

NEW MID-TERTIARY SPORES AND POLLEN GRAINS
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I. ABSTRACT

Twenty-two new species of spores and pollen grains are described from upper middle Eocene, upper Eocene, and lower Oligocene strata of Mississippi and western Alabama. The species are assigned to three modern and 18 fossil genera. All the species but one range at least from the base to the

top of the Yazoo Clay (upper Eocene), and 14 of them range at least from the middle Eocene to the lower Oligocene. *Betulaceoipollenites* Potonié and *Navisulcites* Anderson are considered, respectively, to be junior synonyms of *Trivestibulopollenites* Pflug and *Monosulcites* Couper. *Echiperiporites* van der Hammen and Wymstra is emended to include stephanoporate forms.

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II. INTRODUCTION

A number of new species of spores and pollen grains were encountered by the writer during a study of mid-Tertiary palynomorphs from the eastern Gulf Coast (Fredriksen, 1969). Engelhardt (1964a) illustrated and briefly discussed a number of spore and pollen types from the upper middle Eocene Cockfield Formation of Mis-

issippi, but, with one exception (Engelhardt, 1964b), he made no attempt to name new species. Tschudy and van Loenen (1970) illustrated many spores and pollen grains from the upper Eocene Yazoo Clay of Mississippi, also without naming any new species. Many of the new forms found by the writer range at least from the upper middle Eocene to the lower Oligocene, and the species will also be found by other

TABLE 1

List of localities sampled (M.G.S. = Mississippi Geological Survey).

Western Mississippi:

1. Yazoo City, M.G.S. borehole in SE 1/4, SW 1/4, SE 1/4, sec. 32, T12N, R2W, Yazoo County, Miss. Type locality of the Yazoo Clay.
2. M.G.S. borehole AF-40, SW 1/4, SE 1/4, NW 1/4, sec. 5, T7N, R1W, Hinds County, Miss.
3. Forest Hill, M.G.S. borehole AF-8, SE 1/4, SE 1/4, NE 1/4, sec. 22, T5N, R1W, Hinds County, Miss. Type locality of the Forest Hill Sand.
4. Near Cynthia, clay pit of the Jackson Ready-Mix Concrete Company, SW 1/4, NE 1/4, NW 1/4, sec. 36, T7N, R1W, Hinds County, Miss.
5. Riverside Park in Jackson, Hinds County, Miss. Cockfield Fm. sampled from outcrop, Moodys Branch Fm. and Yazoo Clay from M.G.S. borehole AF-17. Reference locality for the Moodys Branch Fm.

Eastern Mississippi:

6. Near Rose Hill, M.G.S. borehole in NE 1/4, NE 1/4, NE 1/4, sec. 11, T3N, R12E, Jasper County, Miss. Near the type locality of the North Twistwood Creek Clay Member of the Yazoo Clay.
7. Barnett, M.G.S. borehole in SW 1/4, NE 1/4, sec. 30, T2N, R14E, Clarke County, Miss. Near the type locality of the Pachuta Marl Member of the Yazoo Clay.
8. Near Hiwannee, cutbank on the east side of the Chickasawhay River, NE 1/4, SW 1/4, sec. 28, T10N, R7W, Wayne County, Miss. Reference locality for the Red Bluff Clay.
9. Shubuta Hill, outcrop in S 1/2, SW 1/4, sec. 3, T10N, R7W, Clarke County, Miss. Type locality of the Shubuta Clay Member of the Yazoo Clay.
10. Shiloh Creek, roadcut and banks of the creek in SW 1/4, sec. 18, T10N, R5W, Wayne County, Miss.

Western Alabama:

11. Little Stave Creek, off the west side of U.S. Highway 43, 3.5 miles north of Jackson, Clarke County, Ala.

palytologists in these strata. Thus it seems worthwhile to describe and name the more abundant of the new species, and 22 of them are described and illustrated here.

The specimens are from the upper Claiborne Stage (middle Eocene), the Jackson Stage (upper Eocene), and the lower Vicksburg Stage (lower Oligocene) of Mississippi and western Alabama. The study is based on 72 outcrop and core samples. Counts were made of 56 of these samples, and at least one slide from each sample was completely scanned. Partial scans were made of the other 16 samples. The 72 samples represent three sections: (1) a composite section of the upper Claiborne-lower Vicksburg from five localities in western Mississippi, (2) a composite section of the lower Jackson-lower Vicksburg from five localities in eastern Mississippi, and (3) the long section

of upper Claiborne-lower Vicksburg exposed in the banks of Little Stave Creek in Clarke County, Alabama. The mid-Tertiary stratigraphy of this area was summarized by Murray (1961, p. 379-398). The localities sampled by the writer were described by the Mississippi Geological Society (1948, Stops 8, 9 and 14); Moore (1965, p. 50, 117 and 132; figs. 9 and 16-17); Moore *et al.* (1964, figs. 13-14); Rainwater (1960); Southeastern Section, Geological Society of America (1964, p. 8); and Toulmin (1962). Table 1 lists the localities and Table 2 the units that were sampled. The Cockfield and Forest Hill formations were only partially sampled—only the upper five feet of the Cockfield Formation, and only the lower 40 feet of the Forest Hill Formation. The other formations listed in Table 2 were sampled from top to bottom.

TABLE 2

Provincial stages, formations, and members that were sampled (in descending order). Numbers in parentheses show the localities where each unit was sampled (from Table 1).

<i>Western Mississippi</i>	<i>Eastern Mississippi and Western Alabama</i>
Lower VICKSBURG STAGE	Lower VICKSBURG STAGE
Forest Hill Sand (3)	Red Bluff Clay (8, 11)
JACKSON STAGE	JACKSON STAGE
Yazoo Clay (1, 2, 3, 4, 5)	Yazoo Clay
	Shubuta Clay Mbr. (8, 9, 11)
	Pachuta Marl Mbr. (7, 9, 11)
	Cocoa Sand Mbr. (10, 11)
	North Twistwood Creek
	Clay Mbr. (6, 7, 11)
Moody's Branch Fm. (5)	Moody's Branch Fm. (6, 7, 11)
Upper CLAIBORNE STAGE	Upper CLAIBORNE STAGE
Cockfield Fm. (5)	Gosport Sand (11)

III. ACKNOWLEDGMENTS

Most of the samples were processed by Mobil Research and Development Corporation, Dallas, Texas. R. T. Clarke, W. S. Drugg, L. J. Maher, Jr. and R. H. Tschudy improved this paper by their helpful suggestions. Thanks are also given to the Mississippi Geological Survey for making their cores available for study and sampling.

IV. TECHNIQUES AND METHODS

The samples were processed with cold, concentrated HCl; then with 70 percent HF; washed several times with solutions of Darvan 4 or Joy household detergent to break down and remove fine organic matter; treated briefly with concentrated HNO₃ or HNO₃ plus KClO₃; washed with weak NH₄OH; and centrifuged twice in ZnCl₂ solution (s.g. 1.65-2.0). The float fraction was stained with Safranin 0 and mounted on cover slips with Clearcol or Natrosol; the cover slips were cemented to slides with Paraplex or Elvacite 2044.

The coordinates listed in the holotype descriptions and the plate captions locate the specimens on the writer's Zeiss microscope. Each slide has an X scratched on it just to the right of the cover slip, and the coordinates of the center of the X, according to the writer's microscope, are written on the slide label. The coordinates may thus be converted so that the specimens can be located easily on any microscope with standard millimeter stage scales. All of the slides are in the writer's collection.

Relative abundances are based on a minimum count of 100 pollen grains and spores (mainly 150-200 grains; one sample of uppermost Yazoo Clay from Forest Hill, western Mississippi, contained only 57 grains). The relative abundances are expressed in terms of categories that are defined in Table 3 ("infrequent," "occasional," etc.) to emphasize that they are only rough estimates of the true relative abundances of each species in the strata.

Data on the range of each species in this paper include information from Engelhardt

(1964a), who illustrated the assemblage from the upper Cockfield Formation at Jackson, Mississippi (the writer's locality 5). Unless otherwise stated, each species was observed in all three sections: western Mississippi, eastern Mississippi and western Alabama.

TABLE 3

Definitions of relative abundance terms.

<u>Designation</u>	<u>Definition</u>
"Infrequent"	1%
"Occasional"	1-5%
"Common"	6-20%

V. SYSTEMATIC DESCRIPTIONS

Twenty-two new species are described in this paper. Each new name is based on at least ten specimens unless otherwise noted. In the descriptions, the word "design" is used to designate the pattern on the exine that one sees in plan view. For instance, many tegillate exines appear punctate or granulate in plan view even though the surface of the exine may be smooth (grana are smaller than coni, verrucae, etc. but larger than puncta, and they give an LO-effect; puncta are ≤ 0.5 micron in diameter and give an LO- and (or) an OL-effect). The appearance of the exine in optical section is also described. The grain sizes are mostly averages of several measurements made on each grain. In triangular grains the three axes of the triangle were measured and averaged; in round or nearly round grains the long and short axes were averaged. For oval grains "size" means the length of the long axis. The size measurement includes the ornamentation unless otherwise stated.

Most of the new species described in this paper are assigned to form- and organ-genera. However, several of the new species can be assigned with some confidence to

extant genera, and in these cases the name of the modern genus is used as part of the name of the fossil species. For instance, it seems more reasonable to use the name *Myrica propria* n. sp. than to name the species *Triatripollenites proprius* n. sp. and then to remark that the species was undoubtedly produced by plants of the genus *Myrica*. However, no attempt is made to transfer similar species described in the literature to *Myrica* or to some other extant genus.

Genus CONCAVISPORITES Pflug
in Thomson and Pflug, 1953

CONCAVISPORITES STAVENSIS
Frederiksen, n. sp.

Pl. 1, figs. 1-4

Description: Size 30-37 microns, mean 34 microns, holotype 36 microns. Outline triangular, with flattened to rather pointed corners and concave sides. Trilete, sutures usually slightly open, rarely with lips, slightly wavy to straight, extending 3/4 to nearly full radius. Exine 2-2.5 microns thick, thickened little if any along the sides; psilate on the outer surface; inner surface of exine with an irregular network of grooves, especially on the inner surface of the distal? face, and normally including a groove that is parallel with the outline.

Holotype: Pl. 1, fig. 1, slide 10558 A-1, 35.7 x 123.1, Gosport Sand at Little Stave Creek, Clarke County, Alabama.

Remarks: In *Concavisporites praeobtusangulus* Krutzsch, 1959a, the exine appears to be thickened midway along the sides. The botanical affinity of *C. stavensis* is unknown, possibly Gleicheniaceae.

Occurrence: The known range is from the lower Gosport Sand to the lower Forest Hill Sand and the lower Red Bluff Clay; "infrequent" in 16/56 counted samples.

Genus LYGODIUM Swartz, 1801

LYGODIUM? LABRATUM
Frederiksen, n. sp.

Pl. 1, figs. 5-10

Description: Size 29-42 microns, mean 35 microns, holotype 34 microns. Outline triangular; sides slightly convex to slightly concave. Trilete; sutures closed, labra 1.5-3 microns wide, rays straight, extending nearly full radius. Exine about 2 microns thick, sexine:nexine 2-3:1. Entire exine foveolate except labra; foveolae 0.5-1 micron in diameter, some of them anastomosing.

Holotype: Pl. 1, figs. 5-6, slide 10656 A-2, 21.2 x 118.0, Yazoo Clay near Cynthia, Hinds County, Mississippi.

Remarks: *Foveotriletes scrobiculatus* (Weyland and Krieger, 1953) Potonié, 1956, is more densely foveolate. *F. rueterbergensis* Krutzsch, 1962, appears to lack labra. The epithet *labratum* (Latin, "having lips") refers to the presence of labra. *Lygodium? labratum* is similar to spores of *Lygodium flexuosum* (L.) Swartz illustrated by Bolkhovitina (1961, pl. 23, figs. 5a-c). However, the natural affinity of this new species cannot be definitely determined.

Occurrence: The known range is from the upper Gosport Sand to the top of the Yazoo Clay; "infrequent" in eight or nine counted samples; not observed in samples from eastern Mississippi.

Genus UNDULATISPORITES Pflug
in Thomson and Pflug, 1953

UNDULATISPORITES ELSIKII
Frederiksen, n. sp.

Pl. 1, figs. 11-12, 18

Undulatisporites sp. ELSIK, 1968, Pollen et Spores, v. 10, p. 294, pl. 8, fig. 4; pl. 10, fig. 6.

Description: Size 22-47 microns, mean 30 microns, holotype 32 microns. Outline triangular, with convex to slightly concave sides and narrowly rounded corners. Trilete; sutures closed; labra wavy, 0.5-1 micron wide and about 3 microns high, extending nearly to the outline. Exine 1-1.5 microns thick, psilate or rarely infrapunctate, sometimes with one or two coarse folds.

Holotype: Pl. 1, fig. 18, slide 10529 A-1, 31.3 x 111.7, Red Bluff Clay near Hiwannee, Wayne County, Mississippi.

Remarks: This species is distinguished by its high labra. The botanical affinity is unknown.

Occurrence: The known range is from the middle of the Gosport Sand to the lower Forest Hill Sand and the lower Red Bluff Clay; "infrequent" in 10 or 11/56 counted samples. Also reported by Elsik (1968) from the Paleocene of Texas.

Genus FAVOISPORIS Krutzsch, 1959b

FAVOISPORIS CONVEXA
Frederiksen, n. sp.

Pl. 1, figs. 13-17

Description: Size 22-29 microns; mean 25 microns; holotype 29 microns. Outline tri-

PLATE 1

All specimens magnified 800 X

Figures	Page
1-4.	69
<i>Concavisporites stavensis</i> Frederiksen, n. sp.	
(1) Holotype; slide 10558 A-1, 35.7 x 123.1.	
(2-3) Paratype; slide 10558 A-1, 42.0 x 115.5.	
(4) Paratype; a specimen with no internal network of grooves, but with the interior side of the exine roughened; slide 10657 A-1, 24.0 x 116.8.	
5-10.	69
<i>Lygodium? labratum</i> Frederiksen, n. sp.	
(5-6) Holotype; slide 10656 A-2, 21.2 x 118.0.	
(7-8) Paratype; slide 10556 A-1, 23.2 x 113.9.	
(9-10) Paratype; slide 10863 A-2, 32.4 x 112.0.	
11-12, 18.	69
<i>Undulatisporites elsikii</i> Frederiksen, n. sp.	
(11-12) Paratype; folds of the exine around the ends of the labra occur in some specimens, such as this one, but it is unusual for the labra to bifurcate at their ends; slide 10680 A-1, 29.6 x 120.0	
(18) Holotype; slide 10529 A-1, 31.3 x 111.7.	
13-17.	70
<i>Favoisporis convexa</i> Frederiksen, n. sp.	
(13-15) Paratype; slide 10864 A-3, 31.2 x 111.9.	
(16-17) Holotype; slide 10650 A-2, 27.8 x 113.0.	
19-21.	72
<i>Lycopodium venustum</i> Frederiksen, n. sp.	
(19) Paratype; slide 10620 A-1, 23.9 x 119.7.	
(20-21) Holotype; slide 10620 A-1, 25.5 x 118.5.	

Sources of specimens (for localities, see Table 1): Gosport Sand—figs. 1-3, 7-8, loc. 11; Yazoo Clay—figs. 11-12, loc. 1; figs. 9-10, 13-15, loc. 2; figs. 5-6, 16-17, loc. 4; North Twistwood Creek Clay Member—fig. 4, loc. 6; Forest Hill Sand—figs. 19-21, loc. 3; Red Bluff Clay—fig. 18, loc. 8.

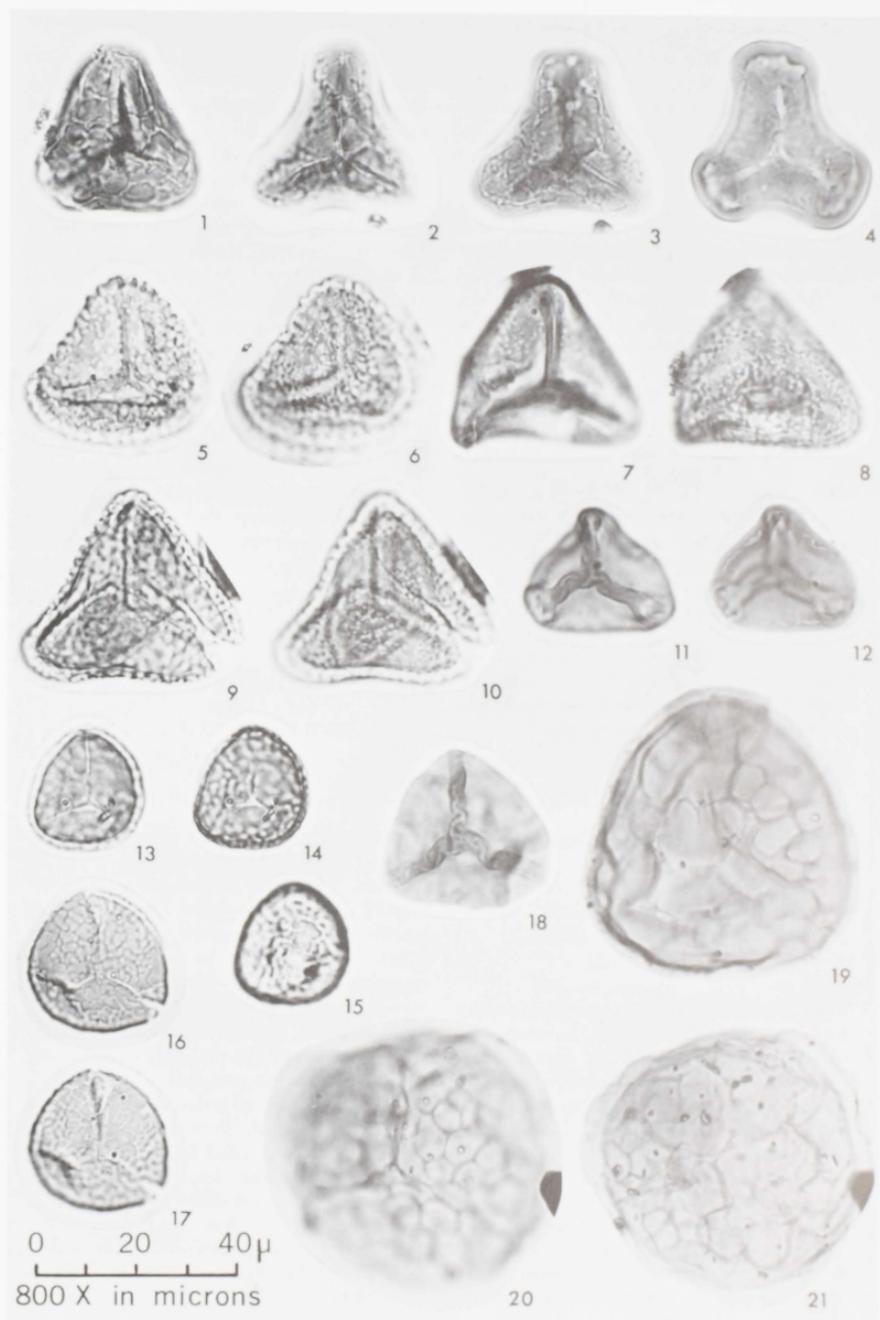


PLATE 1

angular with slightly to strongly convex sides. Trilete, sutures slightly open, lips thin or lacking, rays extending 1/2-3/4 radius. Exine about 1 micron thick, with no thickening at the corners; nexine very thin; proximal face psilate; distal face verrucate to rugulate, the elements very low and 1-1.5 microns wide, with the negative reticulum mostly less than 0.5 micron wide.

Holotype: Pl. 1, figs. 16-17, slide 10650 A-2, 27.8 x 113.0, Yazoo Clay near Cynthia, Hinds County, Mississippi.

Remarks: The epithet *convexa* (Latin) refers to the convex sides of the spores. In the other species of *Favoisporis* the sides are straight to concave. In *Stereisporites semigranulus* Krutzsch, 1963b, and *S. semigranuloides* Krutzsch, 1963b, the exine is thicker at the corners than along the sides. The botanical affinity of *Favoisporis convexa* is unknown; the general shape and psilate proximal face suggest *Lycopodium*, but the verrucate ornamentation of the distal face does not.

Occurrence: The known range is from the base to the top of the Yazoo Clay; "infrequent" in five counted samples; only observed in samples from western Mississippi.

Genus LYCOPODIUM Linné, 1753

LYCOPODIUM VENUSTUM
Frederiksen, n. sp.

Pl. 1, figs. 19-21

Description: Size 45-78 microns including muri, mean 57 microns, holotype 57 microns. Outline round to rounded triangular. Trilete, sutures closed, straight to slightly wavy, extending 1/2 to full radius, labra rather inconspicuous, 0.5 micron wide. Exine 1 micron thick. Reticulum covers distal face and extends to rays or close to them on proximal face. Muri only about 0.3 micron wide, with a very small, triangular thickening at the intersections of the muri, muri baculate to somewhat conate in optical section, 1.4 microns high, some-

what higher at the corners of the grain in a few specimens. Lumina polygonal, 4-10 microns in diameter.

Holotype: Pl. 1, figs. 20-21, slide 10620 A-1, 25.5 x 118.5, Forest Hill Sand at Forest Hill, Hinds County, Mississippi.

Remarks: The epithet *venustum* (Latin, meaning "graceful") refers to the delicate muri in this species. *Retitriletes gracilimuris* (Krutzsch, 1959a) Krutzsch, 1963a, is smaller and has a large, free contact area; *R. reticuloides rhenanus* Krutzsch, 1963a, is slightly smaller and has a broken reticulum on the proximal face; *R. cyclogracilis* Krutzsch, 1963a, is smaller and has lower muri.

Occurrence: The known range is from the lower Yazoo Clay to the lower Forest Hill Sand and the lower Red Bluff Clay; "infrequent" in seven counted samples; not observed in samples from western Alabama.

Genus PROTEACIDITES Couper, 1953

PROTEACIDITES? LAXUS
Frederiksen, n. sp.

Pl. 2, figs. 1-4

Description: Size 21-38 microns (9 specimens), mean 29 microns, holotype 32 microns. Peroblate; outline triangular with slightly convex sides. Exine 2 microns thick, sexine:nexine apparently 1:1. Nexine psilate. Sexine appears to consist solely of a reticulum that is very loose on most specimens, separated from the nexine by as much as 4 microns; one specimen has a closely fitting reticulum (Pl. 2, fig. 3), and a few specimens lack the reticulum altogether (Pl. 2, fig. 4). Lumina of reticulum 2-4 microns in diameter; muri smooth to lumpy in design, coarsely beaded in optical section, 1-1.5 microns wide and 1 micron high. Triplicate, pores 2-4 microns in diameter, cup-shaped in polar view.

Holotype: Pl. 2, figs. 1-2, slide 10637 A-2, 25.0 x 114.8, Yazoo Clay at Jackson, Mississippi.

Remarks: *Proteacidites? laxus* is characterized by its loose, coarse reticulum (*laxus*, Latin for "loose"). The botanical affinity is unknown. In shape and apertures these grains are similar to pollen of the Proteaceae, but the reticulum of *Proteacidites? laxus* is coarser than in that family. McLeroy (1971) stated that Late Cretaceous "proteaceous" pollen from the Northern Hemisphere was probably produced by the Symplocaceae, and, according to her abstract, she intends to publish a new genus to which *P.? laxus* might be assigned. The species is now assigned temporarily to *Proteacidites* for lack of a more suitable genus. There is also a considerable and interesting similarity between *Proteacidites? laxus* and triplicate pollen grains of *Sclerosperma mannii* of the Palmae (illustrated by Sowunmi, 1972, pl. 3, fig. 8; pl. 4, fig. 1).

Occurrence: The known range is from the upper Cockfield Formation to the middle of the Red Bluff Clay; "infrequent" in 9/56 counted samples.

Genus MYRICA Linné, 1753

MYRICA PROPRIA
Frederiksen, n. sp.

Pl. 2, figs. 5, 9-11

Description: Size 21-29 microns, mean 24 microns, holotype 27 microns. Oblate; outline triangular with convex sides. Sexine 1 micron thick midway between pores, thickening gradually to about 2 microns at the pores (tumescence). Nexine everywhere very thin and indistinct. Sexine structureless or faintly tegillate; most of exine has a weakly granulate design, but the design is more sharply granulate over the atria where the underside of the sexine is roughened (tarsus pattern of Wodehouse, 1933, fig. 37). Entire outer surface of exine is smooth. Triplicate, ektopores 0.5-1.5 microns in diameter; endopores about 5 microns in diameter; atria 2-2.5 microns deep and rather indistinct.

TABLE 4

Subspecies of *Triatripollenites excelsus* (Potonié) Thomson and Pflug compared with *Myrica propria* Frederiksen, n. sp.

SUBSPECIFIC EPITHET	AUTHOR	CHARACTERS
<i>excelsus</i>	Potonié, 1931b	More sharply defined atria and less thickening of sexine at the pores
<i>typicus</i>	Pflug in Thomson and Pflug, 1953	Endoplicate
<i>minor</i>	<i>idem</i>	More nearly annulate than tumescent
<i>turgidus</i>	<i>idem</i>	More nearly annulate than tumescent
<i>semiturgidus</i>	<i>idem</i>	Psilate
<i>microturgidus</i>	<i>idem</i>	Smaller than <i>M. propria</i>

Holotype: Pl. 2, fig. 5, slide 10531 A-1, 27.2 x 127.3, Shubuta Clay Member of the Yazoo Clay near Hiwannee, Wayne County, Mississippi.

Remarks: *Myrica propria* differs from *Triatriopollenites excelsus* (Potonié, 1931b) Thomson and Pflug, 1953, as shown in Table 4. The epithet *propria* is Latin for "distinctive" and refers to the fact that this new species is easily recognized.

Occurrence: The known range is from the upper Cockfield Formation and the middle of the Gosport Sand to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" to "occasional" in 24/56 counted samples.

Genus TRIPOROPOLLENITES Pflug
and Thomson
in Thomson and Pflug, 1953

TRIPOROPOLLENITES DISCREPANS
Frederiksen, n. sp.

Pl. 2, figs. 6-8

Description: Size 30-38 microns (5 specimens), holotype 30 microns. Oblate; outline triangular with slightly convex sides. Exine 2.5 microns thick; one thick, uneven fold usually parallels the outline. Sexine about 2 microns thick, structureless to faintly tegillate, surface smooth; nexine 0.5 micron or less thick, inner surface rough, producing sharply punctate design of exine. Triporate, ektopores 1-1.5 microns in diameter, with slight labra and no thickening of sexine at the pores. Nexine ragged near pores; obscure atria or slit-like vestibula may be present.

Holotype: Pl. 2, fig. 6, slide 10690 A-1, 24.3 x 113.6, North Twistwood Creek Clay Member of the Yazoo Clay at Barnett, Clarke County, Mississippi.

Remarks: *Triporopollenites discrepans* is characterized by its thick exine and slight labra, and by the contrast between the thick, smooth sexine and the thin, ragged, rough nexine to which the specific epithet refers

(*discrepans*, Latin, "differing, being unlike"). The botanical affinity is unknown.

Occurrence: Observed only in the North Twistwood Creek Clay Member of the Yazoo Clay in eastern Mississippi and western Alabama; "infrequent" in two counted samples and also observed in one partially scanned sample.

Genus TRIVESTIBULOPOLLENITES Pflug
in Thomson and Pflug, 1953

Betulaceoipollenites POTONIÉ, 1951, *Palaentographica*, Abt. B, v. 91, p. 150, pl. 20, fig. 43.
Trivestibulopollenites PFLUG in THOMSON and PFLUG, 1953, *Palaentographica*, Abt. B, v. 94, p. 84, pl. 9, figs. 25-41.

Betulaceoipollenites Potonié *ex* POTONIÉ, 1960, *Beih. Geol. Jahrb.*, no. 39, p. 114, pl. 7, fig. 142.

Remarks: *Betulaceoipollenites* did not become valid in Potonié (1951b) because at that time Potonié did not give a generic description, nor did he indicate that this was to be a new genus. Potonié (1960, p. 115) pointed out that the type species of *Trivestibulopollenites* and *Betulaceoipollenites* are very similar to each other.

TRIVESTIBULOPOLLENITES ENGELHARDTII
Frederiksen, n. sp.

Pl. 2, figs. 12-14

Betulaceoipollenites cf. *B. bituitus* (Potonié, 1931a) Potonié, 1951b. ENGELHARDT, 1964, *Mississippi Geol. Surv. Bull.* 104, p. 76, pl. 4, fig. 42.

?*Betulaceoipollenites* sp. TSCHUDY and VAN LOENEN, 1970, *U. S. Geol. Surv. Prof. Paper* 643-E, pl. 3, fig. 8.

Description: Size 24-31 microns, mean 27 microns, holotype 30 microns. Oblate; outline rounded triangular. Exine 1 micron thick; sexine:nexine about 3:1. Many specimens have one or two coarse folds crossing the grain. Exine granulate; outline slightly uneven. Sexine slightly thickened at the

pores and abruptly arched, forming labra. Triporate, ektopores 2 microns in diameter. Vestibula 0.5-1 micron deep. Nexine ragged beneath vestibula; endopores 0.5-2.5 microns in diameter. Indistinct or partly formed columellae present across vestibula.

Holotype: Pl. 2, fig. 12, slide 10637 A-2, 40.1 x 113.4, Yazoo Clay at Jackson, Hinds County, Mississippi.

Remarks: *Trivestibulopollenites betuloides* Pflug in Thomson and Pflug, 1953, is psilate and has a thicker nexine. *Betulaceoipollenites bituitus* (Potonié, 1931a) Potonié, 1960, is psilate and has higher labra. The botanical affinity of *Trivestibulopollenites engelhardtii* is probably Betulaceae or Myricaceae.

Occurrence: The known range is from the upper Cockfield Formation and the middle of the Gosport Sand to the lower Forest Hill Sand; "infrequent" in 15/56 counted samples.

Genus PLICAPOLLIS Pflug, 1953

PLICAPOLLIS SPATIOSA Frederiksen, n. sp.

Pl. 2, figs. 15-18

Description: Size 22-29 microns (8 specimens), mean 25 microns, holotype 25 microns. Peroblate; outline triangular with nearly straight sides and blunt corners. Exine 1-1.5 microns thick; exine stratification obscure (sexine:nexine 1:1?); surface slightly rough, design weakly punctate to granulate; exine distinctly plicate. Triporate, ektopores 1-2 microns in diameter; nexine recurved at the pores, forming large, diamond-shaped to lenticular vestibula 2.5-3 microns deep; endopores 3-4 microns in diameter. Inner surface of sexine over vestibula is rough, so that design over vestibula is sharply granulate to punctate.

Holotype: Pl. 2, figs. 15-16, slide 10863 A-2, 38.7 x 118.0, Yazoo Clay, borehole AF-40, northern Hinds County, Mississippi.

Remarks: *Plicapollis spatiosa* is characterized by having straight sides and the large vestibula to which the specific epithet refers (*spatiosa*, Latin, "spacious"). The most similar species is *Triatriopollenites pseudoquietus* Krutzsch, 1960, which has shallow atria and convex sides. The botanical affinity of *Plicapollis spatiosa* is unknown.

Occurrence: The known range is from the lower Yazoo Clay to the lower Forest Hill Sand; "infrequent" in six counted samples; only observed in samples from western Mississippi.

Genus ECHIPERIPORITES van der Hammen and Wymstra, 1964 *emend.* Frederiksen

ECHIPERIPORITES TSCHUDYI Frederiksen, n. sp.

Pl. 2, figs. 19-22

?Aff. *Nothofagus* sp. TSCHUDY and VAN LOENEN, 1970, U.S. Geol. Surv. Prof. Paper 643-E, pl. 3, figs. 23, 27-28.

Description: Size 28-39 microns, mean 33 microns, holotype 35 microns. Originally spheroidal; outline round. Exine 1.5 microns thick, sexine:nexine 4:1; tegillate; ectosexine and endosexine equally thick. Sexine granulate and conate, the coni about 1 micron in diameter at the base, tapering evenly toward the point, and 1-2 microns high. Pores arranged only around the equator, although this is not immediately obvious because the grains were spheroidal and became compressed in many different orientations. Pores may be somewhat difficult to see; the grains are apparently 3- to 8-porate; holotype has 6 or 7 pores. Pores 1-2 microns in diameter; slight labra and (or) slight annuli present; vestibula 1-1.5 microns deep; nexine thickened (to about 0.5 micron) under vestibula; no endopores evident.

Holotype: Pl. 2, figs. 19-20, slide 10545 A-1, 34.3 x 113.2, North Twistwood Creek Clay Member of the Yazoo Clay at Little Stave Creek, Clarke County, Alabama.

PLATE 2

All specimens magnified 800 X

Figures	Page
1-4.	72
<i>Proteacidites? laxus</i> Frederiksen, n. sp.	
(1-2) Holotype; slide 10637 A-2, 25.0 x 114.8.	
(3) Paratype; a specimen with a tightly fitting reticulum; slide 14963 C-1, 43.3 x 117.0. (4) Paratype, a specimen which has lost the reticulum; slide 10643 A-2, 40.9 x 113.2.	
5, 9-11.	73
<i>Myrica propria</i> Frederiksen, n. sp.	
(5) Holotype; slide 10531 A-1, 27.2 x 127.3.	
(9-10) Paratype; slide 10627 A-2, 19.1 x 112.7. (11) Paratype; slide 10529 A-1, 19.6 x 110.0.	
6-8.	74
<i>Triporopollenites discrepans</i> Frederiksen, n. sp.	
(6) Holotype; slide 10690 A-1, 24.3 x 113.6.	
(7-8) Paratype; slide 10547 A-2, 34.3 x 119.1.	
12-14.	74
<i>Trivestibulopollenites engelhardtii</i> Frederiksen, n. sp.	
(12) Holotype; slide 10637 A-2, 40.1 x 113.4.	
(13) Paratype; slide 10663 A-1, 17.4 x 125.1.	
(14) Paratype; slide 10557 A-2, 24.4 x 112.7.	
15-18.	75
<i>Plicapollis spatiosa</i> Frederiksen, n. sp.	
(15-16) Holotype; slide 10863 A-2, 38.7 x 118.0.	
(17-18) Paratype; slide 10650 A-2, 21.5 x 119.8.	
19-22.	75
<i>Echiperiporites tschudyi</i> Frederiksen, n. sp.	
(19-20) Holotype; slide 10545 A-1, 34.3 x 113.2.	
(21-22) Paratype, a specimen lying in good proximal-distal orientation, that is, in polar view; slide 10558 A-1, 44.4 x 113.2.	
23, 28-29, 34-35.	75
<i>Monosulcites asymmetricus</i> Frederiksen, n. sp.	
(23) Paratype; slide 10558 A-1, 34.0 x 120.4.	
(28-29) Holotype; slide 10558 A-1, 43.4 x 120.5.	
(34-35) Paratype; slide 10557 A-2, 19.9 x 113.3.	
24-27.	78
<i>Parsonsidites conspicuus</i> Frederiksen, n. sp.	
(24-25) Holotype; slide 10627 A-2, 20.9 x 120.9.	
(26-27) Paratype; slide 10627 A-2, 17.3 x 124.0.	

(continued on next page)

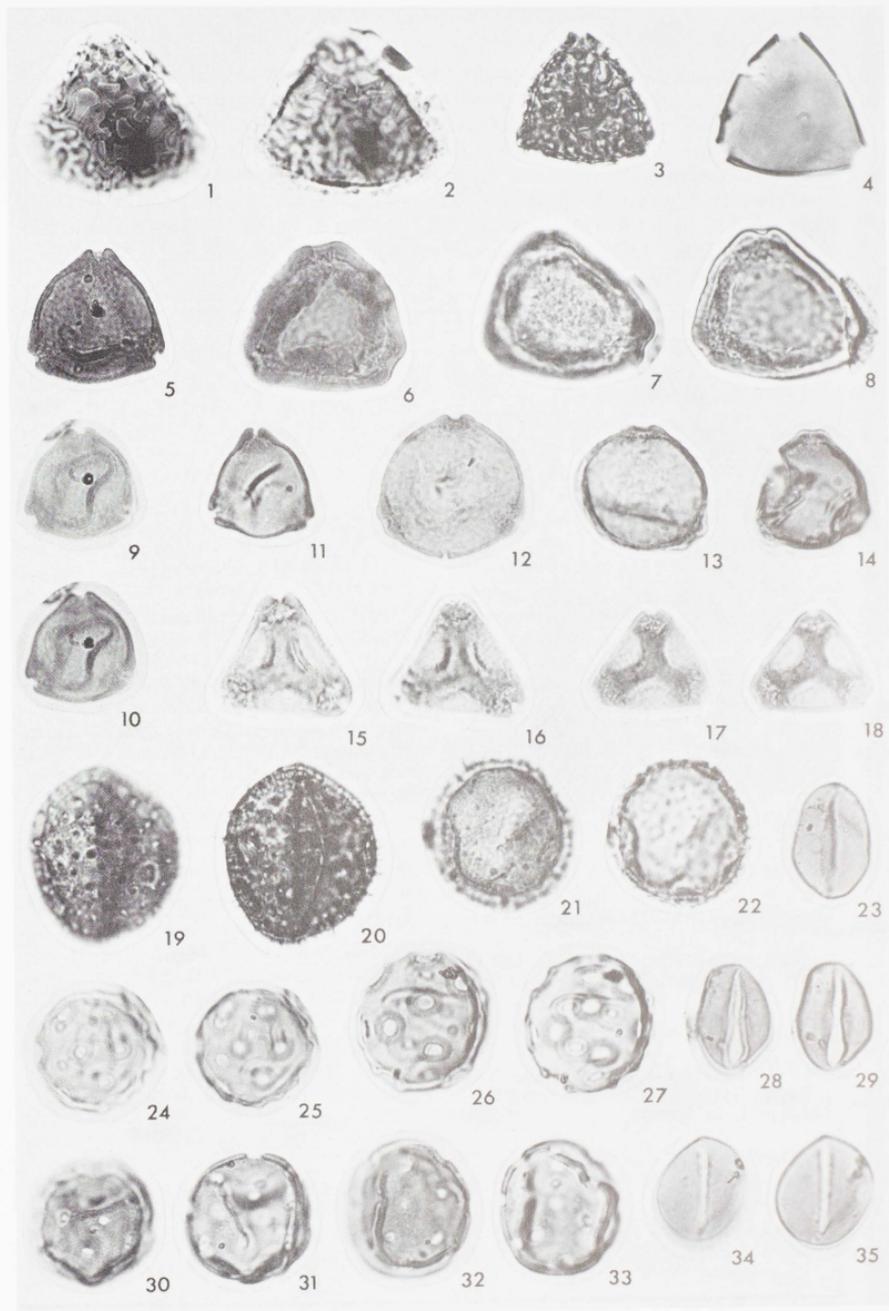


PLATE 2

- 30-33. *Juglanspollenites infrabaculatus* Frederiksen, n. sp. 78
 (30-31) Holotype; slide 10558 A-1, 26.9 x 121.1.
 (32-33) Paratype; slide 10864 A-2, 24.0 x 125.2.

Sources of specimens (for localities, see Table 1): Gosport Sand—figs. 14, 21-23, 28-31, 34-35, loc. 11; Moodys Branch Fm.—fig. 4, loc. 5; fig. 13, loc. 6; Yazoo Clay—figs. 15-16, 32-33, loc. 2; figs. 17-18, loc. 4; figs. 1-2, 12, loc. 5; North Twistwood Creek Clay Member—fig. 6, loc. 7; figs. 7-8, 19-20, loc. 11; Shubuta Clay Member—fig. 5, loc. 8; fig. 3, loc. 11; Forest Hill Sand—figs. 9-10, 24-27, loc. 3; Red Bluff Clay—fig. 11, loc. 8.

Remarks: *Echiperiporites akanthos* van der Hammen and Wymstra, 1964, is periporate but otherwise seems to be similar to *E. tschudyi*. The genus *Echiperiporites* is here-with emended to include stephanoporate grains, as there appears to be no good reason why separate genera should be maintained for the two aperture types. *Malvacearumpollis bakonyensis* Nagy, 1962, has much larger grains than described species of *Echiperiporites*, and the grains have massive, rounded spines. The botanical affinity of *Echiperiporites tschudyi* is probably Malvaceae; the ornamentation is that of a typical malvaceous grain, and a number of modern species of the family have a vestibulate aperture structure.

Occurrence: The known range is from the lower Gosport Sand to the upper Red Bluff Clay; "infrequent" in 10/56 counted samples.

Genus PARSONSIDITES Couper, 1960

PARSONSIDITES CONSPICUUS Frederiksen, n. sp.

Pl. 2, figs. 24-27

Multiporopollenites sp. TSCHUDY and VAN LOENEN, 1970, U.S. Geol. Surv. Prof. Paper 643-E, pl. 3, figs. 31-32.

Description: Size 18-28 microns, mean 23 microns, holotype 24 microns. Outline round. Exine 1 micron thick; tegillate; ectosexine and nexine each slightly thinner than endosexine; infrapunctate, often indistinctly

so. About 15-20 foramina distributed over the entire exine, 2-2.5 microns in diameter; annuli present, 5-7 microns in diameter; exine at the annuli 1.5 microns thick, increase in exine thickness due to thickening of endosexine, design of the annuli distinctly punctate to granulate; no atria present.

Holotype: Pl. 2, figs. 24-25, slide 10627 A-2, 20.9 x 120.9, Forest Hill Sand at Forest Hill, Hinds County, Mississippi.

Remarks: *Parsonsidites conspicuus* is characterized by the large, distinct, infrapunctate annuli to which the specific epithet refers. *Multiporopollenites maculosus* (Potonié, 1931c) Thomson and Pflug, 1953, is larger but has smaller foramina and annuli. *Parsonsidites psilatus* Couper, 1960, is larger, and its annuli do not have such a distinct design. The botanical affinity is probably Chenopodiaceae.

Occurrence: The known range is from the lower Moodys Branch Formation to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" in 22 or 23/56 counted samples.

Genus JUGLANSPOLLENITES Raatz, 1937

JUGLANSPOLLENITES INFRABACULATUS Frederiksen, n. sp.

Pl. 2, figs. 30-33

Description: Size 21-33 microns, mean 27 microns, holotype 27 microns. Outline round to slightly polygonal. Exine about 1.5 microns thick; distinctly tegillate; ecto-

sexine, endosexine and nexine each about 0.5 micron thick; design distinctly granulate; surface smooth. Exine usually crossed by several folds. About 15-20 foramina distributed over the whole exine; foramina round to oval, 1.5-2.5 microns in diameter; no labra, annuli or atria present.

Holotype: Pl. 2, figs. 30-31, slide 10558 A-1, 26.9 x 121.1, Gosport Sand at Little Stave Creek, Clarke County, Alabama.

Remarks: *Juglanspollenites infrabaculatus* is characterized by its lack of aperture structure and by its distinct infrabaculate (tegillate) sexine structure and granulate design. This combination of characters is not typical of either the Juglandaceae or the Chenopodiaceae.

Occurrence: The known range is from the lower Gosport Sand to the lower Forest Hill Sand and the lower Red Bluff Clay; "infrequent" to "occasional" in 28/56 counted samples.

Genus MONOSULCITES Couper, 1953
emend. Potonié, 1958

Monosulcites COUPER, 1953, New Zealand Geol. Surv. Paleont. Bull. 22, p. 65, pl. 8, figs. 130-133.

Monosulcites Couper *emend.* POTONIÉ, 1958, Beih. Geol. Jahrb., no. 31, p. 95, pl. 11, fig. 133.

Navisulcites ANDERSON, 1960, New Mexico Bur. Mines Min. Res., Mem. 6, p. 27, pl. 3, fig. 5.

Remarks: The sulcus in palm-like grains varies from gaping to closed to overlapping within one species. This variation occurs in the type species of *Monosulcites*, *M. minimus* (Cookson, 1947) Couper, 1953. *Navisulcites* was defined by Anderson (1960) as differing from other genera because the grains had gaping sulci, but this does not appear to be a character upon which a genus or perhaps even a species can be distinguished. In addition, the holotype of *Monosulcites minimus* itself has a gaping sulcus.

MONOSULCITES ASYMMETRICUS
Frederiksen, n. sp.

Pl. 2, figs. 23, 28-29, 34-35

Description: Size 10-32 microns, mean 22 microns, holotype 23 microns. Outline of the typical grain is asymmetrically oval, with the widest part closer to one end than the other, like many palm grains; a few grains are elliptical or lenticular; ends usually pointed; length/width 1.2-1.5. Exine about 0.7-1 micron thick, sexine:nexine 2:1; psilate or rarely faintly infrapunctate. Sulcus extends nearly full length of grain; sulcus apparently with marginal thickenings about 0.5 micron wide, although these may only be the upturned edges of the sulcus. Sulcus typically slightly open; may be gaping or overlapping.

Holotype: Pl. 2, figs. 28-29, slide 10558 A-1, 43.4 x 120.5, Gosport Sand at Little Stave Creek, Clarke County, Alabama.

Remarks: *Monosulcites minimus* (Cookson, 1947) Couper, 1953, has a thicker exine; *Monocolpopollenites zieveiensis* Pflug in Thomson and Pflug, 1953, is typically lenticular in outline. The botanical affinity is probably Palmae, although the grains of other monocotyledons are also similar, e.g., *Libertia grandiflora* Sweet (Iridaceae) illustrated by Cranwell (1953, pl. 6, fig. 14).

Occurrence: The known range is from the upper Cockfield Formation and the lower Gosport Sand to the lower Forest Hill Sand and the lower Red Bluff Clay; "infrequent" to "occasional" in 32/56 counted samples.

Genus CONFERTISULCITES
Anderson, 1960

CONFERTISULCITES FUSIFORMIS
Frederiksen, n. sp.

Pl. 3, figs. 6-8

Monosulcites sp. TSCHUDY and VAN LOENEN, 1970, U.S. Geol. Surv. Prof. Paper 643-E, pl. 1, fig. 9.

Description: Size 35-97 microns (mostly 45-85 microns), mean 63 microns, holotype 68 microns. Outline elongate-lenticular with pointed ends; length/width 3-5.5. Exine 1 micron thick; sexine:nexine 3:1; psilate. Sulcus extends full length of grain; it is

slightly open or the edges are slightly overlapping along the whole length.

Holotype: Pl. 3, fig. 6, slide 10650 A-2, 27.1 x 123.0, Yazoo Clay near Cynthia, Hinds County, Mississippi.

Remarks: *Confertisulcites fusiformis* is characterized by its spindle-shaped outline (*fusiformis*, Latin, "spindle-shaped"). *Confertisulcites knowltonii* Anderson, 1960, and *Magnolia scotica* Simpson, 1961, are elliptical, with rounded ends; *Monocolpopollenites magnus* Kedves, 1961, is relatively broader and is psilate, chagrenate or infragranulate, that is, it looks more like modern *Magnolia* pollen than *Confertisulcites fusiformis* does. *C. fusiformis* may belong to the Magnoliaceae, however.

Occurrence: The known range is from the upper Cockfield Formation and the upper Gosport Sand to the top of the Yazoo Clay; possibly occurs also in the lower Forest Hill Sand; "infrequent" in 11 or 12/56 counted samples.

length of grain; lumina may be smaller near sulcus. Sulcus extends full length or nearly full length of grain; usually slightly open, without thickened margins.

Holotype: Pl. 3, figs. 1-2, slide 10627 A-1, 17.7 x 109.6, Forest Hill Sand at Forest Hill, Hinds County, Mississippi.

Remarks: *Monocolpopollenites papillosus* Thomson and Pflug, 1953, has smaller lumina (more lumina present down length of grain). The epithet *vittatus* (Latin, "bound with a ribbon") refers to the ribbon-like appearance of the muri in optical section. The botanical affinity may be Palmae; however, of all species of monosulcate pollen grains observed in the Jackson Stage and adjacent strata, *Liliacidites vittatus* is the most likely to belong to *Myristica* (Myristicaceae), seeds of which were reported by Berry (1924) from upper Eocene or Oligocene strata of Texas.

Occurrence: The known range is from the middle of the Gosport Sand to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" to "occasional" in 22/56 counted samples.

Genus LILIACIDITES Couper, 1953

LILIACIDITES VITTATUS

Frederiksen, n. sp.

Pl. 3, figs. 1-5

Liliacidites sp. TSCHUDY and VAN LOENEN, 1970, U.S. Geol. Surv. Prof. Paper 643-E, pl. 1, figs. 17-18.

Description: Size 28-38 microns, mean 34 microns, holotype 35 microns. Broadly lenticular in outline, the ends slightly pointed; length/width 1.1-1.5. Reticulate; muri in optical section ribbon-like, discontinuous and clavate, with the clavae 0.5-3 micron apart; between clavae, muri are supported by thin bacula. Exine including reticulum 2 microns thick; exine proper 0.5-0.7 micron thick, baculate interval 0.3-0.5 micron high, muri 0.7-1 micron high. Muri 1 micron wide and duplilaculate in design (Tschudy and van Loenen, 1970, pl. 1, fig. 18); lumina polygonal, about 2-3 microns in diameter on proximal face, 10-12 lumina present down

LILIACIDITES TRITUS

Frederiksen, n. sp.

Pl. 3, figs. 13-16

Monosulcites sp. TSCHUDY and VAN LOENEN, 1970, U.S. Geol. Surv. Prof. Paper 643-E, pl. 1, figs. 10, 14.

Description: Size 32-39 microns, mean 34 microns, holotype 33 microns. Outline more or less oval; may be slightly polygonal or asymmetrical; ends rounded to slightly pointed; length/width 1.3-1.9. Exine about 0.3 micron thick excluding ornamentation; distinctly reticulate, the muri clavate in optical section and simpli- to duplilaculate in design. Muri 1 micron high and 0.7-1 micron wide; lumina round to polygonal to oval, 0.5 x 0.5 micron-0.5 x 1 micron in size on proximal side; lumina may be slightly smaller on distal side near sulcus. Sulcus extends full length or nearly full length of grain; sulcus gaping, slightly open all along

its length, or edges overlapping; edges of sulcus turned up so that the edges look thickened.

Holotype: Pl. 3, figs. 13-14, slide 10558 A-1, 34.6 x 115.3, Gosport Sand at Little Stave Creek, Clarke County, Alabama.

Remarks: *Liliacidites variegatus* Couper, 1953, has narrower muri; *Monocolpopollenites pflugii* Takahashi, 1961, has a shorter sulcus, and the muri are narrower and are baculate in optical section; *Monocolpopollenites areolatus retareolatus* Pflug in Thomson and Pflug, 1953, is indistinctly rugulate to reticulate. The epithet *tritrus* means "familiar, commonplace" in Latin and refers to the large number of samples in which this species occurs. The botanical affinity is probably Palmae, but *Astelia trinervia* T. Kirk of the Liliaceae (illustrated by Cranwell, 1953, pl. 5, fig. 12) also look similar.

Occurrence: The known range is from the upper Cockfield Formation and the lower Gosport Sand to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" to "common" in 50/56 counted samples.

Genus CUPULIFEROIDAEPOLLENITES

Thomson in Potonić, *et al.*, 1950

ex Potonić, 1960

CUPULIFEROIDAEPOLLENITES CERTUS

Frederiksen, n. sp.

Pl. 3, figs. 9-12

Tricolpopollenites sp. TSCHUDY and VAN LOENEN, U.S. Geol. Surv. Prof. Paper 643-E, pl. 4, ?fig. 1.

Description: Size 15-26 microns, mean 20 microns, holotype 18 microns. Prolate to subprolate. Tricolpate, colpi extending nearly full length of grain; edges of colpi slightly thickened; colpi with distinct geniculi, sides of colpi pinched together at the geniculi. Exine 0.7-1 micron thick, sexine:nexine 2:1, psilate to faintly punctate.

Holotype: Pl. 3, figs. 9-10, slide 10558 A-1, 36.2 x 115.2, Gosport Sand at Little Stave Creek, Clarke County, Alabama.

Remarks: *Cupuliferoideaepollenites certus* is characterized by its distinct geniculi (*certus*, Latin, "definite, certain," referring to the strongly expressed geniculi). *Pollenites nodus* Doktorowicz-Hrebicka, 1960, is larger. *Tricolpopollenites liblarensis fallax* (Potonić, 1934) Thomson and Pflug, 1953, is smaller and less sharply geniculate. Potonić (1934, p. 70) used the name *Pollenites fallax distentus* for larger, more distinctly geniculate specimens like *C. certus*, but he did not illustrate a specimen of *P. fallax distentus*, and the taxon is therefore invalid. The botanical affinity of *C. certus* may be Leguminosae; similar modern pollen are found, e.g., in *Priotropis cytisoides* Wight and Arm and in *Dorycnium suffruticosum* Villars. A few grains of *C. certus* may also represent *Laguncularia* (Combretaceae), although in the latter genus the grains are usually more spheroidal than in *C. certus*.

Occurrence: The known range is from the lower Gosport Sand to the upper Red Bluff Clay; "infrequent" to "occasional" in 19/56 counted samples.

Genus FOVEOTRICOLPITES Pierce, 1961

FOVEOTRICOLPITES PROLATUS

Frederiksen, n. sp.

Pl. 3, figs. 17-22

Description: Size 22-30 microns, mean 25 microns, holotype 30 microns. Typically prolate, occasionally subprolate. Tricolpate, colpi extending nearly full length of grain, margins not thickened. Exine 1.5 microns thick; tegillate; ectosexine, endosexine and nexine each about 0.5 micron thick; foveolae about 0.3 micron in diameter; ectosexine lumpy in optical section.

Holotype: Pl. 3, figs. 20-22, slide 10663 A-1, 16.2 x 122.1, Moodys Branch Formation near Rose Hill, Jasper County, Mississippi.

Remarks: *Foveotricolpites sphaeroides* Pierce, 1961, is subprolate and has thickened colpi margins. The botanical affinity of *F. prolatus* is unknown.

PLATE 3

All specimens magnified 800 X

Figures		Page
1-5.	<i>Liliacidites vittatus</i> Frederiksen, n. sp.	80
	(1-2) Holotype; slide 10627 A-1, 17.7 x 109.6.	
	(3-5) Paratype; slide 10556 A-1, 25.5 x 122.9.	
6-8.	<i>Confertisulcites fusiformis</i> Frederiksen, n. sp.	79
	(6) Holotype; slide 10650 A-2, 27.1 x 123.0.	
	(7) Paratype; slide 10556 A-1, 25.3 x 123.1.	
	(8) Paratype; slide 10659 A-2, 19.5 x 114.5.	
9-12.	<i>Cupuliferoideaepollenites certus</i> Frederiksen, n. sp.	81
	(9-10) Holotype; slide 10558 A-1, 36.2 x 115.2.	
	(11-12) Paratype; slide 10553 A-1, 39.6 x 114.1.	
13-16.	<i>Liliacidites tritus</i> Frederiksen, n. sp.	80
	(13-14) Holotype; slide 10558 A-1, 34.6 x 115.3.	
	(15-16) Paratype; slide 10661 A-2, 22.1 x 109.3.	
17-22.	<i>Foveotricolpites prolatus</i> Frederiksen, n. sp.	81
	(17-18) Paratype; slide 10663 A-1, 16.4 x 124.9.	
	(19) Paratype; slide 10558 A-1, 34.8 x 118.0.	
	(20-22) Holotype; slide 10663 A-1, 16.2 x 122.1.	
23-27.	<i>Fraxinoipollenites medius</i> Frederiksen, n. sp.	84
	(23-24) Holotype; slide 10663 A-1, 16.9 x 118.7.	
	(25-27) Paratype; slide 10556 A-1, 34.4 x 112.2.	
28-29.	<i>Cupuliferoipollenites brevisulcatus</i> Frederiksen, n. sp.	85
	(28) Holotype; slide 10645 A-2, 29.6 x 115.0.	
	(29) Paratype; slide 10645 A-2, 29.4 x 115.0.	
30-34.	<i>Albertipollenites? araneosus</i> Frederiksen, n. sp.	84
	(30-31) Holotype; slide 10656 A-1, 31.9 x 108.9.	
	(32-33) Paratype; slide 10653 A-1, 28.9 x 113.8.	
	(34) Paratype, a specimen with ragged colpus floors, appearing tricolporate; slide 10637 A-1, 31.9 x 122.4.	

Sources of specimens (for localities, see Table 1): Gosport Sand—figs. 3-5, 7, 9-10, 13-14, 19, 25-27, loc. 11; Cockfield Fm.—Moody's Branch Fm. contact zone—figs. 28-29, loc. 5; Moody's Branch Fm.—figs. 17-18, 20-24, loc. 6; figs. 11-12, loc. 11; Yazoo Clay—figs. 6, 30-33, loc. 4; fig. 34, loc. 5; North Twistwood Creek Clay Member—figs. 8, 15-16, loc. 6; Forest Hill Sand—figs. 1-2, loc. 3.



PLATE 3

Occurrence: The known range is from the upper Cockfield Formation and the lower Gosport Sand to the upper Red Bluff Clay; "infrequent" in 17/56 counted samples.

Genus FRAXINOIPOLLENITES Potonié,
1951a *ex* Potonié, 1960

FRAXINOIPOLLENITES MEDIUS
Frederiksen, n. sp.

Pl. 3, figs. 23-27

Description: Size 30-44 microns, mean 36 microns, holotype 35 microns. Prolate or occasionally perprolate (length/width 1.7-2.2); outline elongate oval with flattened ends. Tricolpate, colpi extending nearly full length of grain; margins may be slightly thickened. Exine 1-1.3 microns thick including ornamentation, exine proper about 0.3 micron thick. Finely reticulate; muri in optical section finely clavate, clavae 0.7-1 micron high, muri 0.3-0.5 micron high; lumina 0.3-0.5 micron in diameter.

Holotype: Pl. 3, figs. 23-24, slide 10663 A-1, 16.9 x 118.7, Moody's Branch Formation near Rose Hill, Jasper County, Mississippi.

Remarks: *Fraxinoipollenites pudicus* (Potonié, 1934) Potonié, 1960, is larger; *Tricolpopollenites haraldii* Manum, 1962, is smaller; *Menispermum scoticum* Simpson, 1961, has a smaller length/width (about 1.5). The specific epithet (*medius*, Latin for "middle") refers to the medium size of the grains in the species. The botanical affinity is unknown; the grains are larger and more prolate than in typical *Fraxinus*.

Occurrence: The known range is from the upper Gosport Sand to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" to "occasional" in 20/56 counted samples.

Genus ALBERTIPOLLENITES Srivastava,
1969

ALBERTIPOLLENITES? ARANEOSUS
Frederiksen, n. sp.

Pl. 3, figs. 30-34

Description: Size 21-37 microns, mean 29 microns, holotype 33 microns. Prolate; outline oval, poles broadly to narrowly rounded. Tricolpate, colpi extending nearly full length of grain, ends of colpi typically broadly rounded (Pl. 3, fig. 31), colpi margins slightly thickened. Bases of colpi sometimes torn or ragged—some specimens appear to be raggedly tricolporate (Pl. 3, fig. 34). Exine excluding ornamentation 1 micron thick; sexine:nexine 3:1. Reticulate, the muri clavate in optical section, clavae 0.7-1 micron high, muri 0.3 micron high; muri 0.3 micron wide, lumina 1.5-2.5 microns in diameter.

Holotype: Pl. 3, figs. 30-31, slide 10656 A-1, 31.9 x 108.9, Yazoo Clay near Cynthia, Hinds County, Mississippi.

Remarks: *Albertipollenites? araneosus* is characterized by its rather large lumina and narrow muri; the specific epithet (*araneosus*, Latin, "full of cobwebs") refers to the ornamentation. *Tricolpites bathyreticulatus* Stanley, 1965, is oblate; *Tricolpites geranioides* Couper, 1960, has wider muri and is larger. According to Srivastava's definition (1969, p. 54-55), *Albertipollenites* includes coarsely reticulate, tricolpate grains in which the reticulum does not become finer toward the colpi. The genus is also defined as containing "oblate to spheroidal" grains. To the writer's knowledge no genus has yet been proposed for prolate, coarsely reticulate, tricolpate grains like *Albertipollenites? araneosus*. However, at present the new species is tentatively assigned to *Albertipollenites* rather than to a new genus. The botanical affinity of *A.? araneosus* is unknown.

Occurrence: The known range is from the upper Cockfield Formation to the lower Forest Hill Sand and the upper Red Bluff Clay; "infrequent" to "occasional" in 21/56 counted samples.

Genus CUPULIFEROIPOLLENITES
Potonié, 1951a ex Potonié, 1960

CUPULIFEROIPOLLENITES
BREVISULCATUS
Frederiksen, n. sp.

Pl. 3, figs. 28-29

Description: Size 14-21 microns, mean 17 microns, holotype 19 microns. Prolate; sides straight and poles broadly rounded. Tricolporate; colpi about 0.5 micron wide, extending only 1/2-3/5 length of grain, margins not thickened; ora alongate, typically 1.5-2 x 4-4.5 microns. Exine 0.5-0.7 micron thick at poles and about 1 micron thick at equator; thickening produces darkened equatorial band 6-7 microns wide. Nexine everywhere very thin. Exine psilate.

Holotype: Pl. 3, fig. 28, slide 10645 A-2, 29.6 x 115.0, Cockfield Formation-Moodys Branch Formation contact zone at Jackson, Mississippi.

Remarks: *Cupuliferoipollenites brevisulcatus* is characterized by its short colpi and prominent, alongate ora and by the equatorial thickening of the exine (*brevis*, Latin for "short;" *sulcatus*, Latin for "furrowed;" referring to the short colpi). The species may belong to the Umbelliferae.

Occurrence: The known range is from the upper Cockfield Formation to the top of the Yazoo Clay; "infrequent" to "occasional" in 14/56 counted samples.

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