FOSSIL POLLEN OF *SABICEA* (RUBIACEAE) FROM THE LOWER MIOCENE CULEBRA FORMATION OF PANAMA[1]

ALAN GRAHAM[2]

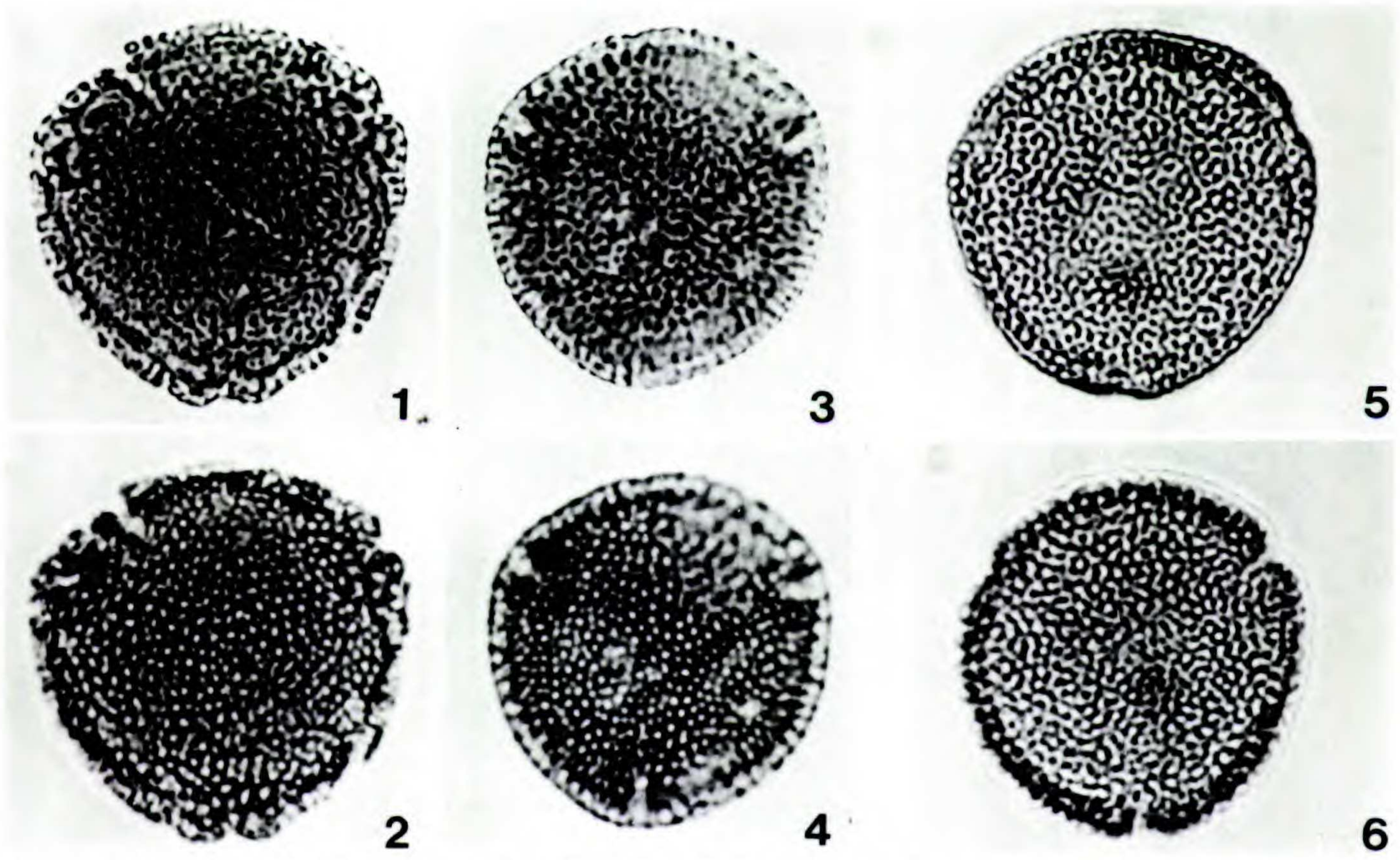
ABSTRACT

Fossil pollen of *Sabicea* (Rubiaceae) has been recovered from the lower Miocene Culebra Formation of Panama. The genus is presently widely distributed in Central and northern South America; it is well represented in the tropical moist and premontane wet forests of Panama. In the lower Miocene it was part of the low- to moderate-altitude insular vegetation characterizing the landscape between southern Mexico and northern Colombia. Its association with other members of the Culebra assemblage indicates tropical paleoclimates similar to those of the present. The genus has not been reported previously in the fossil record.

During studies on Tertiary vegetational history of the Gulf/Caribbean region, pollen and spores are frequently encountered representing genera with no previous fossil record, or whose stratigraphic and/or geographic range is considerably extended by the new records. Examples include *Pelliceria* (Theaceae/Pelliceriaceae; Graham, 1977), *Mortoniodendron* (Tiliaceae) and *Sphaeropteris/Trichipteris* (Cyatheaceae; Graham, 1979), *Micractinium* (Chlorophyta; Graham, 1981), and *Lisianthius* (Gentianaceae; Graham, 1984). Fossil pollen of *Sabicea* (Rubiaceae; Figs. 1–4) has recently been recovered from the lower Miocene Culebra formation of Panama, representing its first known occurrence in the geologic record.

[1] The author gratefully acknowledges comments provided by John Dwyer and pollen material provided by curators at MO. The research was supported by NSF grants BSR-8500850 and BSR-8619203.

[2] Department of Biological Sciences, Kent State University, Kent, Ohio 44242, U.S.A.



FIGURES 1–6. Fossil and modern pollen of *Sabicea* (Rubiaceae).—1, 2. Fossil pollen, Pan core 456, slide 1, ESF coordinates D-17.—3, 4. Fossil pollen, Pan core 470.6, slide 3a, ESF coordinates U-31,3.—5, 6. Modern pollen of *S. colombiana*. All taken at 400×, actual size in μm given in text. Fossil specimens and modern reference material are deposited in the palynology collections, Kent State University, Kent, Ohio.

TABLE 1. Modern Rubiaceae pollen examined.

Taxon	Country	Voucher Collection	Herbarium where Voucher Deposited
Amphidaysa ambigua (Standley) Standley	Panama	*Busey 385*	MO
Coccocypselum guianense (Aublet) Schum.	Honduras	*Nelson & Romero 4263*	MO
C. herbaceum Lam.	Panama	*D'Arcy & D'Arcy 6731*	MO
C. lanceolatum (Ruiz & Pavón) Pers.	Panama	*Antonio 1425*	MO
Didymochlamys connellii N. E. Br.	Guyana	*Maguire et al. 32362*	MO
Gonzalagunia brenesii Standley	Costa Rica	*Croat 26591*	MO
G. bunchosioides Standley	Peru	*Ferreyra 1660*	US
G. panamensis (Cav.) Schum.	Panama	*Johnston 76*	GH
	Honduras	N. Mex. exch.	MO
G. rosea Standley	Panama	*White 7*	GH
Hippotis mollis Standley	Colombia	*Lawrence 505*	MO
H. tubiflora Spruce	Peru	*Klug 3084*	MO
Isertia deamii Bartlett	Guatemala	*Deam 6016*	MO
I. haenkeana A. DC.		Harvard exch.	GH
I. hypoleuca Benth.	Guyana	Shell Oil exch.	
	Costa Rica	*Jiménez 4127*	MO
	Panama	*Stimson 5062*	MO
I. pittieri (Standley) Standley	Colombia	*St. George Exped. 337*	US
Pentagonia brachyotis (Standley) Standley	Panama	*Dwyer 1385*	MO
P. macrophylla Benth.	Panama	STRI exch.	MO
	Panama	*Croat 4646*	MO
P. pubescens Standley	Panama	*Croat 4685*	MO
P. wendlandii Hook.	Panama	*von Wedel 2018*	GH
Raritebe palicoureoides Wernham subsp. *dwyerianum* Kirkb.	Panama	*Mori et al. 6617*	MO
Sabicea brasiliensis Wernham	Brazil	*Irwin et al. 24943*	MO
S. colombiana Wernham	Colombia	*Uribe 3041*	US
	Colombia	*Gentry et al. 47975*	MO
S. panamensis Wernham	Panama	*Dwyer 1831*	MO
S. paranensis (Schum.) Wernham	Peru	*Schunke V. 10548*	MO
S. villosa var. *adpressa* (Wernham) Standley		Harvard exch.	GH
S. villosa Rose & Standley var. *villosa*	Panama	*Luteyn et al. 1798*	MO
	Panama	*von Wedel 2889*	GH
	Panama	*Tyson 3437A*	MO
Schradera blumii Dwyer & Hayden	Panama	*Mori et al. 6625*	MO
Sommera grandis (Bartlett) Standley	Panama	*Allen 1575*	GH
	Panama	*Gentry et al. 13581*	MO

THE COLLECTING LOCALITY

In 1958 the Engineering and Construction Bureau of the Panama Canal Commission drilled a well through the Culebra Formation in front of Gold Hill on the west side of the Canal at latitude 9°02′N, longitude 79°38′W (Hole No. GH-9). Fifty-seven samples were taken from along the 124-meter core, and 21 contained well-preserved pollen and spores. The specimens of *Sabicea* were isolated from samples at the 456- and 470.6-foot depths. Other details on the Culebra Formation are provided by Graham et al. (1985) and Stewart & Stewart (1980). The materials and methods were as described in Graham (1985).

DESCRIPTION

Pollen oblate, amb oval-triangular to nearly circular; tricolpate/porate (apertures short, slit-like, ca. 2 : 1 length:width ratio), 4–6 × 2–3 μm, equatorially arranged, meridionally elongated, equidistant, inner margin faintly dentate (due to overlying sculpture elements), faint costae colpi;

wall 2–3 μm thick, tectate-perforate; finely reticulate, muri smooth, width about equal to diameter of lumen (ca. 0.5 μm); 32–36 μm.

DISCUSSION

Sabicea is a genus of about 125 species of climbing shrubs and vines widely distributed in tropical America and in Africa and Madagascar (Dwyer, 1980a, 1980b). In Panama it is represented by three species: *S. panamensis* (Guatemala to Colombia); *S. villosa* (with var. *villosa* widely distributed in Central and northern South America and with var. *adpressa* known from Panama, Colombia, and Peru); and *S. stellaris* (Panama). *Sabicea villosa* var. *adpressa* grows on Barro Colorado Island where it is "occasional in older clearings, on trails and at the margin of the forest along the lake; less commonly climbing to the top of the forest canopy and sometimes rooting in water," and it "is known from tropical moist forest in the Canal Zone, Bocas del Toro, San Blas, Panamá, and Darién, from premontane wet forest in the Canal Zone, and from premontane wet forest in Panamá and Darién" (Croat, 1978: 827).

Dwyer (1980a: 7) placed *Sabicea* in the tribe Mussaendeae with *Pentagonia, Sommera, Hippotis, Schradera, Amphidaysa, Gonzalagunia, Isertia, Raritebe, Coccocypselum,* and *Didymochlamys.* Pollen was examined from all of these (Table 1), and *Sabicea* can be distinguished on the basis of pollen characters. For example, grains of *Raritebe* examined were smaller (ca. 25 μm), thicker-walled, and tetra- to stephanocolporate. The pollen of *Coccocypselum* was considerably larger (45–50 μm), oblate-spheroidal, and scabrate to finely verrucate.

Three species of *Sabicea* were examined (Table 1), including all species and varieties reported from Panama except *S. stellaris* (holotype, MO, not sampled). The pollen showed only minor differences between the species (e.g., minute variations in wall thickness). The reticulum of the fossil specimens appears slightly more distinct than in the modern pollen examined. The modern forms (Figs. 5, 6) having slightly thicker walls darken more than those with thinner walls during acetolysis and more closely resemble the specimens in this respect. These are not inherent morphological differences or consistent characteristics of the pollen, however, and the specimens cannot be referred to any one modern species.

The specimens were part of a fossil assemblage that includes the following associates (Graham, in prep.; preliminary identifications): *Lycopodium, Selaginella, Alsophila/Cyathea, Pteris, Lygodium,* cf. *Antrophyum, Danaea,* Gramineae, Palmae, *Ilex,* Chenopodiaceae/Amaranthaceae, cf. *Rourea,* cf. *Doliocarpus, Dioscorea/Rajania* type, *Alchornea, Sapium* (*S. haematospermum* type), *Tetrorchidium, Casearia, Acacia,* Malpighiaceae, *Hampea/Hibiscus, Eugenia/Myrcia, Rhizophora, Allophyllus, Cupania, Matayba, Sideroxylon,* and cf. *Guazuma.* The landscape of present-day Central America consisted of low-lying volcanic islands at the time the Culebra assemblage was being deposited during the lower Miocene, ca. 25 Ma (e.g., Stehli & Webb, 1985). The association indicates that *Sabicea* grew in this physiographic setting and under paleoclimates not greatly different from those of the present.

LITERATURE CITED

CROAT, T. B. 1978. Flora of Barro Colorado Island. Stanford Univ. Press, Stanford, California.

DWYER, J. D. 1980a. Rubiaceae. *In* Flora of Panama, Part IX. Ann. Missouri Bot. Gard. 67: 1–256.

———. 1980b. Rubiaceae—Part II. *In* Flora of Panama, Part IX. Ann. Missouri Bot. Gard. 67: 257–522.

GRAHAM, A. 1977. New records of *Pelliceria* (Theaceae/Pelliceriaceae) in the Tertiary of the Caribbean. Biotropica 9: 48–52.

———. 1979. *Mortoniodendron* (Tiliaceae) and *Sphaeropteris/Trichipteris* (Cyatheaceae) in Cenozoic deposits of the Gulf-Caribbean region. Ann. Missouri Bot. Gard. 66: 572–576.

———. 1981. Un alga fosil Micractiniaceae de la Zona del Canal de Panamá. Biotica 6: 229–232.

———. 1984. *Lisianthius* pollen from the Eocene of Panama. Ann. Missouri Bot. Gard. 71: 987–993.

———. 1985. Studies in neotropical paleobotany. IV. The Eocene communities of Panama. Ann. Missouri Bot. Gard. 72: 504–534.

———, R. H. STEWART & J. L. STEWART. 1985. Studies in neotropical paleobotany. III. The Tertiary communities of Panama—geology of the pollen-bearing sediments. Ann. Missouri Bot. Gard. 72: 485–503.

STEHLI, F. G. & S. D. WEBB (editors). 1985. The Great American Biotic Interchange. Plenum, New York.

STEWART, R. H. & J. L. STEWART (with the collaboration of W. P. Woodring). 1980. Geologic Map of the Panama Canal and Vicinity, Republic of Panama. Scale: 1 : 100,000. U.S. Geol. Surv. Misc. Invest. Map I-1232.