen, sample Pb 12387, section EC-150; interpreted here as being recycled); Cenomanian of Alberta (Singh, 1983), Oklahoma (Hedlund, 1966), New Jersey (Kimyai, 1966), and Louisiana (Phillips and Felix, 1971); Albian-Cenomanian of Australia (Burger *in* Norvick and Burger, 1976).

Measurement-26 µm (one specimen measured).

Genus *GLEICHENIIDITES* Ross, 1949

GLEICHENIIDITES SENONICUS Ross, 1949
Fig. 9/5

Occurrence—Jurassic to Tertiary, worldwide: Menefee Formation of New Mexico (abundant).

Measurements-20 (31) 44 m (this study, 11 specimens measured); 24 (30) 41 µm (Skarby, 1964).

Genus *ORNAMENTIFERA* Bolkhovitina, 1966

See Dettmann and Playford (1968, p. 77) for description and synonymy. This genus was diagnosed as gleicheniaceous pollen with sculptural projections. It is easily distinguishable from the genus *Gleicheniidites* Ross by having surface ornamentation.

ORNAMENTIFERA TUBERCULATA (Grigoreva) Bolkhovitina, 1966
Fig. 9/6

1961. *Gleicheniidites tuberculatus* Grigoreva *in* Samoilovitch p. 62, pl. 16, figs. 4a—c, 5a—c, pl. L, fig. 3.

Comments—Gleicheniidites *tuberculatus* is distinct from *Ornamentifera echinata* in having tuberculate rather than echinate ornamentation.

Occurrence—Aptian and Campanian: Menefee Formation of New Mexico (very abundant); Aptian-Albian of Siberia, U.S.S.R. (Grigoreva, 1961).

Measurements-40 (47) 52 m (15 specimens measured).

Families CYATHEACEAE—DICKSONIACEAE-CHEIROPLEURIACEAE—MATONIACEAE
Genus *BIRETISPORITES* Delcourt and Sprumont, 1955, emend. Delcourt, Dettmann and Hughes, 1963

1955. *Biretisporites* Delcourt and Sprumont, p. 40.
1957. *Hymenophyllumsporites* Rouse, p. 363.

Delcourt et al. (1963) emended the genus *Biretisporites* to include trilete spores with well-defined, elevated lips along the laesurae, a triangular to subtriangular amb, and a smooth exine. It differs from *Matonisporites* in lacking apical thickening (radial crassitude or valvae). *Dictyophphyllidites* is distinct in having margo along the laesurae lips. *Hymenophyllumsporites* is a junior synonym of *Biretisporites.*

BIRETISPORITES sp. 1
Fig. 9/7

Description—Trilete spore; amb triangular, sides convex, apices rounded; laesurae long, reaching the periphery, lipped, slightly undulate; exine about 1 µm thick, surface psilate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-28 m (one specimen measured).

BIRETISPORITES sp. 2
Fig. 9/8, 9

Description—Trilete spore; amb triangular, sides convex, apices rounded; laesurae long, reaching the periphery, lipped exine about 1m thick; surface psilate.

Comments—This form is distinct in being very small. It is probably an aborted spore.

Occurrence—Menefee Formation of New Mexico (single grain).

Measurements-12 µ (one specimen measured).

BIRETISPORITES sp. 3
Fig. 9/10

Description—Trilete spore; amb triangular, sides convex, apices rounded (expanded grains show a rounded triangular to semicircular amb); laesurae lipped, long, extending one-half to three-fourths the radius; exine up to 2 µm thick, uniform; surface psilate.

Occurrence—Menefee Formation of New Mexico (common).

Measurements-73-79 µm (four specimens measured).

Genus *CYATHIDITES* Couper, 1953

1960. *Cardioangulina* Maljavkina ex Potonié, p. 28.

CYATHIDITES AUSTRALIS Couper, 1953
Fig. 9/11

Comments—Grains larger than 52 µm should be assigned to *Cyathidites australis.* Smaller grains belong to *C. minor* (Couper, 1953).

Occurrence—Jurassic-Cretaceous, worldwide: Menefee Formation of New Mexico (common).

Measurements-55-58 µm (six specimens measured).

CYATHIDITES MINOR Couper, 1953
Fig. 9/12

Occurrence—Jurassic-Cretaceous, worldwide: Menefee Formation of New Mexico (common).

Measurement-21-45 m (eight specimens measured).

Genus *DICTYOPHYLLIDITES* Couper, 1958, emend. Dettmann, 1963

DICTYOPHYLLIDITES EQUIEXINUS (Couper) Dettmann, 1963
Fig. 9/13

1958. *Matonisporites equiexinus* Couper, p. 140, pl. 20, figs. 13, 14.

Occurrence—Jurassic–Cretaceous: Menefee Formation of New Mexico (rare).

Measurement-42 µm (one specimen measured).

DICTYOPHYLLIDITES HARRISII Couper, 1958
Fig. 9/14

Occurrence—Jurassic–Cretaceous: Menefee Formation of New Mexico (single grain).

Measurement-35 m (one specimen measured).

DICTYOPHYLLIDITES Sp. 1
Fig. 9/15

Description—Trilete spore; laesurae long, reaching the apices, closed, lipped, surrounded by a margo 56 m thick; amb triangular, sides straight or slightly concave, apices broad, rounded; exine thin, surface psilate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-35 m (one specimen measured).

DICTYOPHYLLIDITES sp. 2
Figs. 9/16, 17; 10/1

Description—Trilete spore; laesurae closed, lipped by a narrow tectum, length of laesurae one-half to two-thirds the radius, surrounded by a margo 2-3 thick; amb triangular, sides straight to slightly convex, apices broad, rounded; exine 1.5-2 m thick, psilate.

***Comments—Toroisporis** (Toroisporis) longitorus* described by Gies (1972, p. 59, pl. 2, fig. 14), *Deltoidospora psilastoma* described by Griggs (1970, p. 54, pl. 5, fig. 13), and an undifferentiated form illustrated by Thompson (1966, pl. 14, fig. 10) are similar to the form described here.

Occurrence—Coniacian–Maastrichtian: Menefee Formation of New Mexico (rare); Coniacian–Santonian of southwest Colorado (Thompson, 1969); Campian–Maastrichtian of northwest Colorado (Gies, 1972); Maastrichtian of Washington (Griggs, 1970).

Measurements-50-53 m (three specimens measured).

Genus *KUYLISPORITES* Potonié, 1956

KUYLISPORITES SCUTATUS Newman, 1965
Fig. 10/2, 3

Occurrence—Coniacian–Maastrichtian: Menefee Formation of New Mexico (rare); lower Campanian of northwest Colorado (Newman, 1965); middle Santonian–middle Campanian of Montana (Newman, 1972); Campanian–Maastrichtian (undifferentiated) of northwest Colorado (Kidson, 1971; Gies, 1972); Coniacian–Santonian of southwest Colorado (Thompson, 1969).

Measurements-27-30 m (five specimens measured); 23 (27) 29 pm (Newman, 1965); 24-30 m (Gies, 1972); up to 30 m (Kidson, 1971).

KUYLISPORITES sp.
Fig. 10/4

Description—Trilete spore; laesurae simple, long, reaching almost to the periphery; amb triangular, sides convex, apices rounded; exine about 1 m thick, psi-late.

Comments—This form is distinct from *Kuylisporites scutatus* in having long, simple laesurae and a psilate exine.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-34 µm (one specimen measured).

Genus *MATONISPORITES* Couper, 1958, emend. Dettmann, 1963

Dettmann (1963) emended the genus *Matonisporites* to include psilate trilete spores with thickening of the exine (valvae or radial crassitudes) at the radial apices of the amb.

MATONISPORITES PHLEBOPTEROIDES Couper, 1958
Fig. 10/5

Occurrence—Jurassic–Cretaceous: Menefee Formation of New Mexico (rare).

Measurements--78-90 m; exine 2-3 µm between apices, 5-7 µm at the apices (four specimens measured).

MATONISPORITES sp.
Fig. 10/6

Description—Azonate trilete spore; laesurae lipped, lips 2-3 m thick, bifurcated at the end of each laesura; amb triangular, sides straight or slightly convex, apices rounded; exine psilate, 1-2 µm thick (2-4 µm thick at the apices).

Occurrence—Menefee Formation of New Mexico (common).

Measurements-43-74 µm (seven specimens measured).

Family POLYPODIACEAE
Genus *HAZARIA* Srivastava, 1971

The genus *Hazaria* is distinct from other monolete spores in having thin supratectal processes which are connected to form a reticulate sculpture.

HAZARIA Sp. 1
Fig. 10/7

Description—Monolete spore; shape oval; surface ornamented with low, narrow, supratectal processes which are connected to form a more-or-less regular reticulate pattern; muri thin, short, lumina large; laesura simple, short, about one-half the length of the body.

Comments—Hazaria *sheopiarii* has high sculptural processes and thicker exine.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-25 (27) 29 x 33 (37) 39 µm (five specimens measured).

HAZARIA sp. 2
Fig. 10/8

Description—Monolete spore; laesura simple, about the length of the grain; bean-shaped in side view; surface ornamented with low, narrow, supratectal processes connecting to form an irregular reticulate sculpture.

Comments—Hazaria sp. 1 is oval, slightly shorter in length, and the reticulation is more regular.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-44 x 27 µm (one specimen measured).

Genus *LAEVIGATOSPORITES* Ibrahim, 1933, emend. Schopf, Wilson and Bentall, 1944

For synonymy see Srivastava (1972b).

Schopf et al. (1944) emended the genus *Laevigatosporites* to include monolete spores with smooth exine or finely punctate, apiculate to rugose sculpture. Many extant fern genera produce spores with a smooth, monolete endospore and a sculptured perispore which is easily lost, resulting in an appearance similar to unrelated forms (Srivastava, 1971a). The forms described here are tentatively assigned to the fern family Polypodiaceae.

LAEVIGATOSPORITES ACORDATUS Krutzsch, 1959
Fig. 10/9

Occurrence—Mesozoic and Cenozoic, widely distributed: Menefee Formation of New Mexico (rare).

Measurements-42 x 38 µm (four specimens measured).

LAEVIGATOSPORITES HAARDTII (Potonié and Venitz) Thomson and Pflug, 1953 Fig. 10/10, 11

1934. *Sporites haardtii* Potonié and Venitz, p. 13, pl. 1, fig. 13.

Occurrence—Mesozoic and Cenozoic, widely distributed: Menefee Formation of New Mexico (rare).
Measurement-32 p.m (one specimen measured).

LAEVIGATOSPORITES OVATUS Wilson and Webster, 1946
Fig. 10/12, 13

Occurrence—Late Paleozoic to Cenozoic, worldwide: Menefee Formation of New Mexico (common).

Measurements-32 x 22 p.m (four specimens measured); 31-44 x 19-36 p.m (Wilson and Webster, 1946; Pocock, 1962; Srivastava, 1971).

LAEVIGATOSPORITES PSEUDODISCORDATUS Krutzsch, 1959
Fig. 10/14

Occurrence—Mesozoic and Cenozoic, widely distributed: Menefee Formation of New Mexico (rare).

Measurements-46 x 51 p.m (one specimen measured).

Genus *POLYPODIISPORITES* Potonié, 1934

Comments—This genus is characterized by flat, low verrucae which are packed to form a negative reticulate or foveolate pattern. See Singh (1983) for synonymy and comparison with other monolete spores.

POLYPODIISPORITES sp. 1
Fig. 10/15

Description—Monolete spore; oval to reniform; verrucate to botryoidal; sculptures reduced around the laesura; laesura $^{2}/3$ to $^{3}/4$ of the longest axis.

Occurrence—Menefee Formation of New Mexico (common).

Measurements-29-31 x 37-40 µm (six specimens measured).

POLYPODIISPORITES sp. 2
Fig. 10/16

Description—Monolete spore; laesura inconspicuous; verrucate, verrucae widely scattered; distal surface convex, proximal surface flattened and somewhat constricted; exine about 2 p.m thick.

Comments—Polypodiisporites sp. 2 differs from sp. 1 in being smaller and having plano-convex outline in lateral view.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-20 x 17 µm (one specimen measured).

Genus *VERRUCATOSPORITES* Pflug, 1953

VERRUCATOSPORITES sp.
Fig. 10/17, 18

Description—Monolete spore; bean-shaped; verrucate or gemmate, verrucae diameter 1-2 p.m, widely and randomly scattered; exine 1.5-2 p.m thick.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-28 x 18 p.m (two specimens measured).

TRILETE SPORES INCERTAE SEDIS

Genus *CONCAVISSIMISPORITES* Delcourt and Sprumont, 1955

CONCAVISSIMISPORITES sp.
Fig. 11/1

Description—Trilete spore; amb trilobate, sides deeply concave, exine 1-2 µm thick; surface granulose to verrucate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-48 p.m (one specimen measured).

Genus *FORAMINISPORIS* Krutzsch, 1959

FORAMINISPORIS sp.
Fig. 11/2

Description—Trilete spore; laesurae simple, long, extending to the margin; amb obliquely triangular to irregularly circular; exine apparently two-layered, about 1.5 µm thick; surface covered with large gemmae up to three-fourths p.m wide and 1-2 pm apart, reduced towards the periphery.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-37 p.m (one specimen measured).

Genus *FOVEOSPORITES* Balme, 1957
FOVEOSPORITES sp. Fig.
11/3, 4

Description—Azonotrilete spore; laesurae simple, extending about two-thirds of radius; amb deltoid with rounded apices; exine thin, ornamented by irregular, small fovae.

Comments—This form is similar to *Foveosporites* sp. III described by Drugg (1967, p. 39, pl. 6, fig. 32).

Occurrence—Menefee Formation of New Mexico (rare); Maastrichtian-Danian of California (Drugg, 1967).

Measurements-35 pm (this study; one specimen measured); 35-45 p.m (Drugg, 1967).

Genus *GRANULATISPORITES* Ibrahim, 1933, emend. Potonié and Kremp, 1954

Granulatisporites includes azonate, granulate, trilete spores with rounded triangular amb and simple laesurae.

GRANULATISPORITES GRANULATUS Ibrahim, 1933
Fig. 11/5

Occurrence—Menefee Formation of New Mexico (rare). Similar forms occur extensively in carboniferous rocks. They are probably not related to the Cretaceous forms.

Measurement-25 µm (one specimen measured).

Genus *UNDULATISPORITES* Pflug *in* Thomson and Pflug, 1953

UNDULATISPORITES sp.
Fig. 11/9

Description—Azonotrilete spore; trilete mark undulating, robust, long, reaching the proximal margin, lipped by a thick margo; amb triangular, sides convex, corners sharp; exine less than 1 µm thick, ornamented by dense granules.

Occurrence—Menefee Formation of New Mexico (single specimen, core section EC-150, a shale layer above the Beige seam).

Measurements-27 x 25 p.m (one specimen measured).

Genus *VERRUCOSISPORITES* Ibrahim, 1933, emend. Smith, 1971

VERRUCOSISPORITES sp.
Fig. 11/10-12

Description—Azonotrilete spore; trilete mark narrow, long, extending three-fourths the radius of the proximal surface, lipped by a thin margo; amb circular; exine about 2 p.m thick, distal face verrucate, proximal face minutely granulate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-40-42 µm (three specimens measured).

UNIDENTIFIED SPORE A
Fig. 11/13

UNIDENTIFIED SPORE B
Fig. 11/14

INCERTAE SEDIS

Genus *QUADRIPOLLIS* Drugg, 1967

Drugg established this form genus to accommodate inaperturate palynomorphs united in permanent tetrahedral tetrads. He considered a gymnospermous affinity probable for such forms.

QUADRIPOLLIS sp.
Fig. 11/6-8

Description—Inaperturate palynomorph; grains united in permanent tetrahedral tetrads; exine very thick (12 µm), apparently made up of several layers, surface densely granulated.

Occurrence—Menefee Formation of New Mexico (single grain, core section EC-150, a shale layer above the Tan seam).

Measurements-50 x 48 p.m (one specimen measured).

Division PTERIDOSPERMOPHYTA

Genus *PRISTINUSPOLLENITES* B. D. Tschudy, 1973

The genus *Pristinuspollenites* was proposed to accommodate bisaccate pollen grains with greatly reduced, distally attached bladders that are without thickening at the base of the sacci.

PRISTINUSPOLLENITES MICROSACCUS (Couper) B. D. Tschudy, 1973
Fig. 12/9

1958. *Pteruchipollenites microsaccus* Couper, p. 151, pl. 26, figs. 13, 14.
1962. *Alisporites microsaccus* (Couper): Pocock, p. 61.

Occurrence—Menefee Formation of New Mexico (single grain); Middle and Upper Jurassic of England (Couper, 1958); Jurassic-Cretaceous boundary of western Canada (Pocock, 1962) and eastern Netherlands (Burger, 1966); Campanian of Montana (B. D. Tschudy, 1973). The Upper Cretaceous occurrences may represent recycled specimens.

Measurements-48 x 49 µm (one specimen measured).

Division CYCADOPHYTA—GINKGOPHYTA
Order CYCADALES—GINKGOALES
Genus *CYCADOPITES* Wodehouse ex Wilson and Webster, 1946

This genus was proposed for prolate monosulcate pollen grains similar to those of the gymnospermous genus *Cycas,* with a furrow that extends the entire length of the grain and is always open at the ends. Nichols et al. (1973) compared the structure of the sulcus in this genus with other monosulcate grains produced by angiosperms.

CYCADOPITES spp.
Fig. 12/1-3

At least four morphotypes of *Cycadopites* pollen were recognized in the South Hospah assemblages. The scarcity of this pollen type does not allow their arrangement into meaningful species.

Order BENNETTITALES
Genus *EXESIPOLLENITES* Balme, 1957

EXESIPOLLENITES TUMULUS Balme, 1957
Fig. 12/4

Occurrence—Jurassic-Cretaceous, widespread: Menefee Formation of New Mexico (common).

Measurements-27 (33) 45 m (this study, eight specimens measured); 25 (30) 33 m (Balme, 1957).

Genus *SPHERIPOLLENITES* Couper, 1958

This genus differs from *Exesipollenites* Balme in having a poorly developed pore. Couper (1958) assigned grains smaller than 45 m to this genus.

SPHERIPOLLENITES CLASSOPOLLOIDES (Nilsson) Playford and Dettmann, 1965
Fig. 12/5

1958. *Crassipollenites classopolloides* Nilsson, p. 74, pl. 7, figs. 3-5.

Occurrence—Rhaetic-Liassic of Sweden (Nilsson, 1958) and South Australia (Playford and Dettmann, 1965); Menefee Formation of New Mexico (rare; recycled).

Measurements-27 m (this study, one specimen measured); 24 (30) 40 m (Playford and Dettmann, 1965).

SPHERIPOLLENITES SCABRATUS Couper, 1958
Fig. 12/6

Occurrence—Menefee Formation of New Mexico (common), Middle Jurassic to Lower Cretaceous of England (Couper, 1958) and Canada (Pocock, 1962).

Measurements-21 (38) 47 m (this study, six specimens measured); 25 (30) 42 m (Couper, 1958); 22 (33) 48 m (Pocock, 1962).

Division CONIFEROPHYTA
Family CHEIROLEPIDIACEAE (extinct)
Genus *CLASSOPOLLIS* Pflug, 1953

For synonymy see Srivastava (1976).

CLASSOPOLLIS CLASSOIDES Pflug *in* Thomson and Pflug, 1953
Fig. 12/7

Occurrence—Triassic-Cretaceous, widespread: Menefee Formation of New Mexico (rare).

Measurements-20 (24) 31 μm (16 specimens measured).

CLASSOPOLLIS cf. *CIRCULINA PARVA* Brenner, 1963
Fig. 12/8

Comments—C. *parva* corresponds to the circumscription of the genus *Classopollis* as accepted in this treatment.

Occurrence—Menefee Formation of New Mexico (rare); Lower Cretaceous of Maryland (Brenner, 1963); Cenomanian-Turonian of Wyoming (Griggs, 1970); Campanian-Maastrichtian of Colorado (Gies, 1972).

Measurements-16-21 m (nine specimens measured).

Families TAXODIACEAE—CUPRESSACEAE Genus *INAPERTUROPOLLENITES* Pflug and Thomson *in* Thomson and Pflug, 1953, emend. Potonié, 1958

INAPERTUROPOLLENITES DUBIUS (Potonié and Venitz) Thomson and Pflug, 1953
Fig. 12/10

1934. *Pollenites magnus dubius* Potonié and Venitz, p. 17, pl. 2, fig. 21.

Occurrence—Jurassic-Tertiary, widespread: Menefee Formation of New Mexico (abundant); Lower Cretaceous Potomac Group of Maryland (Brenner, 1963); Albian of Maryland and Delaware (Groot and Penny, 1960); Cenomanian-Turonian of eastern U.S.A. (Groot et al., 1961); Coniacian-Santonian of Colorado (Thompson, 1969); Campanian-Maastrichtian of northwest Colorado (Gies, 1972); Tertiary of Europe (Thomson and Pflug, 1953).

Measurements-31-35 m (three specimens measured); about 35 μm (Groot and Penny, 1960; Groot et al., 1961).

INAPERTUROPOLLENITES MINOR Kedves, 1961
Fig. 12/11-12

Occurrence—Menefee Formation of New Mexico (common); Campanian-Maastrichtian of Utah, U.S.A. (Lohrengel, 1970).

Measurements-14-20 μm (three specimens measured); 10-20 m (Lohrengel, 1970).

Genus *SEQUOIAPOLLENITES* Thiergart, 1938

Sequoia-type fossil leaves commonly occur in the South Hospah outcrop samples. *Sequoiapollenites* has been reported from the Upper Cretaceous and younger strata (Thiergart, 1938; Manum, 1962; Leopold and Pakiser, 1964; Stanley, 1965; Snead, 1969).

SEQUOIAPOLLENITES spp.
Fig. 12/13-15

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-16-31 m (three specimens measured).

Genus *TAXODIACEAEPOLLENITES* Kremp, 1949 ex Potonié, 1958

TAXODIACEAEPOLLENITES HIATUS Potonié, 1958
Fig. 12/16

Occurrence—Middle Albian to Miocene (fide Singh, 1971): Menefee Formation of New Mexico (abundant).
Measurements-25-35 m (three specimens measured).

Family ARAUCARIACEAE
Genus *ARAUCARIACITES* Cookson, 1947 ex Couper, 1953

ARAUCARIACITES AUSTRALIS Cookson, 1947 ex Couper, 1953
Fig. 12/17

Occurrence—Jurassic-Tertiary: Menefee Formation of New Mexico (rare to common).
Measurements-58-83 m (eight specimens measured).

Genus BALMEIOPSIS Archangelski, 1977

BALMEIOPSIS LIMBATUS (Balme) Archangelski, 1977
Fig. 12/18

1957. *Inaperturopollenites limbatus* Balme, p. 31, pl. 7, figs. 83-84.
1969. *Araucariacites limbatus* (Balme) Habib, p. 91, pl. 4, fig. 6.

Occurrence—Jurassic-Ter tiar y: Menefee Formation of New Mexico (common).
Measurements-37 (53) 70 x 49 (63) 81 m (19 specimens measured).

Genus *INAPERTUROTETRADITES* van Hoeken-Klinkenberg, 1964
INAPERTUROTETRADITES SCABRATUS B. D. Tschudy, 1973
Fig. 12/19-21

Comments—The morphology of individual grains of this tetrad type are close to *Araucariacites australis.*
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-49, 64 m (two specimens measured).

Family PINACEAE
Genus *ALISPORITES* Daugherty, 1941

ALISPORITES sp.
Fig. 12/22

Description—Bisaccate pollen grain; length of the central body greater than the breadth; marginal crest present; length of the bladders greater than their breadth and equal to the length of the central body; bladders finely reticulate; distal furrow distinct, narrow, and granulate.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements—Breadth of the grain 94 μm, length of the central body 31 μm, breadth of the central body 28 μm, length of the bladders 31 μm, breadth of the bladders 24 and 21 m (one specimen measured).

Genus *ZONALAPOLLENITES* Pflug, 1953

1958. *Tsugaepollenites* Potonié and Venitz emend. Potonié, p. 48.

ZONALAPOLLENITES sp.
Fig. 13/1, 2

Description—Pollen grain inaperturate, spherical; exine made up of two distinct layers: inner layer 0.5 m thick, uniform in thickness except at the polar areas of the grain where it is discontinued and an ora of about 6 m is formed; outer layer irregular, up to 5 m thick, modified into thick and broad rugulate velum.
Occurrence—Menefee Formation of New Mexico (rare).
Measurement-40 m (one specimen measured).

Family PODOCARPACEAE
Genus *PARVISACCUTES* Couper, 1958

PARVISACCITES RADIATUS Couper, 1958
Fig. 13/3

Occurrence—Uppermost Jurassic-Cenomanian: Menefee Formation of New Mexico (rare, probably recycled).
Measurements-64-69 μm (three specimens measured).

Genus *RUGUBIVESICULITES* Pierce, 1961

RUGUBIVESICULITES RUGOSUS Pierce, 1961
Fig. 13/4

Occurrence—Late Albian-Maastrichtian of North America: Menefee Formation of New Mexico (rare); late Albian of Alberta, Canada (Singh, 1971) and Wyoming (Davis, 1963); Cenomanian of Alberta, Canada (Norris, 1967) and Minnesota (Pierce, 1961); Campanian-Maastrichtian of Colorado (Gies, 1972); Maastrichtian of New Jersey (Waanders, 1974).
Measurements-55 μm (two specimens measured).

Division GNETOPHYTA
Order EPHEDRALES
Family EPHEDRACEAE
Genus *EQUISETOSPORITES* Daugherty, 1941, emend. Singh, 1964

EEQUISETOSPORITES JANSONII Pocock, 1964
Fig. 13/5, 6

Occurrence—Albian: Menefee Formation of New Mexico (single grain, in sample Pb 12494, shale, section EC-50; probably recycled); Saskatchewan, Canada (Pocock, 1964).
Measurements-67 x 34 μm (one specimen measured).

EQUISETOSPORITES MENAKAE Srivastava, 1968b
Fig. 13/7

Occurrence—Campanian-Maastrichtian: Menefee Formation of New Mexico (rare); Maastrichtian of Alberta, Canada (Srivastava, 1968b).
Measurements-26 x 22 m (one specimen measured).

EQUISETOSPORITES ROUSEI Pocock, 1964
Fig. 13/8, 9

Occurrence—Albian: Menefee Formation of New Mexico (rare; probably recycled); Canada (Pocock, 1964).
Measurements-27-33 x 12-14 p.m (three specimens measured).

EQUISETOSPORITES sp.
Fig. 13/10

Description—Polyplicate pollen grain; elongate, slender, 7 plicae, each about 1.5 µm wide, separated by about 0.5 µm wide furrows; plicae fuse at both ends of the grain and do not cross over to the other side.
Occurrence—Menefee Formation of New Mexico (single specimen; sample Pb 12385, shale above the Beige Coal; section EC-150).
Measurements-28 x 7 m (one specimen measured).

Genus STEEVESIPOLLENITES Stover, 1964

STEEVESIPOLLENITES cf. BINODOSUS Stover, 1964
Fig. 13/11

Comments—S. *binodosus* was reported from Albian-Turonian strata of Senegal basin, West Africa. The New Mexico specimen is much smaller and has relatively larger polar knobs. The form from the Cenomanian Dakota Sandstone of Arizona illustrated by Romans (1975, p. 318, pl. 7, figs. 6, 7) as *S. binodosus* has elongate nodes (as opposed to semicircular nodes in the holotype) and a more expanded equatorial region than the holotype.
Occurrence—Menefee Formation of New Mexico (single specimen; sample Pb 12387, Beige Coal; section EC-150; probably recycled).
Measurement—Length 28 µm (one specimen measured).

GYMNOSPERMAE INCERTAE SEDIS

Genus CALLIALASPORITES Dev, 1961

For synonymy see Srivastava, 1975b, p. 73.

CALLIALASPORITES DAMPIERI (Balme, 1957) Dev, 1961
Fig. 13/12-14

For synonymy see Srivastava, 1975b, p. 75.

Occurrence—Jurassic-Eocene, widespread: Menefee Formation of New Mexico (rare).
Measurements-53-55 m (three specimens measured).

Genus EUCOMMIIDITES Erdtman, 1948

According to Srivastava (1978), the stratigraphic range of this genus is Jurassic-Turonian. The occurrence in strata younger than Turonian probably represents recycled specimens.

EUCOMMIIDITES spp.
Fig. 13/15, 16

Occurrence—Menefee Formation of New Mexico (rare; probably recycled).

Genus PERINOPOLLENITES Couper, 1958

PERINOPOLLENITES Cf. . ELATOIDES Couper, 1958
Fig. 13/17, 18

Comments—This form is morphologically similar to, but much smaller than, *P. elatoides.* Pocock (1962) mentioned that the poroid structure is not always clearly shown.
Occurrence—Menefee Formation of New Mexico (2 grains).
Measurements-24 m (this study; two specimens measured); 30 (48) 60 m (Couper, 1958; Pocock, 1962; Brenner, 1963; Burger, 1966; Brideaux and McIntyre, 1975).

Division MAGNOLIOPHYTA (flowering plants)

MONOCOLPATE POLLEN GRAINS

Genus LILIACIDITES Couper, 1953

Couper (1953) proposed this genus for liliaceous monosulcate (and occasionally tricotomosulcate) dispersed fossil pollen grains with reticulate exine; lumina larger in the middle region of the grain, gradually decreasing in size towards the polar ends. *Liliapollis* Krutzsch, 1970, lacks a tectum to connect the collumellate sculpture.

LILIACIDITES INTERMEDIUS COUper, 1953
Fig. 14/1

Occurrence—Upper Cretaceous-Miocene (Couper, 1953): Menefee Formation of New Mexico (rare).
Measurements-28-33 x 38-47 m (three specimens measured).

LILIACIDITES sp. 1
Fig. 14/2

Description—Monocolpate pollen; exine about 0.5 m thick, reticulate, lumina polygonal, up to 2 wide at the central part of the grain, decreasing in size towards the poles; muri about 0.25-0.5 m thick.
Comments—This form is distinct in being small and having relatively large, regularly polygonal reticulation.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-17 x 22 m (one specimen measured).

LILIACIDITES sp. 2
Fig. 14/3, **4**

Description—Monocolpate pollen; amb prolate; ex-ine reticulate, muri about 0.5 m thick; lumina irregular, coarser at the central part of the grain.
Comments—The irregular pattern of the muri is characteristic of this form.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-14-18 x 20-23 µm (four specimens measured).

LILIACIDITES sp. 3
Fig. 14/5

Description—Monocolpate pollen; amb prolate; ex-ine reticulate, about 1.3 m thick, baculate, baculae fuse to form a fine reticulation with lumina up to 0.75 µm wide at the center of the grain and decreasing in size towards the ends; muri about 0.3 m thick.
Comments—The reticulation is relatively very fine in this form.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-26 x 16 µm (one specimen measured).

LILIACIDITES sp. 4
Fig. 14/6

Description—Monocolpate pollen grain; prolate; exine about 1µm thick, reticulate, meshes relatively coarse at the center of the grain (up to 2 µm), decreasing in size towards the ends; muri about 0.3 m thick, forming an irregular polygonal pattern.
Comments—This form differs from *Liliacidites* sp. 3 in having much coarser reticulation.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-29 x 17 µm (one specimen measured).

LILIACIDITES sp. 5
Fig. 14/7

Description—Monocolpate pollen grain; prolate; exine reticulate, meshes irregular in shape, up to 3 p.m at the center of the proximal side, sharply decreasing in size at the longitudinal polar areas and the distal area where the colpus is located; colpus extending the entire length of the grain.
Comments—The differential reticulation of the proximal and distal sides of the grain is characteristic of this form.
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-34 x 24 µm (one specimen measured).

LILIACIDITES sp. 6
Fig. 14/8-10

Description—Monocolpate pollen grain; subprolate; exine reticulate, meshes up to 3 m at the central part of the grain, slightly decreasing towards the longitudinal poles, but sharply decreasing at a small area of each pole; muri up to 1 µm thick, forming a more-or-less regular polygonal pattern.
Comments—This form is subprolate (slightly less elongated than the previously described forms) and has a relatively coarse, regular, reticulation pattern that decreases only slightly in size towards the ends.
Occurrence—Menefee Formation of New Mexico (common).
Measurements-25-27 x 20-22 m (six specimens measured).

Genus *MONOCOLPOPOLLENITES* Pflug and Thomson *in* Thomson and Pflug, 1953, emend. Nichols, Ames and Traverse, 1973

Nichols et al. (1973) emended the genus to include monocolpate pollen grains having a colpus with flared or rounded ends, with or without margo, and a psilate, scabrate, or reticulate exine.

MONOCOLPOPOLLENITES RETICULATUS Nichols, Ames and Traverse, 1973
Fig. 14/11-14

Occurrence—Menefee Formation of New Mexico (common); late Paleocene of Texas (Nichols et al., 1973).
Measurements-24 (27) 30 x 15 (21) 23 µm (seven specimens measured).

MONOCOLPOPOLLENITES cf. *TEXENSIS* Nichols, Ames and Traverse, 1973
Fig. 14/15

Comments—This form is morphologically similar to, but smaller than, M. *texensis.*
Occurrence—Menefee Formation of New Mexico (rare).
Measurements-12 x 19 µm (one specimen measured).

Genus *RETIMONOCOLPITES* Pierce, 1961

This genus can be distinguished from *Liliacidites* by its uniform sculpture which is not differentiated into coarse and fine reticulation.

RETIMONOCOLPITES sp. 1
Fig. 14/16-19

Description—Monocolpate pollen; subprolate, spheroidal; colpus closed, lipped by a margo, curved or undulating; endexine thin, ektexine ornamented by thin baculae which are fused and form a reticulate sculpture; reticulation uniform, often masked as a result of fusion of baculae heads, which gives the surface a granulose appearance; lumina 1-2.5 m; muri about 0.2 µm thick, 0.5-1 m high; the reticulate ektexine tends to detach from the endexine.
Comments—This form is characterized by having spheroidal outline, curved or undulating colpus, and granulose appearance of the surface.
Occurrence—Menefee Formation of New Mexico (only in sample Pb12342; abundant).
Measurements-28 (29) 32 x 30 (33) 35 µm; the

ratio of polar to equatorial axis = 1.07 (1.14) 1.18 (seven specimens measured).

RETIMONOCOLPITES sp. 2
Fig. 14/20, 21

Description—Monocolpate pollen grain; subspheroidal; colpus wide, gaping at the polar ends; exine about 0.5 μm thick, endexine very thin, appressed, ektexine clavate, the heads of clavae fused to form a network on the grain surface, meshes uniform, about 0.25 μm wide.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-20 x 18 μm (one specimen measured).

MONOPORATE POLLEN GRAINS

Genus SPARGANIACEAEPOLLENITES Thiergart, 1938

Thiergart (1938) instituted this genus to include round, reticulate, monoporate pollen grains resembling the pollen of *Sparganium* and *Typha*. *Typhidites* and *Sparganioidites* are nomina nuda. The genus *Graminidites* has an annulate pore and finely granulate exine.

SPARGANIACEAEPOLLENITES HOSPAHENSIS, new species
Fig. 14/22-24

Etymology—After the town of Hospah, New Mexico.

Holotype—Pb12454-4 (118.2 x 26.6), Fig. 14/22.

Diagnosis—Monoporate pollen grain; amb circular; pore (ora) simple, with no distinct margin, about 6 μm wide, rounded; exine less than 1 μm thick, finely reticulate, mesh up to about 1 μm.

Comments—S. *polygonalis* Thiergart, 1938, has a thicker exine, smaller pore, and smaller average size than the new species. *S. hospahensis* closely resembles monads of *Sparganium* and of *Typha angustifolia*. *Typha*-like fossil leaves were reported by Dorf (1942, p. 45, pl. 1, fig. 12) from the Maastrichtian of Wyoming. The occurrence of the typhaceous pollen in the early Campanian of New Mexico seems to be the first record from the rocks of this age.

Occurrence—Menefee Formation of New Mexico (common to abundant).

Measurements-25 (27) 28 m (six specimens measured).

TRICOLPATE POLLEN GRAINS

Genus CUPULIFEROIDAEPOLLENITES Thomson, 1950 ex Potonié, 1960

This genus is distinct from *Tricolpites* by having hyaline, laevigate exine. See Dettmann (1973, p. 12) for discussion of the taxonomy of psilate tricolpate pollen grains.

CUPULIFEROIDAEPOLLENITES LEVITAS, new combination
Fig. 14/25-33

1973. *Tricolpopollenites levitas* B. Tschudy, p. 25, pl. 9, figs. 1-6.

Comments—The genus *Tricolpopollenites* Pflug and Thomson was proposed for tricolpate pollen grains with indistinct equatorial pores in the colpi. The holotype and paratypes of *Tricolpopollenites levitas* are tricolpate. They do not exhibit any incipient pores associated with the colpi. The morphological features of *T. levitas* seem to fit the circumscription of the genus *Cupuliferoidaepollenites*.

Occurrence—Campian: Menefee Formation of New Mexico (very abundant); upper Campanian of Montana (B. Tschudy, 1973).

Measurements—Equatorial diameter 12 (15) 18 m, polar diameter 18 (18) 20 μm (12 specimens measured); polar/equatorial diameter 1.18 (1.27) 1.39 (six specimens measured).

CUPULIFEROIDAEPOLLENITES SANJUANENSIS, new species Fig. 14/34-40

Etymology—After San Juan County, New Mexico.

Holotype—Pb12462-1 (115.9 x 30.6), Fig. 14/34.

Diagnosis—Tricolpate pollen grain, subprolate to prolate; colpi narrow, about half the radius or longer; amb circular; exine very thin, about 0.5 m or less, with no apparent structure; surface smooth, hyaline at x 1000 magnification.

Occurrence—Menefee Formation of New Mexico (abundant).

Measurements-16-20 x 18-24 μm (10 specimens measured).

CUPULIFEROIDEAPOLLENITES AORISTUS, new combination
Fig. 14/41

1967. *Tricolpites* sp. B: Drugg, p. 49, pl. 7, fig. 41.
1973. *Tricolpites aoristus* Chmura, p. 109, pl. 22, fig. 19.

Comments—The genus *Tricolpites* should be restricted to finely reticulate tricolpate pollen grains. The psilate tricolpate pollen assigned to this genus by Drugg (1967) and Chmura (1973) does not fit the diagnostic features. *Tricolpites aoristus* (Drugg) Chmura is hereby transferred to *Cupuliferoidaepollenites aoristus* to distinguish it from finely reticulate tricolpate forms.

Occurrence—Campanian to Danian: Menefee Formation of New Mexico (common); Maastrichtian-Danian of California (Drugg, 1967); Campanian-Maastrichtian of western San Joaquin Valley, California (Chmura, 1973).

Measurements-13-20 μm (three specimens measured); 13-17 m (Drugg, 1967); 14-23 m (Chmura, 1973).

CUPULIFEROIDEAPOLLENITES MUTABILIS,
new combination
Fig. 14/42-44

1971. *Tricolpites mutabilis* Leffingwell, p. 44, pl. 8, figs. 1-3.

Comments—This species is characterized by abrupt thinning of the exine around the colpi.

Occurrence—Campanian–Maastrichtian: Menefee Formation of New Mexico (common); Maastrichtian of Wyoming (Leffingwell, 1971).

Measurements-20-26 μm (five specimens measured); 17-21 m (Leffingwell, 1971).

CUPULIFEROIDAEPOLLENITES sp. 1
Fig. 14/45, 46

Description—Tricolpate pollen grain; prolate; colpi long, extending two-thirds of polar diameter, narrow; amb circular; exine 0.5 m thick, endexine and ektexine fused; surface psilate.

Occurrence—Menefee Formation of New Mexico (common).

Measurements—Polar diameter 15-16 µm (four specimens measured).

CUPULIFEROIDEAPOLLENITES sp. 2
Fig. 14/47

Description—Tricolpate pollen grain; amb triangular, with straight to slightly convex sides; colpi long, gaping, apocolpal area small; surface scabrate to granulate, exine very thin (about 0.2 m), endexine and ektexine difficult to differentiate at x 1000 magnification.

Comments—Gies (1972) reported similar forms as *Tricolpites mutabilis* Leffingwell, 1971, from the Campanian-Maastrichtian of northwest Colorado. However, Gies' form and my specimens lack the abrupt thinning of the exine around the colpi, characteristic of *T. mutabilis.*

Occurrence—Campanian-Maastrichtian: Menefee Formation of New Mexico (abundant); Campanian-Maastrichtian of northwest Colorado (Gies, 1972).

Measurements—Equatorial diameter 14, 19 µm (two specimens measured).

CUPULIFEROIDAEPOLLENITES sp. 3
Fig. 15/1

Description—Tricolpate pollen grain; oblate, amb rounded triangular; colpi very short (brevicolpate), ragged, bordered by a margo; wall layering difficult to discern, surface psilate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 24 µm (four specimens measured).

CUPULIFEROIDAEPOLLENITES sp. 4
Fig. 15/2, 3

Description—Tricolpate pollen grain; oblate, amb triangular to trilobate, sides straight, corners rounded; colpi ragged, gaping, long, extending almost to the poles, without margo; exine about 0.5 m; wall layering indistinct, psilate to scabrate.

Measurements—Equatorial diameter 13-19 µm (five specimens measured).

CUPULIFEROIDEAPOLLENITES sp. 5
Fig. 15/4, 5

Description—Tricolpate pollen, colpi open, very short (brevicolpate), ragged; amb triangular, with convex sides; exine about 0.5 m thick, endexine and ektexine fused together, surface scabrate at x 1000 magnification.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-20-24 µm (two specimens measured).

CUPULIFEROIDEAPOLLENITES sp. 6
Fig. 15/6

Description—Tricolpate pollen grain, colpi short, less than half the radius at polar view, ragged; amb circular; exine about 1 m thick, endexine and ektexine fused, surface psilate at x 1000 magnification.

Occurrence—Menefee Formation of New Mexico (single grain).

Measurements-17 µm (one specimen measured).

Genus *ROUSEA* Srivastava, 1969a

This genus is distinct from *Tricolpites* Couper emend. Potonié in lacking uniform reticulation on the entire exine. The meshes are largest at the mesocolpal areas, decreasing at the apocolpia and along the colpal margins.

ROUSEA sp. 1
Fig. 15/7, 8

Description—Tricolpate pollen grain, colpi narrow, simple, long, reaching almost to the poles; prolate; endexine about 0.25 m, appressed; ektexine 1 m thick, coarsely reticulate in mesocolpal areas, meshes slightly finer at apocolpal areas, sharply decreasing in size on the rest of the surface.

Comments—This form resembles *Rousea georgensis* (Brenner) Dettmann, 1973. However, it differs from that species in having distinct reticulation on the apocolpal areas. In *R. georgensis* the apocolpal area is almost smooth.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-30 x 24 m (two specimens measured).

ROUSEA sp. 2
Fig. 15/9, 10

1972. *Tricolpites* sp. A: Miki, pl. 2, fig. 14.

Description—Tricolpate pollen grain, amb triangular; colpi half the radius, gaping; exine reticulate, meshes up to about 0.75 µm, restricted to mesocolpal and apocolpal areas; rest of exine psilate; endexine about 0.1 µm, ektexine 0.5 µm thick.

Comments—Tricolpites *varifoveatus* McIntyre, 1965, is distinct from this species in larger size and different outline. *Retitricolpites fragosus* Hedlund and Norris, 1968, has a thick exine and a reticulation restricted to the polar areas.

Occurrence—Senonian: Menefee Formation of New Mexico (common); Coniacian-Santonian Futabe Group, northeast Japan (Miki, 1972).

Measurements-14 m (four specimens measured).

Genus *STRIATOPOLLIS* Krutzsch, 1959

STRIATOPOLLIS PARANEUS (Norris), Singh, 1971
Fig. 15/11

1967. *Retitricolpites paraneus* Norris, p. 109, pl. 18, figs. 15-20.

Occurrence—Middle Albian–Cenomanian: Menefee Formation of New Mexico (single grain; sample Pb 12454, shale above the Beige Coal; section EC-75; recycled); middle and late Albian of Canada and U.S.A. (Norris, 1967; Hedlund and Norris, 1968; Singh, 1971; Wingate, 1980); Cenomanian of Australia (Dettmann, 1973).

Measurement-18 m (equatorial diameter, one specimen measured).

Genus *TRICOLPITES* Cookson ex Couper, 1953, emend. Potonié, 1960

See Srivastava (1975b, p. 98) for synonymy. Potonié (1960) emended this genus to accommodate tricolpate, isopolar, oblate to subprolate, reticulate pollen grains having uniform meshes of 1-2 m or less. *Gunnerites* Cookson and Pike, 1954, is a junior synonym of *Tricolpites* having the same type species. *Retitricolpites* (van der Hammen) Pierce 1961, and *Retitricolpites* van der Hammen ex van der Hammen and Wijmstra (1964) are illegitimate names.

TRICOLPITES CONFOSSIPOLLIS Srivastava, 1975b
Fig. 15/12, 13

Occurrence—Menefee Formation of New Mexico (single grain; sample Pb 12385, shale above the Beige Coal; section EC-150; probably recycled); middle Albian of Oklahoma (Srivastava, 1975b).

Measurements-18 x 28 µm (one specimen measured).

TRICOLPITES CRASSIMURUS (Groot and Penny) Singh, 1971
Fig. 15/14, 15

1960. *Tricolpopollenites crassimurus* Groot and Penny, p. 232, pl. 2, figs. 4, 5.

Comments—This species was proposed as a scabrate, fossaperturate, tricolpate pollen resembling the pollen grains of the modern genus *Quercus*. It can be distinguished from *Tricolpites sagax* Norris, 1967, by its larger size, thinner endexine, and scabrate surface. Some of the specimens illustrated by Srivastava (1975b, pl. 46, figs. 23, 24, pl. 47, figs. 1, 2) as *T. sagax* resemble *T. crassimurus*.

Occurrence—Late Albian–Campanian: Menefee Formation of New Mexico (rare); late Albian–Coniacian (fide Srivastava 1975b, p. 100).

Measurement-30 µm (one specimen measured).

TRICOLPITES HIANS Stanley, 1965
Fig. 15/16-20

Comments—Measurements on the South Hospah specimens indicate a prolate spherical to prolate shape for this species (see the shape index and measurements below).

Occurrence—Middle Albian–Paleocene: Menefee Formation of New Mexico (very abundant); middle Albian of Alberta, Canada (Singh, 1971); upper Campanian of Montana (B. Tschudy, 1973); early Paleocene of South Dakota (Stanley, 1965).

Measurements—Equatorial diameter = 11 (16) 22 m, polar diameter = 15 (18) 19 µm**,** polar equatorial diameter = 1.12 (1.22) (1.45) (22 specimens measured).

TRICOLPITES sp. cf. *RETITRICOLPITES MINUTUS* Pierce, 1961
Fig. 15/21-24

1961. *Retitricolpites minutus* Pierce, p. 52, p1. 3, figs. 109, 110. non 1963. *Tricolpopollenites minutus* Brenner, p. 93, pl. 40, figs. 5, 6.
non 1971. *Cupuliferoidaepollenites minutus* (Brenner): Singh, p. 194, pl. 29, figs. 8, 9.
non 1973. *Tricolpites minutus* (Brenner): Dettmann, p. 12, p1. 4, figs. 1-4.

Comments—Tricolpites *minutus* (Pierce) n.comb. is distinct from *Tricolpopollenites minutus* Brenner, 1963, in having clearly larger lumina.

Occurrence—Upper Albian and Upper Cretaceous: Menefee Formation of New Mexico (abundant).

Measurements-5 (9) 15 x 7 (10) 17 m (15 specimens measured).

TRICOLPITES VULGARIS (Pierce) Srivastava, 1969a
Fig. 15/25

1961. *Retitricolpites vulgaris* Pierce, p. 50, pl. 3, figs. 101, 102.

Occurrence—Middle Albian–Maastrichtian (see Srivastava, 1975b, p. 103): Menefee Formation of New Mexico (abundant).

Measurements—Polar diameter 17-22 m (four specimens measured); size range in the literature is 15-31 µm (see Pierce, 1961; Norris, 1967; Singh, 1971; Srivastava, 1969a, 1975b).

TRICOLPITES sp. 1
Fig. 15/26, 27

Description—Tricolpate pollen grain, prolate; colpi simple, long, reaching almost to the poles; exine less than 0.5 m thick, endexine and ektexine not distinguishable, surface minutely reticulate, meshes uniform, less than 0.5 µm wide.

Comments—The exinal structure in this form resembles very closely that of *Tricolpites reticulatus;* however, it does not exhibit the characteristic colpal arrangement of *T. reticulatus.*

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-24 x 16 m (one specimen measured).

TRICOLPITES sp. 2
Fig. 15/28-30

Description—Syn-tricolpate, fossaperturate pollen grain; oblate-spherical; colpi narrow and closed; amb trilobate; exine microreticulate, about 1 µm thick, endexine very thin, ektexine baculate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-11-15 x 12-17 m; polar/equatorial axis = 1-1.3 (four specimens measured).

TRICOLPITES sp. 3
Fig. 15/31

Description—Tricolpate pollen; colpi short, open; exine about 1 m thick, uniformly reticulate, lumina about 1 **m.**

Occurrence—Menefee Formation of New Mexico (single grain; sample Pb 12476, clayey coal at the base of the Blue Coal; section EC-75).

Measurement-17 m (one specimen measured).

TRICOLPITES sp. 4
Fig. 15/32, 33

Description—Tricolpate pollen grain; subprolate; colpi almost reaching the poles, open; exine about 1 **m** thick, endexine about 0.5 **m** thick; ektexine about 0.5 m thick, finely reticulate, lumina about 0.2 m, slightly coarser at the polar areas.

Occurrence—Menefee Formation of New Mexico (abundant).

Measurements-15 m (six specimens measured).

TRICOLPITES sp. 5
Fig. 15/34

Description—Tricolpate, angulaperturate pollen grain; amb obliquely triangular; colpi long, almost reaching the poles, subtended by a robust margo up to 2 **m** thick; endexine very thin, appressed, ektexine clearly baculate, baculae heads fusing to make a reticulate pattern on the surface with lumina up to 1 **p.m.**

Occurrence—Menefee Formation of New Mexico (common).

Measurements-42 µm (three specimens measured).

TRICOLPATE FORM A
Fig. 15/35, 36

Description—Tricolpate foveo-reticulate pollen grain; prolate with rounded poles, amb circular; colpi long, gaping, endexine very thin, ektexine about 1 **m** thick, foveoreticulate, fovae up to 1 **m,** larger at the apocolpal and the central part of the mesocolpal area, gradually decreasing in size towards the colpi; muri 1-1.5 m thick.

Comments—The diagnostic feature of this form is the conspicuous foveo-reticulate sculpture at the apocolpal and the center of the mesocolpal areas, decreasing towards the colpi. The genus *Rousea* Srivastava, 1975b, is reticulate rather than foveo-reticulate, with the meshes large only at the mesocolpal areas and gradually fining and disappearing towards the colpi and the mesocolpia. *Tricolpites* has uniform meshes.

Measurements-23-34 x 29-48 m; polar/equatorial diameter = 1.35-1.41 (five specimens measured).

TETRACOLPATE POLLEN GRAINS
Genus *UTRICULITES* Chlonova, 1969

This form genus is a tetrapertuare reticulate pollen with distinct, smooth endexine and a baculate ektexine.

UTRICULITES VISUS Chlonova, 1969
Fig. 15/37, 38

Occurrence—Menefee Formation of New Mexico (three specimens, probably recycled); Aptian-Albian-?Cenomanian of Siberia (Chlonova, 1969).

Measurements-20-23 µm (three specimens measured).

TRICOLPORATE POLLEN GRAINS
Genus *HOLKOPOLLENITES* Fairchild, 1966

This genus can be differentiated from *Nyssapollenites, Margocolporites,* and *Rhoipites* in having irregular channeling pattern on the exine. See Fairchild *in* Stover et al. (1966) for description.

HOLKOPOLLENITES **sp.** 1
Fig. 15/39, 40

Description—Tricolporate pollen grain, angulaperturate, colpi short, less than half the radius at polar view, thickened by a margo; amb deltoid; exine 2.53 µm thick, distinctly layered, incised by irregular channels more or less parallel to the sides of the grain in polar view.

Occurrence—Lower Campanian: Menefee Formation of New Mexico (rare); restricted to the base of Campanian on the east coast of the United States (Raymond Christopher, pers. comm.).

Measurement—Equatorial diameter 20 m (one specimen measured).

HOLKOPOLLENITES sp. 2
Fig. 15/41, 42

Description—Tricolporate pollen grain; prolate spherical (P/E = 1.1), colpi reaching almost to the poles, subtended by prominent margo; amb triangular with convex sides, exine about 2-5 µm thick, dense, differentiated into two layers of equal thickness; ektexine incised by shallow channels that cause a network pattern on the surface.

Occurrence—Menefee Formation of New Mexico (rare); Santonian-Campanian of the east coast of the United States (Raymond Christopher, pers. comm.).

Measurements—Equatorial diameter 27-30 µm (two specimens measured).

HOLKOPOLLENITES sp. 3
Fig. 15/43, 44

Description—Tricolporate, angulaperturate pollen grain; amb obliquely triangular to circular; colpi short (brevicolpate), ragged, subtended by a thick margo; exinal structure and layering inconspicuous, surface ornamented by very thin, shallow, branching grooves.

Occurrence—Menefee Formation of New Mexico (rare).

Measurement-22 m (one specimen measured).

HOLKOPOLLENITES sp. 4
Fig. 16/1

Description—Tricolporate pollen grain, colpi about half of the radius in polar view, subtended by a robust margo (up to 2.5 µm), pore simple, up to 2.5 µm in diameter; exine about 1.5 µm thick, endexine very thin, appressed, ektexine incised by short channels that cause a vermiculate pattern on the surface.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 24-25 m (two specimens measured).

Genus *MARGOCOLPORITES* Ramanujam ex Srivastava, 1969a

This genus was proposed for oblate to suboblate, reticulate or retipilate, tricolporate pollen with a distinct margo around the colpi.

MARGOCOLPORITES KRUSCHII, new combination
Fig. 16/2-4

1931. *Pollenites kruschii* Potonié, p. 4, fig. 11.
1953. *Pollenites kruschii pseudolaesus* (Potonié): Thomson and Pflug (pars), p. 104, pl. 13, figs. 50, 59, 60 (non figs. 47-49, 5158, 61-63).
1967. *Tricolporopollenites kruschii scutellatus* (Potonié): Krutzsch in: Drugg, p. 50, pl. 7, fig. 43.
1968b. *Tricolporopollenites kruschii* (Potonié): Thomson and Pflug (1953) *in* Elsik (pars), p. 628, pl. 31, figs. 11, 13-15, pl. 32, figs. 13, 7; non p1.31, figs. 1-4, 9, 12, 16, pl. 32, figs. 4-6, pl. 33, figs. 1-3, 8.

Description—Tricolporate, angulaperturate pollen grain; prolate spherical, ranging from spheroidal to subprolate; amb triangular with convex sides and broadly rounded corners; colpi long, extending almost to the poles, marked by a conspicuous margo (2-3 **m);** ora with no apparent thickening, 5-6 µm wide; exine 2-2.5 µm thick, endexine as thick as ektexine or slightly thicker, ektexine made up of closely spaced and fused baculae that cause a microreticulate or punctate pattern on the surface.

Comments—The morphology of this species conforms with the diagnosis of *Pollenites kruschii* Potonié, 1931. Thomson and Pflug (1953) transferred *P. kruschii* to *Tricolporopollenites* and described several subspecies which broadened the original diagnosis of Potonié (1931). Some of the specimens described by Elsik (1968b) as *Tricolporopollenites kruschii* belong to the genus *Margocolporites* (see synonymy above). *Pollenites kruschii* and the subspecies listed in the above synonymy show a distinct margo around the colpi. These forms are therefore placed under the genus *Margocolporites* in this treatment.

Occurrence—Santonian–Paleocene: Menefee Formation of New Mexico (common); Maastrichtian-Danian of California (Drugg, 1967); Paleocene of Texas (Elsik, 1968b) and Europe (Krutzsch *in* Doring et al., 1966; Thomson and Pflug, 1953); Santonian–Campanian of the east coast of the United States (Raymond Christopher, pers. comm.).

Measurements—Equatorial diameter 22 (32) 38 µm; polar diameter 24 (35) 41 µm; P/E 1.0 (1.1) 1.3 (20 specimens measured).

MARGOCOLPORITES MINUTUS, new species
Fig. 16/5-8

Etymology—Minutus (Latin) = small, referring to the small size of this species.

Holotype—Pb12387-2 (126.4 x 30.0), Fig. 16/5.

Diagnosis—Tricolporate pollen grain; very small, oblate, amb obliquely triangular; colpi about half the radius of the amb, gaping, subtended by a margo; margo about 0.5 µm thick; exine very thin, microreticulate.

Comments—The small size of this species differentiates it from other species described here and in the literature.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 8-12 µm (three specimens measured).

MARGOCOLPORITES VARIRETICULATUS, new species
Fig. 16/9-12

1968b. *Tricolporopollenties kruschii* (Potonié): Thomson and Pflug (1953) *in* Elsik, p. 628, pl. 30, figs. 7-10, pl. 31, figs. 1-4, 9, 11-16, p1. 34, figs. 1-5.

Etymology—From *various* (Latin) = various, and *reticulum* (Latin) = mesh or network, in reference to the irregularly reticulate pattern of the exine.

Holotype—Pb12414-7 (123.0 x 37.6), Fig. 16/9, 10, section EC-150, Blue Coal, Menefee Formation, South Hospah, New Mexico.

Diagnosis—Tricolporate pollen grain; prolate; amb triangular, sides straight or slightly concave; colpi long, extending up to two-thirds of the radius in polar view, subtended by a thick margo (about 1.5 µm); pore simple, round, about 5 µm wide, exine about 1.5 m thick, endexine and ektexine of the same thickness; ektexine baculate, baculae heads fusing to form a reticulate pattern; meshes up to 1 µm, larger at the mesocolpal and apolcopal region, decreasing in size towards the colpi.

Comments—This species can be distinguished from *H. kruschii* by its smaller size, more-or-less straight sides in polar view, and larger meshes on the ektexine. It is much larger than the other species described in this study.

Occurrence—Campanian–Paleocene: Menefee Formation of New Mexico (common); Paleocene of Texas (Elsik, 1968b).

Measurements—Equatorial diameter 20-26 µm; polar diameter 31-40 µm (three specimens measured).

MARGOCOLPORITES sp. 1
Fig. 16/13-15

Description—Tricolporate pollen grain, colpi long, reaching almost to the poles, subtended by a distinct margo (about 1 m) at the equatorial area of the grain, tapering towards the poles; pores meridional, round, simple, up to 2 µm in diameter; endexine very thin, appressed, ektexine reticulate, lumina up to 0.5 µm.

Occurrence—Menefee Formation of New Mexico (common).

Measurements-16 x 13 µm (two specimens measured).

MARGOCOLPORITES sp. 2
Fig. 16/16, 17

Description—Tricolporate pollen grain; colpi about one-half the radius at polar view; subtended by a distinct margo about 1m thick at the equatorial area, tapering towards the poles; amb triangular, sides straight or slightly convex, corners truncated; exine about 1 m thick, reticulate, meshes about 1µm at the mescolpal and apocolpal areas, sharply decreasing and diminishing towards the colpi; wall layering inconspicuous.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 16 µm (two specimens measured).

Genus NYSSAPOLLENITES Thiergart ex Potonié, 1960

This genus includes suboblate to spherical, angulaperturate, tricolporate pollen grains with triangular to rounded triangular amb. The margins of the colpi and the pores are distinctly thickened and the exine is infrapunctate.

NYSSAPOLLENITES ALBERTENSIS Singh, 1971
Fig. 16/18-20

Occurrence—Albian-lower Campanian: Menefee Formation of New Mexico (abundant); Albian-lower Cenomanian of Canada and U.S.A. (fide Singh, 1971).

Measurements—Equatorial diameter 10 (15) 22 m; polar diameter 14 (21) 31 µm (21 specimens measured); P/E = 1.4 (nine measurements).

NYSSAPOLLENITES cf. NIGRICOLPUS Singh, 1983
Fig. 16/21, 22

Comments—The South Hospah specimens are morphologically similar to, but larger than, *N. nigricolpus* of Singh (1983), which is 12-17 µm in equatorial diameter.

Occurrence—Menefee Formation of New Mexico (common).

Measurements—Equatorial diameter 20-22 m (three specimens measured).

NYSSAPOLLENITES TRIANGULUS (Groot, Penny and Groot) Singh, 1983
Fig. 16/23-25

1961. *Tricolporopollenites triangulus* Groot, Penny and Groot, p. 134, pl. 26, fig. 26.

Occurrence—Upper Albian-lower Campanian: Menefee Formation of New Mexico (rare); late AlbianConiacian of North America, France, and West Africa (Singh, 1983).

Measurements—Equatorial diameter 15-18 µm; polar diameter 17-20 µm (three specimens measured).

NYSSAPOLLENITES sp.
Fig. 16/26, 27

Description—Tricolporate pollen grain; prolate, amb triangular, sides convex; colpi long, reaching almost to the poles, subtended by a margo up to 1 µm thick; exine less than 0.5 m thick, wall layering difficult to discern at x 1000 magnification, surface psilate.

Comments—This form is smaller than other species of the genus, which are usually not less than 14 µm in equatorial diameter.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-14 x 10 µm (two specimens measured).

PERINOTRICOLPORITES, new genus

Etymology—From *perinium* (Latin) = outer layer, *tri* (Latin) = three, *kolpos* (Greek) = fold, and *poratus* (Latin) = pore-bearing, in reference to the tricolporate aperture and the presence of an outer layer.

Type *species—Perinotricolporites delicatus* n.sp.

Diagnosis—Tricolporate pollen grain; amb triangular, angulaperturate; colpi differentially thickened; exine surrounded by a delicate perine. The perine may readily be stripped away from the central body. The paratype (Fig. 16/31) illustrates partial detachment of the perine.

PERINOTRICOLPORITES DELICATUS, new species
Fig. 16/30, 31

Etymology—delicatus (Latin) = delicate, in reference to the delicate outer layer surrounding the grain.

Holotype—Pb12402-4 (123.8 x 37.2), Fig. 16/30.

Paratype—Pb12385-6 (119.1 x 43.5), Fig. 16/31.

Diagnosis—Tricolpate pollen grain; amb triangular with convex sides and rounded corners; colpi differentially thickened, extend two-thirds the radius in equatorial view; exine about 0.75 µm thick, scabrate or psilate, surrounded by a delicate membraneous perine about 2-4 m wide.

Comments—The specimens which have lost the delicate outer perine would closely resemble the nonperinate form species *Nyssapollenites nigricolpus* Singh in their polar view by exhibiting heavily thickened colpi, similar surface features, and similar outline. These two forms may have different size ranges. However, a large number of specimens of *Perinotricolporites* is needed in order to establish a reliable size range for this form. The South Hospah assemblages yielded only two specimens with perine intact.

Occurrence—Menefee Formation of New Mexico (two specimens measured).

Measurements—Equatorial diameter 26 m, 17 µm without perine (two specimens measured).

Genus *PSILATRICOLPORITES* van der Hammen ex van der Hammen and Wijmstra, 1964

PSILATRICOLPORITES SUBTILIS (Groot, Penny and Groot) Singh, 1983
Fig. 16/32

1961. *Tricolporopollenites subtilis* Groot, Penny and Groot, p. 134, pl. 26, figs. 22, 23.

Occurrence—Cenomanian-Campanian: Menefee Formation of New Mexico (common); Cenomanian of Alberta (Singh, 1983); Cenomanian (Brenner, 1967) and Cenomanian-Coniacian (Groot, Penny and Groot, 1961) of the U.S. Atlantic coast.

Measurements—Equatorial diameter 14-16 m; polar diameter 23-26 m (six specimens measured).

Genus *RANUNCULACIDITES* Sah, 1967

Tricolp(or)ate pollen with colpi covered by a plug (perculum sensu Erdtman, 1952, p. 466).

Cf. *RANUNCULACIDITES* sp.
Fig. 16/28, 29

Comments—Ranunculacidites is a Tertiary genus. The aperture structure of the South Hospah specimens resembles that of this genus. Thus, they are tentatively assigned to it. The possibility of contamination should not be ruled out.

Occurrence—Menefee Formation of New Mexico (two specimens recovered).

Measurements-18, 21 m (two specimens measured).

TRIPORATE POLLEN GRAINS

Genus *CASUARINIDITES* Cookson and Pike, 1954

Srivastava (1972) revised the genus *Casuarinidites* to include triporate pollen having triangular to subcircular amb with convex sides and 2-5 circular to slightly elliptical, usually aspidate pores at the angles. Ektex-ine is thicker than endexine and no atrium is present. This genus was proposed by Cookson and Pike (1954) to accommodate palynomorphs similar to those of the family Casuarinaceae. However, pollen grains more or less similar to those of Casuarinaceae are also produced by Betulaceae, Myricaceae, and Juglandaceae (see Erdtman, 1952, pp. 73, 104, 216, 278).

CASUARINIDITES MICROGRANULATUS, new species
Fig. 16/33-38

Etymology—From *mikros* (Greek) = small, and *granum* (Latin) = grain, in reference to the surface texture of the pollen.

Holotype—Pb 12462-1 (125.0 x 29.2), Fig. 16/34.

Diagnosis—Pollen grain normally triporate, occasionally diporate or tetraporate; amb usually triangular with slightly convex sides; angulaperturate, pores simple, slightly aspidate, exine about 1 μm thick, endexine not discernible, ektexine made up of closely packed pila; spaces between pila produce minute puncta; surface granulate.

Occurrence—Menefee Formation of New Mexico (common to abundant). This form is a good marker for the top of the lower Campanian on the U.S. Atlantic coast (Raymond Christopher, written comm.).

Measurements-21 (25) 32 m (seven specimens measured).

CASUARINIDITES sp.
Fig. 16/39, 40

Description—Triporate pollen grain; oblate, amb triangular, angulaperturate; sides convex; pores circular, slightly aspidate, without annulus; exine 1.5 m thick, endexine very thin, appressed, ektexine scabrate on the surface; no atrium; no interloculum.

Comments—This form can be distinguished from *Casuarinidites microgranulatus* in having a thicker exine and different surface ornamentation.

Occurrence—Menefee Formation of New Mexico (abundant).

Measurements-21-25 m (six specimens measured).

Genus *COMPLEXIOPOLLIS* Krutzsch, 1959, emend. R. H. Tschudy, 1973

COMPLEXIOPOLLIS ABDITUS R. H. Tschudy, 1973
Fig. 16/41-46

Occurrence—Coniacian-Campanian: Menefee Formation of New Mexico (rare); Coniacian-Campanian of Tennessee (R. H. Tschudy, 1973).

Measurements—Equatorial diameter 20 (21) 23 m (this study, six specimens measured); 15-21 m (R. H. Tschudy, 1973).

Genus *LABRAPOLLIS* Krutzsch, 1968

Triporate pollen characterized by small size, planaperturate amb, and three plicae subtending the pores.

LABRAPOLLIS sp. 1
Fig. 17/1-3

Description—Triporate pollen grain; amb triangular, sides straight to convex, planaperturate; pores simple, subtended by plicae that are straight, join adjacent corners and form a triangle in the middle of the amb; exine very thin, wall layering not discernible; surface psilate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 13-16 μm (three specimens measured).

LABRAPOLLIS sp. 2
Fig. 17/4, 5

Description—Triporate pollen grain; oblate, amb circular; pores equatorial, distinctly annulate, aspidate, subtended by plicae; exine about 1 m thick, wall layering indistinct; surface psilate to scabrate.

Comments—This form is distinct from *Labrapollis* sp. 1 in having a circular amb and annulate pores.

Occurrence—Turonian-lower Campanian: Menefee Formation of New Mexico (common); TuronianSantonian of New Jersey (Christopher, 1978, pl. 2, figs. 12, 13).

Measurements—Equatorial diameter 11 (15) 17 μm (six specimens measured).

LABRAPOLLIS sp. 3
Fig. 17/6, 7

Description—Triporate pollen grain; oblate, amb obliquely triangular to circular; pores equatorial, located at the radial corners of the amb, simple, subtended by faint plicae; exine less than 0.5 μm thick, wall layering indistinct; surface psilate to minutely scabrate.

Comments—This form is distinct from *Labrapollis* sp. 1 in having less conspicuous plicae and in the organization of pores. It can be distinguished from

Labrapollis sp. 2 by its simple pore structure and thinner wall.

Occurrence—Menefee Formation of New Mexico (rare to common).

Measurements-10-16 m (four specimens measured).

Genus *MOMIPITES* Wodehouse, 1933, emend. Frederikson and Christopher, 1978

MOMIPITES sp.
Fig. 17/8, 9

Description—Triporate pollen grain; pores equatorial, simple, circular, located at the radial corners of the amb, subtended by faint atria; exine about 1 thick; amb triangular, sides convex, radial corners sharp; wall layering indistinct; surface finely granulate.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-20, 26 m (two specimens measured).

Genus *OSCULAPOLLIS* R. H. Tschudy, 1975

This genus is distinct in having round pores; the exogerminals in *Vacuopollis* are vertical slits.

OSCULAPOLLIS PERSPECTUS R. H. Tschudy, 1975
Fig. 17/10, 11

Occurrence—Campanian: Menefee Formation of New Mexico (rare); upper Campanian (Coffee Sand) of the Mississippi Embayment area (R. H. Tschudy, 1975).

Measurements—Equatorial diameter 25 m (one specimen measured).

Genus *PLICAPOLLIS* Pflug, 1953, emend. R. H. Tschudy, 1975

Tschudy (1975) emended this genus to include triporate, *Normapolles-type* plicate pollen with vestibulum, strongly annulate exogerminals, and thickened endogerminals. Species of *Plicapollis* have been reported from the middle Turonian to the upper Campanian of western North America (R. Tschudy, 1980, p. 10).

PLICAPOLLIS SERTA Pflug, 1953
Fig. 17/12, 13

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-19-20 m (three specimens measured).

Genus *PROTEACIDITES* Cookson ex Couper, 1953

PROTEACIDITES RETUSUS Anderson, 1960
Fig. 17/14, 15

Occurrence—Coniacian-Maastrichtian: Menefee Formation of New Mexico (common); Coniacian-Maastrichtian of the Western Interior of North America (fide Nichols and Jacobson, 1982).

Measurements—Equatorial diameter 14-22 pm (four specimens measured).

PROTEACIDITES THALMANNI Anderson, 1960
Fig. 17/16

Occurrence—Coniacian-Maastrichtian: Menefee Formation of New Mexico (rare).

Measurements-24 m (two specimens measured).

Genus *PSEUDOPLICAPOLLIS* Krutzsch *in* Goczan, Groot, Krutzsch and Pacltova, 1967, emend. Christopher, 1979

Species of this genus have been reported from middle Turonian to upper Campanian of the western North America (R. H. Tschudy, 1980).

PSEUDOPLICAPOLLIS CUNEATA Christopher, 1979
Fig. 17/17, 18

Occurrence—Santonian-lower Campanian: Menefee Formation of New Mexico (rare); Santonian of New Jersey (Christopher, 1979).

Measurements—Equatorial diameter 22, 26 m (two specimens measured); 17 (20) 24 m (christopher, 1979).

PSEUDOPLICAPOLLIS TRIRADIATA, new species
Fig. 17/19-21

Etymology—From *tri* (Latin) = three, and *radius* (Latin) = ray, wheel or spoke, in reference to the three radiating plicae on the pollen.

Holotype—Pb12387-2 (123.2 x 40.8), Fig. 17/19.

Diagnosis—Triporate, *Normapolles-type* pollen; amb triangular, with strongly convex sides and greatly protruding corners; exine about 1 m thick in interapertural region; endexine and ektexine appressed except in pore areas where they separate to form a robust annulus around the exogerminal; inner outline of annulus and extension of endexine form a triangular endogerminal; plicae form prominent double folds, radiate from poles, and extend to germinal regions where they are fused with annuli; plicae consistently present in all specimens; space between walls of plicae forms a triradiate channel that terminates in the vestibula.

Comments—This species is distinct in having permanent, double-walled plicae (in all specimens examined) and robust annuli. In *P. longiannulata* Christopher, 1979, the plicae are usually weakly developed or absent, and endannuli are formed by the extension of endexine into the vestibula. *P. newmanii* does not have robust annuli.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 20-23 m (three specimens measured).

PSEUDOPLICAPOLLIS NEWMANII Nichols and Jacobson, 1982
Fig. 17/22-26

Comments—This species is characterized by prominent plicae which often appear as double folds, and triangular endoporal structures that extend into the vestibula.

Occurrence—Campanian: Menefee Formation of New Mexico (common); Campanian of Colorado, Wyoming, and New Mexico (Nichols and Jacobson, 1982).

Measurements—Equatorial diameter 17-21 (seven specimens measured).

Genus *PSEUDOVACUOPOLLIS* Krutzsch *in* Goczan, Groot, Krutzsch and Pacltova, 1967

This genus was differentiated by Krutzsch (1967) from the genus *Vacuopollis* on the tendency in this pollen toward the development of a constriction in the interapertural area and more strongly differentiated endexinal lamellae. The range of this genus was given by Goczan et al. (1967) as Coniacian-Maastrichtian.

PSEUDOVACUOPOLLIS INVOLUTUS R. H. Tschudy, 1975
Fig. 17/27, 28

Occurrence—Campanian: Menefee Formation of New Mexico (common); upper Campanian and Maastrichtian of Mississippi Embayment (R. Tschudy, 1975).

Measurements-22-23 μm (six specimens measured).

Genus *TRIPOROPOLLENITES* Pflug and Thomson, 1953

This genus was proposed for triporate pollen grains with triangular to obliquely triangular amb and occasionally detectable annulus or labrum. The pore structure in this genus is comparable to the pores in *Corylus* and *Ostrya.*

TRIPOROPOLLENITES sp. 1
Fig. 17/29, 30

Description—Triporate pollen grain; amb deltoid, sides straight to slightly convex, angulaperturate; pores equatorial, slightly elongated meridionally, non-atriate, weakly annulate, slightly aspidate; exine about 1 m thick, wall layering not discernible; surface scabrate.

Occurrence—Menefee Formation of New Mexico (common).

Measurements-29, 35 m (two specimens measured).

TRIPOROPOLLENITES sp. 2
Fig. 17/31, 32

Description—Triporate pollen grain; amb triangular, sides convex, angulaperturate; pores equatorial, simple, non-aspidate, non-atriate, circular, weakly annulate; exine less than 1 m thick; surface granulate.

Comments—This form is differentiated from *Triporopollenites* sp. 1 on the basis of its non-aspidate pores, thinner exine, and granulate rather than scabrate surface.

Occurrence—Menefee Formation of New Mexico (common).

Measurements-27-28 m (six specimens measured).

TRIPOROPOLLENITES sp. 3
Fig. 17/33, 34

Description—Triporate pollen grain (occasionally diporate); amb circular, pores small, slightly annulate; aspidate; non-atriate; exine very thin, wall layers not discernible; surface psilate.

Comments—This form is distinct by its small size, circular amb, and smooth surface.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements-14-15 μm (two specimens measured).

TRIPOROPOLLENITES sp. 4
Fig. 17/35, 36

Description—Triporate pollen grain; amb triangular, with strongly convex sides, to circular; pores large, equatorial, annulate; exine about 3m thick, made up of two distinct layers, endexine less than 0.5 μm thick, appressed except at the germinal areas where it is detached from the ektexine and turned inward to form the base of the vestibulum; surface psilate.

Comments—This form is distinguished by its small size and very thick exine.

Occurrence—Menefee Formation of New Mexico (rare).

Measurements—Equatorial diameter 17-21 μm (two specimens measured).

Genus *VACUOPOLLIS* Pflug *in* Thomson and Pflug, 1953

1953. *Vacuopollis* Pflug, p. 103.
1953. *Conclavipollis* Pflug, p. 105.

VACUOPOLLIS ORTHOPYRAMIS Pflug *in* Thomson and Pflug, 1953 Fig. 17/37, 38

Occurrence—Senonian: Menefee Formation of New Mexico (common); middle Senonian of Germany (Pflug, 1953).

Measurements-25-30 m (four specimens measured).

VACUOPOLLIS SEMICONCAVUS Pflug *in* Thomson and Pflug, 1953
Fig. 17/39-42

Occurrence—Santonian-Campanian: Menefee Formation of New Mexico (common); Santonian of Germany (Pflug, 1953).

Measurements—Equatorial diameter 18-23 m (six specimens measured).

POLYADS

Genus *POLYADOPOLLENITES* Pflug *in* Thomson and Pflug, 1953

This genus was proposed to accommodate the fossil dispersed polyads resembling the pollen massulae of the modern genus *Acacia* (Mimosaceae). Herngreen (1973) described eight-celled polyads from the Cenomanian of Brazil. Mimosaceous-type polyads have also been described by Kedves (1971) from the Coniacian-Santonian and lower Paleocene of Egypt.

POLYADOPOLLENITES sp. 1
Fig. 17/43

Description—A massula of pollen grains made up of about 12 grains; outline circular; individual grains very much like *Polyadopollenites* sp. 2 in size and shape.

Comments—A single grain of this type was found in the South Hospah samples. *Polyadopollenites* sp. 1 and sp. 2 may be members of the same species.

Occurrence—Menefee Formation of New Mexico (single specimen; core section EC-150, Beige Coal seam).

Measurement—Diameter 11 µm (one specimen measured).

POLYADOPOLLENITES sp. 2
Fig. 17/44

Description—A massula of about 25 pollen grains; outline circular; individual grains with tetragonal to pentagonal outline, without any discernible aperture at x 1000 magnification.

Comments—The forms reported by Cookson (1954) from the Tertiary of Australia are much larger. The apparently entomophyllous nature of pollination in the plants producing this pollen type may explain their scarcity in the South Hospah samples.

Occurrence—Menefee Formation of New Mexico (single grain; core section EC-150, Beige Coal seam; the same sample as for *Polyadopollenites* sp. **1).**

Measurement—Diameter 18 µm (one specimen measured).

Discussion and conclusions

Two new genera, eight new species, nine new combinations, and two new ranks are proposed in this paper (Table 4).

The composition of the described assemblage clearly indicates a post-Turonian age for the South Hospah coal-bearing sediments. One hundred and fourteen of the 172 palynomorphs illustrated in this study either are restricted to the Upper Cretaceous strata or the base of their stratigraphic range is in the Upper Cretaceous System. Table 2 summarizes the stratigraphic range of some of the palynomorphs in the South Hospah assemblage which have been used as the basis of the age determination in this study. Among these taxa, the occurrence of *Pseudoplicapollis newmanii*, *Schizosporis scabratus*, *Distancorisporis dakotaensis*, *Osculapollis perspectus*, *Reticulosporis reticulatus*, *Holkopollenites* sp. 1, *Inaperturotetradites scabratus*, and *Equisetosporites menakae* specifically indicates a lower Campanian age for the deposits.

The South Hospah palynoflora is younger than the assemblage described by R. H. Tschudy (1976) from the Crevasse Canyon Formation in McKinley County, and older than the assemblage described by Delfel

TABLE 2—Range of some stratigraphically useful palynomorphs in the South Hospah assemblage.

	pre-Aptian	Aptian	Albian	Cenomanian	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Paleocene	Figure
Aequitriradites spinulosus	—	—	—	—	—	—	—	—	—		7/8
Sestrosporites pseudoalveolatus	—	—	—	—	—	—	—	—	—		7/20
Cicatricosisporites australiensis	—	—	—	—	—	—	—	—	—		8/9
Schizosporis cooksoni	—	—	—	—	—	—	—	—			6/8
Microreticulatisporites uniformis		—	—	—	—	—	—	—	—	—	9/3
Echinatisporis varispinosus		—	—	—	—	—	—	—	—		7/12
Appendicisporites cristatus			—	—	—	—	—	—	—	—	8/3-6
Tricolpites hians			—	—	—	—	—	—	—	—	15/16-20
Aequitriradites ornatus			—	—	—	—	—	—	—		7/7
cf. Retitricolpites minutus			—	—	—	—	—	—	—		15/21-24
Tricolpites vulgaris			—	—	—	—	—	—	—		15/25
Tricolpites crassimurus			—	—	—	—	—	—			15/14,15
Nyssapollenites albertnesis			—	—	—	—	—	—			16/18-20
Nyssapollenites triangulus			—	—	—	—	—	—			16/23-25
Peromonolites subengelmanii				—	—	—	—	—	—	—	7/15,16
Reticulosporis foveolatus				—	—	—	—	—	—		9/1
Camarozonosporites hammenii				—	—	—	—	—	—		7/10,11
Cingutriletes congruens				—	—	—	—	—			6/15
Palambages sp.					—	—	—	—	—		6/2
Proteacidites retusus						—	—	—	—		17/14,15
Proteacidites thalmanni						—	—	—	—		17/16
Complexiopollis abditus						—	—	—			16/41-46
Margocolporites kruschii							—	—	—	—	16/2-4
Dictyophyllidites sp. 2							—	—	—		9/16,17;10/1
Kuylisporites scutatus							—	—	—		10/2,3
Vacuopollis orthopyramis							—	—			17/37,38
Vacuopollis semiconcavus							—	—			17/39-42
Holkopollenites sp. 2							—	—			15/41,42
Pseudoplicapollis cuneata							—	—			17/17,18
Margocolporites varireticulatus								—	—	—	16/9-12
Triporoletes novomexicanus								—	—	—	7/9
Reticulosporis reticulatus								—	—	—	9/2
Schizosporis scabratus								—			6/10-14
Distancorisporis dakotaensis								—			6/16,17
Equisetosporites menakae								—			13/7
Inaperturotetradites scabratus								—			12/19-21
Holkopollenites sp. 1								—			15/39,40
Osculapollis perspectus								—			17/10,11
Pseudoplicapollis newmanii								—			17/22-26

TABLE 3—Stratigraphic ranges of recycled palynomorphs in the South Hospah assemblage.

	pre Apt	Apt	Alb	Cen	Tur	Figure
Todisporites minor	—	—	—	—		8/1,2
Parvisaccites radiatus	—	—	—	—		13/3
Appendicisporites potomacensis	—	—	—	—		8/7
Spheripollenites classopolloides	—					12/5
Pristinuspollenites microsaccus	—					12/9
Appendicisporites unicus			—	—		8/8
Cicatricosisporites cuneiformis			—	—		8/10
Foveogleicheniidites confosus			—	—		9/4
Rugubivesiculites rugosus			—	—		13/4
Striatopollis paraneus			—	—		15/11
Equisetosporites jansonii			—			13/5,6
Equisetosporites rousei			—			13/8,9
Tricolpites confossipollis			—			15/12,13

TABLE 4—List of new taxa described in this study.

Taxon	Status	Figure
Distverrusporis	n.rank	6
Tripunctisporis	n.rank	7
Rhombosporites	n.genus	6
Perinotricolporites	n.genus	16
Rhombosporites tetrangulus	n.sp.	6/3-7
Perinotricolporites delicatus	n.sp.	16/30,31
Sparganiaceaepollenites hospahensis	n.sp.	14/22,24
Cupuliferoidaepollenites sanjuanensis	n.sp.	14/34-40
Margocolporites minutus	n.sp.	16/5-8
Margocolporites varireticulatus	n.sp.	16/9-12
Casuarinidites microgranulatus	n.sp.	16/33-38
Pseudoplicapollis triradiata	n.sp.	17/19-21
Distancorisporis dakotaensis	n.comb.	6/16,17
Distverrusporis antiquasporites	n.comb.	6/18,19
Distverrusporis pocockii	n.comb.	6/20,21
Peromonolites subengelmanii	n.comb.	7/15,16
Reticulosporis reticulatus	n.comb.	9/2
Cupuliferoidaepollenites levitas	n.comb.	14/25-33
Cupuliferoidaepollenites aoristus	n.comb.	14/41
Cupuliferoidaepollenites mutabilis	n.comb.	14/42-44
Margocolporites kruschii	n.comb.	16/2-4

(1979) from the La Ventana Sandstone in Sandoval County. Thus, the assignment of this terrestrial coal-bearing rock unit (by the geologists of the Chaco Energy Company) to the Menefee Formation seems to be appropriate.

The occurrence of some palynomorphs which have been previously reported from younger strata suggests that their total stratigraphic range should be reconsidered. The form species *Peromonolites subengelmanii* (Elsik) (Fig. 7/15, 16), for instance, very closely resembles the specimens of *Isoetes subengelmanii* illustrated by Elsik (1968) from the Paleocene of Texas. Similar forms have also been illustrated from the Frontier Formation of Wyoming (Griggs, 1970). These occurrences extend the stratigraphic range of this form to the Upper Cretaceous.

Another noteworthy palynomorph in this respect is the form species *Sparganiaceaepollenites hospahensis* (Fig. 14/22-24). This form closely resembles the modern pollen of *Typha*. According to Muller (1981), the oldest record of typhaceous/sparganiaceous monoporate pollen is Paleocene. The occurrence of such pollen in the lower Campanian of New Mexico indicates a significantly longer range than suggested in the literature. The chance of contamination seems slight because identical material was recovered from several samples in different cores.

The occurrence of polyads resembling the pollen massulae of the modern genus *Acacia* (Fig. 17/43, 44) is also notable. Polyads assignable to the family Mimosaceae have been reported from middle Eocene and younger rocks (Muller, 1981). Eight-celled polyads from the Cenomanian of Brazil (Herngreen, 1973) and polyads from the Coniacian/Santonian of Egypt (Kedves, 1971) represent two previous reports of this pollen type from Upper Cretaceous rocks.

On the other hand, some palynomorphs present, which have been previously reported only from older strata, represent sedimentary material reworked into the South Hospah depositional environments (Table 3). The recycled palynomorph species, mostly with a reported Albian-Cenomanian stratigraphic range, indicate that the Albian-Cenomanian strata formed part of the rock exposures, and their erosion provided some of the clastic material for the South Hospah deposits.

Acid-resistant marine phytoplankton such as dinoflagellates and acritarchs were not found in the South Hospah palynological assemblages. The absence of other marine microfossils and invertebrate megafossils and the presence of fresh-water algal bodies indicate that the sediments were deposited in fresh-water environments—a lowland-swamp complex. (Jameossanaie, 1986).

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Figures 6-17

Figure 6

(All illustrations × 1000)

1,	*Palambages canadiana* S. K. Srivastava, 1968a		
	Pb12401-9(114.4 × 37.2),	Roll 38-20,	67 μm
2,	*Palambages* sp.		
	Pb12404-1(121.0 × 41.0),	Roll 20-9,	40 × 55 μm
3–7,	*Rhombosporites tetrangulus* n.gen. & sp.		
	3,4 = Pb12457-1(120.7 × 42.9),	Roll 57-22,23,	18 μm
	5 = Pb12457-2(122.9 × 36.1),	Roll 49-5,	19 × 20 μm
	6 = Pb12462-1(115.8 × 39.5),	Roll 50-6,	17 μm
	7 = Pb12378-8(115.9 × 39.1),	Roll 32-1,	17 × 15 μm
8,	*Schizosporis cooksoni* Pocock, 1962		
	Pb12379-2(124.8 × 42.3),	Roll 27-8,	30 μm
9,	*Schizosporis parvus* Cookson & Dettmann, 1959		
	Pb12533 = 3(118.3 × 33.0),	Roll 57-15,	30 × 19 μm
10–14,	*Schizosporis scabratus* Stanley, 1965		
	10 = Pb12387-2(121.5 × 30.6),	Roll 26-19,	24 × 22 μm
	11 = Pb12387-2(114.6 × 43.1),	Roll 18-18,	24 μm
	12 = Pb12387-2(121.5 × 29.9),	Roll 26-18,	24 × 22 μm
	13 = Pb12387-2(116.4 × 31.4),	Roll 18-8,	23 × 22 μm
	14 = Pb12529-1(119.0 × 28.7),	Roll 56-29,	15 μm
15,	*Cingutriletes congruens* Pierce, 1961		
	Pb12500-1(127.2 × 28.8),	Roll 53-22,	43 μm
16,17,	*Distanocorisporis dakotaensis* (Stanley) n.comb.		
	16 = Pb12533-3(122.4 × 39.5),	Roll 57-9,	30 μm
	17 = Pb12460-1(118.7 × 41.6),	Roll 49-28,	25 μm
18,19,	*Distverrusporis antiquasporites* (Wilson & Webster) n.comb.		
	18 = Pb12387-2(123.8 × 40.2),	Roll 16-9,	20 μm
	19 = Pb12374-3(114.0 × 31.6),	Roll 32-6,	20 μm
20–23,	*Distverrusporis pocockii* (Burger) n. comb.		
	20 = Pb123870-2(113.8 × 30.0),	Roll 19-6,	29 μm
	21 = Pb12387-1(125.1 × 47.7),	Roll 5-16,	26 μm
	22,23 = Pb12387-1(119.4 × 31.0),	Roll 5-29,30,	35 μm
24,	*Distverrusporis* sp. 2		
	Pb12387-2(117.5 × 43.0),	Roll 17-22,	31 μm
25,	*Stereisporites stereoides* (Potonié & Venitz) Pflug, 1953		
	Pb124080-1(127.4 × 39.0),	Roll 7-16,	23 μm
26,	*Stereisporites* sp. 1		
	Pb12385-1(129.2 × 38.4),	Roll 2-1,	12 μm
27–29,	*Stereisporites* sp. 2		
	27 = Pb12385-1(128.1 × 39.7),	Roll 2-11,	19 μm
	28 = Pb12387-2(117.9 × 41.5),	Roll 17-20,	23 μm
	29 = Pb12387-2(123.8 × 44.1),	Roll 16-8,	23 μm

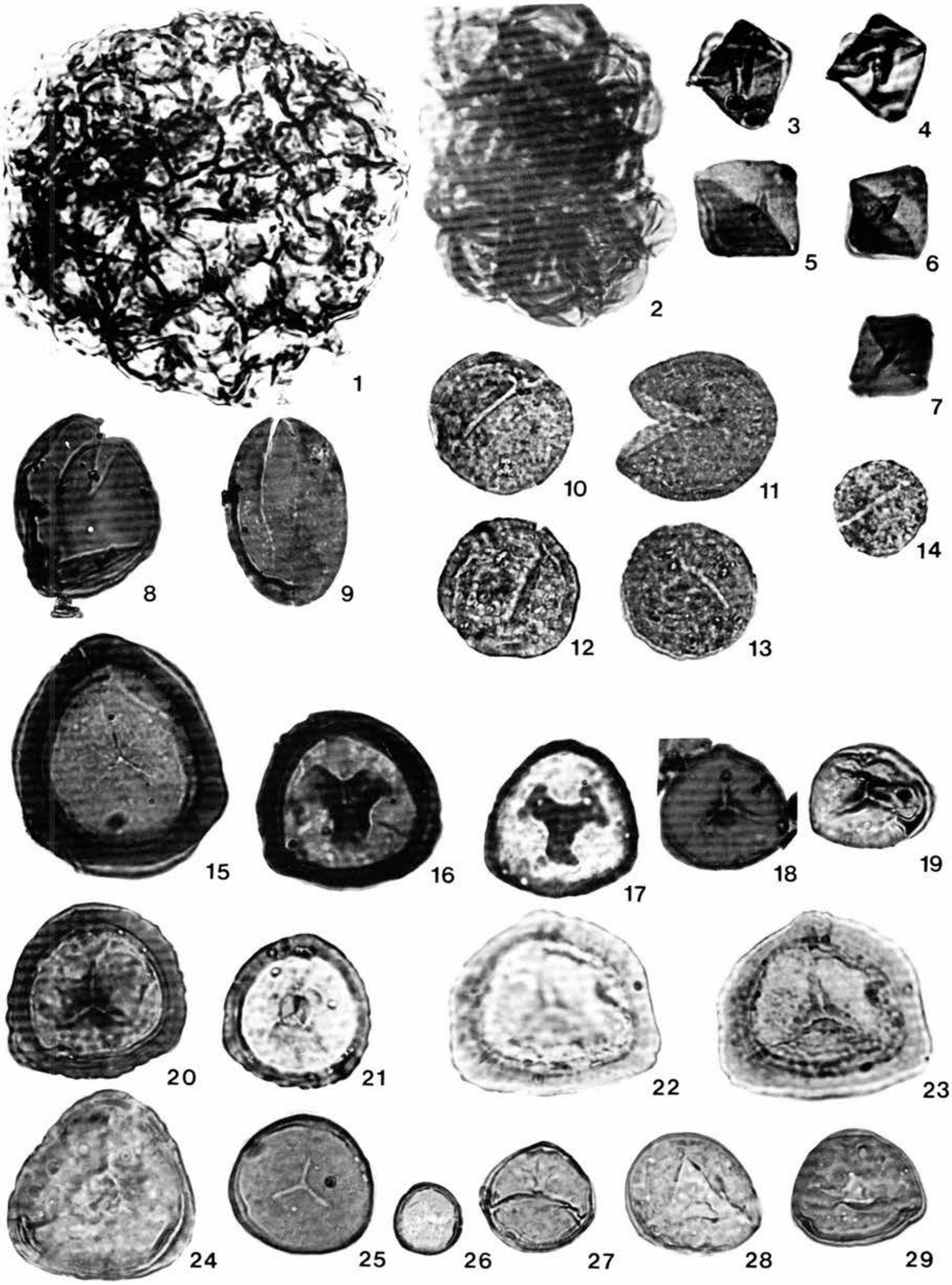
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Figure 7

(All illustrations × 1000)

1–3,	*Stereisporites* sp. 2		
	1,2 = Pb12387-2(126.1 × 29.4),	Roll 15-9,	20 μm
	3 = Pb12387-2(126.5 × 31.9),	Roll 14-21,	22 μm
4–6,	*Tripunctisporis* sp.		
	4 = Pb12385-1(128.0 × 32.9),	Roll 2-12,13,	26 × 22 μm
	5 = Pb12385-1(124.6 × 32.9),	Roll 3-28,	25 μm
	6 = Pb12430-1(110.4 × 40.9),	Roll 52-8,	32 μm
7,	*Aequitriradites ornatus* Upshaw, 1963		
	Pb12411-1(112.6 × 29.8),	Roll 40-3,	52 μm
8,	*Aequitriradites spinulosus* (Cookson & Dettmann) Cookson & Dettmann, 1961		
	Pb12411-1(116.5 × 41.6),	Roll 40-7,	55 μm
9,	*Triporoletes novomexicanus* (Anderson) Srivastava, 1975		
	Pb12401-12(125.3 × 33.7),	Roll 39-16,	53 × 50 μm
10, 11,	*Camarozonosporites hammenii* Amerom, 1965		
	Pb12387-1(114.1 × 45.7),	Roll 5-33,	28 μm
12,	*Echinatisporis varispinosus* (Pocock) Srivastava, 1975		
	Pb12466-1(115.8 × 34.0),	Roll 57-27,	body 23 μm
13,	*Hamulatisporis rugulatus* (Couper) Srivastava, 1972a		
	Pb12387-2(122.6 × 42.4),	Roll 16-19,	49 μm
14,	*cf. Neoraistrickia speciosa* Srivastava, 1972a		
	Pb12385-1(126.3 × 43.5),	Roll 3-4,	23 μm
15, 16,	*Peromonolites subengelmanii* (Elsik) n. comb.		
	15 = Pb12455-1(115.9 × 31.9),	Roll 53-10,	34 × 27 μm
	16 = Pb12533-3(121.9 × 39.7),	Roll 57-8,	41 × 25 μm
17,	*Perotrilites* sp. 1		
	Pb12387-2(121.7 × 27.7),	Roll 16-24,	46 μm
18, 19,	*Perotrilites* sp. 2		
	18 = Pb12344-1(116.0 × 44.7),	Roll 44-3,	28 μm
	19 = Pb12344-1(113.9 × 32.3),	Roll 44-1,	30 μm
20,	*Sestrosporites pseudoalveolatus* (Couper) Dettmann, 1963		
	Pb12387-6(114.8 × 39.8),	Roll 24-15,	46 μm

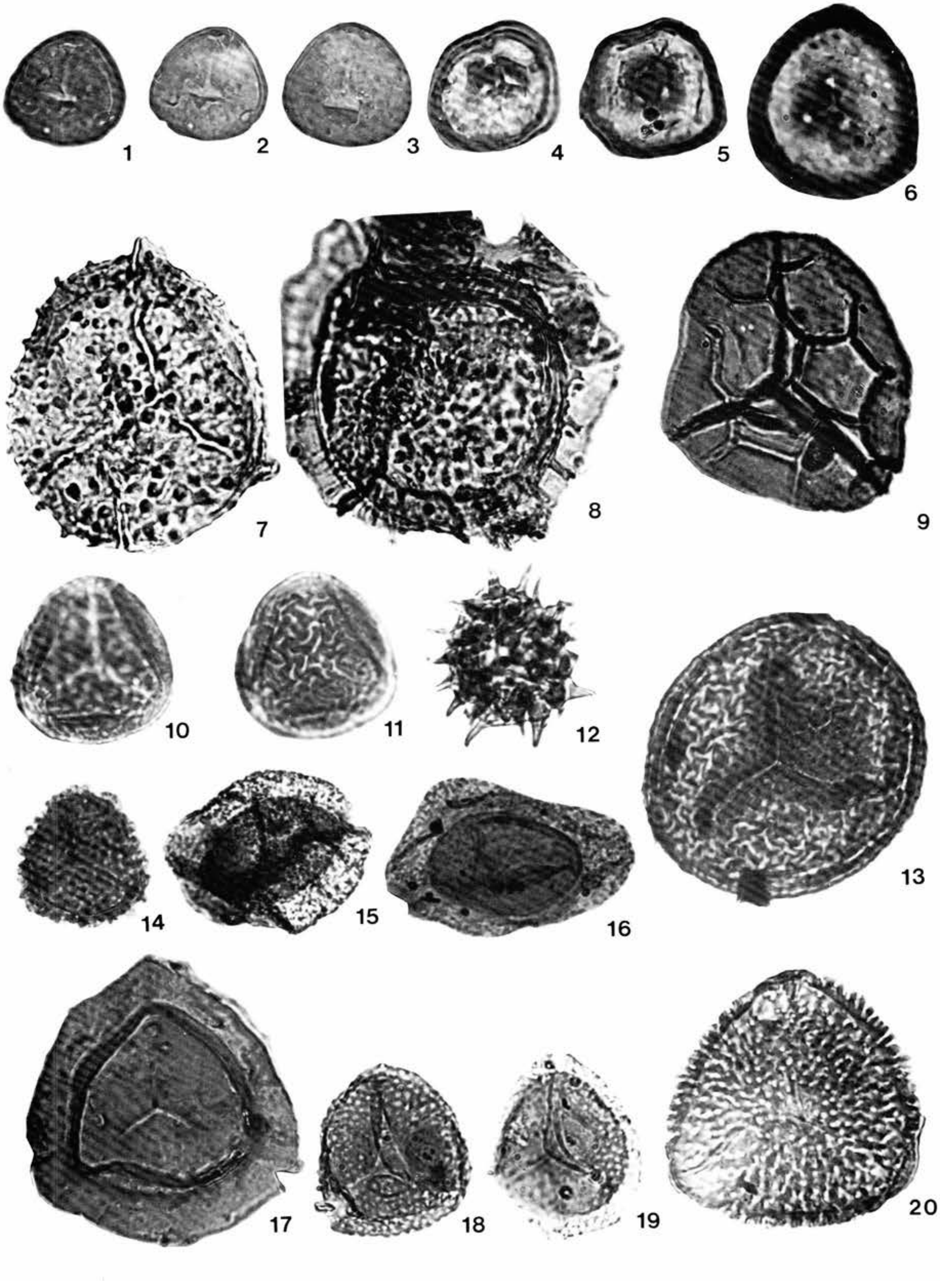
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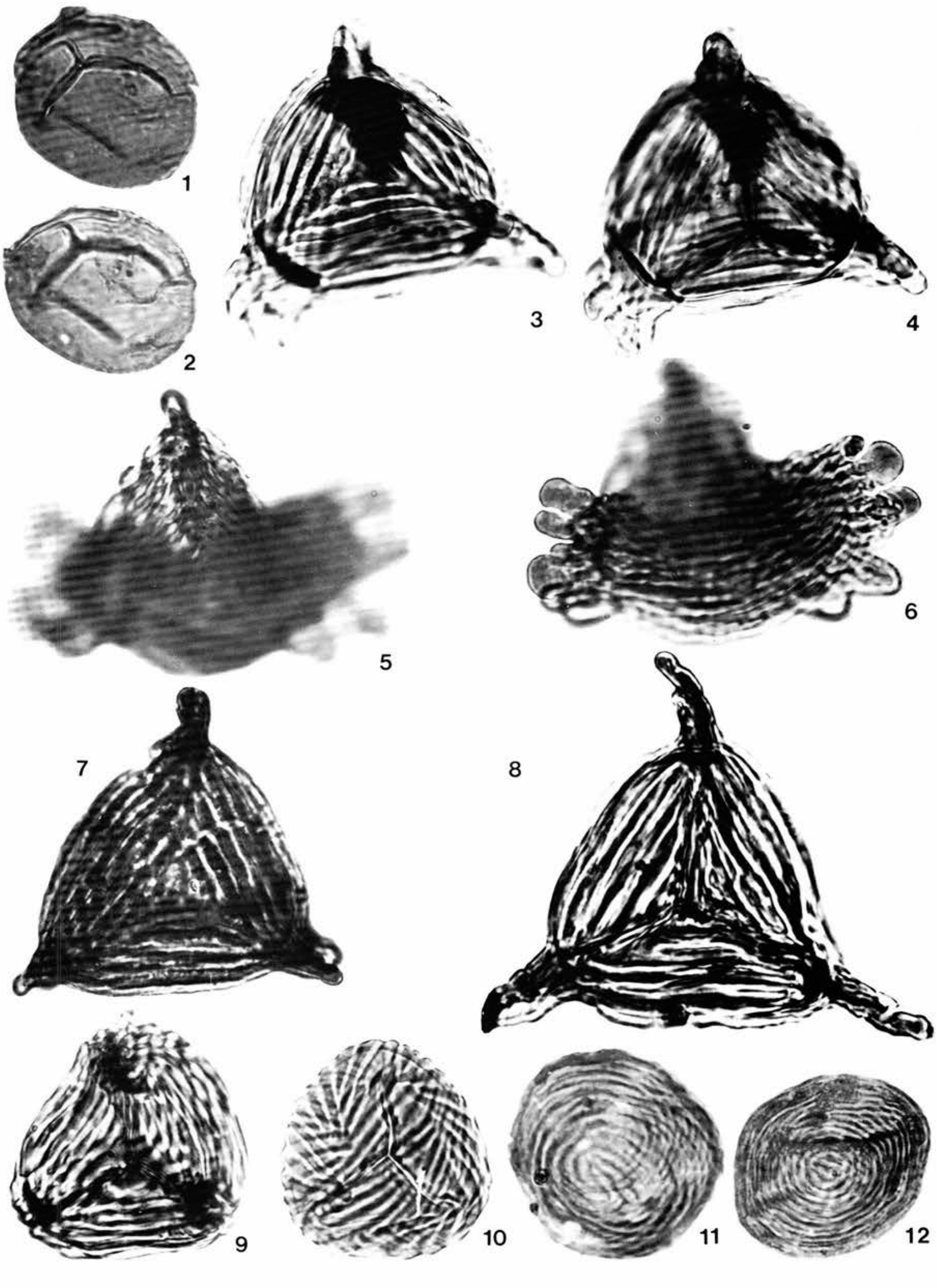
Figure 8

(All illustrations × 1000)

1, 2,	*Todisporites minor* Couper, 1958		
	Pb12387-2(125.8 × 36.0),	Roll 16-2,3,	32 μm
3–6,	*Appendicisporites cristatus* (Markova) Pocock, 1964		
	3,4 = Pb12458-2(111.6 × 35.5),	Roll 49-17,	55 μm
	5,6 = Pb12383-9(122.1 × 29.7),	Roll 33-10,11	
7,	*Appendicisporites potomacensis* Brenner, 1963		
	Pb12378-5(119.0 × 34.2),	Roll 21-16,17,18,	51 μm
8,	*Appendicisporites unicus* (Markova) Singh, 1964		
	Pb12401-12(117.7 × 41.5),	Roll 39-23,24,	66 μm
9,	*Cicatricosporites australiensis* (Cookson) Potonié, 1956		
	Pb12411-1(125.4 × 38.1),	Roll 40-1,	40 μm
10,	*Cicatricosisporites cuneiformis* Pocock, 1964		
	Pb12402-4(108.8 × 41.3),	Roll 8-33,	36 μm
11, 12,	*Chomotriletes minor* (Kedves) Pocock, 1970		
	11 = Pb12394-1(124.0 × 32.4),	Roll 6-5,	35 μm
	12 = Pb12378 = 8(126.5 × 36.8),	Roll 33-2,	35 μm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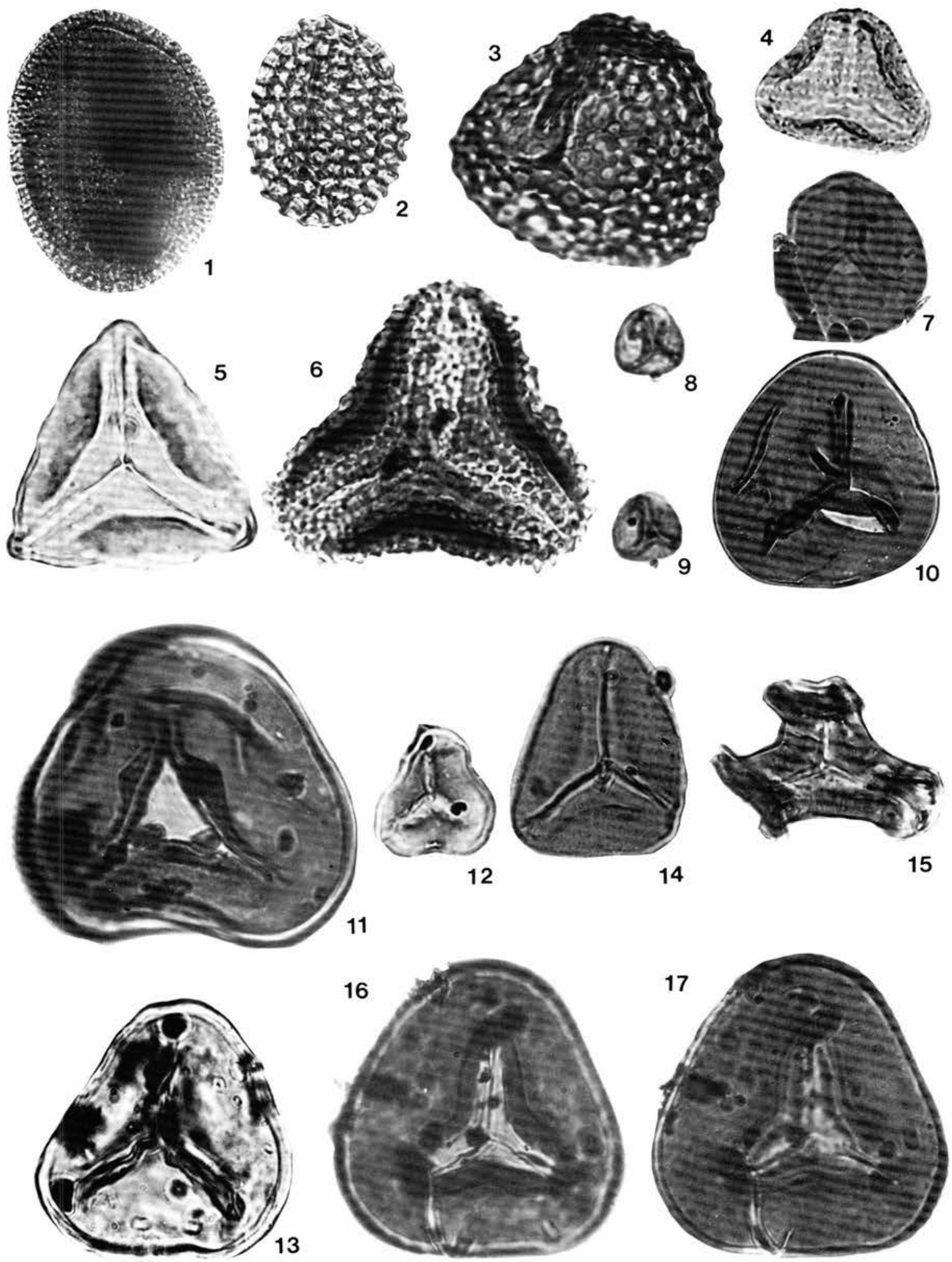
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Figure 10

(Illustration ×1000, except as otherwise indicated)

1,	*Dictyophyllidites* sp. 2		
	Pb12432-1(118.1 × 41.3),	Roll 52-19,	53 μm
2, 3,	*Kuylisporites scutatus* Newman, 1965		
	2 = Pb12402-4(120.8 × 38.8),	Roll 8-28,29,	29 μm
	3 = Pb12387-1(126.5 × 36.9),	Roll 5-11,	29 μm
4,	*Kuylisporites* sp.		
	Pb12387-2(120.1 × 29.0),	Roll 17-12,13,	34 μm
5,	*Matonisporites phlebopteroides* Couper, 1958		
	Pb12428-8(125.8 × 33.6),	Roll 40-19,	78 μm
6,	*Matonisporites* sp.		
	Pb12387-5(116.5 × 40.4),	Roll 24-5,	69 μm (× 500)
7,	*Hazaria* sp. 1		
	Pb12387-1(111.3 × 40.5),	Roll 27-1, 5-37,	39 × 28 μm
8,	*Hazaria* sp. 2		
	Pb12342-8(119.8 × 43.4),	Roll 46-5,	44 × 27 μm
9,	*Laevigatosporites acordatus* Krutzsch, 1959		
	Pb12462-1(112.6 × 43.9),	Roll 57-25,	42 × 38 μm
10, 11,	*Laevigatosporites haardtii* (Potonié & Venitz) Thomson & Pflug, 1953		
	Pb12378-2(126.7 × 43.3),	Roll 8-16,	28 × 20 μm
12, 13,	*Laevigatosporites ovatus* Wilson & Webster, 1946		
	12 = Pb12402-4(123.9 × 37.1),	Roll 8-26,	32 × 22 μm
	13 = Pb12439-1(110.5 × 46.0),	Roll 9-3,	32 μm
14,	*Laevigatosporites pseudodiscordatus* Kurtzsch, 1959		
	Pb12401-10(122.7 × 36.9),	Roll 39-5,	64 × 51 μm
15,	*Polypodiisporites* sp. 1		
	Pb12466-1(125.9 × 28.1),	Roll 51-5,	37 × 28 μm
16,	*Polypodiisporites* sp. 2		
	Pb12385-5(111.3 × 32.7),	Roll 29-3,	20 × 17 μm
17, 18,	*Verrucatosporites* sp.		
	Pb12378-2(127.2 × 46.3),	Roll 8-14,15,	28 × 18 μm

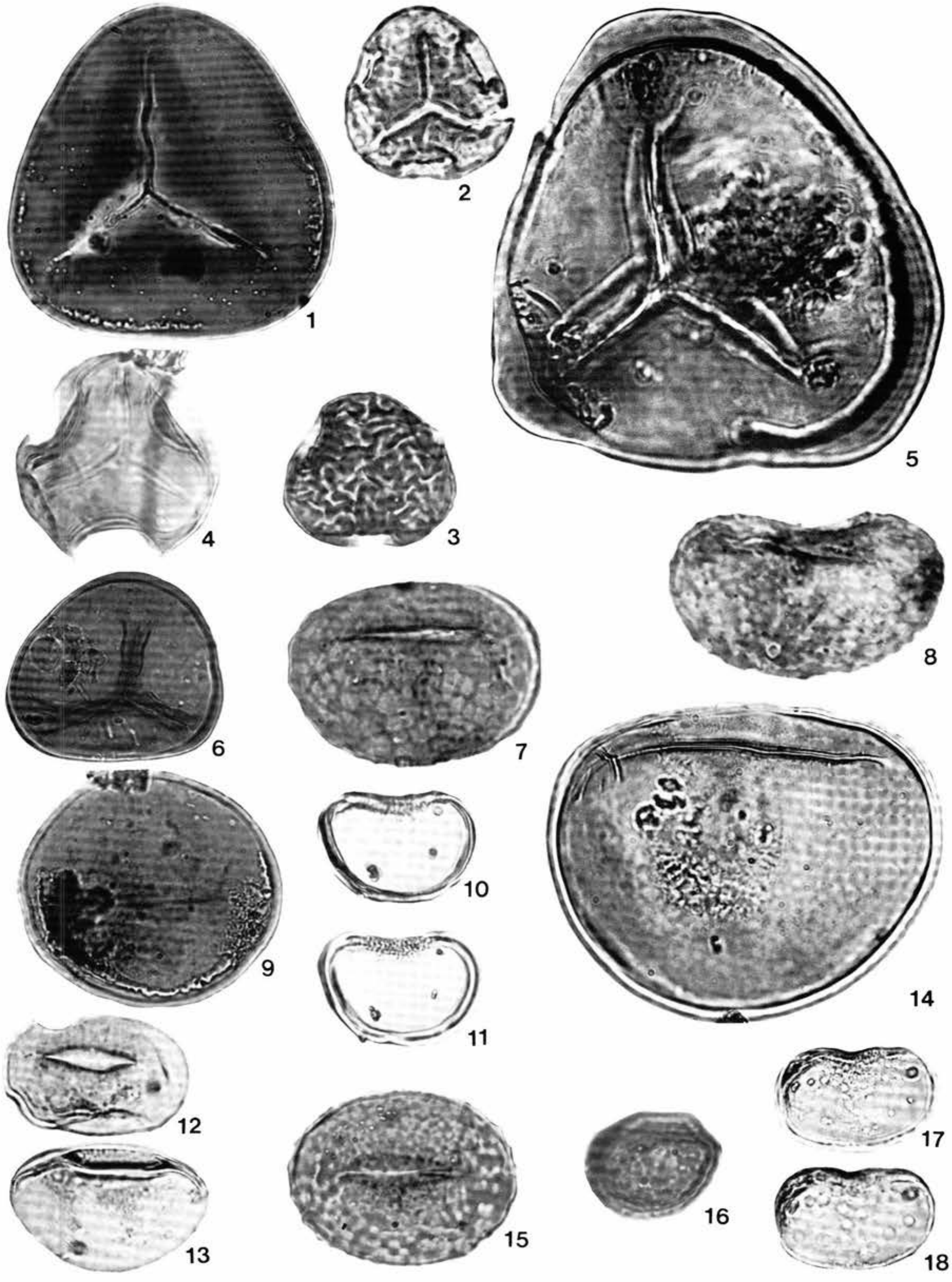
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Figure 11

(All illustrations × 1000)

1,	*Concavissimisporites* sp. Pb12470-1(128.0 × 35.7),	Roll 51-34,	48 μm
2,	*Foraminisporis* sp. Pb12374-3(121.6 × 31.2),	Roll 31-17,	38 μm
3, 4,	*Foveosporites* sp. Pb12438-2(119.6 × 33.1),	Roll 28-20,	35 μm
5,	*Granulatisporites granulatus* Ibrahim, 1933 Pb12387-1(120.0 × 35.0),	Roll 5-27,	25 μm
6-8,	*Quadripollis* sp. Pb12401-12(123.8 × 37.7),	Roll 39-19 to 22,	50 μm
9,	*Undulatisporites* sp. Pb12378-2(128.9 × 44.7),	Roll 21-12,	28 μm
10–12,	*Verrucosisporites* sp. 10,11 = Pb12374-3(119.7 × 42.2), 12 = Pb12374-3(115.2 × 35.5),	 Roll 32-11,12, Roll 32-17,	 40 μm 42 μm
13,	Unidentified spore A Pb12411-1(110.8 × 37.5),	Roll 40-8,9,	45 μm
14,	Unidentified spore B Pb12387-5(117.0 × 39.7),	Roll 24-2,	79 μm

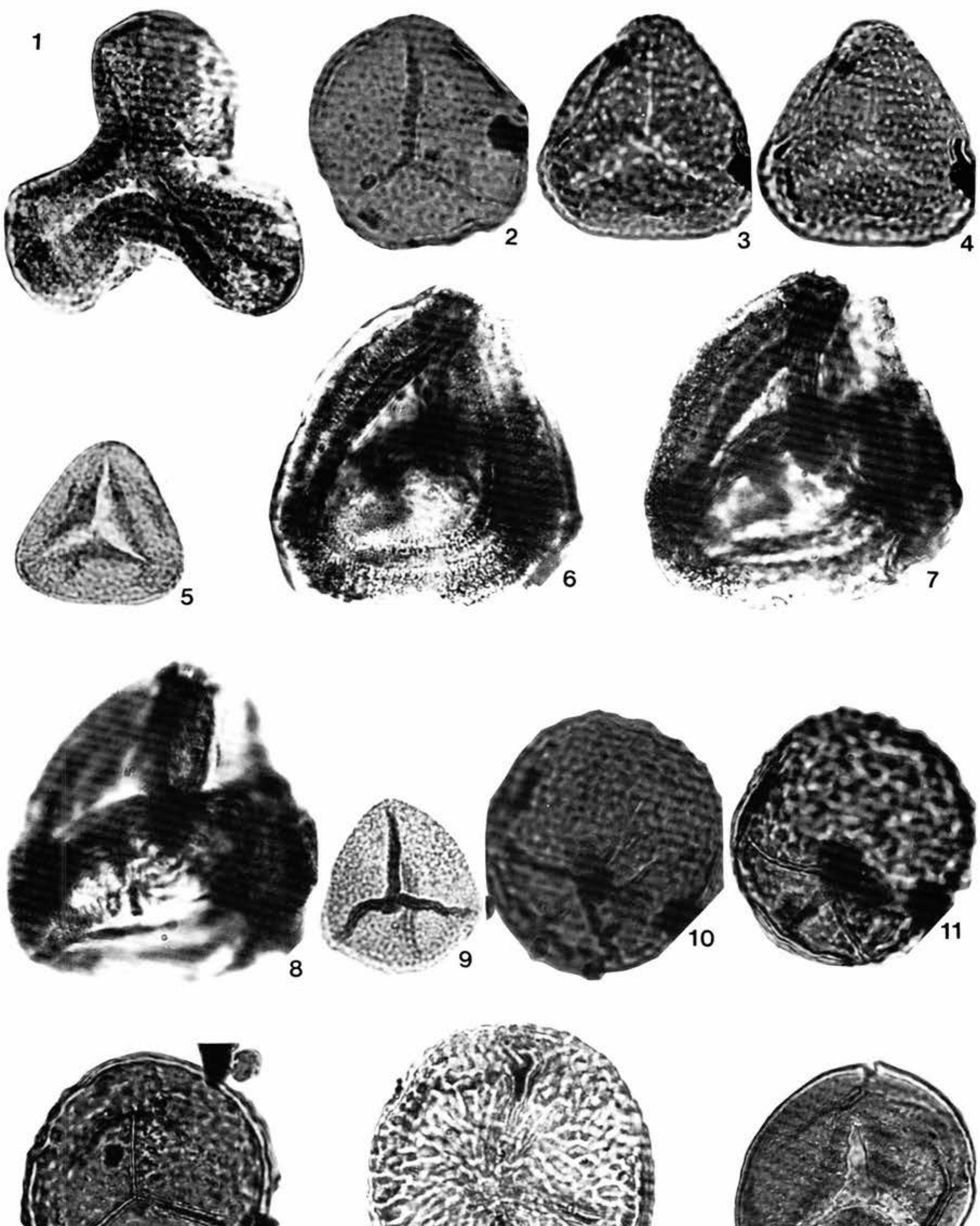
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Figure 12

(All illustrations × 1000)

1–3,	*Cycadopites* spp.		
	1 = Pb12385-1(127.9 × 38.7),	Roll 2-18,	15 × 8 μm
	2 = Pb12387-2(126.8 × 34.6),	Roll 14-14,	20 × 13 μm
	3 = Pb12511-1(112.5 × 37.5),	Roll 54-16,	30 × 16 μm
4,	*Exesipollenites tumulus* Balme, 1957		
	Pb12374-3(123.0 × 30.8),	Roll 31-16,	26 μm
5,	*Spheripollenites classopolloides* (Nilsson) Playford & Dettmann, 1965		
	Pb12394-1(123.8 × 42.4),	Roll 6-6,	27 μm
6,	*Spheripollenites scabratus* Couper, 1958		
	Pb12414-7(123.3 × 41.1),	Roll 38-14,	29 μm
7,	*Classopollis classoides* Pflug, 1953		
	Pb12387-2(126.3 × 35.4),	Roll 15-7,	25 μm
8,	*Classopollis* sp. *cf. Circulina parva* Brenner, 1963		
	Pb12385-1(126.8 × 32.6),	Roll 2-37,	17 μm
9,	*Pristinuspollenites microsaccus* (Couper) B. Tschudy, 1973		
	Pb12404-1(117.0 × 40.8),	Roll 20-15,16,	49 μm
10,	*Inaperturopollenites dubius* (Potonié & Venitz) Thomson & Pflug, 1953		
	Pb12439-1(127.3 × 27.0),	Roll 9-21,	33 μm
11, 12,	*Inaperturopollenites minor* Kedves, 1961		
	11 = Pb12385-1(128.0 × 35.3),	Roll 2-17,	17 μm
	12 = Pb12385-1(129.3 × 31.8),	Roll 2-1,	14 μm
13–15,	*Sequoiapollenites* spp.		
	13 = Pb12430-1(120.6 × 42.8),	Roll 52-6,	16 μm
	14 = Pb12432-1(120.8 × 38.7),	Roll 52-18,	26 μm
	15 = Pb12507-1(114.0 × 33.5),	Roll 54-8,	31 μm
16,	*Taxodiaceaepollenites hiatus* Potonié, 1958		
	Pb12385-1(124.9 × 39.8),	Roll 26-7,8,	25 μm
17,	*Araucariacites australis* Cookson ex Couper, 1953		
	Pb12385-1(125.2 × 40.5),	Roll 3-6,	44 μm
18,	*Balmeiopsis limbatus* (Balme) Archangelsky, 1977		
	Pb12384-7(109.5 × 31.5),	Roll 35-9,	54 μm
19–21,	*Inaperturotetradites scabratus* B. Tschudy, 1973		
	19,20 = Pb12378-5(119.8 × 33.0),	Roll 21-14,	49 μm
	21 = Pb12378-8(122.1 × 38.7),	Roll 30-24,	64 μm
22,	*Alisporites* sp.		
	Pb12387-7(124.3 × 32.8),	Roll 24-21,	94 μm (× 500)

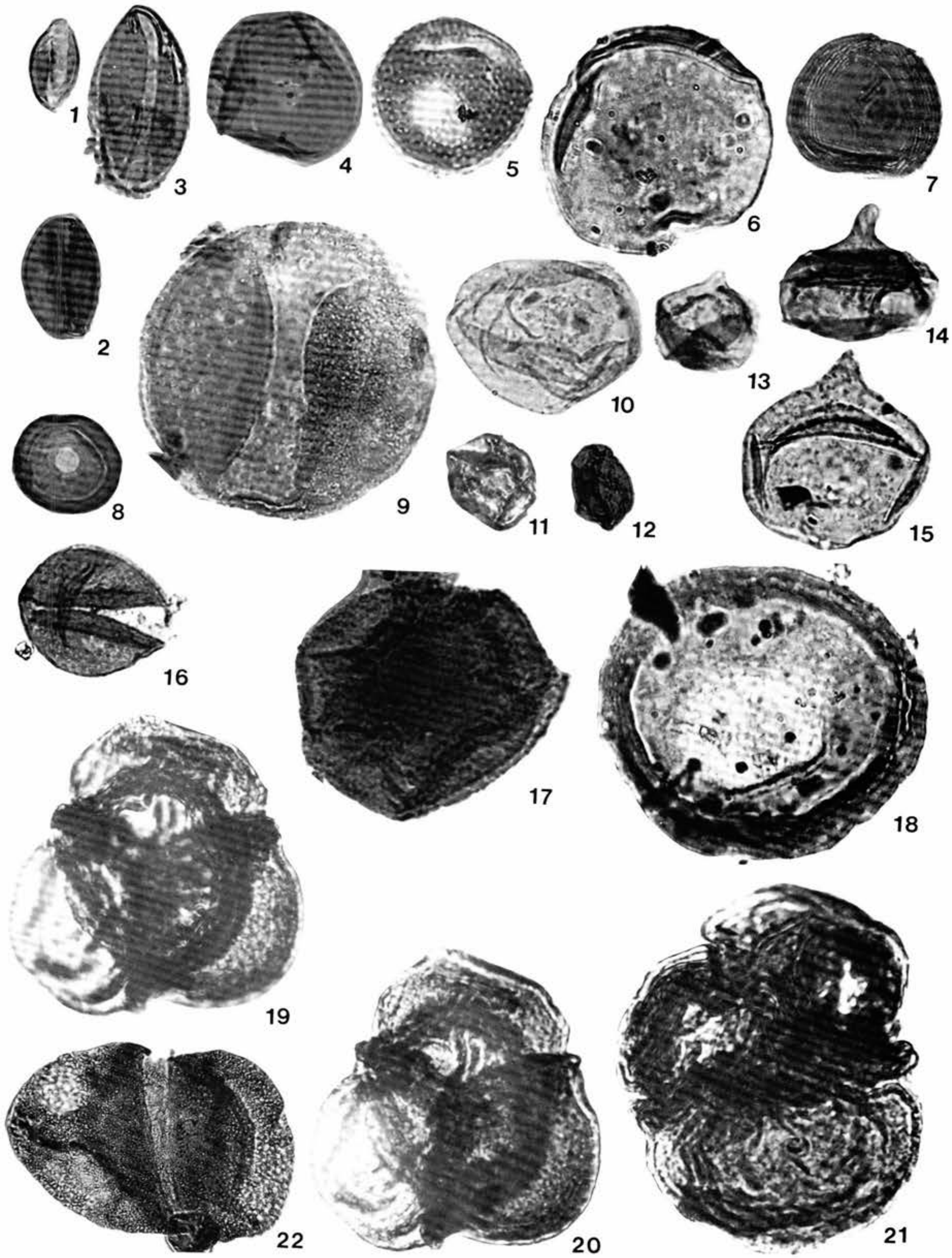
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Figure 13

(All illustrations × 1000)

1, 2,	*Zonalapollenites* sp.		
	Pb12454-1(113.6 × 43.4),	Roll 52-30,	40 μm
3,	*Parvisaccites radiatus* Couper, 1958		
	Pb12384-7(114.4 × 31.3),	Roll 35-10,	69 μm
4,	*Rugubivesicullites rugosus* Pierce, 1961		
	Pb12414-7(115.2 × 40.7),	Roll 38-8,9,	55 μm
5, 6,	*Equisetosporites jansonii* Pocock, 1964		
	Pb12494-1(120.3 × 31.1),	Roll 53-13 to 15,	67 × 34 μm
7,	*Equisetosporites menakae* Srivastava, 1968		
	Pb12457-1(119.0 × 44.6),	Roll 48-16,	26 × 22 μm
8, 9,	*Equisetosporites rousei* Pocock, 1964		
	8 = Pb12439-1(122.9 × 38.2),	Roll 9-16,	29 × 14 μm
	9 = Pb12408-1(127.7 × 43.0),	Roll 7-13,	33 × 12 μm
10,	*Equisetosporites* sp.		
	Pb12385-5(118.8 × 30.3),	Roll 29-2,	28 × 7 μm
11,	*cf. Steevesipollenites binodosus* Stover, 1964		
	Pb12387-2(115.1 × 43.0),	Roll 18-17,	28 μm
12–14,	*Callialasporites dampieri* (Balme) Dev, 1961		
	12 = Pb12374-3(125.5 × 34.8),	Roll 31-4,	53 μm
	13 = Pb12458-1(118.0 × 42.8),	Roll 49-15,	47 μm
	14 = Pb12439-1(116.2 × 37.0),	Roll 52-20,	46 μm
15, 16,	*Eucommiidites* spp.		
	15 = Pb12387-2(123.8 × 35.5),	Roll 16-11,	16.5 × 12.5 μm
	16 = Pb12460-1(122.2 × 38.5),	Roll 49-24,	22 × 17 μm
17, 18,	*Perinopollenites* sp.		
	17 = Pb12379-3(127.6 × 30.2),	Roll 27-11,	24 μm
	18 = Pb12457-1(113.7 × 35.1),	Roll 57-21,	24 μm

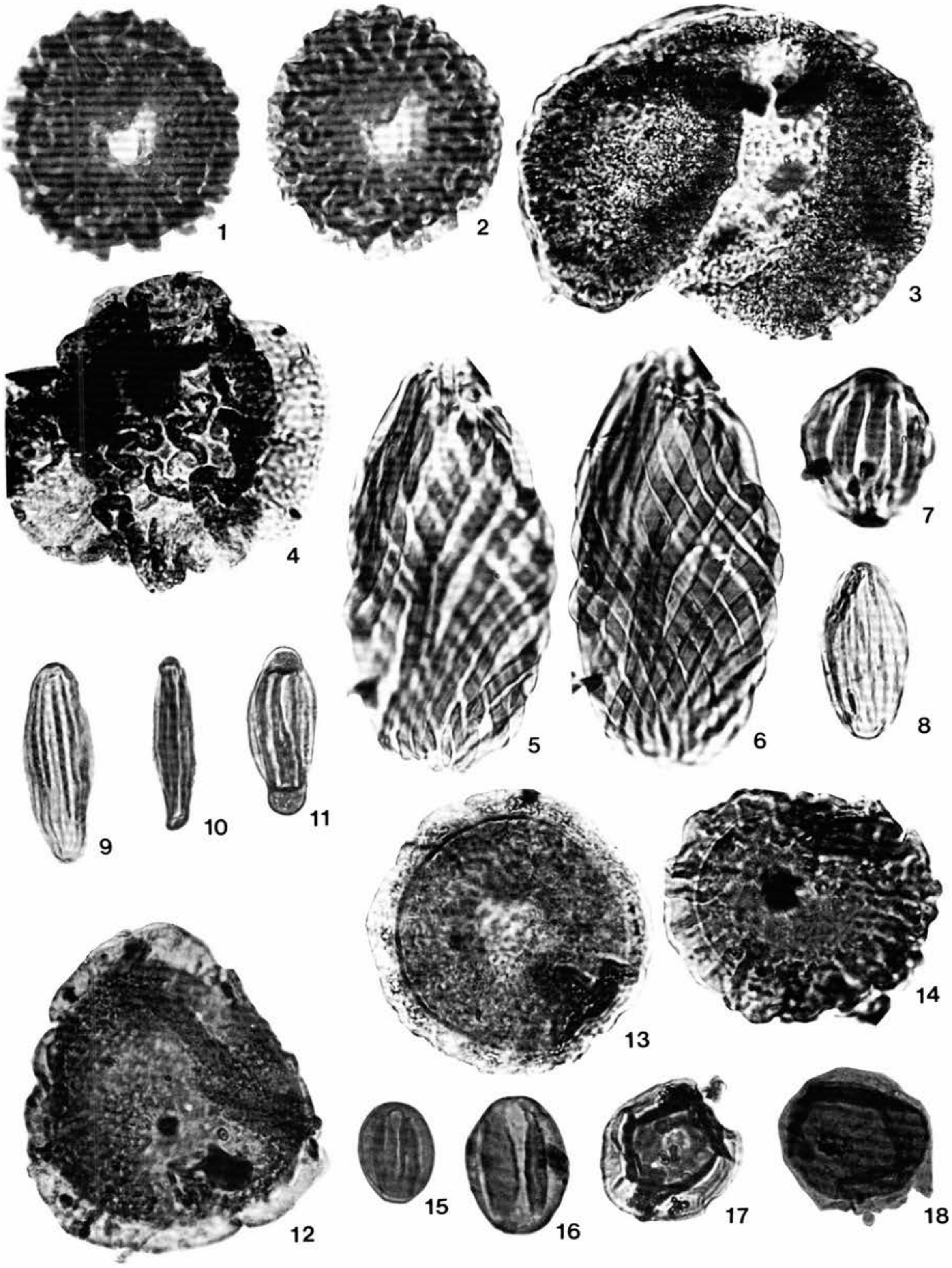
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Figure 14

(All illustrations × 1000)

1,	*Liliacidites intermedius* Couper, 1953		
	Pb12379-2(122.3 × 44.1),	Roll 28-1,	43 × 28 μm
2,	*Liliacidites* sp. 1		
	Pb12484-1(119.0 × 38.7),	Roll 53-27,	17 × 12 μm
3, 4,	*Liliacidites* sp. 2		
	3 = Pb12519-1(112.5 × 33.9),	Roll 56-15,	20 × 4 μm
	4 = Pb12462-1(122.2 × 30.1),	Roll 50-2,	23 × 18 μm
5,	*Liliacidites* sp. 3		
	Pb12387-2(121.2 × 39.7),	Roll 17-1,	26 × 16 μm
6,	*Liliacidites* sp. 4		
	Pb12466-1(125.6 × 30.7),	Roll 57-26,	29 × 17 μm
7,	*Liliacidites* sp. 5		
	Pb12454-1(116.1 × 45.0),	Roll 52-29,	34 × 24 μm
8–10,	*Liliacidites* sp. 6		
	8,9 = Pb12382-2(124.1 × 37.1),	Roll 28-8,	27 × 21 μm
	10 = Pb12404-6(121.4 × 37.9),	Roll 37-5,	22 μm
11–14,	*Monocolpopollenites reticulatus* Nichols et al., 1973		
	11 = Pb12486-1(112.6 × 39.3),	Roll 53-33,	30 × 23 μm
	12 = Pb12486-1(120.0 × 29.9),	Roll 54-3,	30 × 23 μm
	13 = Pb12486-1(121.4 × 29.6),	Roll 54-2,	26 × 20 μm
	14 = Pb12466-1(111.4 × 37.9),	Roll 51-7,	23 × 20 μm
15,	*cf. Monocolpopollenites texensis* Nichols et al., 1973		
	Pb12387-2(120.6 × 37.9),	Roll 17-10,	19 × 12 μm
16–19,	*Retimonocolpites* sp. 1		
	16 = Pb12342-1(125.2 × 37.0),	Roll 43-1,	33 × 28 μm
	17 = Pb12342-1(117.8 × 41.3),	Roll 43-17,	35 × 30 μm
	18 = Pb12342-1(117.7 × 37.5),	Roll 43-18,	33 × 28 μm
	19 = Pb12342-1(117.5 × 32.9),	Roll 43-20,	30 × 28 μm
20, 21,	*Retimonocolpites* sp. 2		
	Pb12456-1(122.2 × 33.6),	Roll 57-18,	19 × 18 μm
22–24,	*Sparganiaceaepollenites hospahensis* n.sp.		
	22 = Pb12454-4(118.2 × 26.6),	Roll 52-35,	25 μm
	23 = Pb12454-1(116.2 × 31.4),	Roll 52-34,	28 μm
	24 = Pb12454-1(117.4 × 39.0),	Roll 52-28,	28 μm
25–33,	*Cupuliferoidaepollenites levitas* (B. Tschudy) n.comb.		
	25 = Pb12428-7(124.4 × 38.8),	Roll 40-15,	20 × 17 μm
	26 = Pb12428-7(118.3 × 30.4),	Roll 40-17,	18 × 13 μm
	27 = Pb12428-7(118.6 × 29.2),	Roll 40-18,	19 × 16 μm
	28 = Pb12428-1(126.5 × 33.4),	Roll 9-26,	18 × 14 μm
	29 = Pb12428-1(127.3 × 31.4),	Roll 9-22,	19 × 14 μm
	30 = Pb12529-1(118.9 × 34.3),	Roll 56-30,	19 × 15 μm
	31 = Pb12529-1(118.9 × 35.0),	Roll 56-31,	18 μm
	32 = Pb12428-8(113.3 × 33.2),	Roll 40-21,	18 μm
	33 = Pb12432-1(117.4 × 39.6),	Roll 52-16,	17 μm
34–40,	*Cupuliferoidaepollenites sanjuanensis* n.sp.		
	34 = Pb12462-1(115.9 × 30.6),	Roll 50-4,	16 μm
	35 = Pb12384-7(115.8 × 39.6),	Roll 36-4,	17 μm
	36 = Pb12342-7(126.5 × 26.2),	Roll 45-9,	19 μm
	37 = Pb12342-7(127.1 × 39.1),	Roll 45-5,	19 μm
	38 = Pb12342-8(116.8 × 44.5),	Roll 46-4,	19 μm
	39 = Pb12387-2(113.4 × 34.7),	Roll 19-7,	20 × 15 μm
	40 = Pb12342-7(124.7 × 40.9),	Roll 45-14,	19 × 16 μm
41,	*Cupuliferoidaepollenites aoristus* (Chmura) n.comb.		
	Pb12408-1(124.0 × 34.3),	Roll 26-14,	15 μm
42–44,	*Cupuliferoidaepollenites mutabilis* (Leffingwell) n.comb.		
	42 = Pb12465-1(127.0 × 27.5),	Roll 50-32,	20 μm
	43 = Pb12463-1(123.7 × 36.6),	Roll 50-16,	24 μm
	44 = Pb12342-7(125.6 × 43.1),	Roll 45-11,	22 μm
45, 46,	*Cupuliferoidaepollenites* sp. 1		
	45 = Pb12387-2(117.0 × 42.8),	Roll 18-3,	14 × 12 μm
	46 = Pb12387-2(116.9 × 35.5),	Roll 18-5,	16 × 12 μm
47,	*Cupuliferoidaepollenites* sp. 2		
	Pb12385-1(128.0 × 44.3),	Roll 2-20,	19 μm

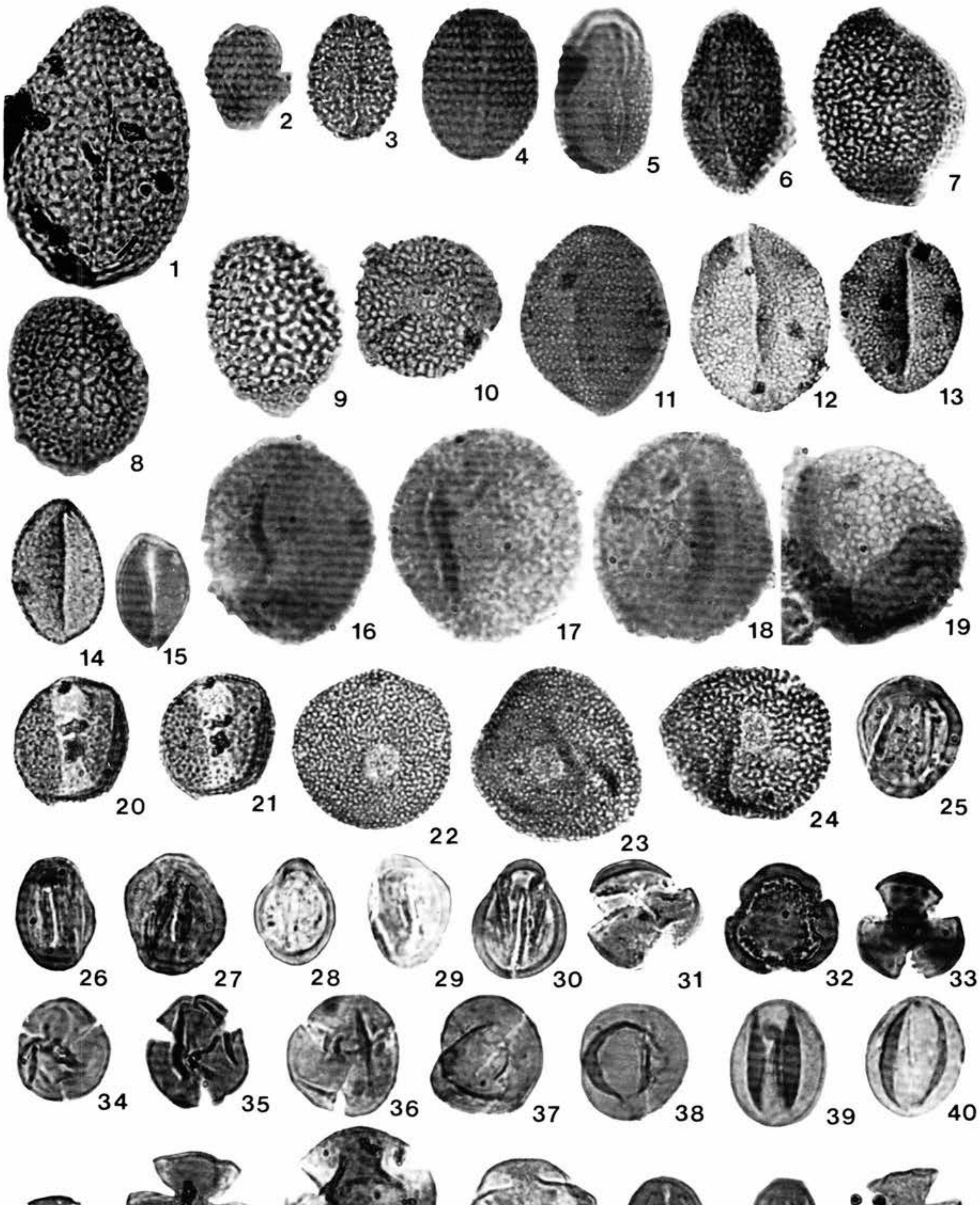
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Figure 15

(All illustrations × 1000)

1,	*Cupuliferoidaepollenites* sp. 3		
	Pb12382-9(127.9 × 31.7),	Roll 34-2,	24 μm
2, 3,	*Cupuliferoidaepollenites* sp. 4		
	2 = Pb12342-7(124.0 × 45.3),	Roll 45-16,	19 μm
	3 = Pb12342-7(123.9 × 39.5),	Roll 45-15,	13 μm
4, 5,	*Cupuliferoidaepollenites* sp. 5		
	4 = Pb12387-2(121.3 × 41.5),	Roll 26-22,	20 μm
	5 = Pb12432-1(112.6 × 33.9),	Roll 52-14,	24 μm
6,	*Cupuliferoidaepollenites* sp. 6		
	Pb12454-1(117.4 × 36.1),	Roll 52-27,	17 μm
7, 8,	*Rousea* sp. 1		
	7 = Pb12362-1(116.0 × 34.2),	Roll 19-24,	29 × 23 μm
	8 = Pb12457-1(120.7 × 41.2),	Roll 57-24,	24 μm
9, 10,	*Rousea* sp. 2		
	Pb12385-1(124.0 × 39.6),	Roll 26-2 to 5,	14 μm
11,	*Striatopollis paraneus* (Norris) Singh, 1971		
	Pb12454-1(112.5 × 33.1),	Roll 52-23,	18 μm
12, 13,	*Tricolpites confossipollis* Srivastava, 1975		
	Pb12385-5(112.6 × 34.0),	Roll 29-11,	28 × 18 μm
14, 15,	*Tricolpites crassimurus* (Groot & Penny) Singh, 1971		
	Pb12466-1(120.7 × 38.5),	Roll 51-9,10,	33 μm
16–20,	*Tricolpites hians* Stanley, 1965		
	16 = Pb12382-2(124.2 × 33.4),	Roll 28-13,	17 μm
	17 = Pb12486-1(127.1 × 26.2),	Roll 54-1,	16 μm
	18 = Pb12374-3(124.5 × 38.0),	Roll 32-15,16,	18 μm
	19 = Pb12374-3(112.6 × 35.1),	Roll 31-2,	17 × 15 μm
	20 = Pb12374-3(115.5 × 31.7),	Roll 31-23,	17 μm
21–24,	*Tricolpites* sp. *cf. Retitricolpites minutus* Pierce, 1961		
	21 = Pb12387-12(113.9 × 38.7),	Roll 19-5,	7 × 5 μm
	22 = Pb12408-1(129.1 × 32.2),	Roll 7-1,	9 × 6 μm
	23 = Pb12408-1(129.5 × 31.3),	Roll 7-8,	12 × 7 μm
	24 = Pb12344-1(113.8 × 30.1),	Roll 44-2,	7 μm
25,	*Tricolpites vulgaris* (Pierce) Srivastava, 1969		
	Pb12385-1(128.7 × 40.0),	Roll 2-5,	17 μm
26, 27,	*Tricolpites* sp. 1		
	26 = Pb12342-8(118.3 × 40.6),	Roll 46-11,	23 μm
	27 = Pb12382-10(122.8 × 36.4),	Roll 35-2,	25 × 17 μm
28–30,	*Tricolpites* sp. 2		
	28 = Pb12387-2(121.1 × 39.0),	Roll 17-5,	13 μm
	29 = Pb12387-2(122.7 × 40.1),	Roll 16-20,	12 μm
	30 = Pb12387-2(122.4 × 46.1),	Roll 16-23,	15 μm
31,	*Tricolpites* sp. 3		
	Pb12476-1(115.8 × 35.6),	Roll 53-25,	17 μm
32, 33,	*Tricolpites* sp. 4		
	Pb12456-1(123.0 × 37.9),	Roll 48-10,	16 × 12 μm
34,	*Tricolpites* sp. 5		
	Pb12467-1(112.5 × 37.6),	Roll 51-17,	42 μm
35, 36,	Tricolpate Forma A		
	35 = Pb12404-1(116.2 × 28.0),	Roll 20-17,	48 × 34 μm
	36 = Pb12342-1(118.5 × 40.0),	Roll 43-15,	23 μm
37, 38,	*Utriculites visus* Chlonova, 1969		
	37 = Pb12456-1(112.5 × 32.8),	Roll 47-18,	20 μm
	38 = Pb12413-7(125.5 × 36.8),	Roll 38-3,	23 μm
39, 40,	*Holkopollenites* sp. 1		
	Pb12513-1(119.1 × 39.0),	Roll 55-1, 54-18,	20 μm
41, 42,	*Holkopollenites* sp. 2		
	41 = Pb12402-5(116.0 × 40.1),	Roll 37-17,	36 μm
	42 = Pb12402-5(116.5 × 32.6),	Roll 37-12,	29 × 27 μm
43, 44,	*Holkopollenites* sp. 3		
	Pb12382-10(121.7 × 38.6),	Roll 34-4,5,	24 μm

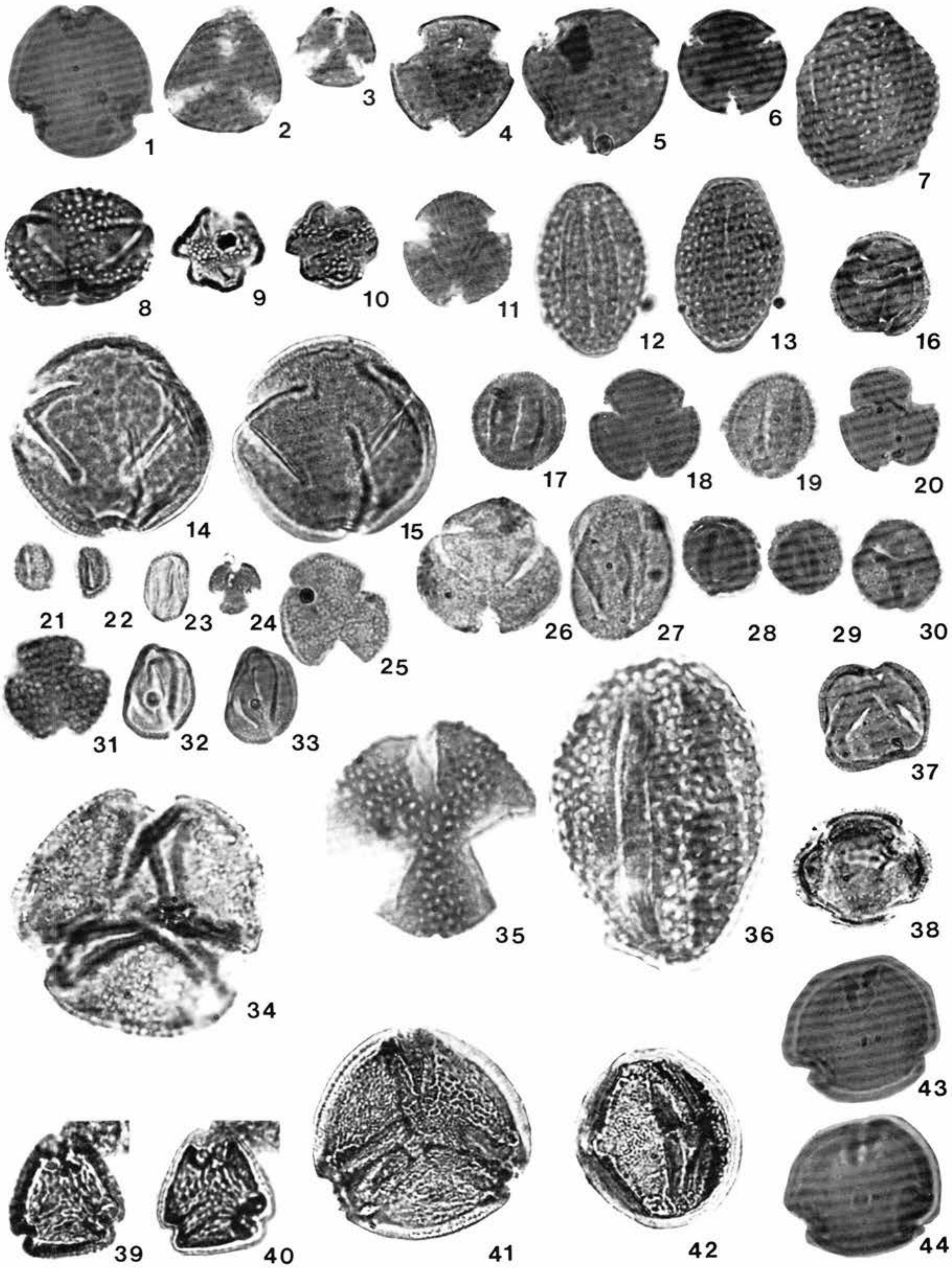
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Figure 16

(All illustrations × 1000)

1,	*Holkopollenites* sp. 4		
	Pb12382-2(124.2 × 35.3),	Roll 28-10,11,	25 μm
2–4,	*Margocolporites kruschii* (Potonié) n.comb.		
	2 = Pb12402-5(115.1 × 33.1),	Roll 37-13,	36 μm
	3 = Pb12402-5(121.8 × 28.8),	Roll 37-21,	36 μm
	4 = Pb12401-12(114.8 × 33.0),	Roll 39-14,	37 μm
5–8,	*Margocolporites minutus* n.sp.		
	5 = Pb12386-6(112.1 × 37.7),	Roll 36-10,	8 μm
	6,7 = Pb12387-2(126.4 × 30.0),	Roll 15-5,6,	10 μm
	8 = Pb12408-1(113.7 × 38.2),	Roll 7-33,34,	12 μm
9–12,	*Margocolporites varireticulatus* n.sp.		
	9,10 = Pb12414-7(123.0 × 39.7),	Roll 38-10,11,	26 μm
	11 = Pb12414-7(123.9 × 39.6),	Roll 38-6,	31 × 20 μm
	12 = Pb12404-6(125.5 × 28.2),	Roll 37-1,2,	20 μm
13–15,	*Margocolporites* sp. 1		
	13 = Pb12387-2(121.6 × 28.8),	Roll 26-17, 16-25,	16 μm
	14 = Pb12404-6(123.3 × 28.7),	Roll 37-4,	15 × 13 μm
	15 = Pb12408-1(128.5 × 40.3),	Roll 7-11,	15 μm
16, 17,	*Margocolporites* sp. 2		
	16 = Pb12387-2(123.8 × 38.2),	Roll 16-10,	17 μm
	17 = Pb12404-6(112.7 × 38.1),	Roll 34-24,	16 μm
18–20,	*Nyssapollenites albertensis* Singh, 1971		
	18 = Pb12385-1(124.9 × 40.7),	Roll 3-22,	20 μm
	19 = Pb12385-1(120.0 × 41.1),	Roll 4-16,	14 μm
	20 = Pb12439-1(112.2 × 37.1),	Roll 9-4,	20 μm
21, 22,	*cf. Nyssapollenites nigricolpus* Singh, 1983		
	21 = Pb12385-1(127.2 × 32.6),	Roll 2-36,	20 μm
	22 = Pb12385-1(127.2 × 43.2),	Roll 2-32,	22 μm
23–25,	*Nyssapollenites triangulus* (Groot, Penny & Groot) Singh, 1983		
	23 = Pb12384-7(12.2 × 34.7),	Roll 35-21,	20 μm
	24 = Pb12384-7(126.7 × 31.1),	Roll 35-11,	18 μm
	25 = Pb12384-7(123.5 × 42.0),	Roll 35-16,	18 μm
26, 27,	*Nyssapollenites* sp.		
	26 = Pb12385-1(127.6 × 35.0),	Roll 2-29,	14 × 10 μm
	27 = Pb12385-1(129.2 × 34.9),	Roll 2-3,	10 μm
28, 29,	*Ranunculacidites* sp.		
	28 = Pb12387-2(127.2 × 41.0),	Roll 14-3,	21 μm
	29 = Pb12387-2(120.6 × 38.0),	Roll 17-11,	18 μm
30, 31,	*Perinotricolporites delicatus* n.gen. & sp.		
	30 = Pb12402-4(123.8 × 37.2),	Roll 8-27,	26 μm
	31 = Pb12385-6(119.1 × 42.5),	Roll 33-7,8,	26 μm
32,	*Psilatricolporites subtilis* (Groot, Penny & Groot) Singh, 1983		
	Pb12387-2(125.9 × 35.0),	Roll 15-22,	20 × 15 μm
33–38,	*Casuarinidites microgranulatus* n.sp.		
	33 = Pb12518-1(126.4 × 29.9),	Roll 56-10,	26 μm
	34 = Pb12462-1(125.0 × 29.2),	Roll 50-3,	26 μm
	35 = Pb12460-1(122.3 × 41.1),	Roll 49-22,	24 μm
	36 = Pb12529-1(125.5 × 35.7),	Roll 56-32,	23 μm
	37 = Pb12470-1(119.0 × 32.3),	Roll 51-20,	25 μm
	38 = Pb12460-1(125.3 × 35.2),	Roll 49-29,	34 μm
39–40,	*Casuarinidites* sp.		
	39 = Pb12523-1(111.1 × 31.2),	Roll 56-27,	21 μm
	40 = Pb12523-1(114.9 × 36.1),	Roll 56-28,	24 μm
41–46,	*Complexiopollis abditus* R. H. Tschudy, 1973		
	41 = Pb12428-8(118.4 × 41.6),	Roll 40-20,	20 μm
	42,43 = Pb12408-1(121.7 × 40.4),	Roll 26-15,16,	22 μm
	44 = Pb12486-1(117.4 × 33.4),	Roll 53-34,	21 μm
	45,46 = Pb12496-1(120.0 × 38.9),	Roll 53-20,21,	23 μm

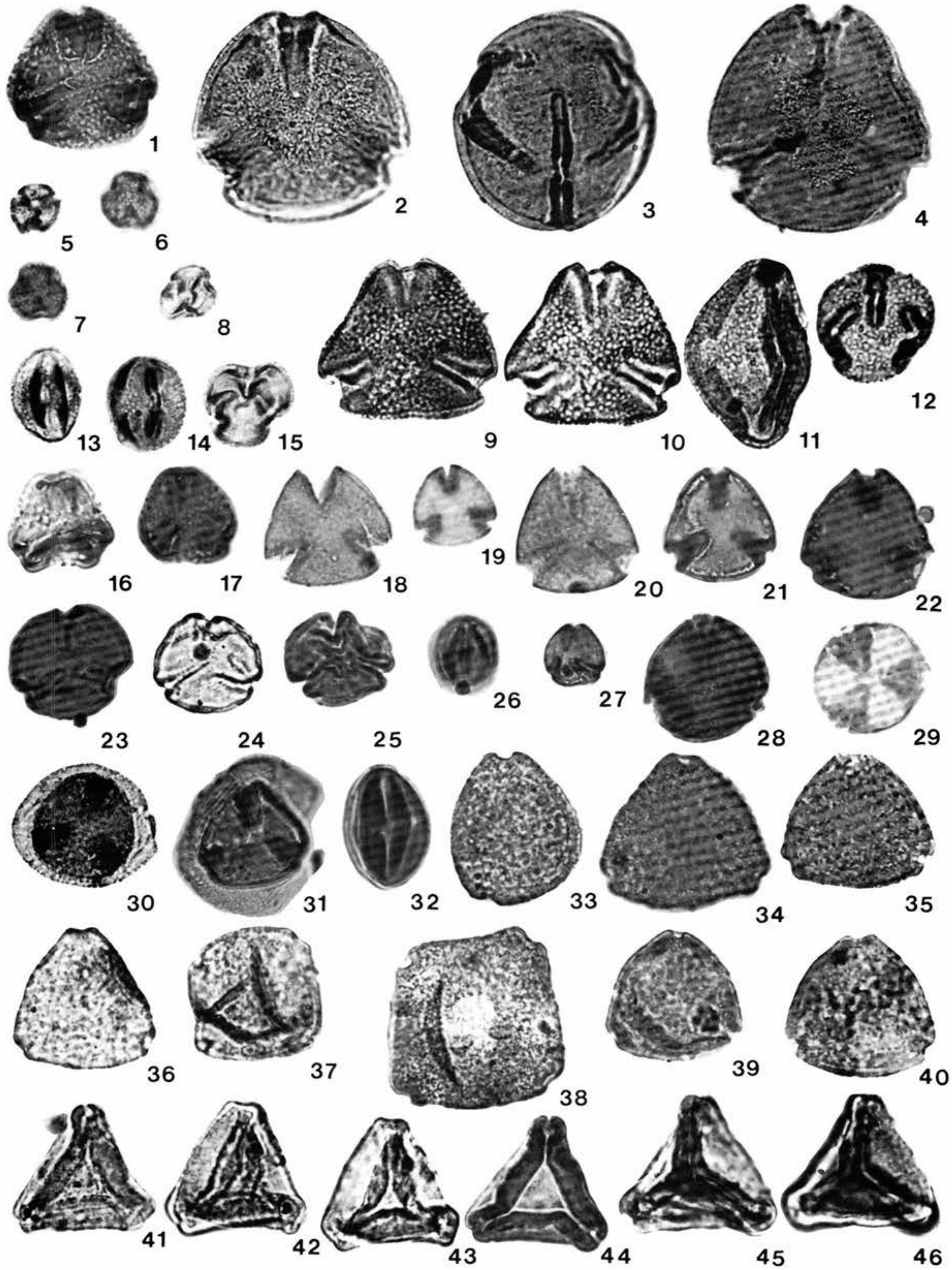
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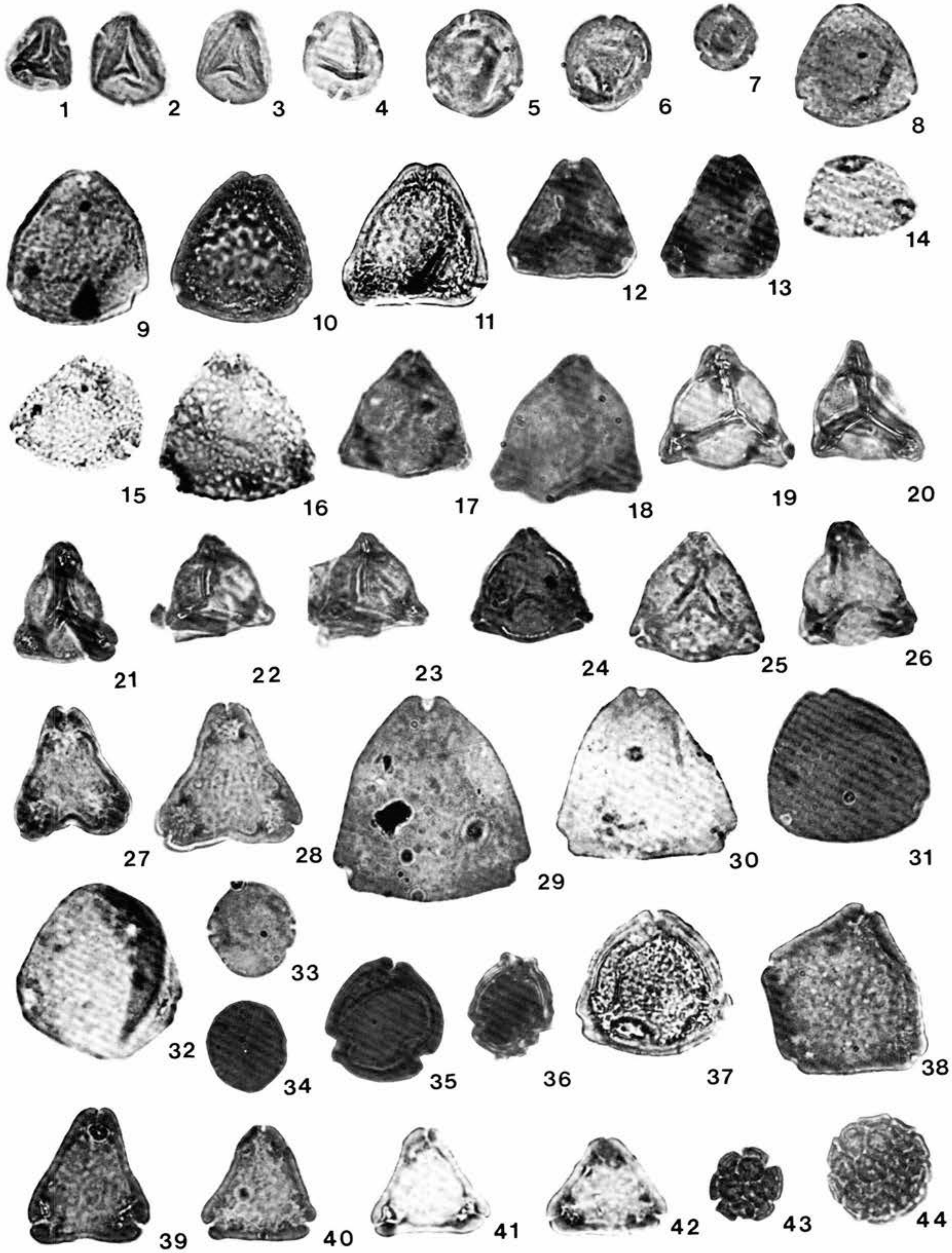
Figure 17

(All illustrations × 1000)

1–3,	*Labrapollis* sp. 1		
	1 = Pb12385-1(124.7 × 34.0),	Roll 3-17,18,	13 μm
	2,3 = Pb12385-1(124.6 × 28.5),	Roll 3-29,	15 μm
4, 5,	*Labrapollis* sp. 2		
	4 = Pb12385-1(124.6 × 35.4),	Roll 3-19,	15 μm
	5 = Pb12456-1(115.8 × 35.6),	Roll 48-5,	17 μm
6, 7,	*Labrapollis* sp. 3		
	6 = Pb12449-1(117.4 × 29.3),	Roll 47-4,	17 μm
	7 = Pb12449-1(123.0 × 38.8),	Roll 47-7,	11 μm
8, 9,	*Momipites* sp.		
	8 = Pb12385-1(115.0 × 45.0),	Roll 4-35,	20 μm
	9 = Pb12385-1(117.9 × 35.2),	Roll 4-26,	26 μm
10, 11,	*Osculapollis perspectus* R. H. Tschudy, 1975		
	10 = Pb12458-1(112.3 × 31.8),	Roll 49-13,	24 μm
	11 = Pb12387-2(121.5 × 45.2),	Roll 26-20,	25 μm
12, 13,	*Plicapollis serta* Pflug, 1953		
	12 = Pb12470-1(116.8 × 37.7),	Roll 57-28,	20 μm
	13 = Pb12505-1(117.6 × 32.7),	Roll 54-9,	20 μm
14, 15,	*Proteacidites retusus* Anderson, 1960		
	14 = Pb12385-1(115.8 × 32.1),	Roll 4-30,	19 μm
	15 = Pb12349-1(118.0 × 40.3),	Roll 9-13,	22 μm
16,	*Proteacidites thalmanni* Anderson, 1960		
	Pb12385-1(119.3 × 39.0),	Roll 4-24,	24 μm
17, 18,	*Pseudoplicapollis cuneata* Christopher, 1979		
	17 = Pb12387-2(127.2 × 27.5),	Roll 14-10,	22 μm
	18 = Pb12342-3(119.2 × 40.8),	Roll 44-22,	26 μm
19–21,	*Pseudoplicapollis triradiata* n.sp.		
	19 = Pb12387-2(123.8 × 34.0),	Roll 16-5,	23 μm
	20 = Pb12387-2(125.8 × 43.5),	Roll 15-25,	20 μm
	21 = Pb12387-2(123.2 × 32.5),	Roll 16-13,	20 μm
22–26,	*Pseudoplicapollis newmannii* Nichols & Jacobsen, 1982		
	22,23 = Pb12387-2(126.4 × 38.9),	Roll 15-2,	17 μm
	24 = Pb12511-1(122.3 × 35.3),	Roll 54-17,	19 μm
	25 = Pb12518-1(111.1 × 37.8),	Roll 56-5,	21 μm
	26 = Pb12457-1(119.0 × 44.6),	Roll 48-15,	20 μm
27, 28,	*Pseudovacuopollis involutus* Tschudy, 1975		
	27 = Pb12456-1(112.5 × 34.4),	Roll 47-19,	21 μm
	28 = Pb12387-2(115.8 × 31.0),	Roll 18-16,	23 μm
29, 30,	*Triporopollenites* sp. 1		
	29 = Pb12114-5(118.0 × 43.0),	Roll 1-17,	35 μm
	30 = Pb12114-5(125.0 × 44.7),	Roll 1-2,	29 μm
31, 32,	*Triporopollenites* sp. 2		
	31 = Pb12463-1(124.3 × 35.7),	Roll 50-18,	27 μm
	32 = Pb12342-7(120.7 × 25.8),	Roll 45-21,	28 μm
33, 34,	*Triporopollenites* sp. 3		
	33 = Pb12411-1(125.4 × 37.0),	Roll 40-2,	15 μm
	34 = Pb12400-5(119.1 × 30.9),	Roll 34-19,	14 μm
35, 36,	*Triporopollenites* sp. 4		
	35 = Pb12382-10(115.4 × 30.2),	Roll 34-13,	21 μm
	36 = Pb12385-5(112.6 × 34.0),	Roll 29-10,	17 μm
37, 38,	*Vacuopollis orthopyramis* Pflug, 1953		
	37 = Pb12523-1(116.3 × 30.4),	Roll 56-26,	25 μm
	38 = Pb12458-1(119.9 × 28.5),	Roll 49-14,	30 μm
39–42,	*Vacuopollis semiconcavus* Pflug, 1953		
	39 = Pb12385-1(129.4 × 35.8),	Roll 2-7,	23 μm
	40 = Pb12385-1(124.6 × 38.8),	Roll 3-26,	19 μm
	41 = Pb12387-1(127.9 × 32.6),	Roll 5-7,	18 μm
	42 = Pb12387-1(128.5 × 36.3),	Roll 5-3,	18 μm
43,	*Polyadopollenites* sp. 1		
	Pb12387-2(114.4 × 30.0),	Roll 18-19,	11 μm
44,	*Polyadopollenites* sp. 2		
	Pb12387-2(114.4 × 31.7),	Roll 18-20,	18 μm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Selected conversion factors*

TO CONVERT	MULTIPLY BY	TO OBTAIN
Length		
inches, in	2.540	centimeters, cm
feet, ft	3.048×10^{-1}	meters, m
yards, yds	9.144×10^{-1}	m
statute miles, mi	1.609	kilometers, km
fathoms	1.829	m
angstroms, Å	1.0×10^{-8}	cm
Å	1.0×10^{-4}	micrometers, μm
Area		
in^2	6.452	cm^2
ft^2	9.29×10^{-2}	m^2
yds^2	8.361×10^{-1}	m^2
mi^2	2.590	km^2
acres	4.047×10^{3}	m^2
acres	4.047×10^{-1}	hectares, ha
Volume (wet and dry)		
in^3	1.639×10^{1}	cm^3
ft^3	2.832×10^{-2}	m^3
yds^3	7.646×10^{-1}	m^3
fluid ounces	2.957×10^{-2}	liters, l *or* L
quarts	9.463×10^{-1}	l
U.S. gallons, gal	3.785	l
U.S. gal	3.785×10^{-3}	m^3
acre-ft	1.234×10^{3}	m^3
barrels (oil), bbl	1.589×10^{-1}	m^3
Weight, mass		
ounces avoirdupois, avdp	2.8349×10^{1}	grams, gr
troy ounces, oz	3.1103×10^{1}	gr
pounds, lb	4.536×10^{-1}	kilograms, kg
long tons	1.016	metric tons, mt
short tons	9.078×10^{-1}	mt
oz mt^{-1}	3.43×10^{1}	parts per million, ppm
Velocity		
ft sec^{-1} (= ft/sec)	3.048×10^{-1}	m sec^{-1} (= m/sec)
mi hr^{-1}	1.6093	km hr^{-1}
mi hr^{-1}	4.470×10^{-1}	m sec^{-1}

TO CONVERT	MULTIPLY BY	TO OBTAIN
Pressure, stress		
lb in^{-2} (= lb/in^2), psi	7.03×10^{-2}	kg cm^{-2} (= kg/cm^2)
lb in^{-2}	6.804×10^{-2}	atmospheres, atm
lb in^{-2}	6.895×10^{3}	newtons (N)/m^2, N m^{-2}
atm	1.0333	kg cm^{-2}
atm	7.6×10^{2}	mm of Hg (at 0° C)
inches of Hg (at 0° C)	3.453×10^{-2}	kg cm^{-2}
bars, b	1.020	kg cm^{-2}
b	1.0×10^{6}	dynes cm^{-2}
b	9.869×10^{-1}	atm
b	1.0×10^{-1}	megapascals, MPa
Density		
lb in^{-3} (= lb/in^3)	2.768×10^{1}	gr cm^{-3} (= gr/cm^3)
Viscosity		
poises	1.0	gr cm^{-1} sec^{-1} *or* dynes cm^{-2}
Discharge		
U.S. gal min^{-1}, gpm	6.308×10^{-2}	l sec^{-1}
gpm	6.308×10^{-5}	m^3 sec^{-1}
ft^3 sec^{-1}	2.832×10^{-2}	m^3 sec^{-1}
Hydraulic conductivity		
U.S. gal day^{-1} ft^{-2}	4.720×10^{-7}	m sec^{-1}
Permeability		
darcies	9.870×10^{-13}	m^2
Transmissivity		
U.S. gal day^{-1} ft^{-1}	1.438×10^{-7}	m^2 sec^{-1}
U.S. gal min^{-1} ft^{-1}	2.072×10^{-1}	l sec^{-1} m^{-1}
Magnetic field intensity		
gausses	1.0×10^{5}	gammas
Energy, heat		
British thermal units, BTU	2.52×10^{-1}	calories, cal
BTU	1.0758×10^{2}	kilogram-meters, kgm
BTU lb^{-1}	5.56×10^{-1}	cal kg^{-1}
Temperature		
°C + 273	1.0	°K (Kelvin)
°C + 17.78	1.8	°F (Fahrenheit)
°F − 32	5/9	°C (Celsius)

**Divide by* the factor number to reverse conversions.
Exponents: for example 4.047×10^{3} (see acres) = 4,047; 9.29×10^{-2} (see ft^2) = 0.0929.

Editor: Jiri Zidek

Typeface: Palatino

Presswork: Miehle Single Color Offset
Harris Single Color Offset

Binding: Smyth sewn with softbound cover

Paper: Cover on 12 pt. Kivar
Text on 70 lb white matte

Ink: Cover—PMS 320
Text—Black

Quantity: 700