Species of *Aquilapollenites* and *Fibulapollis* From Two Upper Cretaceous Localities in Alaska

GEOLOGICAL SURVEY PROFESSIONAL PAPER 643-A

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By BERNADINE D. TSCHUDY

CONTRIBUTIONS TO PALEONTOLOGY

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Occurrence, description, and illustration of fossil pollen

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1969

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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Washington, D.C. 20402 - Price $1 (paper cover)

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SPECIES OF *AQUILAPOLLENITES* AND *FIBULAPOLLIS* FROM TWO UPPER CRETACEOUS LOCALITIES IN ALASKA

By BERNADINE D. TSCHUDY

ABSTRACT

Eight new species of *Aquilapollenites* from northern and eastern Upper Cretaceous localities in Alaska are named and described. Three previously described species of *Aquilapollenites* also were present in the samples at these localities; two of these species were originally reported from Cretaceous sedimentary rocks of Russia and one was described from Upper Cretaceous sedimentary rocks from Canada. The latter three species are also present in Upper Cretaceous rocks of the northern Rocky Mountains of the United States. None of the eight new species of *Aquilapollenites* has been observed in samples from the Rocky Mountain region.

One species of the genus *Fibulapollis*, a genus probably closely allied to *Aquilapollenites*, was found in the Alaskan samples, but it occurs only as rare specimens. The species is also present in some Upper Cretaceous samples from the Rocky Mountain region and is similar to two previously described species from Siberia.

INTRODUCTION

Since 1957, many species of *Aquilapollenites* have been reported from Upper Cretaceous and (or) Paleocene sedimentary rocks from the Rocky Mountain regions of Canada and the United States and from Russia, Japan, Malaysia, Scotland, and Africa. (See summary in Tschudy and Leopold (1969).) Recently, forms pertaining to this genus have been recognized in Alaskan sedimentary rocks by oil company palynologists and by workers in the U.S. Geological Survey Denver Pollen Laboratory; however, Alaskan species of *Aquilapollenites* have not been reported in the literature. Judging from the diversity of forms found in the few samples reported here, the taxa described probably represent a very small percentage of the total number of species of the genus which exist in the Upper Cretaceous of Alaska.

Two species of the genus *Fibulapollis* were previously described from sediments from the Chulym-Enisei depression (western Siberia) of the U.S.S.R. A species of *Fibulapollis* similar to the two species reported from Russia is present in the Upper Cretaceous samples from the two Alaskan localities of this report and is also present in Upper Cretaceous sedimentary rocks from localities in the Rocky Mountain region.

PHOTOGRAPHY

The transmitted light photographs which illustrate the taxa in this report were taken on a Zeiss photoscope. Apochromatic × 40 and Neofluar × 100 oil immersion objectives and 35 millimeter KB–14 film were used. Four of the new species are illustrated by scanning electron microscope (SEM) photographs as well as by standard light microscope photographs. The SEM photographs were taken by Charles M. Drew at the Naval Weapons Center at China Lake, Calif.; methods used in the preparation and photographing of these pollen grains are the same as those described by Drew and Tschudy (1968, p. 1830).

TYPE SLIDES

Slides containing type specimens of new taxa, as well as slides containing nontype grains represented on the plates, are on file at the U.S. Geological Survey Denver Pollen Laboratory. The type specimens are within black ink circles marked on the slides; they may also be located by the mechanical stage coordinates which are included in the plate explanations and with the individual holotype and paratype assignments. The author's coordinate readings for the center point of a 1- by 3-inch standard microscope slide are 108.2×12.4 mm (horizontal×vertical axes); with the slide label placed to the left on the microscope stage, the vertical coordinates decrease toward the bottom edge of the slide and the horizontal coordinates decrease toward the right edge of the slide. Conversion of coordinates to those of another mechanical stage may be made by the methods of Traverse (1958) and Tschudy (1966).

SAMPLE LOCALITIES AND THEIR RESPECTIVE SPECIES OF *AQUILAPOLLENITES* AND *FIBULAPOLLIS*

The samples used in this study are from the pollen slide files of the U.S. Geological Survey Denver Pollen Laboratory. The localities from which the Alaskan samples were collected and the species of *Aquilapollenites* and *Fibulapollis* which were found at each locality are designated in figure 1.

Five samples (A, B, C, G, H) from USGS paleobotany locality D3124 were collected July 18, 1951, along the Colville River in northern Alaska, lat 69°40′ N., long 151°25′ W., in T. 4 N., R. 2 E. (Umiat quadrangle), by C. A. Arnold, R. A. Scott, and J. S. Lowther. These samples are from the Colville Group of Late Cretaceous age.

One sample, from USGS paleobotany locality D1799, was collected in 1961 on the east bank of the Nation River in eastern Alaska, lat 65°19.6′ N., long 141°29.6′ W., in SE¼ sec. 23, T. 6 N., R. 30 E. (Charley River B–1 quadrangle), by E. E. Brabb. This sample was taken from rocks of Late Cretaceous age.

Rocky Mountain pollen localities mentioned in this report are listed in table 1.

RELATIVE ABUNDANCE OF *AQUILAPOLLENITES*, *FIBULAPOLLIS*, AND OTHER PALYNOMORPHS

Palynomorph counts were made for four of the more productive samples from the two localities in Alaska. The species of *Aquilapollenites* and *Fibulapollis* present and their abundance in respect to each other and to other palynomorphs are shown in table 2. In this table the other palynomorphs found in the samples are classified only under genera or groups.

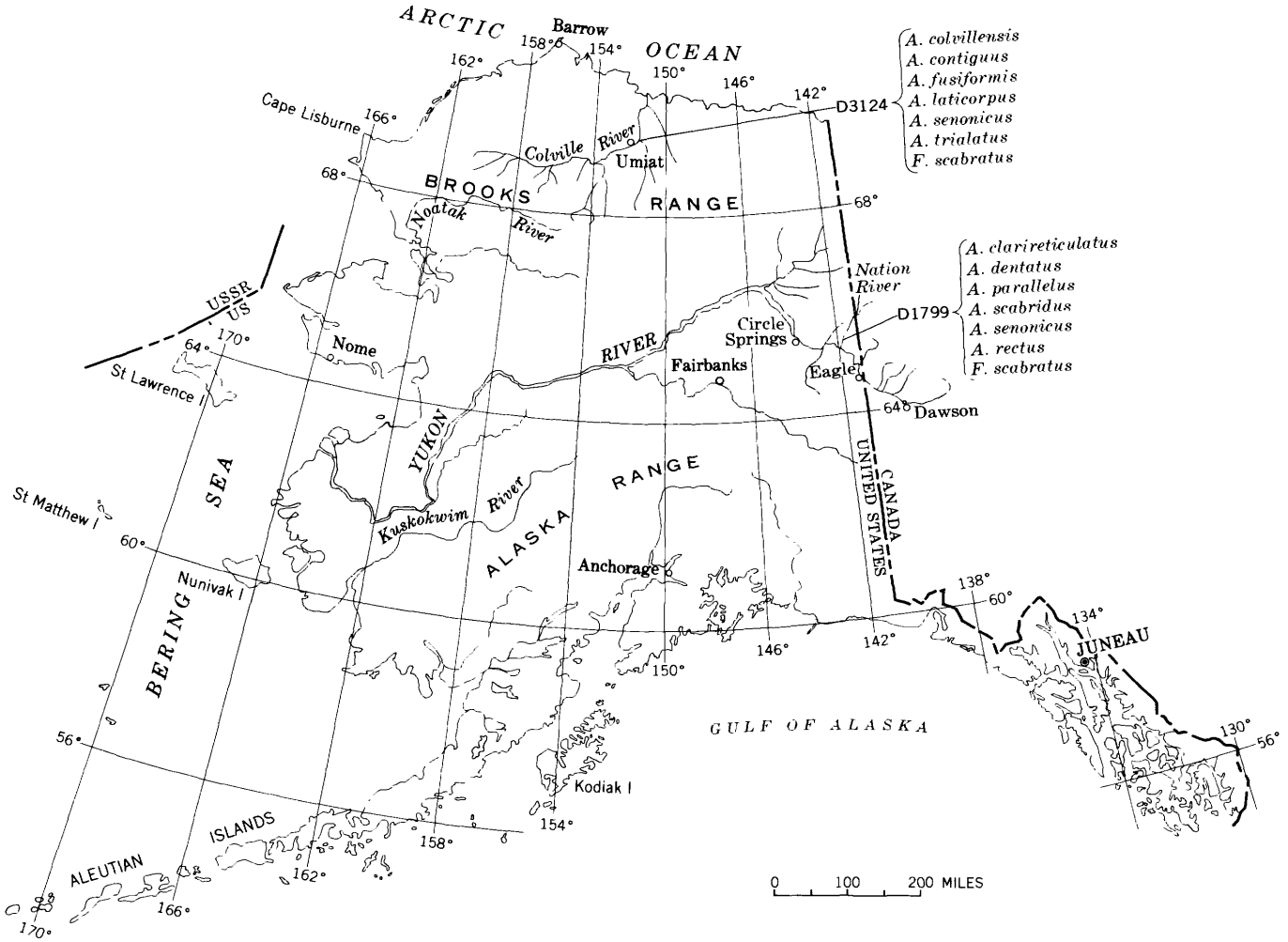

FIGURE 1.—Index map of Alaska showing sample localities and their respective species of *Aquilapollenites* and *Fibulapollis*.

TABLE 1.—*Rocky Mountain pollen localities*

USGS paleobotany locality No.	Locality					
	State	County	Sec.		T.	R.
D1330-4	Wyoming	Niobrara	NE¼NE¼	23	38 N.	62 W.
D1330-5	do	do	NW¼NE¼	23	38 N.	62 W.
D1330-19	do	do	NE¼NW¼	23	38 N.	62 W.
D1330-26	do	do	SE¼SE¼	14	38 N.	62 W.
D1331-2, -5	do	do	SW¼SW¼	14	38 N.	62 W.
D1602	do	do	C	3	37 N.	64 W.
D1603	do	do	NE¼SE¼	7	37 N.	64 W.
D1750-B	do	Carbon	NW¼	12	15 N.	92 W.
D3147-B	Montana	Garfield		1	21 N.	37 E.
D3472-B, -C, -D, -E, -F.	do	do		29	21 N.	34 E.
D3690-B	do	Dawson		14	141 N.	55 E.
D3690-C, -D, -H	do	do		14	141 N.	55 E.
D3718-E, -I	do	Fergus	NW¼NW¼	13	22 N.	17 E.
D3724-B, -E	do	do	NE¼SW¼	12	22 N.	17 E.
D3725-A	do	Blaine	NW¼	26	24 N.	17 E.
D3730-A, -D	do	Dawson		2	141 N.	55 E.
D3740-B	Wyoming	Sheridan	NE¼NW¼ NW¼.	19	57 N.	86 W.
D3754-A	Montana	Garfield		29	21 N.	34 E.
D3980-E	Colorado	Montrose	C	36	47 N.	7 W.

TABLE 2.—*Relative abundance, in percent, of the species of* Aquilapollenites, Fibulapollis, *and other palynomorphs*

[Palynomorphs not identified to species are listed merely under genera or larger groups. Numbers represent percentages and are based on counts of 200 palynomorphs per sample; plus sign indicates presence of palynomorphs in samples where they did not occur within counts]

Palynomorph	Sample localities			
	D1799	D3124-B	D3124-G	D3124-H
Aquilapollenites clarireticulatus	4	0	0	0
colvillensis	0	39.5	20.5	4
contiguus	0	2.5	6	0
dentatus	7.5	0	0	0
fusiformis	0	.5	1	0
laticorpus	0	.5	0	0
parallelus	2.5	0	0	0
rectus	10	0	0	0
scabridus	+	0	0	0
senonicus	+	1	+	0
trialatus	0	0	0	1.5
Fibulapollis scabratus	+	+	+	0
Fern spores:				
Monolete	42	2	6	3
Trilete	3.5	10.5	4	8.5
Conifer pollen:				
cf. *Dacrydium*	0	0	5	0
cf. *Sequoia*	0	0	0	2.5
Inaperturopollenites	0	.5	.5	2.5
Other conifer pollen	0	.5	32.5	1
Nonconifer pollen:				
Monosulcate	5	22.5	8.5	3
Erdtmanipollis	.5	0	0	0
Cranwellia	11	0	+	+
Loranthacites (sensu Mtchedlishvili, 1961)	4.0	0	0	0
Miscellaneous triporate and tricolpate pollen	10	.5	.5	.5
Algae:				
Botryococcus	0	10.5	7.5	0
Incertae sedis	0	9	8	73.5
Total:				
Aquilapollenites	24	44	27.5	5.5
Other palynomorphs	76	56	72.5	94.5
	100	100	100	100

ACKNOWLEDGMENTS

Glenn E. Rouse furnished a slide of his type material from Canada which contained pollen useful for comparison with Alaskan and Rocky Mountain forms. Ivan J. Mittin translated the parts of Russian publications that are included in this report. A. F. Chlonova's prompt replies to correspondence, as well as her examination of and comments about pollen which was sent to her, are greatly appreciated. The author is particularly grateful to Estella B. Leopold for helpful advice and criticisms during the entire preparation of this report.

The scanning electron microscope photographs were generously contributed by Charles M. Drew of the Naval Weapons Center, China Lake, Calif.

SUMMARY

Eight new species of *Aquilapollenites* and one new species of *Fibulapollis* are named and described from two Upper Cretaceous localities in Alaska. Known distributions of three previously named species of *Aquilapollenites* which were present in these samples are noted, and two of these species are redescribed.

The eight new species of *Aquilapollenites* appear to be distinctly different from any species which have been encountered in sedimentary rocks from the Rocky Mountain region and from species which have been reported from the U.S.S.R. Four of the eight new species were found in the sample from eastern Alaska; the remaining four, in samples from the northern Alaska locality.

Of the three previously known species of *Aquilapollenites* which were found in the Alaskan samples: One was described from Senonian sedimentary rocks from the Western Siberian lowlands (Sym River) and has been found to range from lower Campanian into upper Maestrichtian in the Rocky Mountains; another species, previously named from the Maestrichtian-Danian of Yakutia (Linde River, central Siberia), has been found in the lower Campanian Eagle Sandstone in Montana; and the third, described from Upper Cretaceous seidmentary rocks of Alberta, Canada, has been found in the middle Campanian Claggett Shale in Montana. Grains very similar (or equal) to this last species have been reported from Siberia.

The one species of *Fibulapollis* which was present in samples from both Alaskan localities has been found to range from lower Campanian into lower Maestrichtian, in the Rocky Mountains. This taxon is similar to two species of *Fibulapollis* previously described from the Chulym-Enisei depression of Western Siberia.

SYSTEMATIC DESCRIPTIONS

Form genus Aquilapollenites (Rouse) Funkhouser, 1961

Aquilapollenites Rouse, 1957, p. 370–371. Type species: *Aquilapollenites quadrilobus* Rouse, 1957. Type specimen: Designated by Rouse (1957, p. 371) from the Brazeau Formation, Upper Cretaceous, Alberta, Canada [McMaster University Palaeobotanical Collection, Hamilton, Ontario, Canada, slide Cs–31]; illustrated in Radforth and Rouse (1954, pl. 1, fig. 14), and in Tschudy and Leopold (1969, pl. 2, figs. 1A–B).

Aquilapollenites (Rouse) Funkhouser, 1961 (April), p. 193–194.

Triprojectacites Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 203–204) (supergroup of Mtchedlishvili).

Triprojectus Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 204–205).

Aquilapollenites Rouse et Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 209).

Integricorpus Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 217).

Mancicorpus Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 218–219).

Parviprojectus Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 225).

Projectoporites Mtchedlishvili, 1961 (in Samoilovitch and others, 1961 (July), p. 227).

Tricerapollis Chlonova, 1961 (August), p. 85.

Taurocephalus Simpson, 1961 (December), p. 440.

Mancicorpus (Mtchedlishvili) Srivastava, 1968b, 695–697.

Aquilapollenites (Rouse) Funkhouser, 1961 (in Tschudy and Leopold, 1969).

Aquilapollenites senonicus (Mtchedlishvili) Tschudy and Leopold, 1969

Plate 1, figures 1–14

Mancicorpus senonicum Mtchedlishvili, 1961 (in Samoilovitch and others, 1961, p. 224–225). Holotype: pl. 72, figs. 2a–c; Paleophytological Laboratory of the Scientific Research Institute of Petroleum and Geological Exploration (VNIGRI), preparation 6196; Western Siberian lowlands, Sym River, Kolokol'nikov Yar, specimen 8528; lower Symian subsuite, Senonian.

Mancicorpus senonicus Mtchedlishvili, 1961 (in Srivastava, 1968a, p. 1488).

Aquilapollenites senonicus (Mtchedlishvili) Tschudy and Leopold, 1969.

The following is a translation by Ivan Mittin of the description of *Mancicorpus senonicum* Mtchedlishvili, 1961 (in Samoilovitch and others, 1961, p. 224–225):

"*Diagnosis.* Pollen grains are large, three furrowed. Proximal(?) end of body cylindrical, with rounded end. There is a distal(?) node. Equatorial projections in contact with the body form an angle nearly at right angles. Exine of medium thickness, clublike (pilata), reticulate.

"*Description.* Pollen grains 32.5μ to 36.5μ [microns] in height, average height 34.6μ; its diameter from 44.2μ to 48.6μ, average 46.5μ; the length of the body from 30.5μ to 35.4μ, average 32.5μ; width of body 9.7μ to 14.9μ, average 12.5μ; length of equatorial projections from 15.8μ to 19.1μ, average 17.5μ; width of equatorial projections 10.1μ to 12.1μ, average 11.1μ.

"The pollen grains are three furrowed. The proximal end of the body is elongated-rectangular in form with the rounded end that becomes wider in the direction of the equatorial projections. Distal(?) end is represented by a small node. Equatorial projections joining the body nearly at right angles. Projections are long and rather wide, furrows long and narrow. Exine about 1.3μ thick, the layer of nexine of the grain body is almost one half as thick as the sexine and it becomes wider near the projections; thick parts of the nexine are long for more than one half of the length of the projections, the structure of sexine is clublike with the rods thin, the heads small, rounded, and they converge at the edge of the body forming a sheath. The greatest thickness of the sexine layer is observed at the place of transition of the body into the equatorial projections. The sculpture is reticulate, the walls are composed of clublike protrusions, in plan having lenticular structure. The size of cells decreases toward the end of the body and equatorial projections. The ends of projections are covered with the exine that retains clublike structure which can be distinguished at magnification, ×1,350.

"*Material.* Ten well-preserved specimens.

"*Variations.* The pollen grains of this species vary a little, frequently the end of the body is slightly bent and in some specimens the thin ends of equatorial projections may be destroyed or broken.

"*Comparison and remarks.* By the dimension of pollen and the structure of the exine the species in the description resembles *M. trapeziforme* sp. n. It differs from it in the presence of a distal node, the form of the body and the size of the angle formed at the contact of the body with the equatorial projections. It differs from *M. tenue* sp. n. in the size and the form of the body and in the length of equatorial projections.

"*Locality.* Western Siberian lowlands, River Vakh and drill hole 27–K, interval 329.90–343.15 m [meters] collected by E. N. Petrov, lower(?) Maestrichtian; River Sym, Kolokol'nikov Yar, specimen 8528, collected by S. V. Lebedev, Senonian (lower Symian subsuite); River Sym, upper Symian drill hole 14, specimen 18, interval 23.4–26.9 m, Maestrichtian.

"*Distribution.* Senonian of the eastern part of the Western Siberian lowlands."

Records of occurrence.—

Rock unit	Stage or series	USGS paleobotany locality No. or literature reference	Locality [1] State and (or) country
			U.S.S.R.
Lower Symian subsuite.	Senonian	Mtchedlishvili (in Samoilovitch and others, 1961).	Western Siberia
(?)	Lower(?) Maestrichtian.	do	Do.
(?)	Maestrichtian	do	Do.
			Canada.
Edmonton Formation.	Maestrichtian	Srivastava (1968a)	Alberta.
			U.S.A.
(?)	Upper Cretaceous	D1799	Alaska.
Colville Group	do	D3124-B, -G	Do.
(?)	do	D1750-B	Wyoming.
Lance Formation, upper part.	Upper Maestrichtian.	D1602	Do.
Hell Creek Formation, middle part.	Upper and middle Maestrichtian.	D3730-A, -D	Montana.

See footnote at end of table.

Rock unit	Stage or series	USGS paleobotany locality No. or literature reference	Locality [1] State and (or) country
			U.S.A.
Hell Creek Formation, lower part.	Middle Maestrichtian.	D3147-B	Montana.
Do	do	D3472-B, -C, -D, -E, -F.	Do.
Do	do	D3690-C, -D, -H	Do.
Do	do	D3754-A	Do.
Lance Formation, lower part.	do	D1603	Wyoming.
Fox Hills Sandstone, Colgate Member.	Middle or lower Maestrichtian.	D3690-B	Montana.
Fox Hills Sandstone	Lower Maestrichtian.	D1331-2, -5	Wyoming.
Judith River Formation, upper part.	Upper Campanian	D3725-A	Montana.
Fruitland Formation	do	D3980-E	Colorado.
Judith River Formation, lower part.	Middle Campanian	D3740-B	Wyoming.
Pierre Shale, Mitten Black Shale Member.	Middle or lower Campanian.	D1330-5	Do.
Eagle Sandstone, middle part.	Lower Campanian	D3718-E	Montana.

[1] For specific Rocky Mountain localities see table 1.

Description.—Based on 55 specimens from the U.S. Geological Survey collections listed above. Tricolpate, heteropolar pollen grains with three equatorial protrusions. In equatorial view: grains with a domelike major pole, a nodelike minor pole, and three equatorial protrusions extending at nearly right angles from polar axis of grain or drooping slightly toward minor pole. Polar axis 27μ to 37μ; equatorial diameter (including equatorial protrusions) 36μ to 48μ; length of major polar protrusion 14μ to 17.5μ, width (measured halfway between base of protrusion and the pole) 14μ to 17.5μ; length of equatorial protrusions 14μ to 20μ, width (measured at midlength) 10.5μ to 15μ; major polar protrusions usually slightly larger, in some cases equal to, or rarely smaller than equatorial protrusions; minor pole protruding slightly or in rare specimens not protruding. In polar view: grains triangular, with slightly convex, slightly concave, or irregularly concave-convex sides, with rounded or pointed corners. Apertures: colpi extending the length of the equatorial protrusions, nearly anastomosing at minor pole (in some grains colpi appear to anastomose; in other grains colpi do not quite anastomose), colpi extend only a short distance onto base of major polar protrusion. Pollen wall: exine two layered; endexine (except for endexinal thickenings) thin or as much as 0.5μ thick, very thin on ends of equatorial protrusions at colpal margins; axillary endexinal thickenings, tear shaped to lens shaped, as much as 4μ thick in thickest part, extending onto equatorial protrusions for approximately half the length of the protrusions, extending onto base of major polar protrusion, and reaching nearly to minor pole; endexinal thickenings often lacking, some specimens show distinct thin areas or cavities from which thickenings have probably been dissolved (pl. 1, figs. 1, 2); ektexine approximately 1μ thick on minor polar protrusion and on basal half of major polar protrusion; ektexine usually slightly thinner on major polar dome than on remainder of body, ektexine on equatorial protrusions as much as 0.5μ thick; ektexinal elements columnar, joined at tips—resulting in a reticulate body sculpture; lumina of reticulum on minor polar protrusion and on approximate basal half of major polar protrusion as much as 0.5μ in diameter; lumina on major polar dome usually smaller than on remainder of body; sculpture of equatorial protrusions very finely reticulate (magnification $\times$ 1,000) or granulate; granula less than 0.5μ in diameter, with very low relief, scattered over surface of equatorial protrusions.

Remarks.—The grains described above closely resemble *Aquilapollenites* (alias *Mancicorpus*) *senonicus* as it was described and illustrated by Mtchedlishvili. Slightly wider ranges in size and form in the Alaskan specimens may be due to the much greater number of grains examined (Mtchedlishvili included a total of only 10 specimens for his description). Variations in *A. senonicus* as described by Mtchedlishvili and as found in this study are discussed below:

1. Some of the Alaskan specimens have wider equatorial and major polar protrusions but a great many are as slender as those described by Mtchedlishvili.
2. *A. senonicus* was described by Mtchedlishvili as having equatorial projections joining the body nearly at right angles. The Alaskan specimens were found to have equatorial protrusions which ranged from a nearly right angle position to a slight tilt toward the direction of the minor pole.
3. Mtchedlishvili did not mention the shape or maximum thickness of the endexinal thickenings; he merely stated that thick parts of the nexine extend for more than half the length of the (equatorial) projections. His photograph of the holotype (in Samoilovitch and others, 1961, pl. 72, fig. 2a) shows a thin area in an axilla which closely resembles the endexinal cavities in some of the Alaskan grains (pl. 1, figs. 1, 2).

Similar species.—*A. senonicus* strikingly resembles *Aquilapollenites delicatus* Stanley (1961, p. 346–347) but can easily be distinguished by its lack of spines on the major and minor polar protrusions. The shape of *A. senonicus* resembles that of *Aquilapollenites quadrilobus* Rouse (1957, p. 371) but its coarser body reticulum and lack of spines separate it from the latter species. *A. senonicus* appears to closely resemble "*Mancicorpus*" *trapeziforme* Mtchedlishvili (in Samoilovitch and others, 1961, p. 221–222); however, Mtchedlishvili stated that the former differs "in the presence of a distal node, the form of the body, and the size of the angle formed at the contact of the body with the equatorial projections" (translation by Ivan Mittin).

Aquilapollenites clarireticulatus (Samoilovitch) n. comb.

Plate 2, figures 1–8; plate 3, figures 1–7

Integricorpus clarireticulatus Samoilovitch, 1965, p. 123–124. Holotype: figs. 2a–b (p. 123) and pl. I, figs. 2a–d (p. 403); Paleophytological Laboratory of the Scientific Research Institute of Petroleum and Geological Exploration (VNIGRI), preparation 10535a; Linde River, Yakutia, U.S.S.R.; top of Chirimyian suite, Maestrichtian-Danian.

The following is a translation by Ivan Mittin of the description of *Integricorpus clarireticulatus* Samoilovitch, 1965, p. 123–124:

"*Diagnosis.* Pollen grains from rather large to large, isopolar or subisopolar, with three equatorial furrows and three meridianal furrows. Body ellipsoidal, large, with three equatorial protrusions. Protrusions inclined with respect to body, narrow, not long. Exine rather thin, clublike, reticulate, not sheathed.

"*Description.* Diameter of pollen grains in polar position 49.7μ. In equatorial position: polar axis 56.8μ, equatorial axis (with protrusions) 54.7μ, width of ends of body 25.3μ, length of equatorial protrusions 13.5μ to 18.7μ, width 5.5μ to 10.0μ.

"Pollen grains isopolar or subisopolar, with three meridianal and three equatorial furrows. Body large, ellipsoidal, one of its ends is slightly pointed, the other rounded. In polar position pollen triangular in outline with straight or slightly convex sides. Equatorial protrusions are situated at an angle to the body and form with the polar axis an angle about 30°, they are narrow, not long, rounded in cross section, gradually narrowing toward ends, which may be found destroyed. Six furrows: three of them pass through the protrusions meridianally, the other three follow the equator between the protrusions; all furrows narrow, slitlike, with slightly rough margins. Exine is rather thin on the ends of the body (slightly larger than 1.0μ), it thickens to 2.7μ to 3.5μ (nexine thickenings) in the areas between the ends of the body and protrusions. Layers poorly distinguishable. Traced are: endonexine, very thin; ektonexine, becoming thicker in transition to protrusions and wedging out toward their ends and on the poles, and sexine of clublike structure, with heads of irregular form; width of the layer of heads does not exceed the width of the layer of columns. Sculpture highly clear, meshlike; walls of cells thin; cells very large on mesocolpium, sharply decrease in size and become elongate near equatorial furrows. Pollen dark yellow in color.

"*Material.* Four specimens well and medium preserved from three localities.

"*Variability.* Has not been traced because of insufficient amount of material.

"*Comparison and Remarks.* Pollen of the species under description resembles very little the pollen grains of other species of subterm Triprojectacites It differs from pollen grains of *Integricorpus bellum* N. Mtch., with which it is most comparable, in more angular form of body that narrows toward the ends, in thinner exine and in less coarse mesh appearance, as well as in the presence of a noticeable network in the equatorial zone which in *I. bellum* is almost lacking the sculpture. It differs from *Parviprojectus reticulatus* N. Mtch. in larger size, in the reclining position of the protrusions, in the presence of equatorial furrows and considerable coarser and larger meshlike appearance of the exine.

"N. D. Mtchedlishvili (1961), who recognized the form genus *Integricorpus*, and to which we refer the species in the description, did not indicate the presence of equatorial furrows in pollen grains.

"We came to the conclusion that they exist in the pollen of *Integricorpus* on the basis of our late findings of individual grain halves which were torn along the equator, which can happen only in the presence of highly thin exine (membrane of the furrows) along it.

"The presence of equatorial furrows in pollen of some other representatives of the subterm Triprojectacites, such as in *Aquilapollenites novacolpites* Funk., is also noted by John Funkhouser (Funkhouser, 1961).

"*Localities.* Yakutia, River Linde, exposure 1025, specimen 6, lignite; exposure 1028 specimen 2, clay; exposure 1039, specimen 4, clay. Collector V. V. Zabaluev. Maestrichtian-Danian (upper part Chirimyian suite).

"*Distribution.* Maestrichtian-Danian of Yukutia."

Records of occurrence.—

Rock unit	Stage or series	USGS paleobotany locality No. or literature reference	Locality: State and(or) country
Chirimyian Suite	Maestrichtian-Danian	Samoilovitch (1965)	Yakutia, U.S.S.R.
Eagle Sandstone, upper part.	Lower Campanian	D3718–I	Montana, U.S.A.[1]
(?)	Upper Cretaceous	D1799	Alaska, U.S.A.

[1] For specific locality see table 1.

Description.—Based on 40 specimens from USGS paleobotany localities D1799 and D3718–I. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions; polar axis 28μ to 44μ, equatorial diameter (including equatorial protrusions) 29μ to 42μ. In equatorial view: body of grain oval, with broadly rounded poles, distended at equator where merging with V-shaped to U-shaped equatorial protrusions; polar protrusions much larger than equatorial protrusions; many specimens having equatorial protrusions bent or broken. In polar view: grains triangular, with irregularly concave-convex sides. Apertures: colpi reaching full length of equatorial protrusions, extend-

ing onto body for approximately three-fourths the distance to poles; three furrows present on equator between equatorial protrusions. Pollen wall: exine two layered; endexine (exclusive of costae) thin; axillary endexinal costae present or lacking (probably dependent on chemical processing of sediment); costae when present bow shaped, as much as 2μ thick in thickest part, extending approximately half the length of the equatorial protrusions, reaching onto body for approximately three-fourths the distance to poles; ektexine on body 0.5μ to 1μ thick, with maximum thickness between polar areas and equator; ektexinal elements columnar, fused at tips forming round-topped muri; surface sculpture of body reticulate to striate; lumina of reticulum as much as 1.5μ in diameter in areas between poles and equator, usually slightly smaller on polar areas than between poles and equator; muri close together in equatorial zone, parallel to each other and arranged perpendicular to equatorial furrows—resulting in an equatorial belt (about 15μ wide) of differentiated sculpture; striations persisting beyond ends of equatorial furrows, fanning out onto equatorial protrusions (SEM photograph, pl. 2, fig. 8; pl. 3, fig. 7), striations discontinuous on protrusions at their approximate midlength; on outer ends of equatorial protrusions exine thin, wall layers usually not discernible, sculpture smooth or granular. As seen in SEM photographs, the reticulate-striate appearance on the polar protrusions results from the joining of the elongate, more or less parallel muri of high relief with the horizontal muri of lower relief (SEM photograph, pl. 2, fig. 8; pl. 3, fig. 1); at high magnification (approximately × 10,800) the elongate muri appear cordlike, many branch, and some interweave (SEM photograph, pl. 3, fig. 1).

Remarks.—The specimens just described appear, except for their smaller size, very similar to "*Integricorpus*" *clarireticulatus* as it was described and illustrated by Samoilovitch. Difference in size could be the result of differences in chemical processing in the two laboratories. The Samoilovitch description was based on only four specimens; a larger population of the Russian material conceivably might have yielded a wider size range.

Because "*Integricorpus*" *clarireticulatus* conforms to the genus *Aquilapollenites* (Rouse) Funkhouser, it has been transferred to *Aquilapollenites*.

Similar species.—*A. clarireticulatus* n. comb. resembles *A. reticulatus* (Mtchedlishvili) Tschudy and Leopold (1969) but can easily be distinguished by its equatorial furrows and by the distinct bands of striate sculpture adjacent to the furrows at the equator.

A. clarireticulatus resembles *A. novacolpites* Funkhouser (1961, p. 196) except that the equatorial protrusions of *A. clarireticulatus* are not constricted between their tips and the body of the grain as they are on *A. novacolpites* (as seen on its type specimens and on several additional specimens found on the type slide). The equatorial zone of striate sculpture which characterizes *A. clarireticulatus* is not present in the type specimens or in other specimens found on the type slide of *A. novacolpites*.

Aquilapollenites trialatus Rouse, 1957

Plate 4, figures 1–5

Aquilapollenites trialatus Rouse, 1957, p. 371, pl. 2, figs. 14, 15. Type specimen: Rouse, 1957, pl. 2, fig. 14; McMaster University Palaeobotanical Collection; Slide Leth No. 8, 1:5(ii); Lethbridge City Collieries, south-central Alberta, Canada; Oldman Formation, Upper Cretaceous.

Aquilapollenites trialatus Rouse, 1957 (in Tschudy and Leopold, 1969).

Records of occurrence.—

Rock unit	Stage or series	USGS paleobotany locality No. or literature reference	Locality: State and(or) country
Oldman Formation	Upper Cretaceous	Rouse (1957)	Alberta, Canada.
Colville Group	Upper Cretaceous	D3124-H	Alaska, U.S.A.
Claggett Shale, upper part.	Middle Campanian	D3724-E	Montana, U.S.A.[1]

[1] For specific locality see table 1.

Remarks.—Specimens of *A. trialatus* found in the Alaskan sample USGS paleobotany locality D3124–H closely resemble specimens found on a slide (Leth No. 8, 1:5 (i) Ger) of type material loaned by Glenn E. Rouse to this laboratory.

In samples from the Rocky Mountain area the author has found only a few specimens of *A. trialatus;* however, two new varieties of *A. trialatus* from Campanian sedimentary rocks of the Rocky Mountains are described by Tschudy and Leopold (1969).

Grains from the Upper Cretaceous (Lindian suite) from Yakutia, central Siberia, U.S.S.R., were identified as *A. trialatus* Rouse by Bolkhovitina (1959, p. 127) and grains from the Senonian (lower Symiar subsuite) from a locality near the Sym River in the Western Siberian lowlands, which appear very similar or equal to *A. trialatus*, were described by Mtchedlishvilli (in Samoilovitch and others, 1961, p. 217–218) as *Integricorpus bellum.*

Aquilapollenites parallelus n. sp.

Plate 5, figures 1–11; plate 6, figures 1–2; and plate 7, figures 1–2

Holotype.—USGS paleobotany locality D1799, slide (5) at 100.7×12.8; plate 5, figure 1; lat 65°19.6′ N., long

141°29.6′ W.; SE¼ sec. 23, T. 6 N., R. 30 E. (Charley River B–1 quadrangle); east bank of Nation River, Alaska; Upper Cretaceous.

Paratype.—USGS paleobotany locality D1799, slide (7) at 77.7×14.9; plate 5, figures 8, 11; same locality data as for holotype.

Paratype.—USGS paleobotany locality D1799, slide (5) at 79.9×19.8; plate 5, figures 4, 6; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D1799.

Description.—Based on 23 measured specimens and on many more examined in less detail. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions. In equatorial view: polar axis 33μ to 59μ (commonly 45μ to 55μ), equatorial diameter (including equatorial protrusions) 28μ to 55μ (commonly 42μ to 50μ), diameter of body 14μ to 24μ, length of equatorial protrusions 13μ to 21μ, width of equatorial protrusions 6.5μ to 10.5μ; body having nearly parallel sides and flattened or broadly rounded ends; equatorial protrusions having parallel sides and rounded ends; width of equatorial protrusions usually about half the diameter of body. In polar view: grains triangular, with concave or irregular sides; poles of body triangular, with slightly convex sides (pl. 6, fig. 6). Apertures: colpi extending full length of equatorial protrusions, in some specimens gaping at ends of protrusions, apparently not extending onto body or, if so, for a very short distance; colpi usually visible only in oblique and polar views of grains. Pollen wall: exine two layered; endexine (except for endexinal costae) less than 0.5μ thick; axillary endexinal costae as much as 2μ thick in thickest part, extending approximately two-thirds the distance to ends of equatorial protrusions, extending only slightly onto body of grain; ektexine 0.5μ to 2.0μ thick, forming ektexinal ridges (lirae)—ridges give the grains an overall striate appearance; in SEM photographs (pls. 6, 7) surface of grains appear fluted (or plaited); lirae nearly smooth at × 1,000 magnification, at SEM high magnification (× 10,800) ridges have scattered wartlike projections (pl. 6, fig. 2); lirae oriented nearly perpendicular to colpal margins on equatorial protrusions; at ends of protrusions lirae endings form toothed colpal margins (SEM photographs, pl. 7, figs. 1–2); lirae on the body (in equatorial view) parallel to polar axis in the equatorial zone, irregularly arranged or in fingerprint pattern near poles, and parallel to circumference of body between poles and equator; in polar view of grains, triangular pole having lirae approximately perpendicular to sides of triangle and encircling corners (pl. 5, fig. 6).

Remarks.—The grains described above have been given the species name *parallelus* because of the nearly parallel sides of both the polar and the equatorial protrusions as seen in equatorial view of the grains.

Similar species.—*A. parallelus* most closely resembles *Aquilapollenites conatus* Norton (1965, p. 142) but can be distinguished by its proportionally narrower equatorial protrusions and coarser lirae on the equatorial protrusions. The ektexinal ridges of *A. parallelus* do not appear to be connected by horizontal muri, whereas the ridges of *A. conatus* are at least in part connected by narrow horizontal muri (ladderlike); sometimes these muri give the surface of the grains a reticulate to striate appearance.

The parallel-sided body of *A. parallelus* distinguishes it from *Aquilapollenites bertillonites* Funkhouser (1961, p. 196) and *Aquilapollenites wilfordi* Muller (1968, p. 16–17).

Aquilapollenites fusiformis n. sp.

Plate 8, figures 1–12

Holotype.—USGS paleobotany locality D3124–G, slide (6) at 111.9×18.1; plate 8, figures 1, 2; lat 69°40′ N., long 151°25′ W.; T. 4 N., R. 2 E. (Umiat quadrangle); along Colville River, Alaska; Colville Group, Upper Cretaceous.

Paratype.—USGS paleobotany locality D3124–G, slide (6) at 109.1×10.2; plate 8, figure 3; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D3124–B, –G.

Description.—Based on 22 specimens in equatorial view, 13 specimens in polar view, and three in oblique views. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions. In equatorial view: body rhomboidal to spindle shaped, poles narrowly rounded to rather pointed; polar axis 35μ to 55μ; equatorial diameter (including equatorial protrusions) 29μ to 52μ; equatorial protrusions V-shaped, 12μ to 16μ long (measured from free end of protrusion inward to onset of body sculpture). In polar view: shape of grains triangular, with plane to irregularly concave-convex sides and pointed or rounded corners. Apertures: colpi slitlike or often gaping, extending full length of equatorial protrusions and onto body nearly to poles. Pollen wall: exine two layered; endexine on body (exclusive of costae) less than 0.5μ thick; axillary endexinal costae long, bow shaped, as much as 3μ thick in thickest part, tapering to very thin ends, extending nearly to poles and reaching nearly to ends of equatorial protrusions (costae often lacking, probably having been dissolved during chemical processing of grains); ektexine of body less than 1μ or sometimes as much as 3μ thick; ektexinal elements elongate, very thin or as much as about 0.25μ wide, irregularly distributed or more or less parallel,

sometimes connected by horizontal muri; sculpture varying from rugulate to striate-reticulate, or in fingerprint pattern; ektexine sometimes thickened to as much as 3μ at poles and elements more compact than on remainder of body; ektexine of equatorial protrusions less than 0.5μ thick, elements compact, sculpture finely granulate to faintly striate.

Remarks.—Except for variation in coarseness of ektexinal sculpture the described specimens are quite uniform in appearance. The spindlelike shape in equatorial view suggested the name *fusiformis* for this species.

Similar species.—*A. fusiformis*, in common with *Aquilapollenites trialatus* Rouse (1957, p. 371), *Aquilapollenites reticulatus* (Mtchedlishvili) Tschudy and Leopold (1969), and *Aquilapollenites bertillonites* Funkhouser (1961, p. 196) has finely ornamented V-shaped equatorial protrusions. The spindlelike shape and rugulate to striate-reticulate body sculpture of *A. fusiformis* distinguish it from the reticulate species *A. trialatus* and *A. reticulatus;* its surface sculpture easily distinguishes it from the distinctly striate species *A. bertillonites.*

Aquilapollenites dentatus n. sp.

Plate 9, figures 1–12; plate 10

Holotype.—USGS paleobotany locality D1799, slide (7) at 90.9×8.9; plate 9, figures 1, 4, 7; lat 65°19.6′ N., long 141°29.6′ W.; SE¼ sec. 23, T. 6 N., R. 30 E. (Charley River B–1 quadrangle); east bank of Nation River, Alaska; Upper Cretaceous.

Paratype.—USGS paleobotany locality D1799, slide (7) at 79.9×7.2; plate 9, figures 2, 5; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D1799.

Description.—Based on over 30 measured specimens and on many more grains examined in less detail. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions. In equatorial view: polar axis 29.5μ to 55μ (commonly 45μ to 52μ), equatorial diameter (including equatorial protrusions) 35μ to 58μ (commonly 45μ to 58μ), diameter of body 10.5μ to 21μ, diameter or equatorial protrusions 7.5μ to 14μ, length of equatorial protrusions 11μ to 21μ; shape of body oval; diameter of polar protrusions usually slightly greater than diameter of equatorial protrusions; lengths of polar and equatorial protrusions usually approximately equal; polar and equatorial protrusions broadly rounded at ends. In polar view: shape of grains triangular, with slightly concave sides and rounded corners; equatorial protrusions slightly flattened in plane parallel to polar axis of grain. Apertures: colpi reaching total length of equatorial protrusions, extending a short distance onto body, sometimes gaping at ends of equatorial protrusions. Pollen wall: exine two layered, endexine (except for endexinal costae) usually less than 0.5μ thick; axillary endexinal costae bow shaped to lens shaped or irregular (some costae having a bulge or apparent thickening directly at the angle of the axillae), costae as much as 4.5μ thick in thickest part, extending one-half to two-thirds the length of equatorial protrusions and onto the body for one-third to one-half the distance to poles; ektexine approximately 1μ thick; ektexinal elements columnar, their diameter approximately equal to the distance between them, covered by a perforate tectum—resulting in a foveolate surface sculpture; a row of conical spines, 2.5μ to 4μ long, present along colpal margins at tips of equatorial protrusions and pointing toward polar axis (retroflexed); in SEM photograph (at × 4,200 magnification) the spines at colpal margins appear thornlike and somewhat flattened (pl. 10); smaller conical spines 1μ to 2μ long ornamenting surface of grain—these mainly restricted to polar domes and an equatorial band where they extend onto equatorial protrusions for one-half to two-thirds the length of the protrusions; tips of equatorial protrusions devoid of spines except for the row of large spines at colpal margins; spines on polar protrusions standing perpendicular to surface or having a slight tendency to point poleward; along equatorial band the spines tend to point away from tips of equatorial protrusions.

Remarks.—The new species was given the name *dentatus* (toothed, pointed) because of the conspicuous row of large, sharp-pointed spines present along the colpal margins at the tips of the equatorial protrusions.

Similar species.—*A. dentatus* n. sp. resembles *Aquilapollenites attenuatus* Funkhouser (1961, p. 194, 196) but can easily be distinguished because it has a single row of enlarged spines confined to the colpal margins at the ends of the equatorial protrusions, whereas *A. attenuatus* has spines scattered over the ends of the equatorial protrusions and also continuing along the colpal margins as far as, or nearly to the body; the spines at the tips of the equatorial protrusions in *A. dentatus* are conspicuously larger than the body spines whereas the spines on the equatorial protrusions of *A. attenuatus* are not noticeably larger than the body spines. *A. dentatus* tends to be smaller than *A. attenuatus* but size ranges do overlap. *A. dentatus* usually has thicker axillary endexinal thickenings than *A. attenuatus.*

Aquilapollenites colvillensis n. sp.

Plate 11, figures 1–18

Holotype.—USGS paleobotany locality D3124–G, slide (5) at 109.5×21.8; plate 11, figures 1, 2, 3; lat 69°40′ N., long 151°25′ W.; T. 4 N., R. 2 E. (Umiat

quadrangle); along Colville River, Alaska; Colville Group, Upper Cretaceous.

Paratype.—USGS paleobotany locality D3124–G, slide (16) at 83.9×10.4; plate 11, figures 4, 8; same locality data as for holotype.

Paratype.—USGS paleobotany locality D3124–G, slide (6) at 110.1×7.6; plate 11, figures 5, 6; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D1324–B, –G, –H.

Description.—Based on the examination of more than 60 specimens in equatorial, polar, and oblique views. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protusions. In equatorial view: body of grain having nearly parallel sides and broadly rounded poles; polar axis approximately two times the body diameter; equatorial protrusions having nearly parallel sides and broadly rounded ends, extending at right angles from body, usually shorter and narrower than polar protrusions; polar axis 27μ to 45μ, diameter of body 12.5μ to 20μ, equatorial diameter (including equatorial protrusions) 28μ to 40μ, length of equatorial protusions 8μ to 12μ, width of equatorial protusions 10μ to 14μ. In polar view: grains triangular; sides slightly concave, slightly convex, or irregular; colpi at corners, in some specimens gaping. Apertures: colpi reaching full length of equatorial protrusions and onto body of grain for approximately one-third the distance to poles. Pollen wall: exine two layered; endexine (exclusive of costae) thin; axillary endexinal costae lens shaped to sausage shaped (pl. 11, fig. 11), as much as 4μ thick in thickest part, occupying approximately half the length of equatorial protrusions and extending onto body for about one-fourth the distance to poles; costae, as viewed from their ends, rounded poleward and flattened equatorially (pl. 11, figs. 16, 17); costae usually lacking in grains which have had long Schulze treatment during removal from rock matrix;[1] ektexine (except at colpal margins) about 0.5μ thick; ektexinal elements columnar, compact, joined at tips—resulting in a finely foveolate-reticulate to nearly smooth appearance to surface of grain; ektexine at colpal margins very thin; broad-based projections, about 0.5μ long, spaced at 1.5μ to 2μ intervals, ornamenting body of grain; sharp pointed conical spinae (1μ to 1.5μ long), spaced at 1.5μ to 2μ intervals, ornamenting equatorial protrusions, tending to point backward (retroflexed) from ends of protrusions and toward body of grain.

Similar species.—*A. colvillensis* resembles *A. laticorpus* n. sp. (p. A12) and *A. rectus* n. sp. (p. A10) but is easily distinguishable from the latter two species. *A. colvillensis* has coarser surface ornamentation than *A. laticorpus* and it has a nearly parallel-sided body whereas *A. laticorpus* has a broadly oval body. The equatorial protrusions of *A. colvillensis* are nearly always considerably smaller than the polar protrusions whereas the equatorial protrusions of *A. laticorpus* and *A. rectus* are usually approximately the same size as the polar protrusions. *A. colvillensis* tends to have a polar axis greater than its equatorial diameter whereas *A. rectus* tends to have a polar axis shorter than its equatorial diameter.

The shape of *A. colvillensis* is similar to that of *Aquilapollenites spinulosus* Funkhouser (1961, p. 194), but the former has coarser surface ornamentation. *A. spinulosus* has fine, slender spines over its entire surface, whereas *A. colvillensis* has short, broad-based projections on its body and longer, conical spines on its equatorial protrusions.

The nearly parallel-sided body of *A. colvillensis* resembles that of "*Projectoporites*" *ovalis* Mtchedlishvili (in Samoilovitch and others, 1961, p. 228–229); however, the two species differ in that *A. colvillensis* is much smaller than "*P.*" *ovalis* (polar axis 47.5μ to 50.8μ, diameter of body 23.7μ to 31.2μ) and the body ornamentation of *A. colvillensis* consists of short, broad-based projections whereas that of "*P.*" *ovalis* consists of slender, longer, sharp-pointed spines. "*P.*" *ovalis* was described as having pores rather than colpi; however, inasmuch as only four specimens were examined this feature may not have been certain.

Aquilapollenites rectus n. sp.

Plate 12, figures 1–13; plate 13, figures 4, 9

Holotype.—USGS paleobotany locality D1799, slide (4) at 113.3 × 18.1; plate 12, figure 1; lat 65° 19.6′ N., long 141° 29.6′ W.; SE¼ sec. 23, T. 6 N., R. 30 E. (Charley River B–1 quadrangle); east bank of Nation River, Alaska; Upper Cretaceous.

Paratype.—USGS paleobotany locality D1799, slide (4) at 98.4×11.7; plate 12, figure 2; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D1799.

Description.—Based on 23 specimens in equatorial and oblique views and six in polar view. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions; polar axis 30μ to 37μ; equatorial diameter (including equatorial protrusions) 33μ to 45μ. In equatorial view: body of grain broadly oval; polar axis slightly shorter than or about equal to equatorial diameter; polar protrusions equal to or slightly larger or smaller than equatorial protrusions; polar and equatorial protrusions broadly rounded at their ends; areas

[1] Preliminary experiments carried out in this laboratory on this species indicate that endexinal costae are removed by long Schulze treatment.

of attachment of equatorial protrusions to body (the axillae) concave. In polar view: grains triangular, with rounded corners and plane or irregularly concave-convex sides. Apertures: colpi extending full length of equatorial protrusions, apparently not extending onto body, or, if they do, for only a very short distance. Pollen wall: exine two layered; endexine thin (except for endexinal costae), very thin at colpal margins at ends of equatorial protrusions; axillary endexinal costae lens shaped (in equatorial view of grain), 1.5μ to 2.5μ thick in thickest part, extending one-third to one-half the length of the equatorial protrusions, extending a short distance onto base of polar protrusions; ektexine very thin at colpal margins at ends of equatorial protrusions, 0.5μ to 1.0μ thick on remainder of grain, having maximum thickness on approximate basal half of polar protrusions; ektexinal elements columnar, joined at tips—giving a finely reticulate appearance to surface of grain; reticulum slightly coarser on basal part of polar protrusions than on remainder of grain; conical spines and baculae 1.0μ to 1.5μ long, distributed over entire surface of grain, on equatorial protrusions tending to point toward polar axis of grain.

Remarks.—The species was given the name *rectus* (straight) because of its rather stiff or rigid appearance.

Similar species.—*A. rectus* n. sp. resembles *A. laticorpus* n. sp. (this report, p. A12) but differs from it in having larger surface projections (spines and baculae); *A. rectus* also has a more concave curvature in the axillae than *A. laticorpus*. The equatorial protrusions of *A. rectus* are more distinctly prominent than they are in *A. laticorpus*. When the grains here described as *A. rectus* were found in sample D1799 they were believed to be the species *A. laticorpus* n. sp. which was earlier found in sample D3124; however, further study of many specimens from the two samples showed the two species to be distinct.

A. rectus, n. sp. resembles *A. colvillensis* n. sp. (this report, p. A9), but it has equatorial protrusions which are larger in proportion to the polar protrusions. *A. rectus* has surface projections of nearly uniform size distributed over the entire grain, whereas *A. colvillensis* has distinctly larger surface projections on the equatorial protrusions than on the polar protrusions.

In size of grain and type of surface ornamentation, *A. rectus* n. sp. resembles *Aquilapollenites spinulosus* Funkhouser (1961, p. 194) but differs because it has proportionally shorter polar protrusions and proportionally wider equatorial protrusions (in equatorial view of grain). *A. spinulosus* usually has a longer polar axis than equatorial diameter and the reverse relationship is usually true for specimens of *A. rectus*.

Aquilapollenites scabridus n. sp.

Plate 13, figures 1–11; plate 14, figures 1–2

Holotype.—USGS paleobotany locality D1799, slide (5) at 86.2×11.8; plate 13, figures 1, 2; lat 65°19.6′ N., long 141°29.6′ W.; SE¼ sec. 23, T. 6 N., R. 30 E. (Charley River B–1 quadrangle); east bank of Nation River, Alaska; Upper Cretaceous.

Paratype.—USGS paleobotany locality D1799, slide (7) at 90.3×12.0; plate 13, figure 3; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D1799.

Description.—Based on 18 specimens in equatorial and oblique views and two specimens in polar view. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions. In equatorial view: polar axis 32μ to 43μ, equatorial diameter (including equatorial protrusions) 32μ to 45μ; polar axis usually approximately equal to equatorial diameter, polar protrusions smaller than, or in some specimens about equal in size to, equatorial protrusions; poles broadly rounded, or in many specimens flattened; equatorial protrusions with broadly rounded ends; attachment areas (axillae) of equatorial protrusions to body concave. In polar view: shape triangular, with plane or irregular concave-convex sides. Apertures: colpi extending the length of the equatorial protrusions, at least in some specimens extending onto body for approximately one-fourth the distance to poles. Pollen wall: exine two layered; endexine less than 0.5μ thick (except for endexinal costae); axillary endexinal costae (in specimens where present) bow shaped to sausage shaped (as seen in equatorial view of grain), as much as 3μ thick in thickest part, occupying one-third to one-half the length of the equatorial protrusions, extending a short distance onto body of grain; costae lacking in some specimens, represented only by thin areas from which they were probably removed during chemical processing of sample; ektexine 1μ to 1.5μ thick, with maximum thickness on basal part of polar protrusions, ektexine very thin at colpal margins at ends of equatorial protrusions; ektexinal elements columnar, tectate; columellae usually visible at × 1,000 magnification on polar protrusions of well-preserved grains; polar domes almost smooth, remainder of surface of grain densely scabrate; on SEM photograph (pl. 14, fig. 2) at × 10,400 magnification, the sculpturing elements on the equatorial zone and on an equatorial protrusion appear approximately twice as high as wide and their peaks are rounded to bluntly conical; at × 4,200 magnification the sculpturing elements can be seen to be more compactly arranged on the polar domes than on the remainder of the grain. (See pl. 14, fig. 1.)

Remarks.—The species was given the name *scabridus* because of its rough surface sculpture.

Similar species.—In shape and size *A. scabridus* is very similar to *A. rectus* n. sp. (this report, p. A10), but it lacks the spinose ornamentation which characterizes the latter species.

The polar domes of *A. scabridus*, in common with those of *A. procerus* Samoilovitch (1965, p. 126–128), are smooth or nearly so; however, the sculpture of the polar domes of *A. scabridus* is not as sharply distinct from that of the remainder of the grain as it is in *A. procerus*. *A. scabridus* has proportionally shorter polar protrusions and broader equatorial protrusions (in equatorial view of grains) than has *A. procerus*.

In shape of grain and nearly smooth polar domes, *A. scabridus* resembles *A. turbidus* Tschudy and Leopold (1969); but it differs because it does not have the spinose ornamentation in the equatorial zone of the body and on the equatorial protrusions.

Aquilapollenites contiguus n. sp.

Plate 15, figures 1–15

Holotype.—USGS plaeobotany locality D3124–G, slide (5) at 88.7×5.7; plate 15, figures 1, 2; lat 69°40′ N., long 151°25′ W.; T. 4 N., R. 2 E. (Umiat quadrangle); along Colville River, Alaska; Colville Group, Upper Cretaceous.

Paratype.—USGS paleobotany locality D3124–G, slide (6) at 100.9×3.5; plate 15, figure 3; same locality data as for holotype.

Paratype.—USGS paleobotany locality D3124–G, slide (5) at 102.7×10.4; plate 15, figure 4; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D3124–B, –G.

Description.—Based on 20 specimens in equatorial and oblique views and seven in polar view. Tricolpate, isopolar to subisopolar pollen grains. In equatorial view: polar protrusions shorter than equatorial protrusions and more broadly rounded at ends, area of attachment of equatorial protrusions to body slightly concave, polar axis usually less than equatorial diameter; polar axis 22.5μ to 28μ, equatorial diameter 30.5μ to 44μ. In polar view: shape triangular, with plane, slightly convex, slightly concave, or irregular sides; most specimens with earlike corners—these bearing slitlike or gaping colpi. Apertures: colpi short, dissecting ends of equatorial protrusions, not extending onto body of grain, usually not visible in equatorial view of grains. Pollen wall: exine two layered, 1μ to 1.5μ thick, thinner at colpal margins; endexine (except for endexinal costae) thin; axillary endexinal costae in specimens where present as much as 2.5μ wide at thickest part, usually approximately three times longer than wide (in equatorial view of grain), teardrop to lens shaped; costae sometimes lacking, represented only by costal cavities or thin areas from which costae were probably removed during chemical processing of sample; ektexine two to three times thicker than endexine, columnar, apparently tectate; columellae extremely fine, often difficult to distinguish even at × 1,000 magnification; surface sculpture granulate to scabrate.

Remarks.—The species was given the name *contiguus* (touching, bordering) because it just barely conforms to the circumscription of the genus *Aquilapollenites*—*A. contiguus* having only a slight concavity (in equatorial view of grain) in the axillae where the equatorial protrusions join the body of the grain, in contrast to most species of *Aquilapollenites* which have more deeply concave axillary areas.

Similar species.—*A. contiguus* resembles *Fibulapollis scabratus* n. sp. (this report p. A13) but is distinguishable because of the presence of the slight concavity in the axillae where the equatorial protrusions join the body of the grain. The endexinal thickenings of *A. contiguus* are usually more elongate than those of *F. scabratus*. The latter species usually has an equatorial diameter approximately equal to the polar axis whereas *A. contiguus* nearly always has an equatorial diameter considerably greater than its poplar axis.

Aquilapollenites laticorpus n. sp.

Plate 16, figures 1–8

Holotype.—USGS paleobotany locality D3124–G, slide (15) at 90.1×8.0; plate 16, figure 1; lat 69°40′ N., long 151°25′ W.; T. 4 N., R. 2 E. (Umiat quadrangle); along Colville River, Alaska; Colville Group, Upper Cretaceous.

Paratype.—USGS paleobotany locality D3124–G, slide (18) at 116.8×6.9; plate 16, figures 2, 3; same locality data as for holotype.

Occurrence.—USGS paleobotany locality D3124–B, –G.

Description.—Based on 20 specimens in equatorial and oblique views and two in polar view. Tricolpate, isopolar to subisopolar pollen grains with three equatorial protrusions. In equatorial view: polar axis 28μ to 43μ, equatorial diameter (including equatorial protrusions) 28μ to 43μ; polar axis usually approximately equal to equatorial diameter; polar protrusions equal to, or slightly larger or smaller than equatorial protrusions; polar and equatorial protrusions broadly rounded at ends; areas of attachment of equatorial protrusions to body (the axillae) broadly concave. In polar view: grains triangular, with slightly convex, slightly concave, or irregular sides. Apertures: colpi extending full length of equatorial protrusions, reaching a short dis-

tance onto body. Pollen wall: exine two layered; endexine thin (except for endexinal costae); axillary endexinal costae in specimens where present lens shaped to sausage shaped (as seen in equatorial view of grains), occupying approximately half the length of the equatorial protrusions and extending a short distance onto body of grain; costae lacking in some specimens, represented only by thin areas from which costae were probably dissolved during chemical processing of sample; ektexine 0.5μ to 1μ thick, with maximum thickness on basal part of polar protrusions, thin at colpal margins on ends of equatorial protrusions; ektexinal elements columnar, joined at tips—resulting in a finely reticulate appearance to surface of grain; reticulum usually slightly coarser in a band around approximate basal half of polar protrusions; small baculae (or spinae) less than 1μ long, sparsely distributed over surface of grain.

Remarks.—The species was given the name *laticorpus* (*latus*, broad; *corpus*, body) because of its equatorially broadened body.

Five specimens resembling *A. laticorpus* but differing in that they have distinctly larger surface projections on the equatorial protrusions were found in USGS paleobotany locality D3124–G (pl. 16, figs. 9, 10); these specimens have not been named and described here owing to insufficient diagnostic material.

Similar species.—*A. laticorpus* n. sp. has slight resemblance to *A. colvillensis* n. sp. (p. A9, this report) and to *Aquilapollentes spinulosus* Funkhouser (1961, p. 194), but it differs from both in having smaller surface projections and a more broadly oval body. In equatorial views the bodies of *A. colvillensis* and *A. spinulosus* usually have more or less parallel sides.

A. laticorpus has smaller surface projections than *A. rectus* n. sp. (p. A10, this report) and in equatorial views of grains the equatorial protrusions of *A. laticorpus* merge more gradually with the body than do those of *A. rectus*.

Form genus Fibulapollis Chlonova, 1961

Fibulapollis Chlonova, 1961, p. 87.

The following description from Chlonova (1961, p. 87) is a translation by Ivan Mittin:

"*Description.*—Outline of the pollen body is more or less rounded or rounded-triangular, more rarely four angular. There are three pores or more rarely four. Pore apertures have a square form (rarely rounded). Exine is two-layered, 1μ to 1.5μ thick, it is thicker at various degrees at the edges or margins of the aperturelike zone. Grains are smooth or carry fine dotted banded sculpture, relatively small (not large), 15μ to 48μ. The color is light yellow.

"Type species of genus *Fibulapollis mirificus* (Chlonova) comb. nov." See *Triporina mirifica* Chlonova (1957, p. 44, pl. 1, figs. 4–6).

Description (morphological interpretation of present author).—Tricolpate, isopolar to subisopolar (or heteropolar?) pollen grains with three (or rarely four[2]) equatorial expansions in apertural areas; equatorial expansions not appearing as distinct equatorial protrusions but merging gradually with body of grain. Shape of grains in equatorial view oval to rounded rhomboidal, shape in polar view triangular. Colpi slitlike, cutting equatorial expansions in plane parallel to polar axis of grain. Exine at least two-layered; prominent variously shaped endexinal thickenings present at or near ends of colpi. Endexinal thickenings lacking in some specimens; probably dissolved during chemical processing of sample. Sculpture smooth or finely ornamented.

Remarks.—In shape and size *Fibulapollis* resembles *Cranwellia* Srivastava (1966, p. 537) but is easily distinguishable becaues of its nonstriate surface sculpture.

The oval to rounded rhomboidal shape of *Fibulapollis* in equatorial view separates it from isopolar (or subisopolar) species of *Aquilapollenites* which in equatorial view have concave contact areas where the equatorial protrusions join the body.

Fibulapollis scabratus n. sp.

Plate 16, figure 11–20

Holotype.—USGS paleobotany locality D3124–A, slide (1) at 97.8×7.3; plate 16, figure 11; lat 69°40′ N., long 151°25′ W.; T. 4 N., R. 2 E. (Umiat quadrangle); along Colville River, Alaska; Colville Group, Upper Cretaceous.

Paratype.—USGS paleobotany locality D3124–A, slide (1) at 103.7×20.2; plate 16, figure 12; same locality data as for holotype.

Paratype.—USGS paleobotany locality D3124–A, slide (1) at 96.8×20.2; plate 16, figure 13; same locality data as for holotype.

Records of occurrence.—

Rock unit	Stage or series	USGS paleobotany locality No.	Locality[1] State and country
			U.S.A.
Colville Group	Upper Cretaceous	D3124–A, –B, –C, –G	Alaska.
(?)	do	D1799	Do.
Fox Hills Sandstone	Lower Maestrichtian	D1331–5	Wyoming.
Pierre Shale, upper unnamed shale member.	Upper Campanian	D1330–26	Do.
Pierre Shale, lower unnamed shale member.	do	D1330–19	Do.
Pierre Shale, Mitten Black Shale member.	Middle or lower Campanian.	D1330–4	Do.
Claggett Shale, middle part.	Lower Campanian	D3724–B	Montana.

[1] For specific Rocky Mountain localities see table 1.

[2] Chlonova (1961, p. 87). Grains having four equatorial expansions were not found by the present author.

Description.—Based on more than 40 specimens. Tricolpate, isopolar to subisopolar (or heteropolar?) pollen grains. In equatorial view: grains oval to rounded rhomboidal; polar areas broadly rounded; apertural areas distended equatorially but not forming equatorial protrusions distinct from body, protruded areas merging gradually onto body of grain—not forming angles; polar axis 23μ to 31.5μ, equatorial diameter 25.5μ to 38μ; polar axis commonly about equal to equatorial diameter, or sometimes slightly less or more than equatorial diameter. In polar view: grains triangular, with straight, slightly convex, slightly concave, or irregular sides. Apertures: colpi slitlike, present on broadly rounded ends of equatorial expansions, in plane parallel to polar axis of grain, reaching approximately one-third the distance to poles. Pollen wall: exine two layered, 0.5μ to 1μ thick, thinner at colpal margins; endexine (exclusive of costae) thin; endexinal costae lens shaped, teardrop shaped or nearly round, as much as 2μ thick in thickest part, usually not much longer than wide, located at colpal ends; endexinal costae lacking in some specimens but thin areas are present (pl. 16, figs. 15, 17) and probably indicate positions from which costae were dissolved during chemical processing of rock sample; ektexine two to three times thicker than endexine, columnar, tectate; columellae extremely small, usually perceptible at × 1,000 magnification; surface sculpture scabrate.

Remarks.—Because the specimens described above appeared to conform to the genus *Fibulapollis* and possibly were equivalent to *Fibulapollis mirificus* (Chlonova) Chlonova (1961, p. 87) or *Fibulapollis punctatus* Chlonova (1961, p. 87), some of the Alaskan material was sent to A. F. Chlonova for examination. After a study of the Alaskan specimens Dr. Chlonova (written commun., Nov. 3, 1964) replied that in size and shape they are close to *F. mirificus*, but that the exine of *F. mirificus* is thicker and is smooth or slightly granular. She also mentioned that the average size of pollen of *F. mirificus* is smaller than that of the Alaskan pollen—though she believed that this size difference might be accounted for by differences in laboratory methods. Dr. Chlonova also compared the Alaskan specimens with *F. punctatus;* she stated that *F. punctatus* is larger than the Alaskan grains but that the ornamentation of the two is quite corparable. She said that there were other distinguishing features such as form and size of the apertures and thickness of exine in the aperturelike zone. She concluded that our specimens probably came from closely related plants.

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INDEX

[Italic page numbers indicate descriptions]

PLATES 1-16

PLATE 1

FIGURES 1–14. *Aquilapollenites senonicus* (Mtchedlishvili) Tschudy and Leopold, 1969 (p. A4).

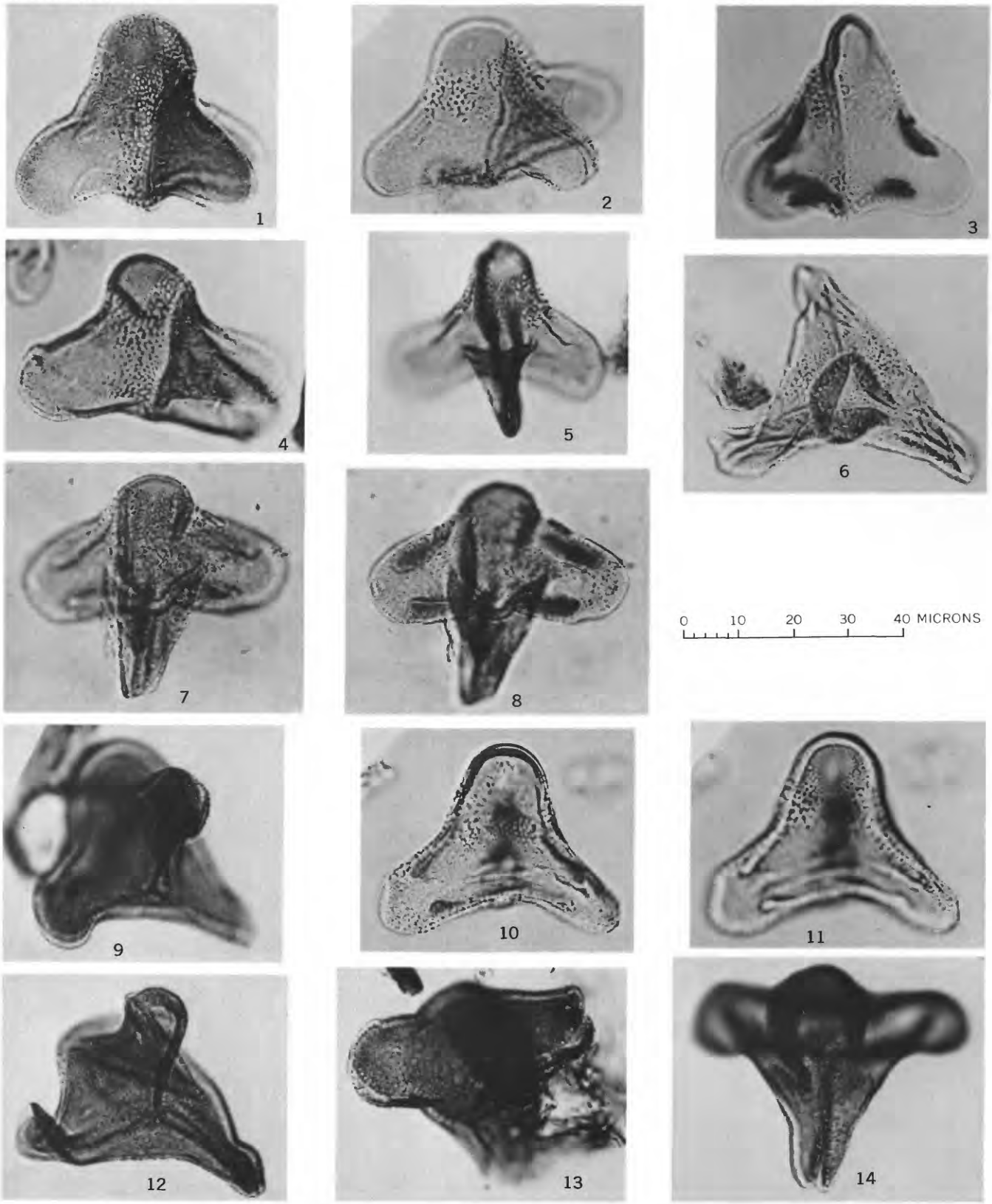
1. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 112.6×3.1.
2. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 110.7×3.0.
3. Equatorial view. USGS paleobotany loc. D3124–G, slide (25) at 107.2×22.3.
4. Equatorial view. USGS paleobotany loc. D3124–G, slide (6) at 81.2×19.7.
5. Equatorial view. USGS paleobotany loc. D1602, slide (2) at 90.9 ×16.2.
6. Polar view. USGS paleobotany loc. D3124–G, slide (15) at 98.9 ×20.8.

7, 8. Oblique equatorial view, high and low focus. USGS paleobotany loc. D3124–B, slide (2) at 91.5×10.7.

9. Oblique view. USGS paleobotany loc. D3124–G, slide (5) at 100.5×2.2.

10, 11. Oblique equatorial view, mid and high focus. USGS paleobotany loc. D3472–D, slide (1) at 76.9×15.4.

12. Oblique view. USGS paleobotany loc. D3124–G, slide (5) at 113.0×6.8.
13. Oblique view. USGS paleobotany loc. D3124–G, slide (5) at 105.5 ×7.5.
14. Oblique view. USGS paleobotany loc. D3124–G, slide (5) at 95.9 ×8.8.



AQUILAPOLLENITES SENONICUS (MTCHEDLISHVILI) TSCHUDY AND LEOPOLD

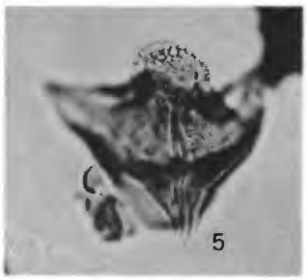
PLATE 2

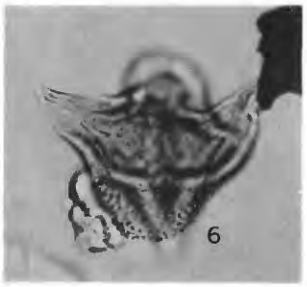
FIGURES 1–8. *Aquilapollenites clarireticulatus* (Samoilovitch) n. comb. (p. A6)

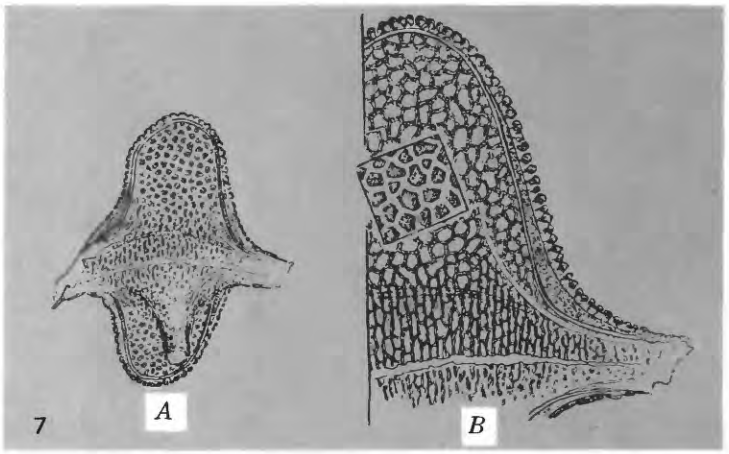
1. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 95.3×4.9.
2. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 111.6 ×21.3.
3. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 97.3 ×14.1.
4. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 92.7 ×19.4.

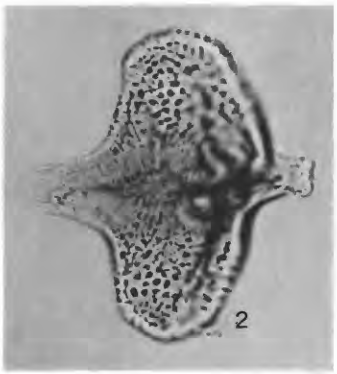
5, 6. Oblique view, low and high focus. USGS paleobotany loc. D1799, slide (4) at 95.3×12.0.

7. Copy of drawings of holotype of *Integricorpus clarireticulatus* (from Samoilovitch, 1965, p. 123). *A*, × 600 (approximate), *B*, × 1,350 (approximate).
8. Scanning electron microscope photograph. Equatorial view; grain partially covered by debris. X indicates position X on specimen at higher magnification illustrated on pl. 3, fig. 1. USGS paleobotany loc. D1799. Photograph by Charles M. Drew.









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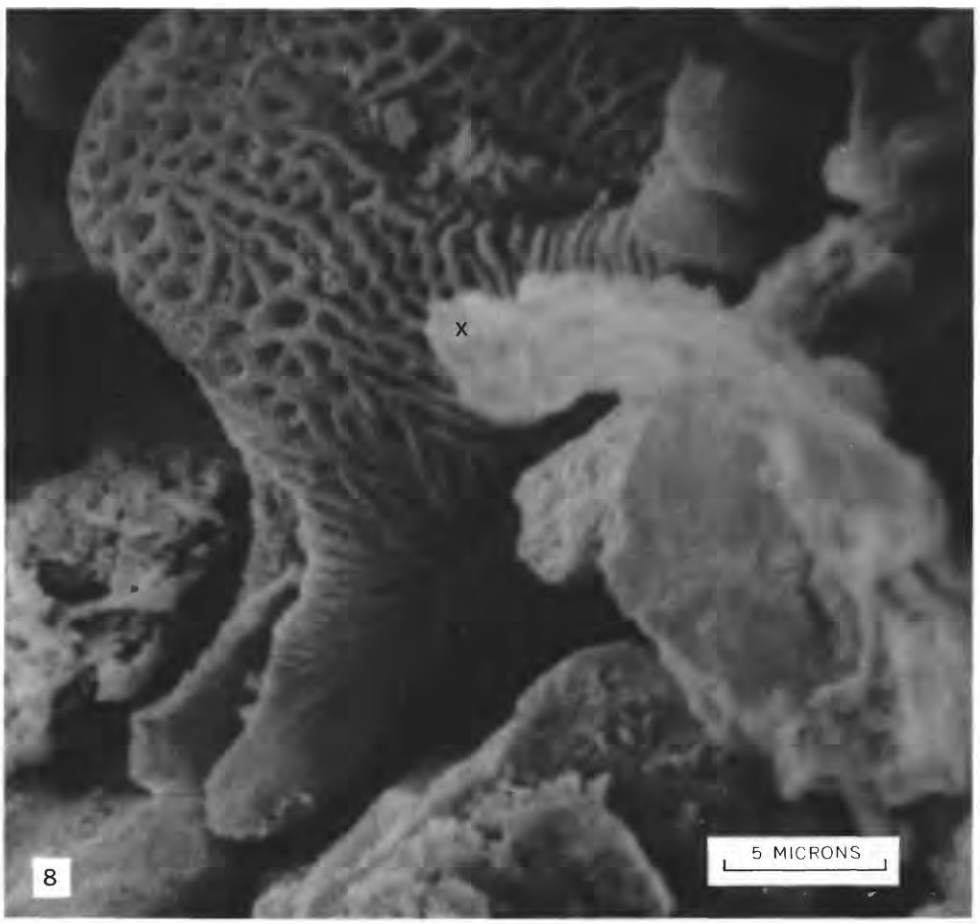
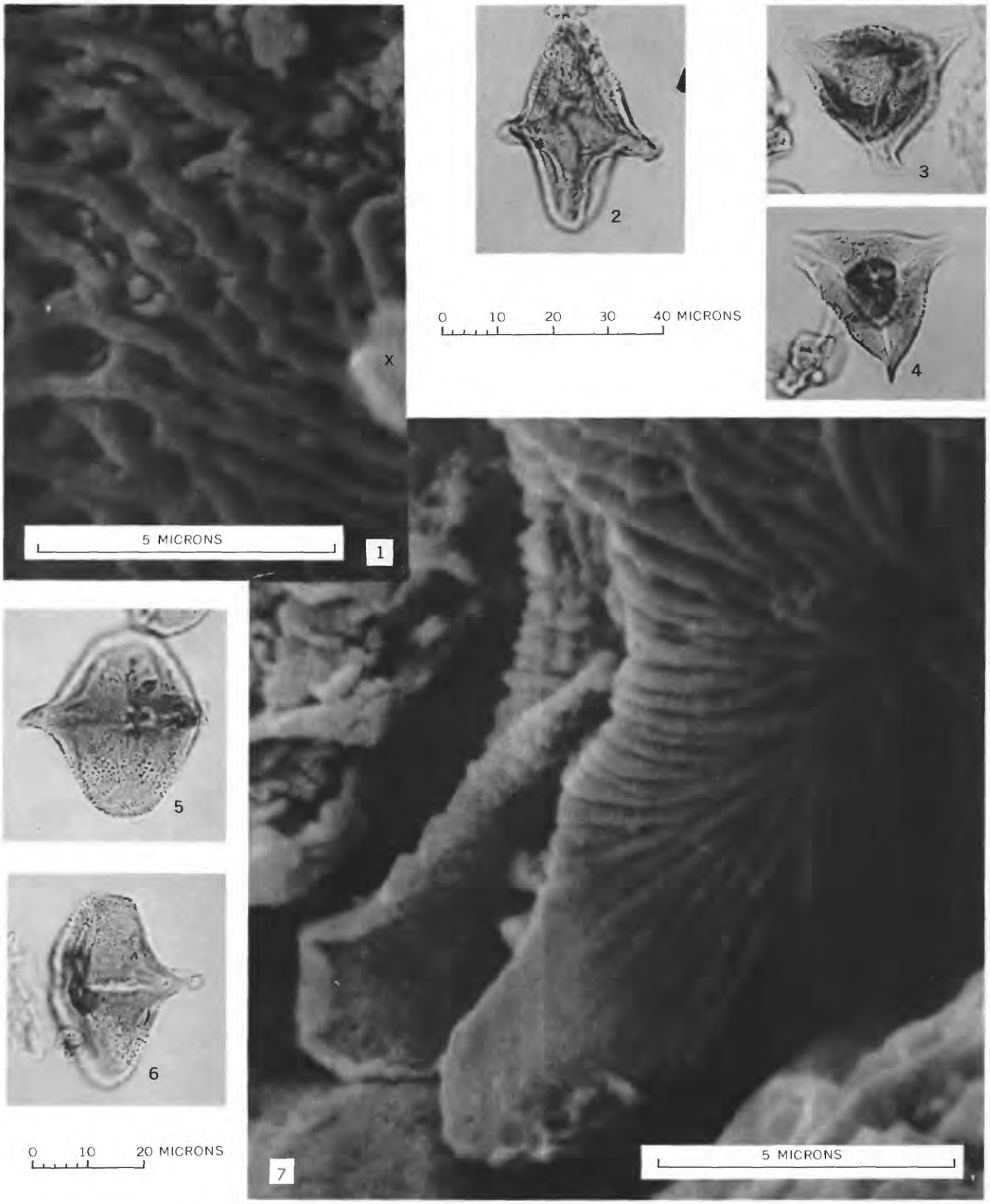


AQUILAPOLLENITES CLARIRETICULATUS (SAMOILOVITCH) N. COMB.

PLATE 3

FIGURES 1–7. *Aquilapollenites clarireticulatus* (Samoilovitch) n. comb. (p. A6).

1. Scanning electron microscope photograph (× 10,800) showing surface detail. X indicates position X on specimen at lower magnification illustrated on pl. 2, fig. 8. USGS paleobotany loc. D1799. Photograph by Charles M. Drew.
2. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 108.2×6.9.
3. Polar view. USGS paleobotany loc. D1799, slide (4) at 102.6×2.9.
4. Polar view. USGS paleobotany loc. D1799, slide (4) at 92.8×15.8.
5. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 81.4×20.8.
6. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 97.2×6.9.
7. Scanning electron microscope photograph. High magnification (×10,800) of the equatorial protrusion shown at the lower left on pl. 2, fig. 8. USGS paleobotany loc. D1799. Photograph by Charles M. Drew.

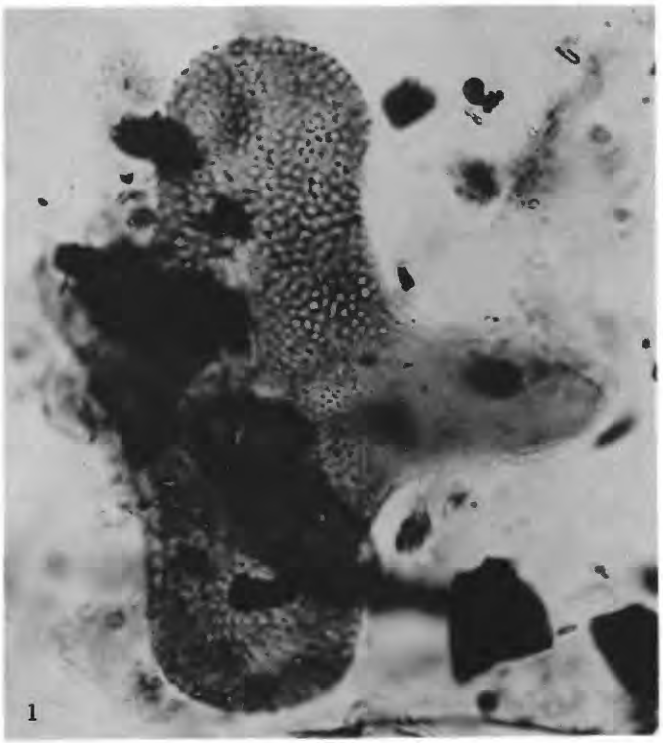


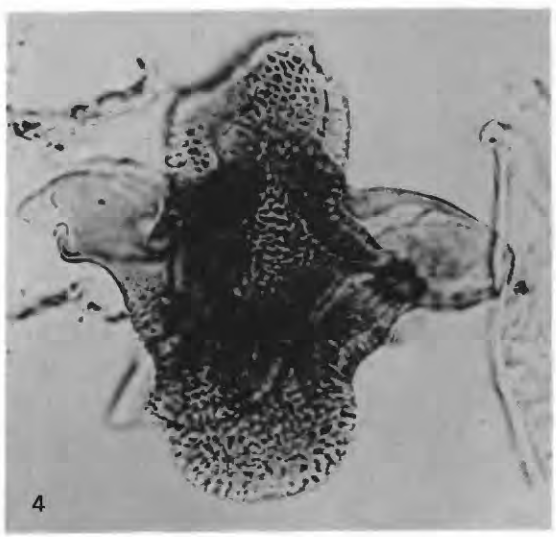
AQUILAPOLLENITES CLARIRETICULATUS (SAMOILOVITCH) N. COMB.

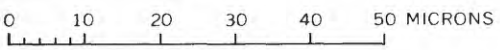
PLATE 4

FIGURES 1–5. *Aquilapollenites trialatus* Rouse (p. A7).

1. Equatorial view. A specimen from Rouse's type material. Rouse slide Leth No. 8, 1:5(i) Ger; at 78×15.1.
2. Equatorial view. USGS paleobotany loc. D3124–H, slide (1) at 94.8×19.3.
3. Equatorial view. USGS paleobotany loc. D3124–H, slide (3) at 115.4×19.8.
4. Equatorial view. USGS paleobotany loc. D3124–H, slide (1) at 101.3×19.4.
5. Polar view. USGS paleobotany loc. D3124–H, slide (3) at 104.4×17.2.







AQUILAPOLLENITES TRIALATUS ROUSE

PLATE 5

FIGURES 1–11. *Aquilapollenites parallelus* n. sp. (p. A7).

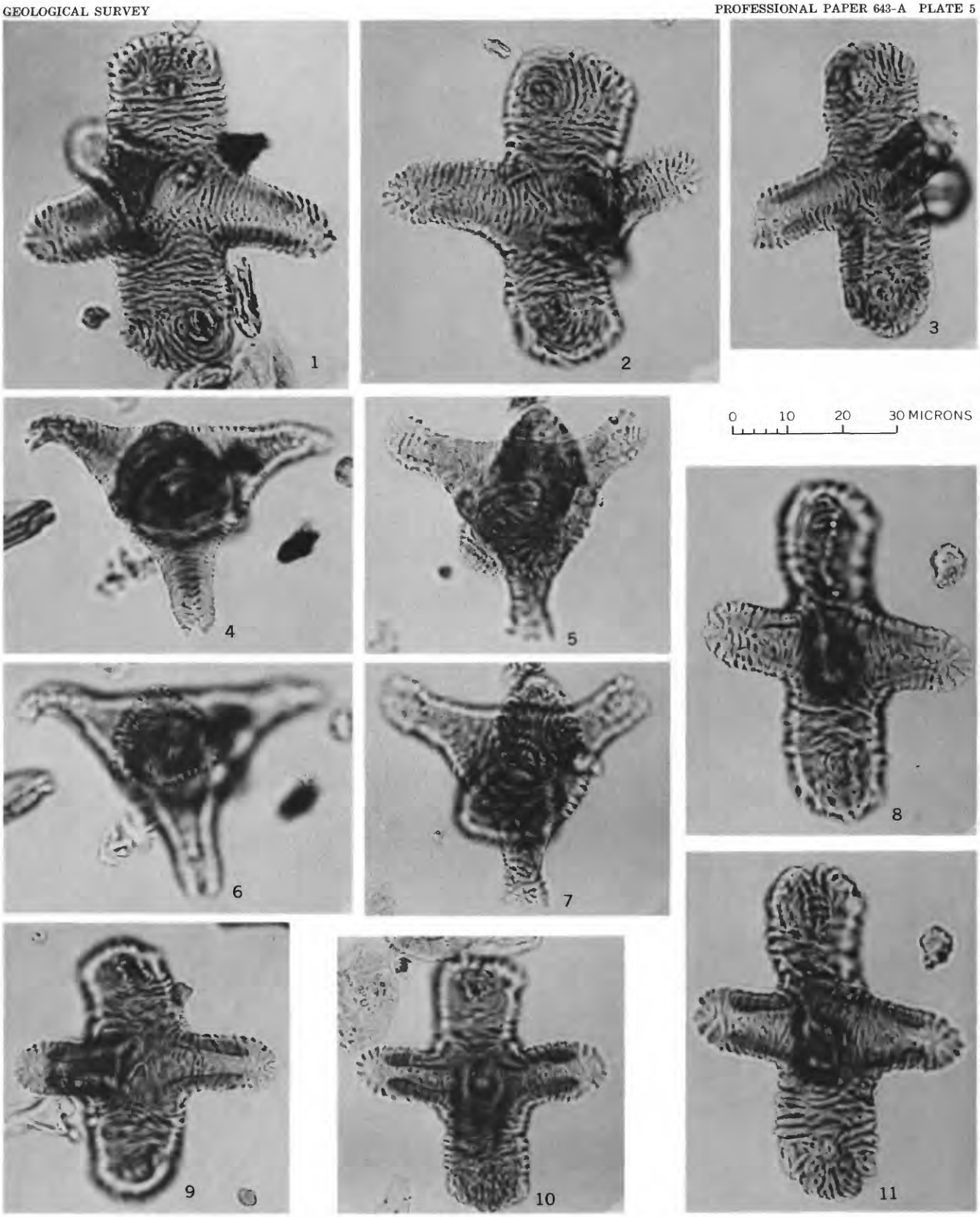
1. Equatorial view of holotype. USGS paleobotany loc. D1799, slide (5) at 100.7×12.8.
2. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 107.5×16.1.
3. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 110.9×19.9.

4, 6. Polar view of a paratype, mid and high focus. USGS paleobotany loc. D1799, slide (5) at 79.9×19.8.

5, 7. Polar view, mid and high focus. USGS paleobotany loc. D1799, slide (7) at 103.1×21.8.

8, 11. Equatorial view of a paratype, high and mid focus. USGS paleobotany loc. D1799, slide (7) at 77.7×14.9.

9. Equatorial view. USGS paleobotany loc. D1799, slide (7) at 96.2×11.9.
10. Equatorial view. USGS paleobotany loc. D1799, slide (5) at 104.1×14.1.

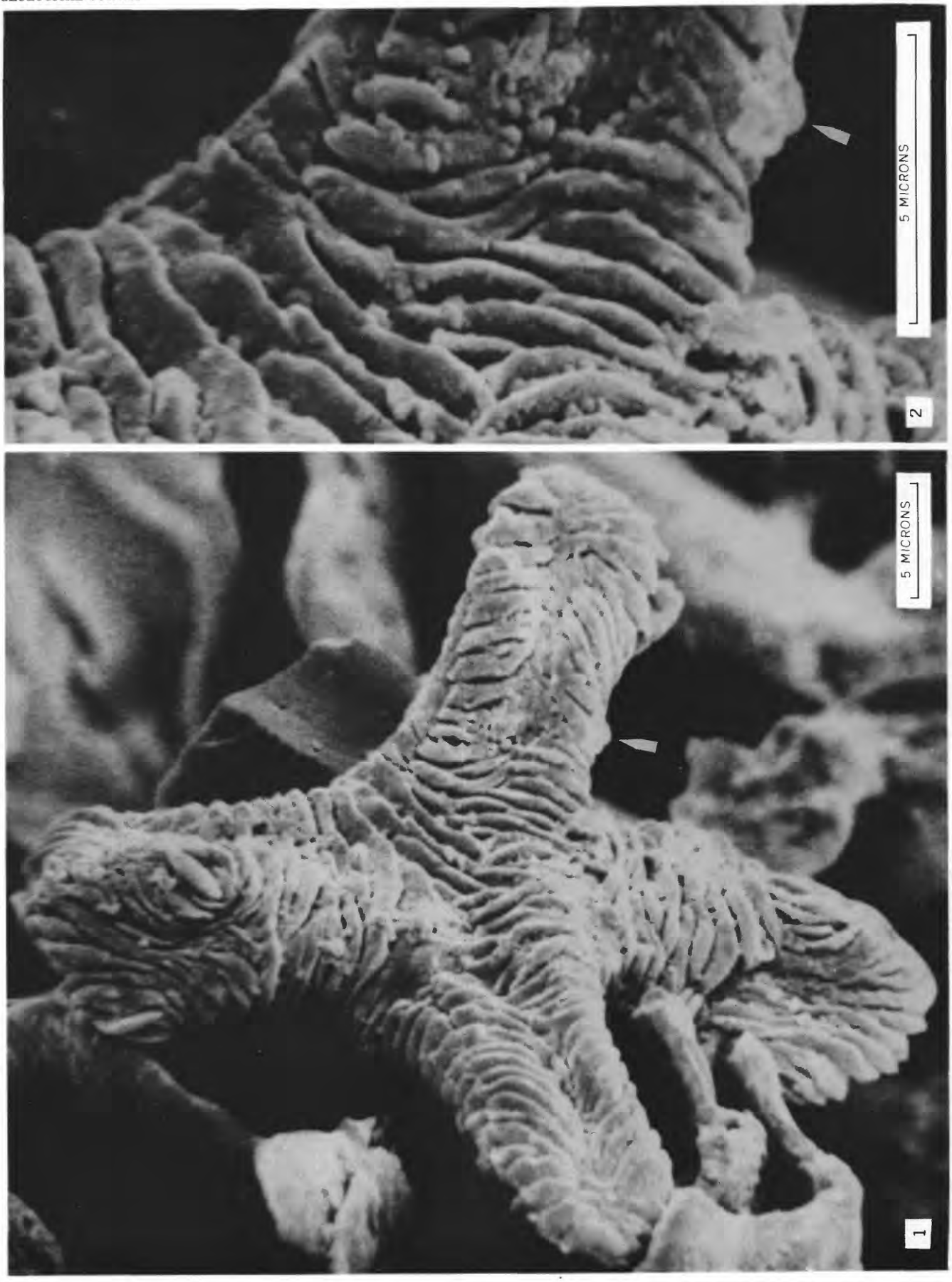


AQUILAPOLLENITES PARALLELUS N. SP.

PLATE 6

FIGURES 1–2. *Aquilapollenites parallelus* n. sp. (p. A7).

1. Scanning electron microscope photograph. Equatorial view (× 4,300 magnification). USGS paleobotany loc. D1799.
2. Scanning electron microscope photograph. Higher magnification (× 10,800) of a portion of grain in fig. 1 (arrows denote corresponding positions on figs. 1 and 2). Photographs by Charles M. Drew.

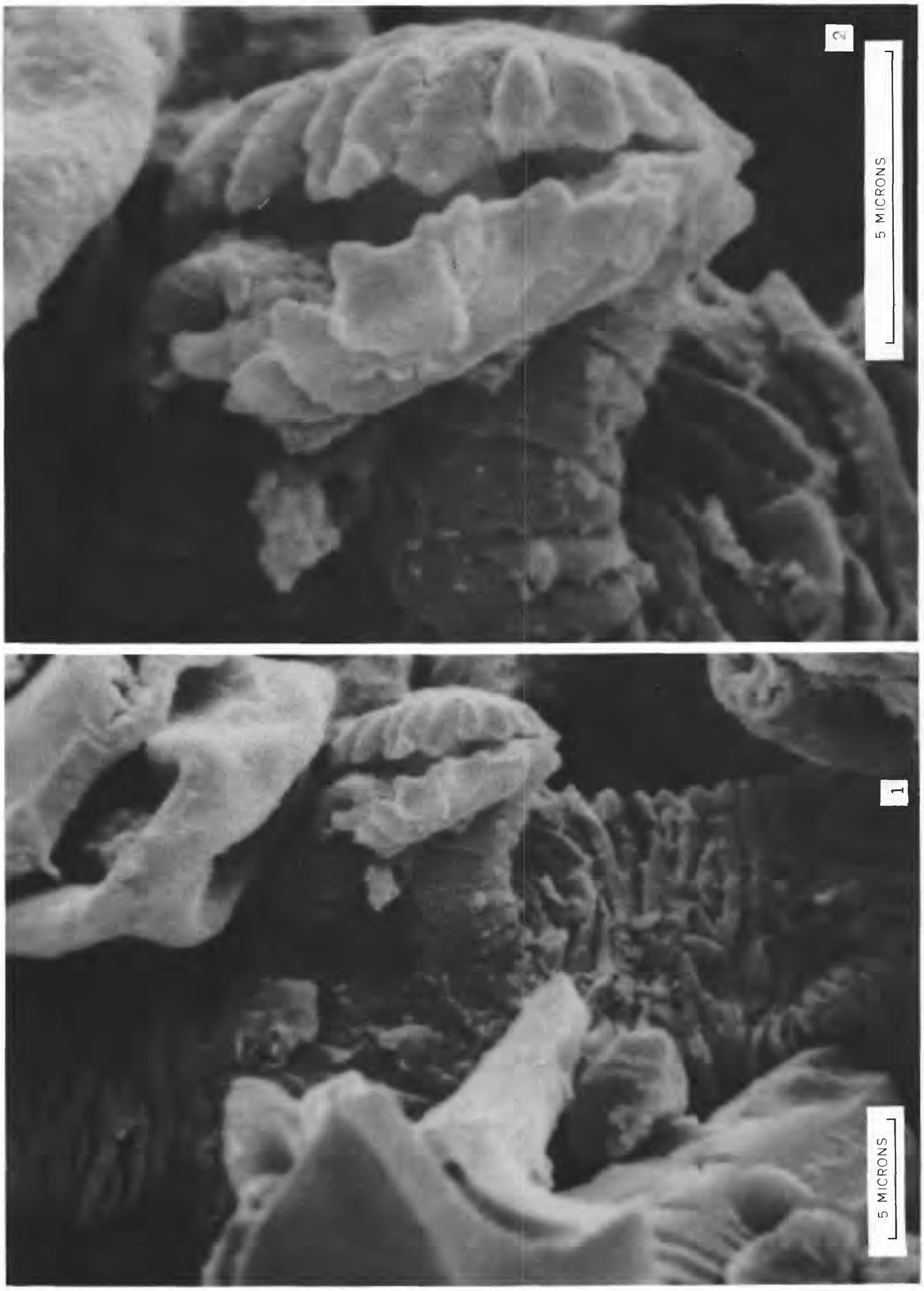


AQUILAPOLLENITES PARALLELUS N. SP.

PLATE 7

FIGURES 1–2. *Aquilapollentites parallelus* n. sp. (p. A7).

1. Scanning electron microscope photograph. Equatorial view of a specimen partially covered by debris showing an equatorial protrusion with open colpus at end (× 4,200 magnification). USGS paleobotany loc. D1799.
2. Scanning electron microscope photograph. Portion of grain shown in fig. 1 at greater magnification (× 10,400). Photographs by Charles M. Drew.



AQUILAPOLLENITES PARALLELUS N. SP.

PLATE 8

FIGURES 1–12. *Aquilapollenites fusiformis* n. sp. (p. A8).

1, 2. Equatorial view of holotype, low and high focus. USGS paleobotany loc. D3124–G, slide (6) at 111.9×18.1.

3. Polar view of paratype. USGS paleobotany loc. D3124–G, slide (6) at 109.1×10.2.

4, 5. Polar view, high and low focus. USGS paleobotany loc. D3124–G, slide (6) at 117.0×16.5.

6. Equatorial view. USGS paleobotany loc. D3124–G, slide (6) at 78.4×5.8.

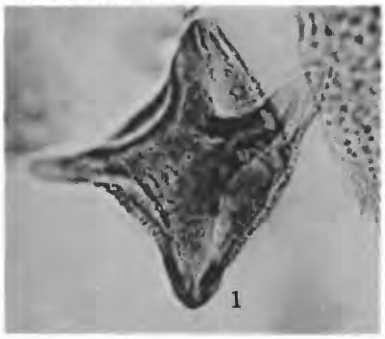
7. Equatorial view. USGS paleobotany loc. D3124–G, slide (20) at 107.1×23.0.

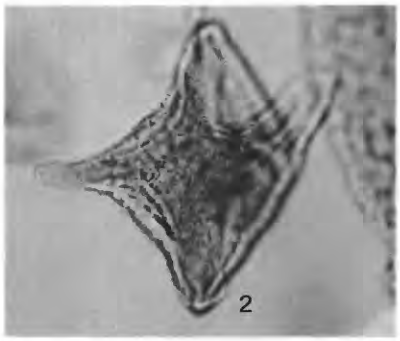
8. Equatorial view. USGS paleobotany loc. D3124–G, slide (36) at 105.8×17.1.

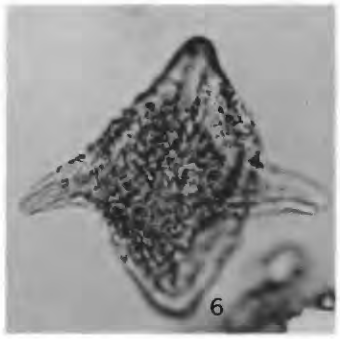
9. Equatorial view. USGS paleobotany loc. D3124–G, slide (6) at 89.2×21.2.

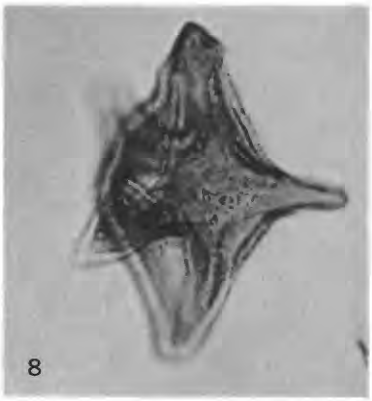
10. Equatorial view. USGS paleobotany loc. D3124–G, slide (15) at 93.1×17.6.

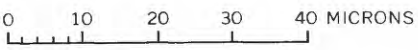
11, 12. Oblique view, low and mid focus. USGS paleobotany loc. D3124–G, slide (6) at 92.2×21.0.











AQUILAPOLLENITES FUSIFORMIS N. SP.

PLATE 9

FIGURES 1–12. *Aquilapollenites dentatus* n. sp. (p. A9).

1, 4, 7. Equatorial view of holotype, low, mid and high focus. USGS paleobotany loc. D1799, slide (7) at 90.9×8.9.

2, 5. Polar view of paratype, mid and high focus. USGS paleobotany loc. D1799, slide (7) at 79.9×7.2.

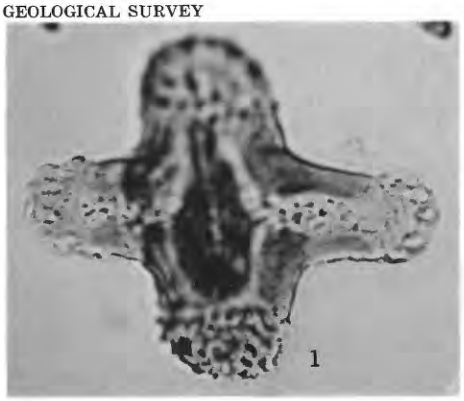
3, 6. Equatorial view, mid and low focus. USGS paleobotany loc. D1799, slide (7) at 90.4×22.0.

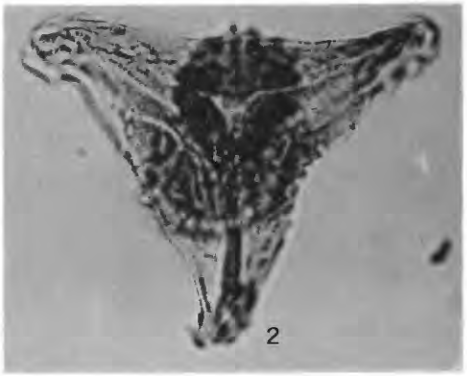
8. Polar view. USGS paleobotany loc. D1799, slide (4) at 113.3×12.8.

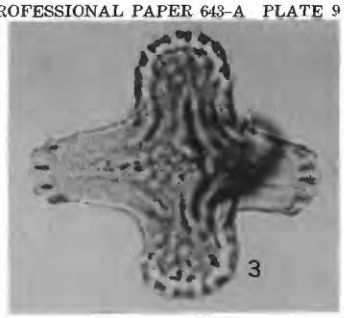
9. Equatorial view. USGS paleobotany loc. D1799, slide (5) at 101.7×6.6.

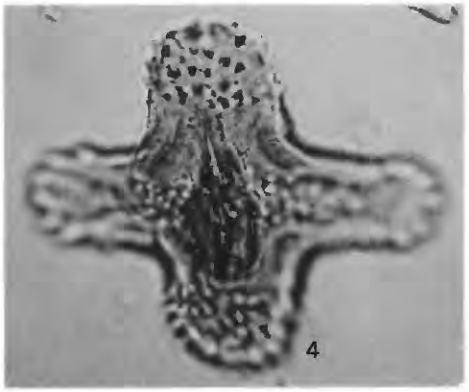
10, 11. Oblique equatorial view, mid and high focus. USGS paleobotany loc. D1799, slide (4) at 108.1×14.1.

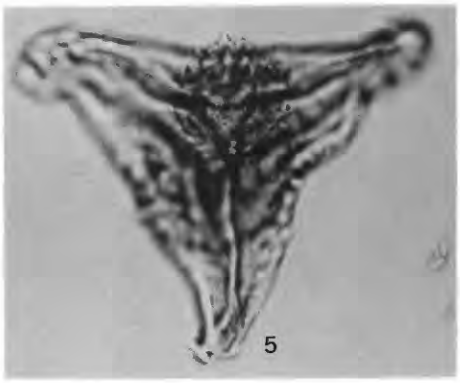
12. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 109.2×4.1.

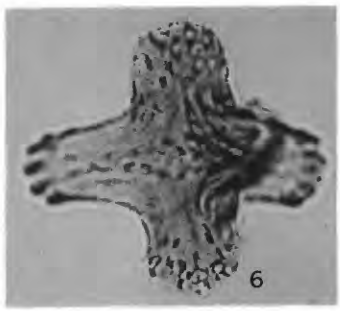


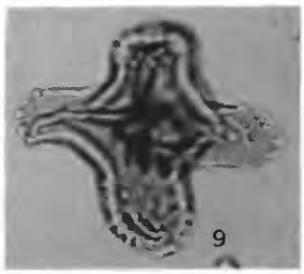


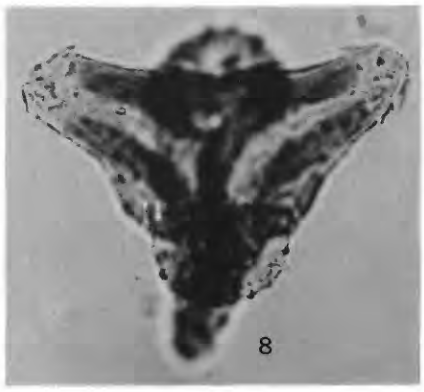


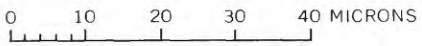


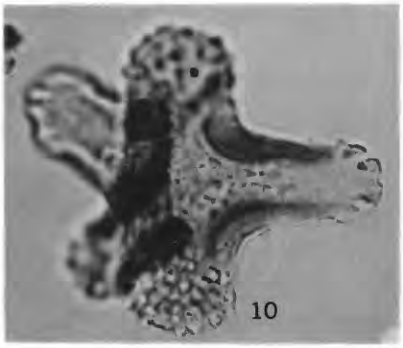


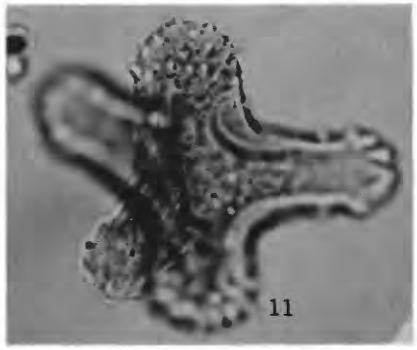








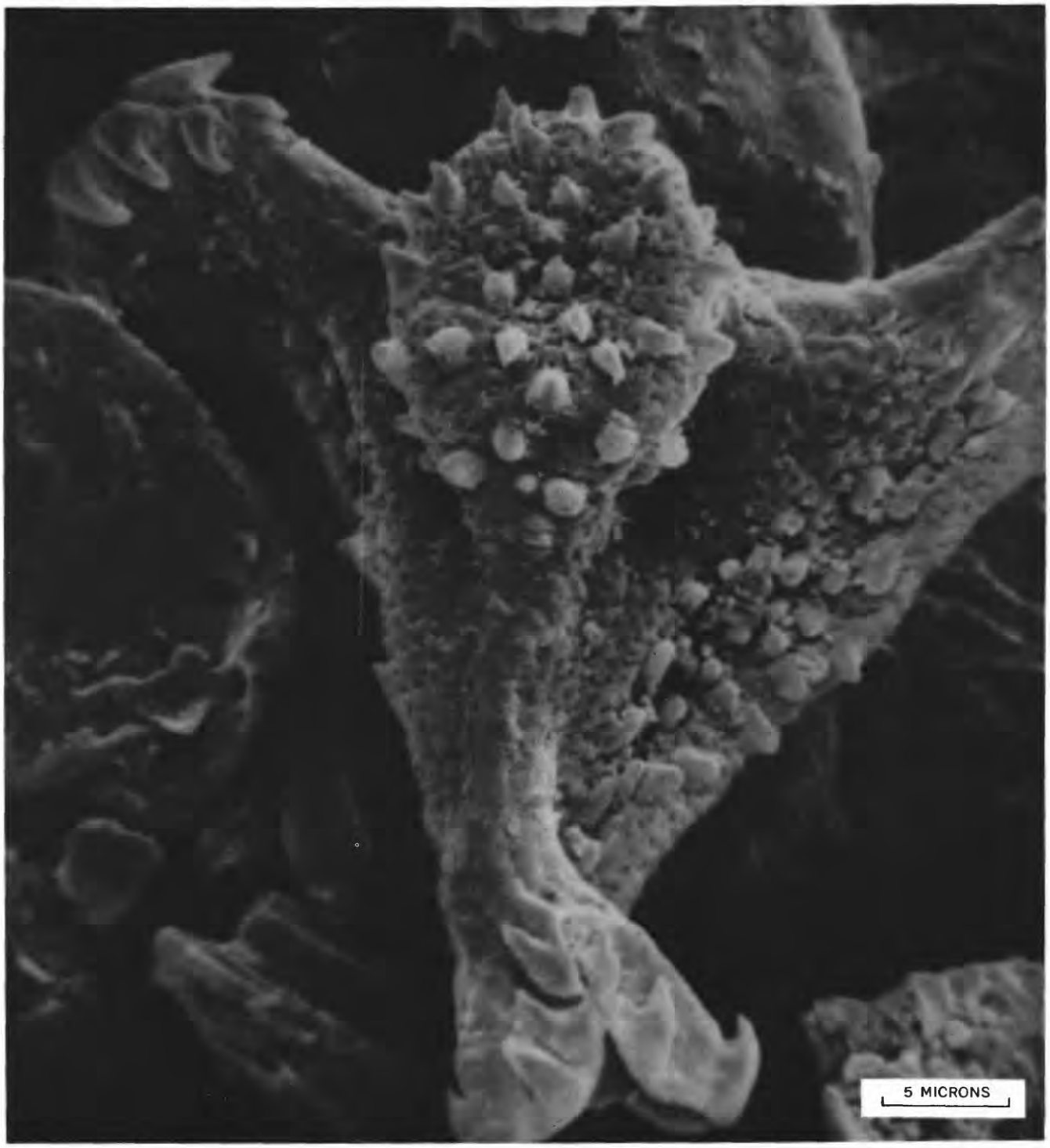




AQUILAPOLLENITES DENTATUS N. SP.

PLATE 10

FIGURE 1. *Aquilapollenites dentatus* n. sp. (p. A9).
Scanning electron microscope photograph. Oblique view (× 4,200). USGS paleobotany loc. D1799. Photograph by Charles M. Drew.



AQUILAPOLLENITES DENTATUS N. SP.

PLATE 11

FIGURES 1–18. *Aquilapollenites colvillensis* n. sp. (p. A9).

1, 2, 3. Equatorial view of holotype, high, mid, and low focus. USGS paleobotany loc. D3124–G, slide (5) at 109.5×21.8.

4, 8. Equatorial view of a paratype, mid and low focus. USGS paleobotany loc. D3124–G, slide (16) at 83.9×10.4.

5, 6. Polar view of a paratype, high and mid focus. USGS paleobotany loc. D3124–G, slide (6) at 110.1×7.6.

7. Polar view. USGS paleobotany loc. D3124–G, slide (6) at 90.4×15.6.

9. Equatorial view. USGS paleobotany loc. D3124–G, slide (36) at 93.6×2.2.

10. Oblique view. USGS paleobotany loc. D3124–G, slide (6) at 84.9×5.8.

11. Equatorial view. USGS paleobotany loc. D3124–G, slide (25) at 100.1×8.6.

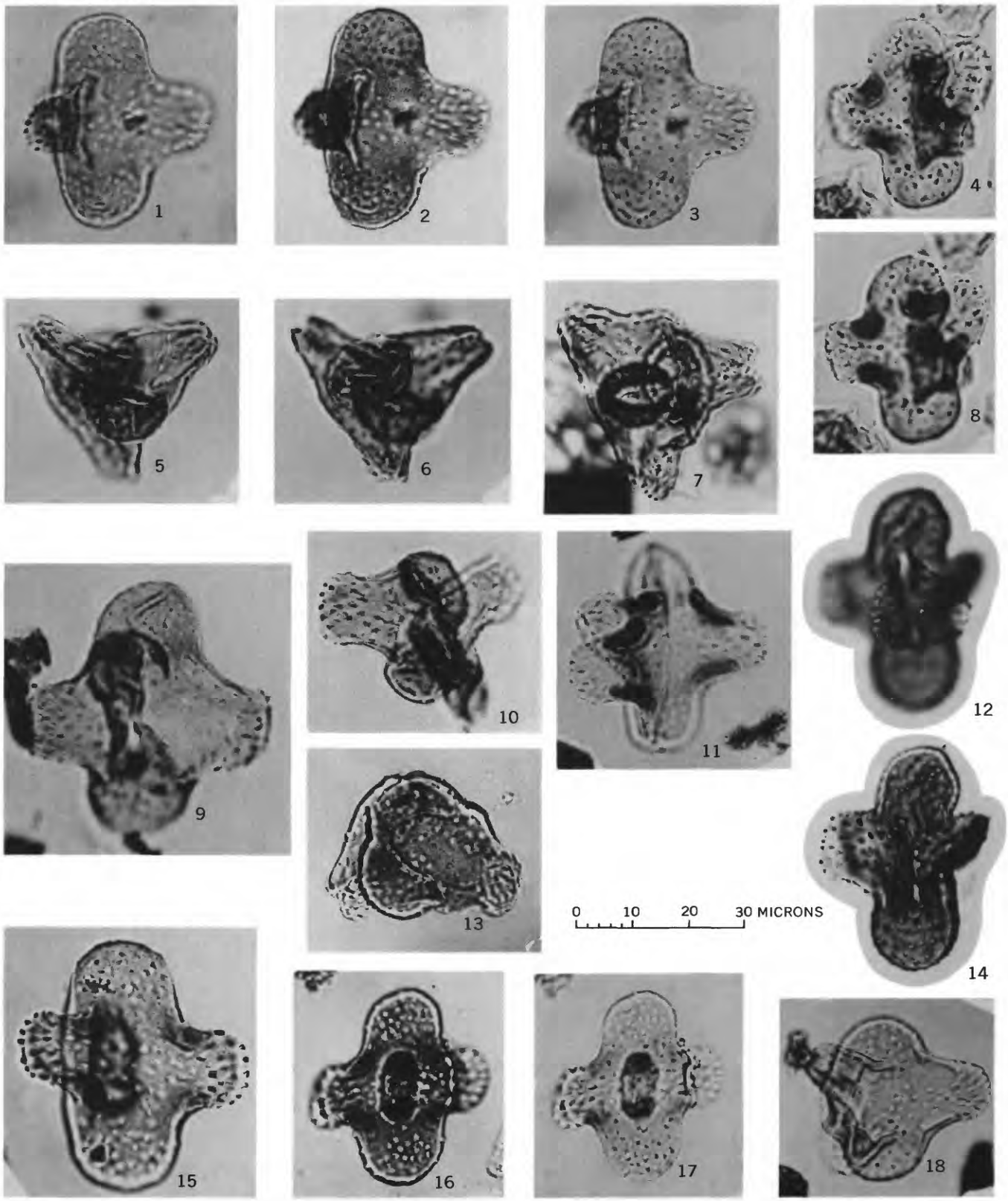
12, 14. Equatorial view, low and mid focus. USGS paleobotany loc. D3124–G, slide (6) at 82.9×5.7.

13. Oblique view. USGS paleobotany loc. D3124–B, slide (2) at 119.0×7.5.

15. Equatorial view. USGS paleobotany loc. D3124–H, slide (1) at 81.8×7.8.

16, 17. Equatorial view, high and mid focus. USGS paleobotany loc. D3124–B, slide (2) at 93.1×15.2.

18. Oblique equatorial view. USGS paleobotany loc. D3124–B, slide (17) at 109.0×7.1.

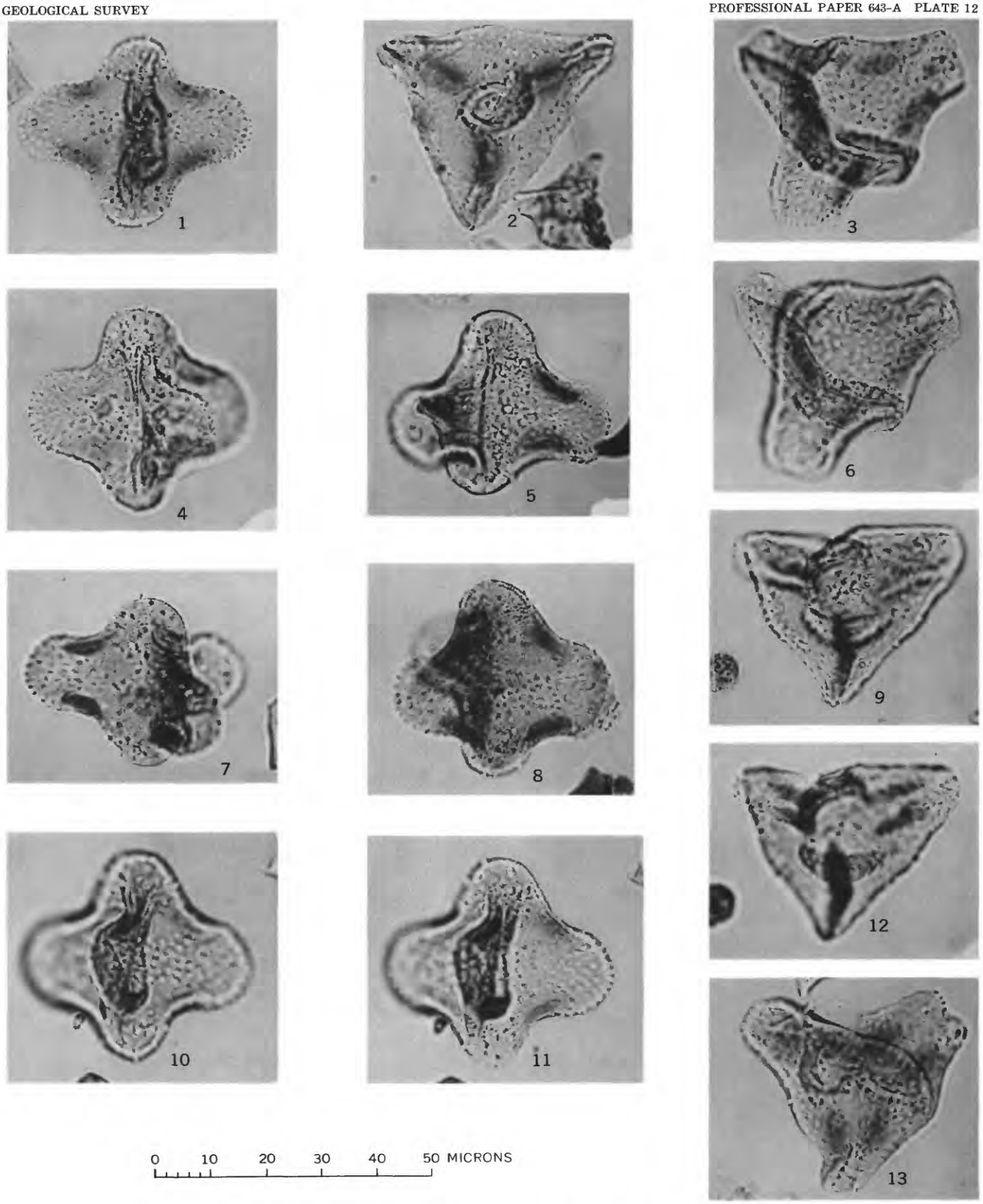


AQUILAPOLLENITES COLVILLENSIS N. SP.

PLATE 12

FIGURES 1–13. *Aquilapollenites rectus* n. sp. (p. A10)

1. Equatorial view of holotype. USGS paleobotany loc. D1799, slide (4) at 113.3×18.1.
2. Polar view of paratype. USGS paleobotany loc. D1799, slide (4) at 98.4×11.7.
3, 6. Polar view, low and high focus. USGS paleobotany loc. D1799, slide (7) at 89.4×22.1.
4. Equatorial view. USGS paleobotany loc. D1799, slide (2) at 111.4 ×8.8.
5. Oblique equatorial view. USGS paleobotany loc. D1799, slide (4) at 98.5×4.3.
7. Equatorial view. USGS paleobotany loc. D1799, slide (6) at 86.3 ×17.1.
8. Equatorial view. USGS paleobotany loc. D1799, slide (4) at 101.2 ×2.0.
9, 12. Polar view, mid and low focus. USGS paleobotany loc. D1799, slide (6) at 84.3×17.0.
10, 11. Equatorial view, high and mid focus. USGS paleobotany loc. D1799, slide (7) at 86.5×19.5.
13. Polar view. USGS paleobotany loc. D1799, slide (4) at 100.0×2.2.



AQUILAPOLLENITES RECTUS N. SP.

PLATE 13

FIGURES 1–3, 5–8, 10–11. *Aquilapollenites scabridus* n. sp. (p. A11).

1, 2. Equatorial view of holotype, two levels. USGS paleobotany loc. D1799, slide (5) at 86.2×11.8.

3. Polar view of paratype. USGS paleobotany loc. D1799, slide (7) at 90.3×12.0.

5. Polar view. USGS paleobotany loc. D1799, slide (6) at 87.3×9.7.

6. Equatorial view. USGS paleobotany loc. D1799, slide (7) at 89.9×3.9.

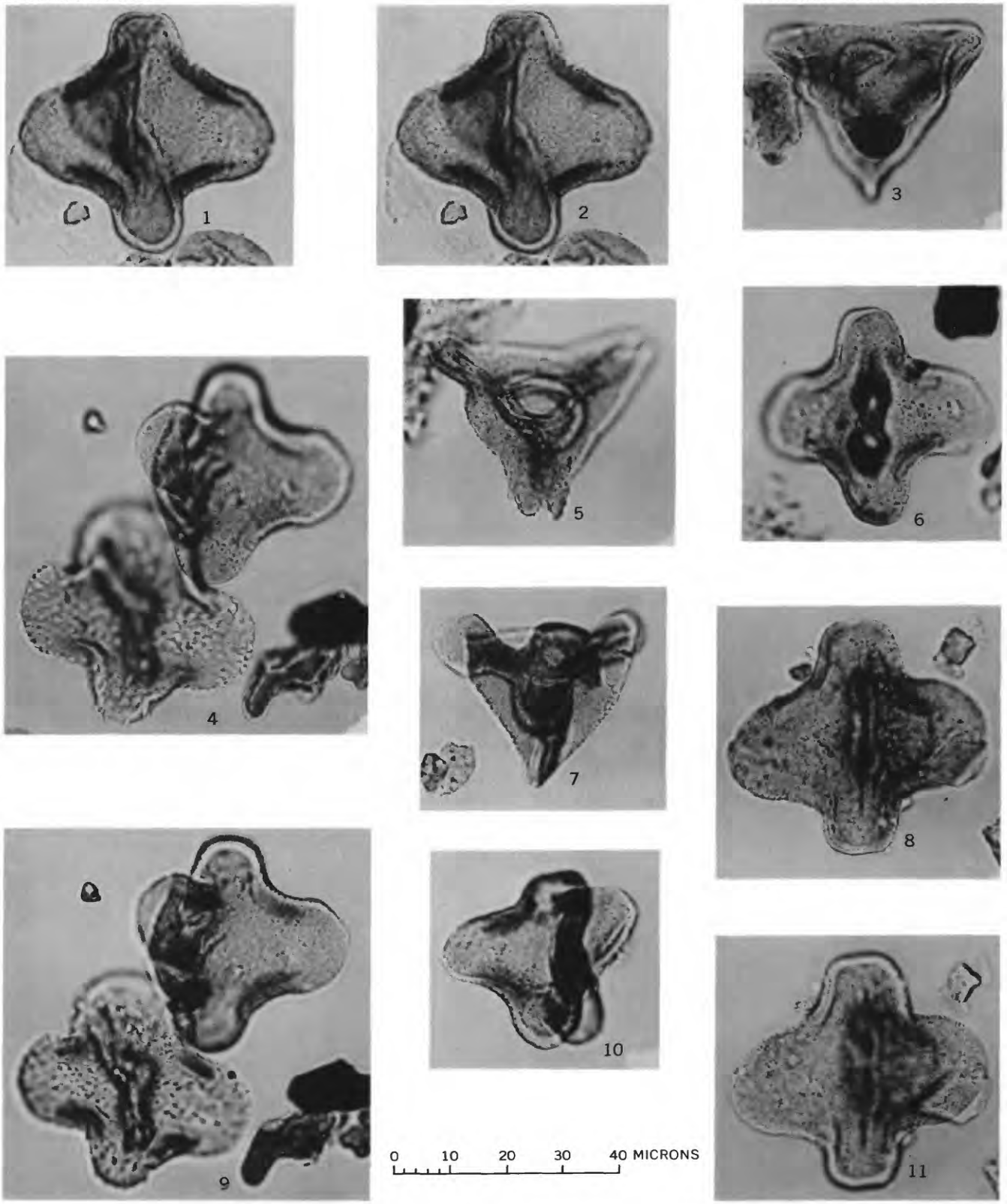
7. Polar view. USGS paleobotany loc. D1799, slide (5) at 81.1×10.6.

8, 11. Equatorial view, mid and high focus. USGS paleobotany loc. D1799, slide (7) at 86.8×19.3.

10. Oblique equatorial view. USGS paleobotany loc. D1799, slide (4) at 101.3×2.3.

4, 9. *Aquilapollenites scabridus* n. sp. (p. A11) with *Aquilapollenites rectus* n. sp. (p. A10).

4, 9. Equatorial views of *A. scabridus* (above) and *A. rectus* (below), high and mid focus. USGS paleobotany loc. D1799, slide (4) at 87.9×13.7.

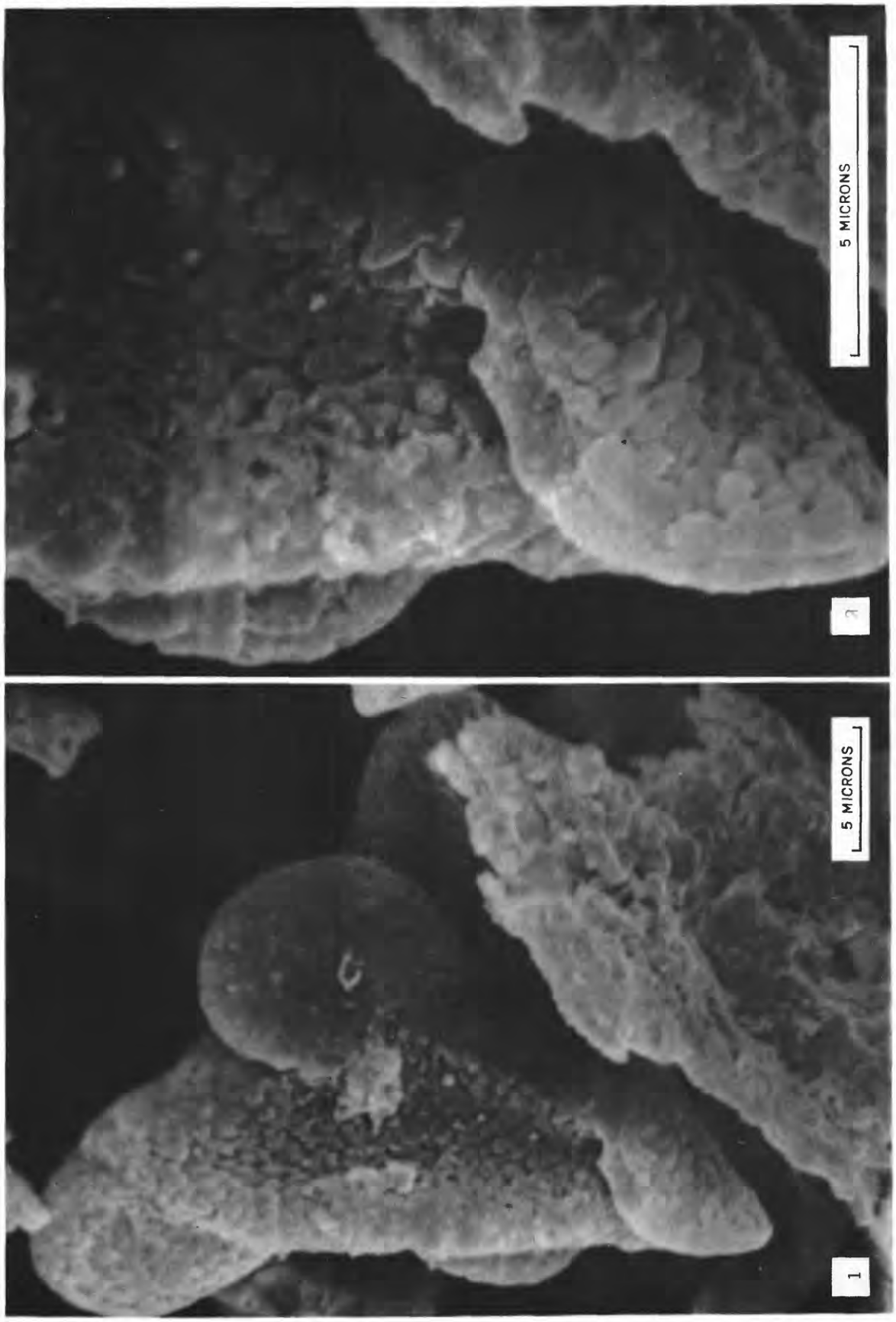


AQUILAPOLLENITES SCABRIDUS N. SP. AND *AQUILAPOLLENITES RECTUS* N. SP.

PLATE 14

FIGURES 1–2. *Aquilapollenites scabridus* n. sp. (p. A11).

1. Scanning electron microscope photograph, oblique view (× 4,200). USGS paleobotany loc. D1799.
2. Scanning electron microscope photograph. Higher magnification (× 10,400) of lower portion of specimen shown in fig. 1. Photographs by Charles M. Drew.



AQUILAPOLLENITES SCABRIDUS N. SP.

PLATE 15

FIGURES 1–15. *Aquilapollenites contiguus* n. sp. (p. A12).

1, 2. Equatorial view of holotype, high and mid focus. USGS paleobotany loc. D3124–G, slide (5) at 88.7×5.7.

3. Oblique view of a paratype. USGS paleobotany loc. D3124–G, slide (6) at 100.9×3.5.

4. Polar view of a paratype. USGS paleobotany loc. D3124–G, slide (5) at 102.7×10.4.

5. Polar view. USGS paleobotany loc. D3124–G, slide (6) at 92.3×4.6.

6. Oblique view. USGS paleobotany loc. D3124–G, slide (6) at 111.7×17.3.

7. Equatorial view. USGS paleobotany loc. D3124–G, slide (6) at 82.8×8.8.

8, 11. Oblique view, high and mid focus. USGS paleobotany loc. D3124–G, slide (15) at 101.5×14.6.

9. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 87.2×19.8.

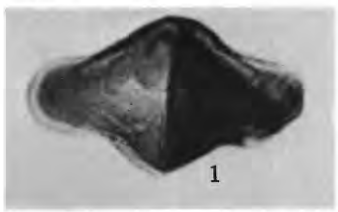
10. Equatorial view. USGS paleobotany loc. D3124–G, slide (15) at 105.1×11.7.

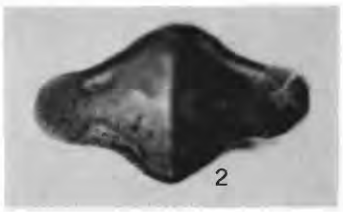
12. Polar view. USGS paleobotany loc. D3124–G, slide (5) at 97.2×4.8.

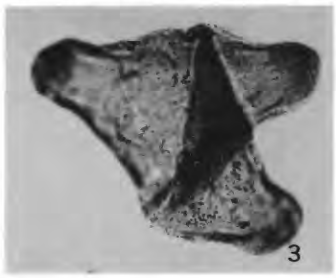
13. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 85.4×15.0.

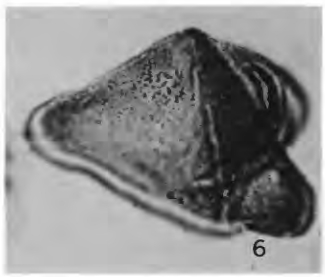
14. Oblique equatorial view. USGS paleobotany loc. D3124–G, slide (15) at 106.1×14.6.

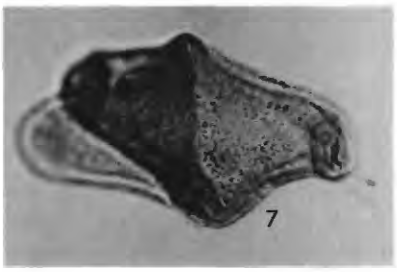
15. Polar view. USGS paleobotany loc. D3124–G, slide (6) at 117.3×16.4.

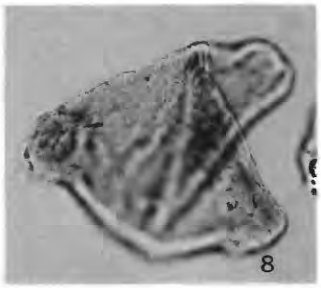


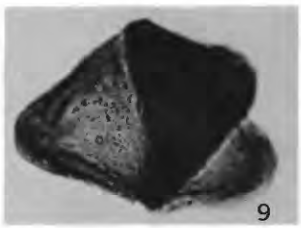


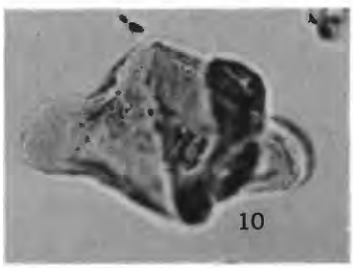


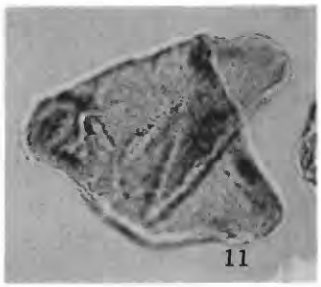


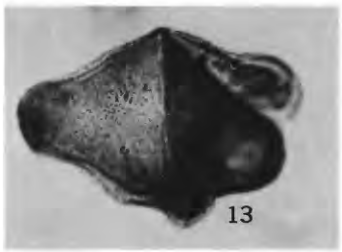


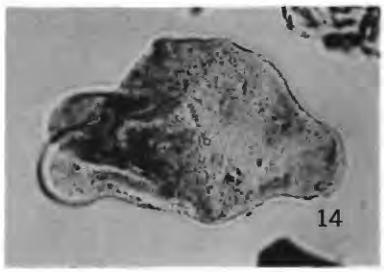


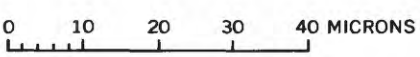












AQUILAPOLLENITES CONTIGUUS N. SP.

PLATE 16

FIGURES 1–8. *Aquilapollenites laticorpus* n. sp. (p. A12).

1. Equatorial view of holotype. USGS paleobotany loc. D3124–G, slide (15) at 90.1×8.0.

2, 3. Polar view of paratype, high and mid focus. USGS paleobotany loc. D3124–G, slide (18) at 116. 8×6. 9.

4. Oblique equatorial view. USGS paleobotany loc. D3124–G, slide (15) at 114. 5×10. 2.

5, 6. Equatorial view, high and mid focus. USGS paleobotany loc. D3124–G, slide (6) at 86.9×14.8.

7. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 99.1×21.2.

8. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 80.5×16.9.

FIGURES 9–10. Cf. *Aquilapollenites laticorpus* (p. A13).

9, 10. Equatorial view, mid and high focus. USGS paleobotany loc. D3124–G, slide (5) at 101.1×4.8.

FIGURES 11–20. *Fibulapollis scabratus* n. sp. (p. A13).

11. Equatorial view of holotype. USGS paleobotany loc. D3124–A, slide (1) at 97.8×7.3.

12. Polar view of a paratype. USGS paleobotany loc. D3124–A, slide (1) at 103.7×20.2.

13. Oblique equatorial view of a paratype. USGS paleobotany loc. D3124–A, slide (1) at 96.8×20.2.

14. Oblique equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 81.9×10.2.

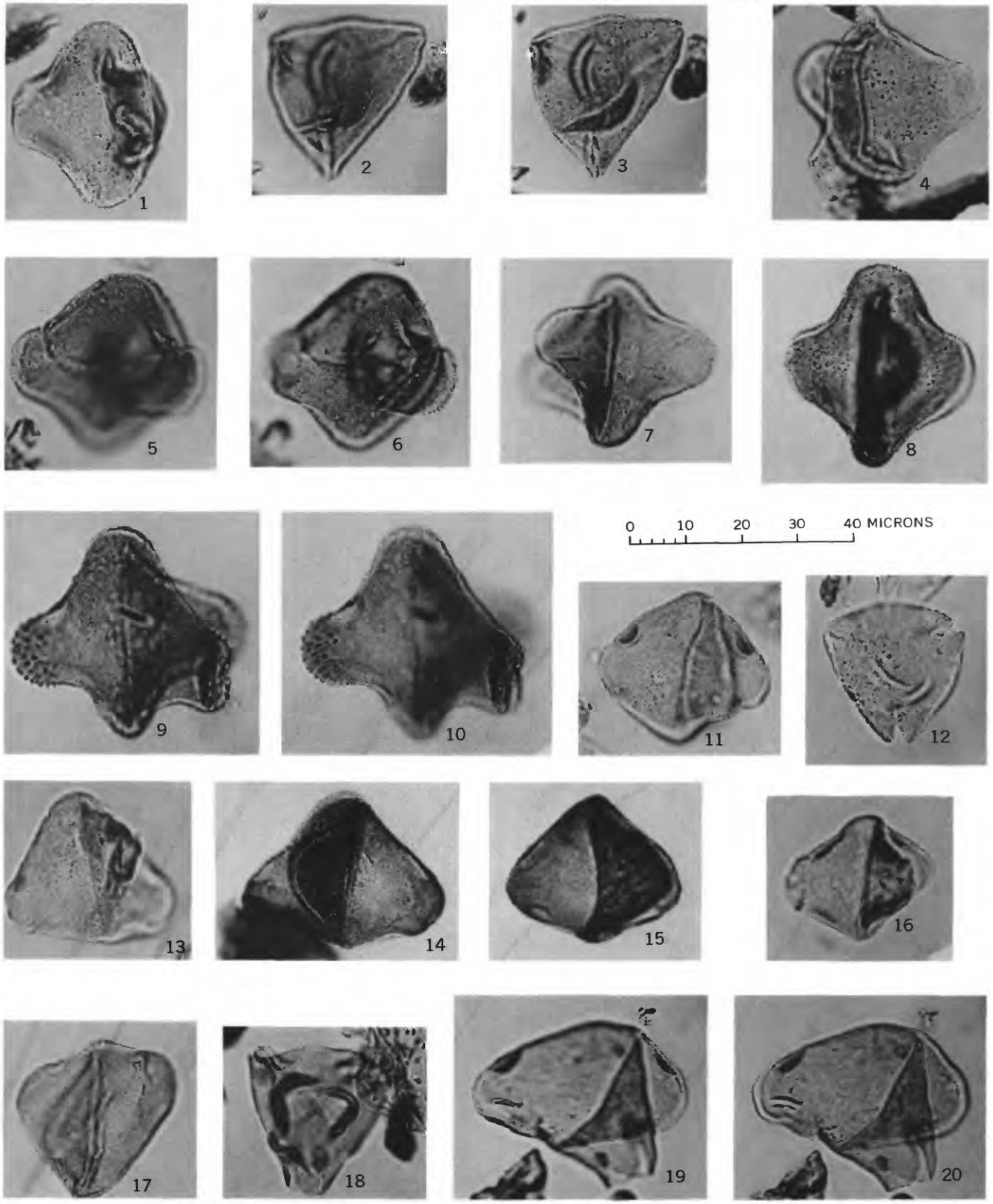
15. Equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 94.8×2.1.

16. Equatorial view. USGS paleobotany loc. D1330–4, slide (3) at 95.4×3.9.

17. Oblique equatorial view. USGS paleobotany loc. D3124–G, slide (5) at 107.3×21.0.

18. Polar view. USGS paleobotany loc. D1330–19, slide (3) at 84.8× 11.5.

19, 20. Oblique view, low and high focus. USGS paleobotany loc. D3124–G, slide (15) at 97.7×17.7.



AQUILAPOLLENITES LATICORPUS N. SP. AND *FIBULAPOLLIS SCABRATUS* N. SP.